International Energy Agency

Energy Technology Initiative on
Demand Side Management Technologies and Programmes

What Do We Know About What We Know?

Task 24 – Phase I

Closing the Loop – Behaviour Change in DSM:
From Theory to Practice

A Review of Behaviour-Based Energy Efficiency Data Collection Methodology

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Beth Karlin, Rebecca Ford, Alyssa Wu, Veronica Nasser, and Cynthia Frantz

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Executive Summary

Behaviour-based energy interventions (i.e., programmes targeting savings through consumer energy use) are based on the idea that people can be encouraged to use less energy if the underlying determinants of behaviour change in some way. Research on such programmes suggests potential savings, but results vary and much is still unknown about the specific variables that impact programme effectiveness. This is due in part to the way these programmes are typically evaluated.

Most energy efficiency evaluations use changes in the amount of energy consumed (measured in kWh) as the dependent variable for determining effectiveness. Although this is an ideal measure of whether energy efficiency interventions work, additional information could add significantly to our understanding about how and for whom they work. Recent efforts have been made to include such information and more and more studies are now collecting self-reported data from participants in order to better understand how and for whom behaviour-based energy interventions work. However, widespread agreement on what data to collect and how to collect it is still lacking. Such standardisation is common in related fields such as education and psychology, but has yet to take hold in energy programme evaluation. The development of consistent, validated measures would improve our overall ability to account for variation in treatment effects and improve programme functioning and delivery.

As such, the current report presents a methodological review of behaviour-based energy intervention studies in the *customer feedbac*k and *residential building retrofit* areas, which were conducted over the past 10 years to determine what data has been collected and how it has been collected. This review will form the basis of further work undertaken by the study authors and for Subtask 9 of the IEA DSM Task 24 extension (Phase II – see www.ieadsm.org/task/task-24-phase-2/).

The work presented here suggests that future research should evaluate programmes using standardised measures across a range of key variables. The use of standard measures would enable cross-comparisons to be made across different studies, and the incorporation of questions about context, behaviours, attitudes, knowledge, and user experience would provide researchers with insights into a richer understanding of how and for whom different behaviour-based interventions work best. Ultimately, this should result in more streamlined and effective programmes that are targeted appropriately for different audiences.

In addition, studies would do well to make better use of mixed methods for data collection. Only 26 of the 85 studies reviewed here used interviews to collect data, with 9 studies running focus groups. This type of data collection allows for triangulation, which can be helpful when trying to get deeper insights into the holistic impacts of behaviour-based energy interventions.

Finally, we recommend that study authors provide better transparency in the methods they use. With only 4 of the 85 studies publishing their actual evaluation instrument, it is not possible for researchers to refer to and build upon instruments that have already been developed. Creating and sharing validated data collection instruments would facilitate a consistency of measurement that could be implemented across the countless additional studies expected to be conducted in the coming years. Such consistency can improve and aggregate our overall knowledge across studies.

1 Introduction

As the effects of climate change become increasingly prevalent, many countries are faced with the challenge of greening their energy systems through demand side management. Household behaviour has been identified as an efficient and effective way to meet this challenge, with up to 20% potential savings using currently available technology (Dietz et al., 2009). Many changes can be made immediately and without economic sacrifice or loss of well-being (Dietz et al., 2009; Gardner & Stern, 2008) and a variety of public and private intervention programmes have targeted such behaviour in recent decades. The USA State and Local Energy Efficiency Action Network (2012) use the term 'behavior-based energy efficiency programs' to describe their programmes, and define them as "those that utilize strategies intended to affect consumer energy use behaviors in order to achieve energy and/or peak demand savings" (p. 1). Their list of such programmes includes "outreach, education, competition, rewards, benchmarking and/or feedback elements" (p. 1). These programmes are all based on the idea that consumers can be encouraged to use less energy if the underlying determinants of their behaviour change in some way.

Such behaviour-based energy interventions can be categorised more broadly as "involving either antecedent strategies (i.e. commitment, goal setting, information, modelling) or consequence strategies (i.e. feedback, rewards)" (Abrahamse, Steg, Vlek, & Rothengatter, 2005 p. 273). Overall, the research on these programmes shows potential for energy savings, but results vary significantly (from negative effects to over 20% in energy savings) and much is still unknown about the variations both between- and within-studies that impact programme effectiveness (see Ehrhardt-Martinez, Laitner, & Donnely, 2010; Lutzenhizer et al., 2009).

Part of this limited understanding is due to the way that such behaviour-based energy programmes are typically evaluated. Most programme evaluations use energy savings (measured in kWh) as the dependent variable for determining effectiveness. Although this is an ideal measure of whether behaviour-based energy interventions work, additional information about the participants' subjective experience could add substantially to our understanding about not only whether different intervention strategies work, but how and for whom they work.

An important review of intervention studies aimed at household energy conservation (Abrahamse et al., 2005) concluded that "underlying determinants of energy use and energy-related behaviors have hardly been examined." Although this situation has improved in recent years, significant variation remains in the variables collected and specific questions used during evaluation. No standard measures or metrics currently exist to conduct such assessment, which makes comparisons across studies difficult. Such standardisation is common in related fields such as education and psychology, and has two major benefits. First, the use of standard methodologies that are theoretically grounded and rigorously empirically validated will result in better data: study results will be more accurate and reliable. Second, a more consistent evaluation methodology would improve our overall ability to aggregate knowledge across studies and contribute to a more robust understanding of energy efficiency as a resource.

This paper presents a methodological review of behaviour-based energy interventions. It explores those key variables needed to move "beyond kWh" and into a more holistic understanding of how and for whom behaviour-based energy interventions work best.

This report specifically aims to answer the following questions:

1. What key variables should data be collected on to enable an understanding as to how and for whom behaviour-based energy interventions work?
2. What are the different types of behaviour-based interventions that have been studied in recent years and what methods did the study authors use to collect data?
3. What sort of data was collected about which key variables and how?
4. Were any specific and consistent methods or measures (such as previously developed scales or instruments) used in any of the studies?

Section 2 addresses the first research question and presents a literature review exploring the theoretical rationale for including particular key variables, and the value of a consistent instrument to evaluate them. Section 3 presents an overview of the data collection methods implemented in this report, required to address the remaining research questions, and Section 4 presents study findings. In Section 5, conclusions and suggestions for future research are provided.

2 Literature Review

Understanding the role of contextual and psycho-social variables in conservation behaviour is vital to programme assessment for a number of reasons. From a purely statistical point of view, accounting for such variables removes much of the "noise" inherent in intervention studies (by increasing the accuracy of our models). If there is, for example, a gender difference in the rate in which homeowners respond to findings from energy audits and this difference is not accounted for statistically, it increases the overall variability in findings, reducing the accuracy of study findings and masking a potentially important relationship. This can also bias findings if a linear regression model is used (resulting in omitted variable bias). Capturing such information is vital to ensure that enough data is collected and pulled into our models so that they can increase our inferential abilities.

It is also important to identify the sub-populations for whom programmes work best. As the marketing industry has come to recognise, a one-size-fits-all approach is not the most effective strategy. Increasingly, advertisers are turning to niche marketing – tailoring messages and offers to particular segments of the population – which is proving to be more efficient and more successful. The promotion of energy efficient behaviours can similarly benefit from a more nuanced approach to understanding market segments. Collecting information on sub-populations can help inform programme development for particular audiences.

Finally, understanding why a programme works – or doesn't work - is also important. Identifying the most important mechanism through which the intervention works (mediators) helps programme designers to generalise their success to other settings and behaviours. When a programme does not work, measuring the most likely mediators of behaviour change will allow programme administrators to more quickly identify where their programme has broken down and why it has failed to achieve the desired effect. This section reviews past literature on variables that have been found to impact pro-environmental behaviour that are good candidates for inclusion in programme evaluations to achieve the benefits described above.

2.1 Theories of Pro-Environmental Behaviour

Theories that have been tested for their utility in predicting and explaining pro-environmental behaviour have been historically grouped into two general categories: (1) rational (or individualistic) theories, and (2) moral (or altruistic) theories (Bamberg & Moser, 2007).

Rational theories presume that individuals are naturally information-seeking and make purposeful, carefully considered decisions about how to behave based on anticipated costs and benefits of available options (Scott, 2000). The *Theory of Planned Behaviour* (TPB; Ajzen, 1991) exemplifies this perspective (Armitage & Conner, 2001). TPB classifies the beliefs guiding individuals' rational decision-making processes as: (1) behavioural beliefs (i.e., attitudes toward the behaviour), (2) normative beliefs (i.e., attitudes about typical or expected behaviours), and (3) control beliefs (i.e., perceived control over the behaviour). According to TPB, these three sets of beliefs influence a person's behavioural intentions, which largely determine her/his behaviour.

As environmental issues generally involve the use of natural resources, which are both collective and limited, the optimal choice for the individual is often in conflict with the common interest (Hardin, 1968). Because of this conflict, altruistic (or moral) motives may account for many pro-environmental behaviours (Dunlap et al., 2000; Schwartz, 1994). The most commonly studied moral theory of pro-environmental behaviour is the *Norm Activation Model* (NAM; Schwartz, 1977), which stipulates that the activation of a "personal norm," or sense of moral obligation, influences pro-social behaviour. Although originally applied to altruism toward other people, Stern (2000), (Stern & Dietz (1994) later expanded this notion of altruistic behaviour to include non-human species or the planet in general in his *Theory of Environmentally Significant Behavior* (or Value-Belief-Norm Theory). According to this model, values influence beliefs, which in turn motivate and guide behavior. However, these values and beliefs are only activated when something a person cares about is threatened, and that person feels that they have both the responsibility and the ability to change it.

