BEHAVIOUR CHANGE INTERVENTIONS FOR REDUCED ENERGY USE

Best Practices for Universities

INTERNATIONAL ALLIANCE OF RESEARCH UNIVERSITIES

Behaviour Change Interventions for Reduced Energy Use:
Best Practice for Universities

– Rupert Stuart-Smith, September 2017

CONTENTS

EXECUTIVE SUMMARY

Behaviour change interventions are a vital component of global efforts to tackle climate change. This report is designed to provide sustainability practitioners, policymakers and building users with a framework for designing successful initiatives to reduce energy use at universities.

There is no one best way for altering high energy-consuming behaviours, and in order to create enduring, high-impact policies in universities, interventions should aim to change social norms through holistic and multi-pronged approaches. These approaches may involve education, modelling, incentives, environmental restructuring, persuasion, and enabling. Any one-intervention approach is less likely to create success[1;2]

The Michie, Atkins, & West Behaviour Change Wheel can be used as a framework for designing comprehensive and effective interventions. Nine broad intervention options outlined in their model and are linked here to specific interventions with relevance to universities. A case study is given demonstrating how the framework presented here can be used to design a behaviour change intervention for reducing energy consumption, and a more detailed literature review of the most effective intervention approaches is also provided.

INTRODUCTION

Behavioural interventions have considerable potential to reduce energy use at universities, yet many initiatives to alter behaviours at universities are designed predominantly based on what '[seems] like a good idea at the time [3p.14]. This report is designed to support the transition to an evidence-based approach to reducing energy consumption and emissions through behavioural changes.

Changes to building fabric may play an important role in reducing emissions, but the 'very long lifespans of buildings and retrofits' locks-in energy use, necessitating behavioural change if energy use reductions are to continue to occur [4 p. 675]. If the impacts of climate change are to be minimised, it is vital that deep greenhouse gas emission reductions are made across all