Many values can influence pro-environmental beliefs and behaviors in the above model. Biospheric values—a concern for the environment; altruistic values, such as a concern for future generations; and egoistic values of saving money or being more comfortable can all lead a person to consider engaging in pro-environmental behaviour (Schultz, 2001?). World views such as the *New*

Ecological Paradigm (Dunlap et al, 2000) - which recognises nature as a limited resource that can be harmed by human activity) and connection to nature (Mayer & Frantz, 2004) - feeling like an egalitarian member of the natural world – also demonstrably predict pro-environmental behaviour.

In addition to these major approaches, a number of other variables have been found to predict conservation behaviour in particular, including energy concern (Curtis, Simpson-Housley, & Drever, 1984; Verhallen & Van Raaij, 1981), and price sensitivity (Long, 1993; Verhallen & Van Raaij, 1981). The UK Government released a comprehensive review of different behavioural models and theories of change (Darnton, 2008) and Mourik and Rotmann (2013) analysed over 40 case studies from around the world which – implicitly or explicitly – used various theories and models of behaviour in real-life energy interventions.

It is important note that the above approaches to predicting behaviour are not mutually exclusive, but rather can and should be integrated (e.g., Turaga, Howarth, & Borsuk, 2010). The best approach to programme assessment will not limit itself to one theoretical perspective, but rather will consider all variables identified as predictors of behaviour. Future testing will identify the most essential and useful of these predictors for inclusion in a final toolkit.

2.2 Importance of Context

A recent criticism of both rational and moral models of conservation behaviour is their neglect of contextual influences (Steg & Vlek, 2009). Physical characteristics of homes, personal characteristics of occupants, and knowledge levels may exert great influence over such behaviour and must be included. Understanding the context of residential energy use in particular is critical; building-related variables such as home location and size are highly related to a household's carbon footprint while demographic variables such as income and home ownership, as well as knowledge measures such as awareness of key issues and options for change, are highly related to a person's ability to engage in some energy conservation behaviours (Stern, 2011).

Many studies have found that energy conservation is predicted by a variety of such contextual variables, including age (Curtis et al., 1984; Gatersleben, Steg, & Vlek, 2002; Painter, Semenik, & Belk, 1983; Sardianou, 2007), homeownership (Curtis et al., 1984; Gatersleben et al., 2002; Painter et al., 1983), income (Gatersleben et al., 2002; McDougall, Claxton, Ritchie, & Anderson, 1981), education (Gatersleben et al., 2002; Painter et al., 1983), family size (Curtis et al., 1984), and home type (Sardianou, 2007). Models derived from these analyses suggest that the most powerful explanation of energy conservation requires a consideration of contextual measures, combining demographic and building related variables with knowledge, value and belief measures.

2.3 Distinguishing Among Behaviours

Some have argued that pro-environmental behaviour should be viewed and studied as an aggregate, undifferentiated construct rather than as a set of multiple and distinct behaviours (Kaiser, 1998; Kaiser & Gutscher, 2003; Oskamp, 2000). Likewise, many conservation programmes discuss energy use holistically, suggesting that people "conserve energy" as if it were a single action. The term energy conservation, however, encompasses a diverse set of specific behaviours. Even within a subset of actions, such as those related to lighting, one can e.g. differentiate between turning off lights when leaving a room, installing energy efficient lighting, or setting light timers.

A growing body of research suggests that these behaviours vary in terms of their situational determinants and environmental impacts and, therefore, conceptual distinctions among conservation actions may lead to greater predictive validity and improved interventions (Barr, Glig, & Ford, 2005; Black et al., 1985; Karlin et al., 2012; Stern, 2000). This research suggests that energy conservation "dimensions" such as curtailment (e.g., reducing routine use) and efficiency (changes in energy infrastructure and/or technology) may have different predictive profiles, but theoretical analysis has identified inconsistencies and empirical analysis has suggested the potential to obscure potentially optimal "maintenance" behaviours (Karlin et al., 2012). Caution should be taken with such terms and it is recommended to ask about specific behaviours rather than rely on such categories.

2.4 An Integrated Approach to Context and Behaviour

Guagnano, Stern, and Dietz (1995) provided a useful theory that integrates psychological and contextual factors as well as differences in specific behaviours. Their *A-B-C model* posits that behaviour is influenced by both attitudinal and contextual factors and that the stronger one set of factors is in predicting behaviour, the less force the other exerts. If there are sufficient contextual

barriers to engaging in such a behaviour, then individuals are highly unlikely to engage in it, regardless of its alignment with self-interest or pro-social intent. For example, Black et al. (1985) found that some behaviours, such as adding home insulation, were not associated with normative beliefs when constrained by contextual factors such as household infrastructure and homeownership. On the other hand, contextual cues may trigger pro-environmental behaviour, even without sufficient self-interest or pro-social motivation. Guagnano et al. (1985), for example, found that the explanatory power of personal norm beliefs decreased for recycling behaviour when convenient curbside pick-up became available. Therefore, attitudes will be most influential on pro-environmental behaviour when context does not exert great influence on either promoting or restricting a behaviour.

2.5 User Experience

While the theories above all relate to pro-environmental behaviour, they focus on characteristics of the individual rather than the interaction between the individual and the actual intervention. Past research on behaviour-based energy efficiency has primarily tested various intervention techniques and strategies experimentally but with little attention to design features or user experience (Fitzpatrick & Smith, 2009; Froehlich, Findlater, & Landay, 2010). If we are looking at behaviour-based energy interventions then it is also important to consider how users respond to the intervention, i.e. the usability or user experience.

Although the definition of usability is sometimes simplified to "ease of use", a more comprehensive definition takes into account several characteristics related to user experience (Quesenbery, 2001). The ISO 9241 standard definition of usability is "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use". Additional work has defined several characteristics of usability within the above definition. Although variations abound, a common definition of usability includes five key characteristics: effectiveness, efficiency, error tolerance, ease of use, and engagement (Quesenbery, 2001). A combination of these variables has been found to be important in predicting the degree to which people accept and use particular information technologies (Davis, 1989; Lewis, 1995; Nielsen & Hackos, 1993).

2.6 Summary of Key Variables

The review of literature on pro-environmental behaviour indicates that the following factors may play a key role in affecting the level to which an individual engages with pro-environmental behaviours: context (e.g., age, homeownership, financial resources, education, family size, physical characteristics of homes, etc.), behaviours (e.g. conservation, efficiency, maintenance, etc.), attitudes (e.g., energy concern, price sensitivity, environmental concern, personal and social norms, etc.), knowledge (i.e., a specific type of contextual variable that indicates the degree to which householders understand energy and issues relating to energy), and user experience (e.g. how engaging the intervention was, error tolerance, how useful householders perceived it to be).

These key variables of **context, behaviour, attitude, knowledge**, and **user experience** may provide insights as to how and for whom different behaviour-based energy interventions work best. The remainder of this report focuses on evaluating the levels to which these concepts have been considered by prior studies.

Table 1: Summary of key variables

Attitudes	energy concern, price sensitivity, environmental concern, personal and social norms
Context	age, homeownership, financial resources, education, family size, physical characteristics of homes
Knowledge	the degree to which householders understand energy and issues relating to energy
User experience	how engaging the intervention was, error tolerance, how useful householders perceived it to be
Behaviours	conservation, efficiency, maintenance

3 Methods

The study utilised the method of content analysis, which is a technique of compressing large amounts of text into a manageable data set by creating and coding the text into categories based on a set of specific definitions (Stemler, 2001). The sample of studies was drawn from the past 10 years of empirical studies on residential behaviour-based interventions in the feedback and building retrofit domains. The current section discusses the methodology used to find and include relevant studies as well as to collect and code data.

3.1 Literature Search

Following standard literature synthesis procedures (Cooper, 2010; Rothstein & Hopewell, 2009), the following five methods were used to locate relevant studies: (1) review of IEA DSM Task 24 Subtask 1 case studies[1], (2) keyword search in reference databases, (3) conference programme search, (4) backward search (where the reference sections of selected papers are reviewed for relevant studies) and (5) forward search. This search included articles published between 2003 and 2013.

We started with a review of the IEA DSM Task 24 Subtask 1 'Monster' report (Mourik and Rotmann, 2013). An examination of the reference list of this Task identified 16 relevant papers.

Next, keyword searches were conducted in PsycINFO, JSTOR, Web of Science, and Google Scholar using the combinations of keywords listed in Table 1. A total of 70 articles were identified through keyword search.

Table 2: Keyword Search Terms

	Energy Conservation	Energy Efficiency
Audit	6	1
Commitment	11	1
Feedback	19	3
Goal setting	1	0
Rebate	3	14
Reward	4	0
Social norm	5	0
Subsid*	2	0

Searches also were conducted of the proceedings for the European Council for an Energy Efficient Economy (ECEEE), American Council for an Energy Efficient Economy (ACEEE), and International Energy Programme Evaluation Conference (IEPEC). Using this method, 205 new papers were identified: 28 from ACEEE, 115 from ECEEE, and 62 from IEPEC.

This set included eight review articles (Abrahamse et al., 2005; Darby, 2006; Froehlich et al., 2010; Harris & Hummer, 2010; Khawaja et al., 2007; Osbaldiston & Schott, 2011; Solberg, 2003; Stragier et al., 2012). Backward searches,were performed on these articles. Ten papers were identified by this method. In addition to the backwards searches, forward searches were conducted on the papers identified from a review of residential energy behaviour interventions. This search method utilised Google Scholar to identify papers that have cited these review articles. Through this method, another 14 papers were identified.

At this point, a preliminary list of 315 studies was compiled and evaluated for study inclusion.

3.2 Inclusion

The 315 identified papers were examined independently by two study authors for inclusion in the analysis. Discrepancies regarding inclusion of a particular paper were resolved by discussion among the researchers. To be included in the methodological review, a study had to meet the following criteria (the number of studies excluded due to each criteria is in parentheses):

[1] http://www.ieadsm.org/publication/task-24-subtas…ster-storybook/

1. The study must have reported on primary, empirical data (92).
2. The study must have involved a behavioural intervention (99).
3. The study must have focused on residential energy behaviour. Studies conducted in a lab-based, office, or industrial setting were excluded (30).
4. The goal of the study must have been overall energy savings or load shifting (9).

Altogether, 230 papers were excluded, with the remaining 85 included for analysis.

3.3 Coding Procedure

The 85 remaining studies were then read and coded for general information (e.g., year, sample size), intervention strategy use (e.g., feedback, incentive), methods used to collect data (e.g., surveys, interviews, focus groups) and variables collected (e.g., context, attitudes, knowledge). Because the coding process involved some degree of subjectivity, both raters independently coded the same 10% of the studies to establish reliability until inter-rater reliability was acceptably high (kappa > .700) for all variables. The raters then divided the remaining studies among themselves to code independently.

A detailed coding sheet was developed based on established guidelines of meta-analysis (Wilson, 2009) and each study was coded according to the same criteria. For each study, the following information was extracted and coded:

General Information. In this section, we noted basic information about each study—year published, number of participants, and whether it collected quantitative and/or qualitative data.

Intervention Type. We coded the type of intervention as commitment, audit, workshop, media campaign, feedback, and/or incentives. Intervention strategies were defined as follows:

1. *Commitment* - participants made an oral or written promise to change their behaviour, made either privately (e.g., written down) or publically (e.g., announced via Facebook);
2. *Audits* - participants received targeted suggestions for energy efficiency behaviours that were tailored to their home, determined by either a home visit by a professional auditor or by a web/software program where they answered a set of questions;
3. *Workshops* - participants attended a physical or online event to gain general information about energy efficiency;
4. *Media campaigns* – participants received information about energy efficiency via mass media, including broadcast, print, signage, and digital media;
5. *Feedback* - participants received information about actual household energy use, often with comparison to a goal, past behaviour, or the behaviour of their peers; and
6. *Incentives* - participants were provided a financial reward for reducing their energy consumption or provided a rebate or subsidy to purchase an energy efficient device.

Participants who received more than one of the above interventions were coded as having received both interventions.

Data Collection Method. This section coded on whether qualitative data was collected via surveys (structured questionnaires), interviews (semi-structured, usually one-on-one formal consultations), and/or focus groups (interactive group discussions). Additionally, for each method, we coded for who participated in the data collection, what kind of data was collected, when and where the data collection was conducted, and how long it took.

Measures Collected. We collected on the following types of measures:

1. *Context* (census data and energy-specific characteristics such as appliance holdings);
2. *Attitudes* (general feelings toward the environment, conservation, etc.),
3. *Knowledge* (awareness of general environmental issues or of personal energy use);
4. *User experience* (response to and interaction with the experiment itself); and
5. *Behaviour* (actions taken to conserve energy).

For each one, we coded how the data was collected—whether with multiple choice questions (selecting either a single answer or multiple answers), binary responses, Likert scales, or open-ended responses. We also noted whether the studies employed established scales and whether the studies made mention of household-level or societal-level impacts of their studies.

In some cases, information being coded for a particular study was either not obtainable from the study report (e.g., number of subjects contacted) or was ambiguous (e.g., random assignment); therefore, not all studies could be coded on every variable. When information was missing in a study and there was no clue to support a reasonable estimate, the data was coded as not reported.

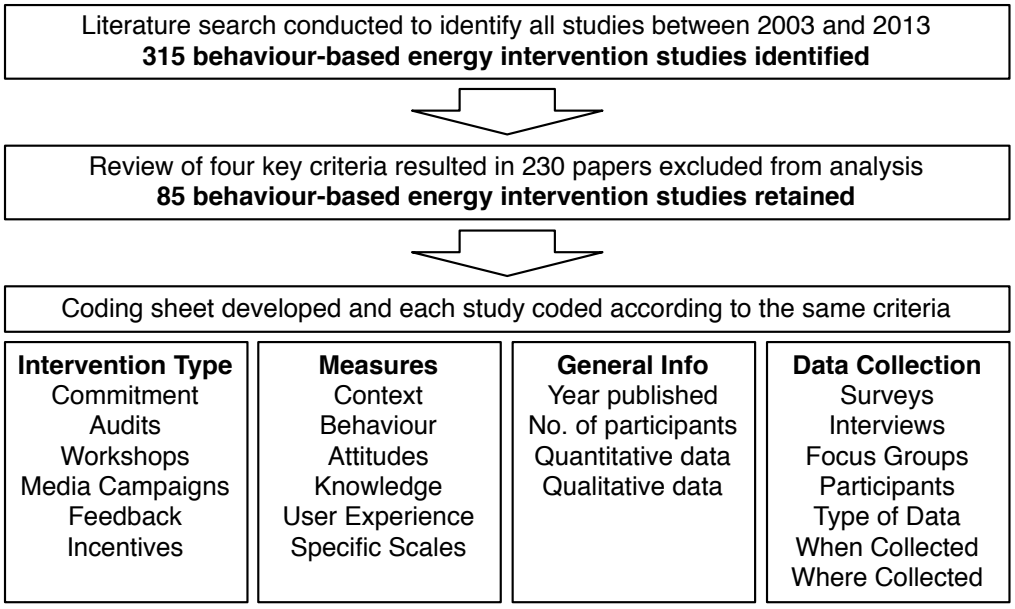

Figure 1: Overview of methods implemented in this paper

4 Findings

This section presents an evaluation of the study data collected, as described in Section 3, in order to answer the following questions:

1. What are the different types of behaviour-based interventions that have been studied in recent years and what methods did the study authors use to collect data? (Addressed in Sections 4.1 and 4.2).
2. What sort of data was collected about what key variables and how? (Addressed in Sections 4.3 and 4.4)
3. Were any specific and consistent methods or measures (such as previously developed scales or instruments) used in any of the studies? (Addressed in Sections 4.5 and 4.6)

4.1 Intervention Types

Though the search criteria for studies covered a whole spectrum of antecedent and consequence behaviour-based energy interventions, by far the most common intervention type was feedback, which was implemented by 60 of the 85 studies (71%). In contrast, the least common intervention types were workshops, which were only implemented by 1 study (1%), and commitment, which was used in 3 studies (4%). The reason for this disproportionate distribution is unclear, although it may have something to do with the commonly-used 'deficit model' approach to intervention design (see Mourik and Rotmann, 2013). Issues relating to the relative costs of these interventions, the mandatory EU roll-out of smart metering and billing, and their perceived impact may be influential, particularly with the increasing prevalence of smart meters. To a certain extent, it appears that researchers are focusing on standard and familiar industry approaches (marketing, incentives, technology) that do not fully take advantage of strategies from behavioural research with equal or better empirical support for their effectiveness (e.g., norms, commitments).

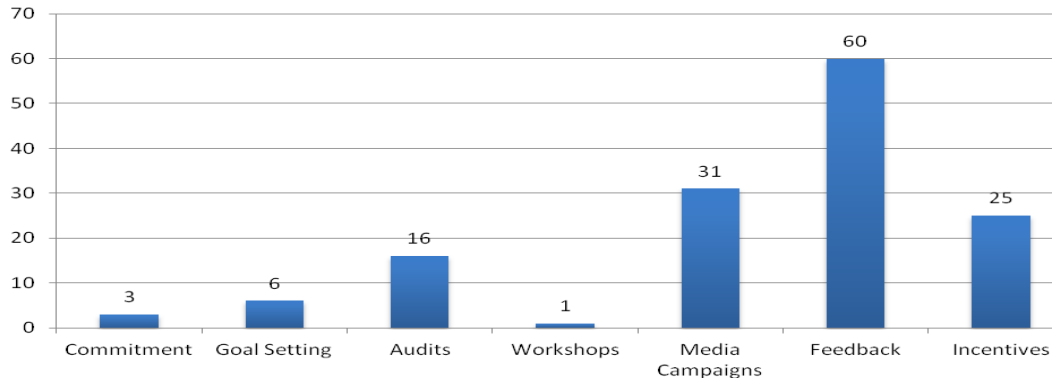

Figure 2: Frequency of Intervention Types

4.2 Data Collection Methods Implemented

What? The most frequently used method of collecting data was surveys, or structured questionnaires, which appeared in 62 of the 85 studies (73%). Second most frequently used were interviews, or semi-structured, usually one-on-one formal consultations, appearing in 25 studies (29%). The least frequently used method was focus groups, or interactive group discussions, appearing in 11 studies (13%). The emphasis on surveys makes sense, as they are easier to administer consistently than interviews or focus groups, and generate relatively standard quantitative data.

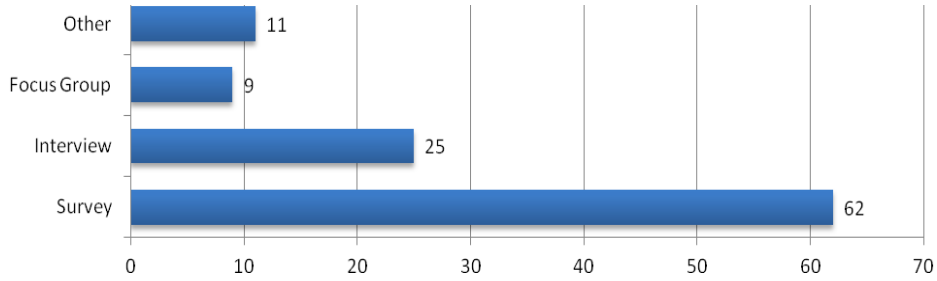

Figure 3: Methods used to collect data

Eleven studies (13%) collected qualitative data using methods that could not be classified as surveys, interviews, or focus groups. Six studies collected data on participants' user experience through logs of their interactions with the applications, such as sign-ons and downloads; another study recorded audio and video to capture users' facial and verbal reactions to the feedback system, as well as using a screen recorder to capture users' actions on the computer. Three studies asked participants to take photos of their energy-saving behaviours, while another asked participants to write daily blogs about the intervention. Two studies used quizzes—similar to surveys, but with objectively correct answer choices—to assess participants' knowledge.

Did the paper provide the instruments? Of the 62 studies that used surveys, 4 (6%) included their entire survey instrument, 16 (26%) included part of the instrument, and the remaining 42 (68%) omitted the instrument entirely. Of the 25 studies that used interviews, 1 paper (4%) included the entire instrument, 7 (28%) included part of the instrument, and the remaining 17 (68%) omitted the instrument entirely. No studies included focus group protocols or questions. This lack of transparency in measurement procedures exacerbates the limitations that result from inconsistent assessment tools: researchers and evaluators cannot easily determine post hoc whether similar sounding constructs from different studies were actually measured in similar ways. It also creates a culture in which many individuals with varying degrees of training and experience are perpetually reinventing the wheel, rather than building on the work and experience of others.

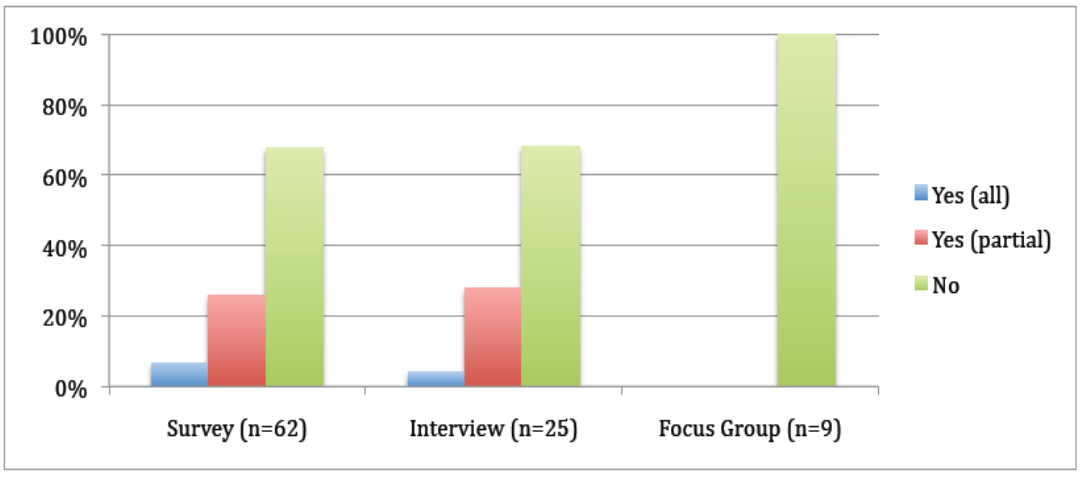

Figure 4: Number of studies providing the instrument used to collect data

When? Within the 62 studies that used surveys, 33 surveys (53%) were conducted before the intervention, 17 (27%) were conducted during, and 39 (64%) were conducted after. Within the 25 studies that used interviews, 5 studies (20%) conducted interviews before the intervention, 5 (20%) were conducted during, and 15 (60%) were conducted after. Within the 9 studies that used focus groups, 1 focus group (11%) was held during the intervention, and 2 (22%) were held after the intervention. The timing for the remaining 6 (67%) focus groups could not be determined with the information provided. Twenty-eight studies (33%) reported conducting multiple surveys. Of these,

13 administered pre- and post-intervention surveys, and 8 administered surveys at all three times. Four studies reported conducting interviews both before and after their interventions.

The relative infrequency with which participants were surveyed more than once represents an important opportunity to improve future research. Incorporating a pre-post survey strategy into a randomised trial adds significant benefits. Because individual differences both within and between groups can be precisely and accurately taken into account and controlled for, it is much easier to detect differences that develop between treatment groups as well as changes over time. As a result, smaller sample sizes are needed, which can save considerably on the cost of research.

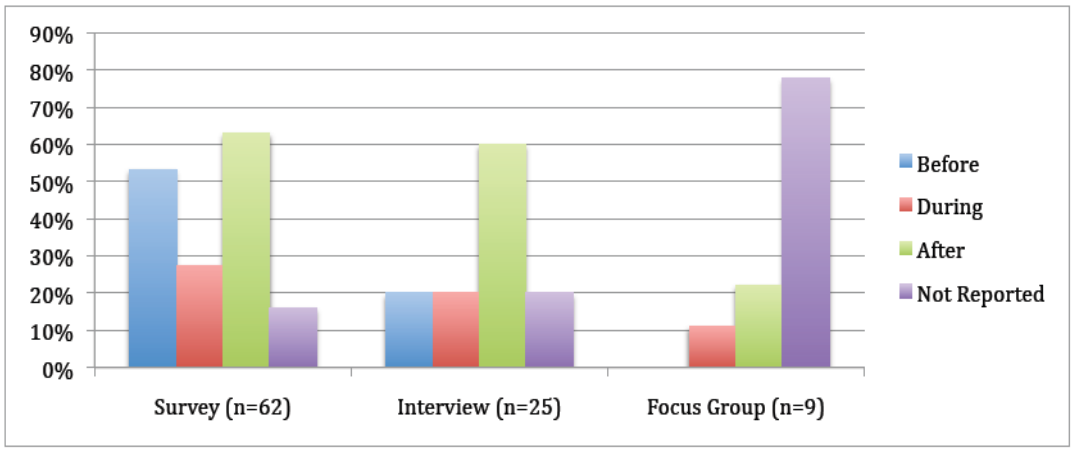

Figure 5: Indication of studies collecting data at different time periods

Where? Out of the 62 studies that conducted surveys, 11 (18%) offered their surveys on paper, 14 (23%) offered them online, and 11 (18%) offered them over the phone. There was no discernible relationship between size of study and survey methodology. Out of the 25 studies that conducted interviews, 10 (40%) performed them in person, while 3 (12%) performed them over the phone. None of the studies that conducted focus groups reported where they took place, but they were presumed to have been conducted in person. It is, however, conceivable that the focus groups were held online, such as via Skype.

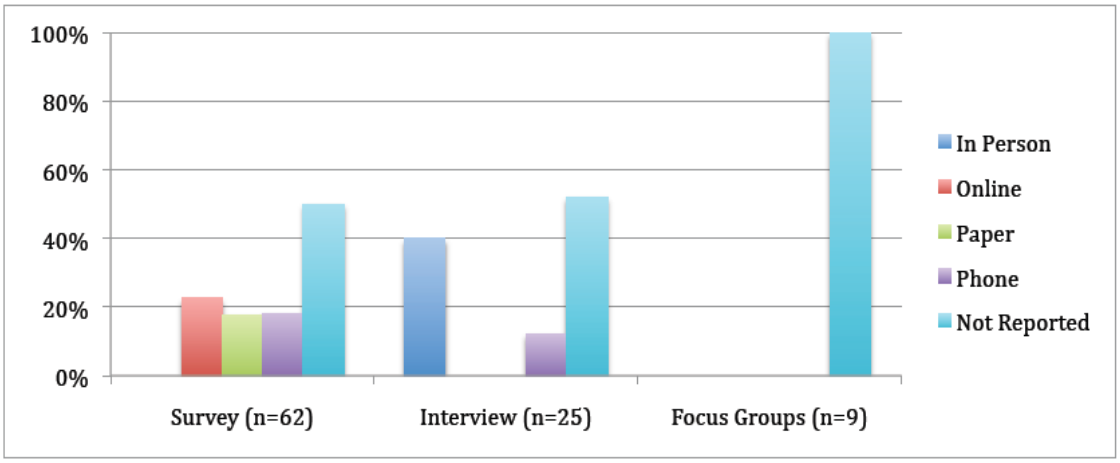

Figure 6: Indication of where study authors conducted data collection

One study offered its surveys both on paper and online, one offered its surveys both on paper and over the phone, and one offered its surveys on paper, online, and over the phone. One study offered interviews both in person and over the phone.

4.3 Measures Collected

Of the 85 studies evaluated, 69 collected data beyond kWh. This section explores what data was collected about the key variables of context, behaviours, attitudes, knowledge, and user experience.

Context. Context variables were collected in 45% of the studies corresponding to the demographics of the home occupants, the building characteristics, and the user-building interactions. These are shown in Figure 7 along with the number of studies collecting this type of information.

The most commonly collected demographics were age of occupants, collected by 27 of the 85 studies (32%), number of occupants (26%), and income (21%). The least commonly collected demographics were age of home, geographic location, time home is occupied, and years at current address, appearing in 2 studies (2%) each.

Context variables are some of the easiest data to quantify and collect, and the fact that less than half of the assessments recorded this data represents a major missed opportunity to gain insight into the effectiveness of interventions across sub-populations.

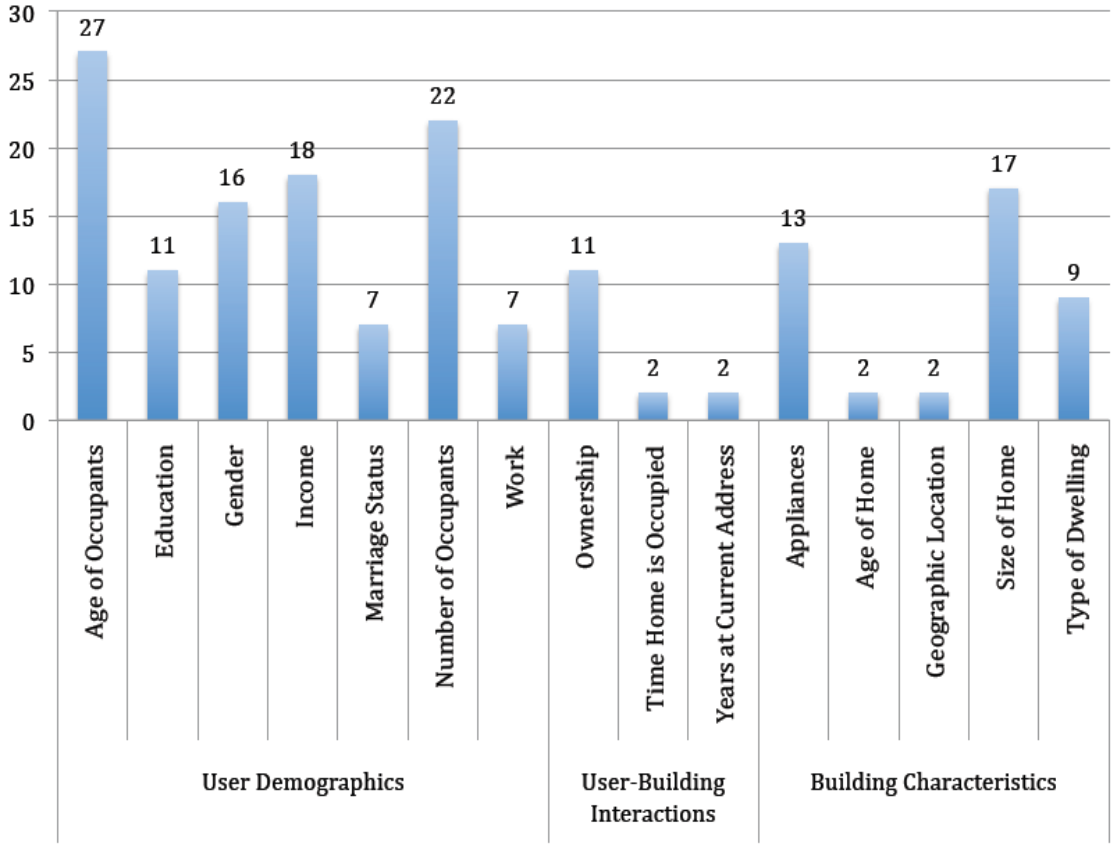

Figure 7: Context variables collected by studies

Behaviours. Behaviours were by far the most common data beyond kWh collected, with 45 (51%) studies collecting information about behaviours. Surveys were used in 40 studies to collect behavioural information. The interview method was used in 17 of the studies, while only 6 studies used a focus group. Most studies included more than one method for collecting information. The most common combination was surveys and focus groups. Three studies asked participants to take photos of their energy saving behaviours. See Figure 10 below for a comparison of data collection methods across key measures. The behaviours that were asked about represent a broad spectrum of conservation, efficiency, and maintenance behaviours. The vast majority of these studies (96%) asked questions about very specific behaviors (e.g., "Do you close the faucet while washing hands?"), rather than about a broad class of behaviors (e.g., "how often do you try to conserve energy?"). This focus on specificity is consistent with behavioral research demonstrating that different behaviors often have very different determinants and barriers (McKenzie-Mohr, 2011).

Attitudes. There were 33 (38%) studies that collected information about attitudes. Surveys were used in 16 studies to collect information on attitudes. The interview method was used in 5 of the studies, while only one study used a focus group.

There were a total of 57 specific questions asked about attitudes across the studies (see Figure 8). Out of the 57 specific attitudes evaluated, 27 (47%) of them centered on behavioural intention. This ranged from attitude toward maintaining new habits to barriers for not undertaking behaviours. Five (9%) studies asked about environmental attitudes, such as general attitudes toward the environment and level of environmental concern. Six questions (10%) asked about attitudes toward energy conservation, for example, changes in attitudes toward conservation or the importance of conservation. Two questions (3%) asked about self-efficacy with regards to energy conservation. Four (7%) questions related to interest in energy: for example, "how often do you think about your energy bill?" Thirteen (23%) of the attitudes measured could not be categorised based on the information provided in the study report.

Taken as a group, the attitude questions that tended to be included reflected theory and research in the social sciences: assessors were asking questions that were relevant to predicting behavior. However, these questions were not asked in consistent ways from study to study, making comparison across studies difficult. Many items were written for the particular study, and were not user tested or validated. This creates the possibility that poorly worded or confusing questions will yield poor data. Within each study, only some of the relevant behavioral predictors were included. Finally, only 33% asked any attitudinal questions at all. The development of a streamlined, validated set of questions that captures the full range of relevant behavioral predictors would be a great asset to the assessment of energy interventions.

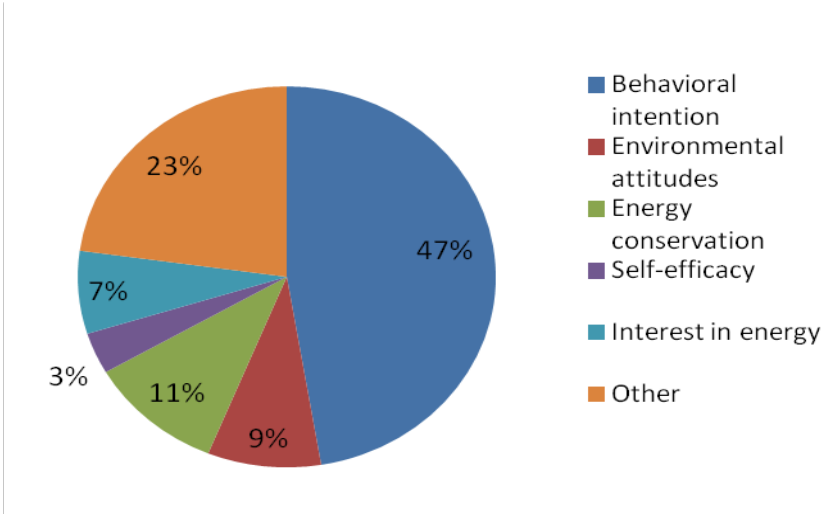

Figure 8: Proportion of questions addressing different types of attitudes

Knowledge. There were 18 (21%) studies that collected information about knowledge. This information was mainly collected through surveys, as 8 (44%) of the studies used a survey. No study mentioned using the interview method to collect information on knowledge. Only 1 (5%) study mentioned using a focus group. To assess participant's knowledge, 2 (11%) studies used quizzes.

Measurement of knowledge generally centered on participants' awareness of their own energy-saving tactics and tended to be measured with open-ended questions. There were a total of 18 specific questions about knowledge. Out of the 18 questions, 10 (59%) of them asked about general household awareness, focusing on knowledge of household use, monetary value of last bill and awareness of Energy Star label products. Four (22%) of the questions asked about perceived knowledge, and 3 (17%) questions asked about environmental knowledge, for example, awareness of the climate crisis. One (6%) question asked about changes in knowledge toward energy conservation.

The relationship between knowledge and behaviour is not straightforward. Some studies (e.g. Ajzen et al., 2011) have found no relationship between knowledge and energy conservation. However,

other theories and research suggests that knowledge in the form of awareness of threat (e.g. understanding of climate change) does impact behaviour (Stern, 2000). The heterogeneity of the knowledge questions included in the studies examined suggests that the field would benefit greatly from a coherent, shared understanding of the kind of knowledge that are relevant to achieving behavior change.

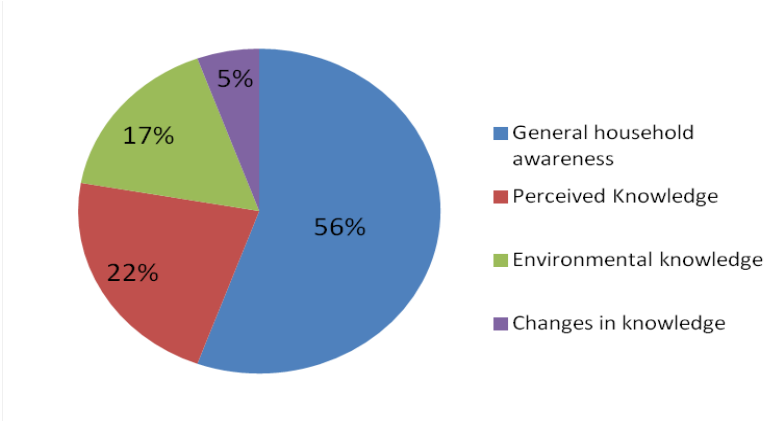

Figure 9: Proportion of questions addressing different aspects of knowledge

User experience. There were 47 (55%) studies that collected information about user experience. Surveys were used in 25 (53%) of the studies. The interview method was used in 18 (38%) of the studies, while only 2 (4%) studies used a focus group. Six (13%) studies used different techniques to assess user experience. These include using interactive logs of their interactions with the systems. Recording devices were also used to capture participants' reactions to the system and interactions with the system.

The measurement of user experience was highly variable. Questions tended to be open-ended and involved a wide range of information that fell into two primary categories: (1) how the participants interacted with the intervention, and (2) their perceived usefulness of and satisfaction with the intervention. There were 117 user-experience related questions. 87 (74%) of those questions related to how the user related to the intervention, including barriers to using the interface, changes in understanding of energy usage, and benefits of use. Thirty (26%) of the questions in turn related to perceived usefulness and satisfaction with the intervention. The development of a more standardised approach to measuring usability would improve the quality of information collected as well as facilitate the comparison across studies.

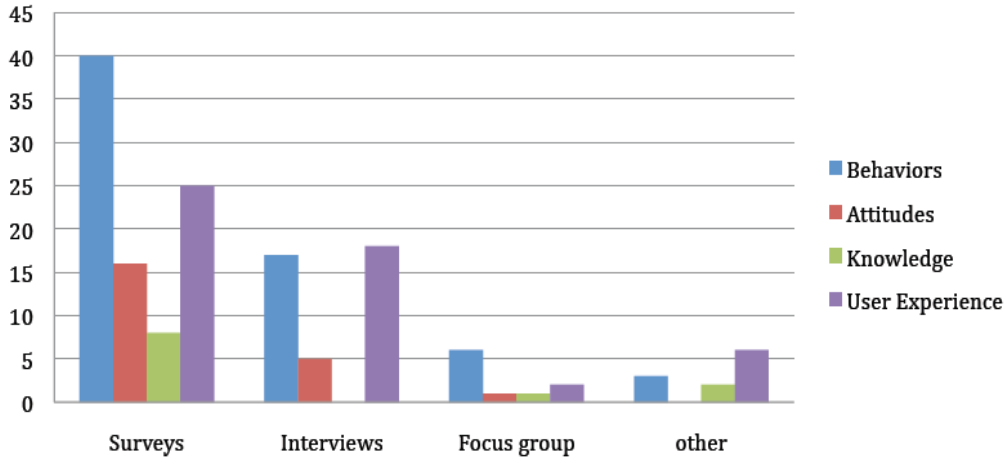

Figure 10: Indication of how data were collected for the key variables

4.4 Timing of Data Collection

This section explores when data were collected about the key variables of context, behaviours, attitudes, knowledge, and user experience.

Behaviours. Within the 40 studies that collected behavioural information through surveys, 27 (68%) were collected before the intervention, 13 (33%) were collected during, 30 (75%) were collected after, and 6 (15%) did not specify when they were collected. Of the 17 studies that used interviews, 3 (18%) were conducted before the intervention, 3 (18%) were conducted during, 8 (45%) were conducted after, and 5 (29%) did not specify. Of the 6 studies that used focus groups, 1 (17%) was held during the intervention, 2 (33%) were held after, and 4 (67%) did not specify.

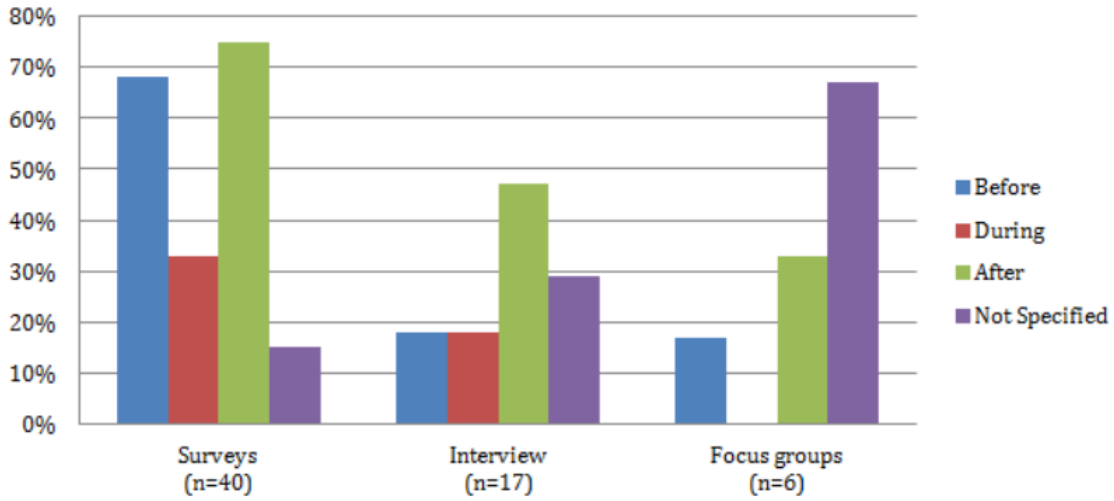

Figure 11: Indication of when behavioural measures were collected for each study

Attitudes. Within the 16 studies that collected information on attitudes through surveys, 12 (75%) were conducted before the intervention, 5 (31%) were conducted during, 10 (63%) were conducted after, and 4 (25%) were not specified. Within the 5 studies that used interviews, 1 study (20%) was conducted before the intervention, 1 study (20%) was conducted during, 4 (80%) were conducted after, and 0 (0%) were not specified. The one study that used focus groups did not specify timing of data collection.

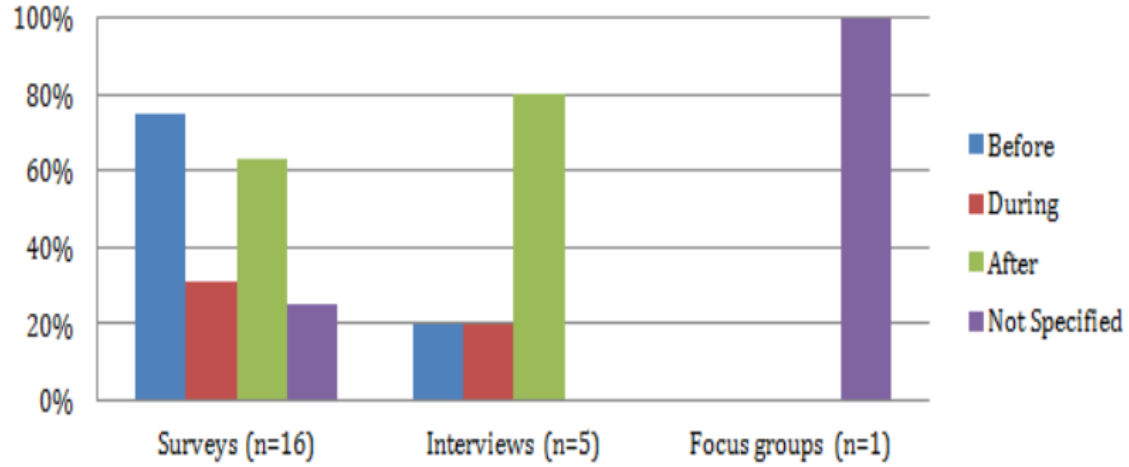

Figure 12: Indication of when attitude measures were collected for each study

Knowledge. Within the 8 studies that collected information on knowledge through surveys, 7 (88%) were conducted before the intervention, 4 (50%) were conducted during, 6 (75%) were conducted after, and 1 (13%) study was not specified. For the one study that used a focus group, time was not specified.

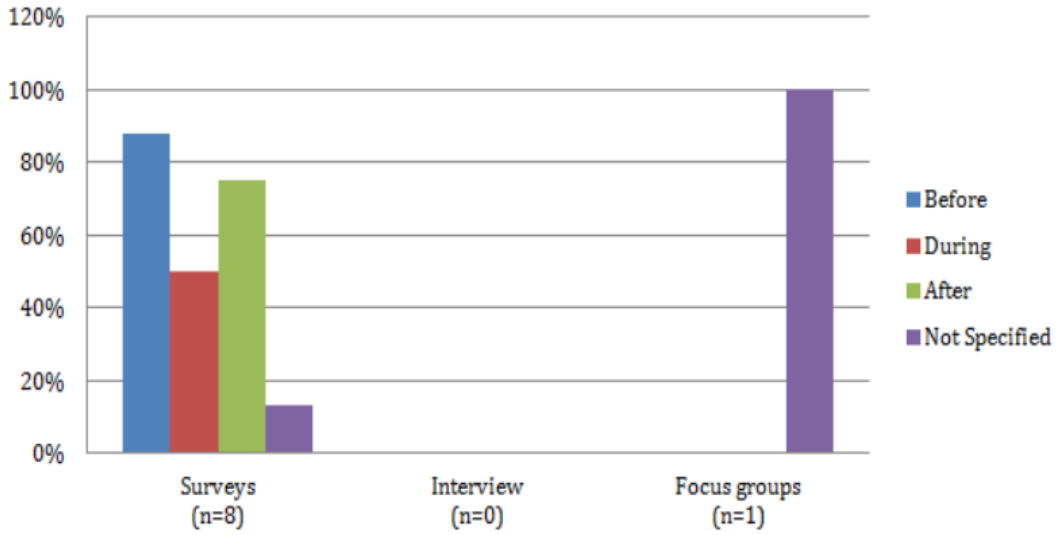

Figure 13: Indication of when knowledge measures were collected for each study

User Experience. Within the 25 studies that collected information on user experience through surveys, none were conducted before the intervention, 2 (8%) studies were conducted during, 23 (92%) were conducted after, and 2 (8%) were not specified. Within the 17 studies that used interviews, none were conducted before the intervention, 3 studies (18%) were conducted during, 13 (76%) were conducted after, and 2 (12%) were not specified. Within the 2 studies that used focus groups, both studies (100%) were conducted after.

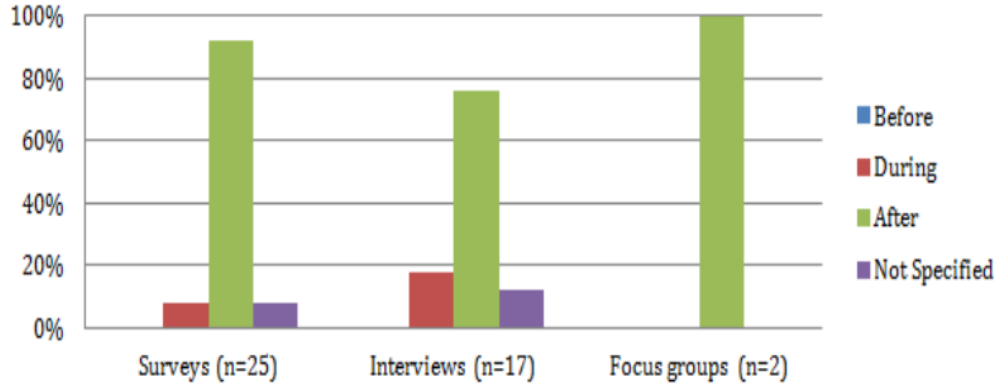

Figure 14: Indication of when user-experience measures were collected for each study

4.5 Data Collection Methods

This section considers the means by which data were collected about key variables.

Behaviours. Questions were formatted in multiple choice (select one), multiple choice (select all that apply), binary, Likert scale, open-ended and not specified. Out of the 45 studies that collected information about behaviours, 17 used open-ended, 9 used Likert Scale, 4 used binary, 4 used multiple choice select all, and 18 studies did not specify format.

Attitudes. Out of the 33 studies that collected information about attitudes, 9 studies used the form of Not Specified, 5 used open-ended, 11 used Likert Scale, 5 used binary, 2 used multiple choice select all, and 1 used multiple choice select one.

Knowledge. Out of the 18 studies that collected information about knowledge, 3 studies used the form of Not Specified, 8 used open-ended, 1 used Likert Scale, 3 used binary, 1 used multiple choice select all, and 1 used multiple choice select one.

User Experience. Out of the 47 studies that collected information about knowledge, 13 studies used the form of Not Specified, 30 used open-ended, 13 used Likert Scale, 11 used binary, 3 used multiple choice select all, and 3 used multiple choice select one.

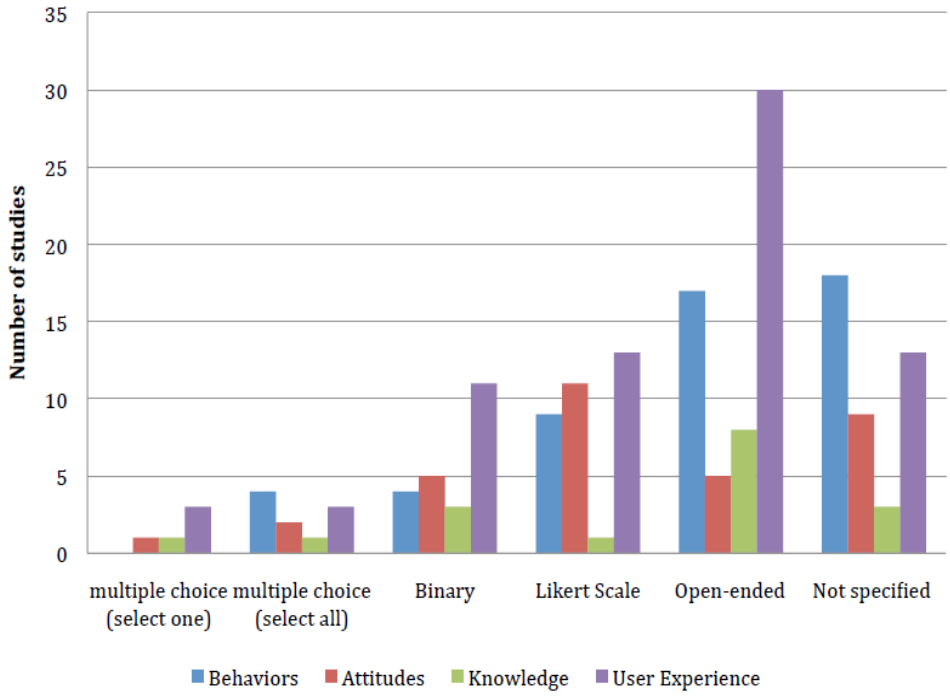

Figure 15: Data collection methods used to capture key variables

4.6 Specific Scales

Only 5 studies (6%) employed established scales. One study (Dillahunt, 2013) used the original *New Environmental Paradigm (NEP)*, while another two (Kurz et al., 2005 and Lawson et al., 2011) used the revised *New Ecological Paradigm*. Another study (Allen & Janda, 2006) used the *Connectedness to Nature Scale* and one (Sintov et al., 2010) used a modified version of the Schultz *Pro-environmental Behavior Scale*. These measures are described in the appendix.

In summary, a number of shortcomings in current data collection practices have been documented in this section. The first is the lack of data collected by the studies; only 40 of 85 studies collected data on behaviours, 16 on attitudes, 8 on knowledge, and 25 on user experience. Second, despite the worthy endeavors of the study authors who did collect this data, many failed to collect pre- and post- intervention measures about behaviours, attitudes, and knowledge. Unless both pre- and post measures are collected, it is not possible to attribute savings in energy to changes in these variables due to the intervention, or to understand how behaviour-based energy interventions work.

A third limitation is lack of consistency in how key constructs are measured. This issue is exacerbated by the lack of transparency in study reports of how constructs are measured, making it nearly impossible to identify similar constructs and measurement approach post hoc. The lack of consistency results in two further issues. First, because there is no agreed-upon method for measuring constructs (or even agreement on which constructs to measure) researchers often develop their own items, without psychometrically testing or validating them. Very few studies have used validated measures to collect data about specific key variables. Only 5 of the 85 studies (6%) implemented these standard measures at all, and of these studies only two used the same measure. Second, this lack of consistent or standard measures prohibits cross-study comparison and limits our ability to understand some of the key factors affecting the success of behaviour-based energy interventions.

A final concern about the current approach to assessment is that while some (but not all) studies have focused on appropriate behaviours and attitudes, the assessment of knowledge and usability is much more haphazard and not in line with insights from the behavioural sciences. In short, there is much room for improvement in the assessment of energy interventions.

5 Conclusion

As more and more utilities and regulatory agencies focus their attention on behaviour-based energy efficiency programmes, there is an urgency to ensure that evaluations of such programmes are done in as rigorous a manner as possible. A review of 85 behaviour-based energy interventions spanning commitment, goal setting, audits, media campaigns, feedback, and incentives, reveals that most researchers are collecting data "beyond kWh." Of the 85 studies reviewed, 69 collected data about at least one of the following measures: context, behaviour, attitude, knowledge, and user experience. Most (62 studies) did this using survey instruments; however, only 4 authors actually documented the instrument used in their paper. In addition, few studies collected data about all relevant variables; 27 collected information about context, 45 about behaviours, 33 about attitudes, 18 about knowledge, and 47 about user experience.

While the metrics used to measure whether these various programmes work is fairly standard and easy to compare between studies, the variables and metrics used to measure how and for whom they work have been left to individual researchers. As a result, the metrics and methods implemented to evaluate this are inconsistent between studies, and few attempts have been made at creating a replicable model. Such standardisation is common in related fields such as education and psychology, but have yet to take hold in energy efficiency programme evaluation.

The work presented here suggests that future research should evaluate studies using standardised measures across a range of key variables informed by the best behavioral science research. The use of a standard measure would enable cross-comparisons to be made across different studies, and the incorporation of questions about context, behaviours, attitudes, knowledge, and user experience, would provide researchers with insights to a richer understanding of how and for whom different behaviour-based based interventions work best.

In addition, studies would do well to make better use of mixed methods for data collection. Only 26 used interviews to collect data, with 9 studies running focus groups. This type of data collection allows for triangulation, which can be helpful when trying to get deeper insights into the holistic impacts of behaviour-based energy interventions. The further addition of mixed-model designs (collecting pre- and post-intervention data as well as randomized conditions) would further enhance the insights gained from each study.

Finally, we recommend that study authors provide better transparency in the methods they use. With only 4 of the 85 studies publishing their instrument, it is not possible for researchers to refer to and build upon instruments that have already been developed. Providing access to these instruments would facilitate the development and proliferation of consistent measures that could be implement across the countless additional studies expected to be conducted in the coming years. Such knowledge is essential for behaviour-based programs to take their rightful seat at the table of energy resources, such as fossil and alternative fuels.

The approach we advocate above inevitably gives rise to a number of concerns. First, interventions differ considerably from one another in terms of their goals, the intervention itself, and the cultural context in which it is executed. Questions that may be considered standard in one context may seem culturally insensitive in another; similarly, behaviours or attitudes that are central to one intervention may be irrelevant to another. It is clear that effective assessment will always have to be tailored to the specific context. However, this is not inherently inconsistent with an approach that encourages assessors to choose from a standardised and validated set of measures. The testing of the tool in different cultures and contexts, as part of Subtask 9 of Task 24 Phase II, will identify and alleviate some of these concerns.

A second concern is cost: will adopting such a measurement approach increase the expense of evaluating energy interventions? In fact, it is quite likely that a standardised approach informed by best practice and theory in the behavioural sciences will decrease costs. The development and wide availability of standardised tools will not only increase the quality of the data generated, but also decrease the staff time required to design assessments. Further, the insights generated from going beyond kWh have the potential to dramatically improve energy interventions and how they are delivered, creating more cost-effective, impactful programmes.

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Appendix

Table 3. Original New Environmental Paradigm Scale (Dunlap et al., 2000)

Do you agree or disagree that:
1. We are approaching the limit of the number of people the earth can support
2. The balance of nature is very delicate and easily upset
3. Humans have the right to modify the natural environment
4. Humankind was created to rule over the rest of nature
5. When humans interfere with nature it often produces disastrous consequences
6. Plants and animals exist primarily to be used by humans
7. To maintain a healthy economy we will have to develop a “steady state” economy where industrial growth is controlled
8. Humans must live in harmony with nature in order to survive
9. The earth is like a spaceship with only limited room and resources
10. Humans need not adapt to the natural environment because they can remake it to suit their needs
11. There are limits to growth beyond which our industrialized society cannot expand
12. Mankind is severely abusing the environment

Table 4. Revised New Ecological Paradigm Scale (Dunlap et al., 2000)

Do you agree or disagree that:
1. We are approaching the limit of the number of people the earth can support
2. Humans have the right to modify the natural environment to suit their needs
3. When humans interfere with nature it often produces disastrous consequences
4. Human ingenuity will insure that we do NOT make the earth unlivable
5. Humans are severely abusing the environment
6. The earth has plenty of natural resources if we just learn how to develop them
7. Plants and animals have as much right as humans to exist
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations
9. Despite our special abilities humans are still subject to the laws of nature
10. The so-called “ecological crisis” facing humankind has been greatly exaggerated
11. The earth is like a spaceship with very limited room and resources
12. Humans were meant to rule over the rest of nature
13. The balance of nature is very delicate and easily upset
14. Humans will eventually learn enough about how nature works to be able to control it
15. If things continue on their present course, we will soon experience a major ecological catastrophe

Table 5. Connectedness to Nature Scale (Mayer & Frantz, 2004)

Please answer each of these questions in terms of the way you generally feel. There are no right or wrong answers. Using the following scale, in the space provided next to each question simply state as honestly and candidly as you can what you are presently experiencing. (1 = strongly disagree; 3 = neutral; 5 = strongly agree)

1. I often feel a sense of oneness with the natural world around me.
2. I think of the natural world as a community to which I belong.
3. I recognize and appreciate the intelligence of other living organisms.
4. I often feel disconnected from nature.
5. When I think of my life, I imagine myself to be a part of a larger cyclical process of living.
6. I often feel a kinship with animals and plants.
7. I feel as though I belong to the Earth as equally as it belongs to me.
8. I have a deep understanding of how my actions affect the natural world.
9. I often feel part of the web of life.
10. I feel that all inhabitants of Earth, human, and nonhuman, share a common “life force.”
11. Like a tree can be part of a forest, I feel embedded within the broader natural world.
12. When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature.
13. I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.
14. My personal welfare is independent of the welfare of the natural world.

Table 6. Schultz Proenvironmental Behavior Scale (Schultz et al., 2005)

Values	
Universalism	Environmental behaviors
Benevolence	Ascription of responsibility for local problems
Power	Ascription of responsibility for global problems
Achievement	Seriousness of local environmental problems
Self-direction	Seriousness of global environmental problems
Stimulation	Environmental measures
Hedonism	Egoistic concerns
Tradition	Altruistic concerns
Conformity	Biospheric concerns
Security	New environmental paradigm

IEA Demand Side Management Energy Technology Initiative

The Demand-Side Management (DSM) Energy Technology Initiative is one of more than 40 Co-operative Energy Technology Initiatives within the framework of the International Energy Agency (IEA).The Demand-Side Management (DSM) Energy Technology Initiative, which was initiated in 1993, deals with a variety of strategies to reduce energy demand. The following member countries and sponsors have been working to identify and promote opportunities for DSM:

Austria	Norway
Belgium	Spain
Finland	Sweden
India	Switzerland
Italy	United Kingdom
Republic of Korea	United States
Netherlands	ECI (sponsor)
New Zealand	RAP (sponsor)

Programme Vision: Demand side activities should be active elements and the first choice in all energy policy decisions designed to create more reliable and more sustainable energy systems
Programme Mission: Deliver to its stakeholders, materials that are readily applicable for them in crafting and implementing policies and measures. The Programme should also deliver technology and applications that either facilitate operations of energy systems or facilitate necessary market transformations

The DSM Energy Technology Initiative's work is organised into two clusters:
The load shape cluster, and
The load level cluster.

The 'load shape" cluster will include Tasks that seek to impact the shape of the load curve over very short (minutes-hours-day) to longer (days-week-season) time periods. Work within this cluster primarily increases the reliability of systems. The "load level" will include Tasks that seek to shift the load curve to lower demand levels or shift between loads from one energy system to another. Work within this cluster primarily targets the reduction of emissions.

A total of 24 projects or "Tasks" have been initiated since the beginning of the DSM Programme. The overall programme is monitored by an Executive Committee consisting of representatives from each contracting party to the DSM Energy Technology Initiative. The leadership and management of the individual Tasks are the responsibility of Operating Agents. These Tasks and their respective Operating Agents are:

Task 1 International Database on Demand-Side Management & Evaluation Guidebook on the Impact of DSM and EE for Kyoto's GHG Targets – *Completed*
Harry Vreuls, NOVEM, the Netherlands

Task 2 Communications Technologies for Demand-Side Management – *Completed*
Richard Formby, EA Technology, United Kingdom

Task 3 Cooperative Procurement of Innovative Technologies for Demand-Side Management – *Completed*
Hans Westling, Promandat AB, Sweden

Task 4 Development of Improved Methods for Integrating Demand-Side Management into Resource Planning – *Completed*
Grayson Heffner, EPRI, United States

Task 5 Techniques for Implementation of Demand-Side Management Technology in the Marketplace – *Completed*
Juan Comas, FECSA, Spain

Task 6 DSM and Energy Efficiency in Changing Electricity Business Environments – *Completed*
David Crossley, Energy Futures, Australia Pty. Ltd., Australia

Task 7 International Collaboration on Market Transformation – *Completed*
Verney Ryan, BRE, United Kingdom

Task 8 Demand-Side Bidding in a Competitive Electricity Market – *Completed*
Linda Hull, EA Technology Ltd, United Kingdom

Task 9 The Role of Municipalities in a Liberalised System – *Completed*
Martin Cahn, Energie Cites, France

Task 10 Performance Contracting – *Completed*
Hans Westling, Promandat AB, Sweden

Task 11 Time of Use Pricing and Energy Use for Demand Management Delivery- *Completed*
Richard Formby, EA Technology Ltd, United Kingdom

Task 12 Energy Standards
To be determined

Task 13 Demand Response Resources - *Completed*
Ross Malme, RETX, United States

Task 14 White Certificates – *Completed*
Antonio Capozza, CESI, Italy

Task 15 Network-Driven DSM - *Completed*
David Crossley, Energy Futures Australia Pty. Ltd, Australia

Task 16 Competitive Energy Services
Jan W. Bleyl, Graz Energy Agency, Austria / Seppo Silvonen/Pertti Koski, Motiva, Finland

Task 17 Integration of Demand Side Management, Distributed Generation, Renewable Energy Sources and Energy Storages
Seppo Kärkkäinen, Elektraflex Oy, Finland

Task 18 Demand Side Management and Climate Change - *Completed*
David Crossley, Energy Futures Australia Pty. Ltd, Australia

Task 19 Micro Demand Response and Energy Saving - *Completed*
Linda Hull, EA Technology Ltd, United Kingdom

Task 20 Branding of Energy Efficiency - *Completed*
Balawant Joshi, ABPS Infrastructure Private Limited, India

Task 21 Standardisation of Energy Savings Calculations - *Completed*
Harry Vreuls, SenterNovem, Netherlands

Task 22 Energy Efficiency Portfolio Standards - *Completed*
Balawant Joshi, ABPS Infrastructure Private Limited, India

Task 23 The Role of Customers in Delivering Effective Smart Grids - *Completed*
Linda Hull. EA Technology Ltd, United Kingdom

Task 24 Phase I: Closing the loop - Behaviour Change in DSM: From theory to practice – *Completed*
Task 24 Phase II: Helping the Behaviour Changers
Sea Rotmann, SEA, New Zealand and Ruth Mourik DuneWorks, Netherlands

Task 25 Business Models for a more Effective Market Uptake of DSM Energy Services
Ruth Mourik, DuneWorks, The Netherlands

For additional Information contact the DSM Executive Secretary, Anne Bengtson, Liljeholmstorget 18,11761 Stockholm, Sweden. Phone: +46707818501. E-mail: anne.bengtson@telia.com
Also, visit the IEA DSM website: http://www.ieadsm.org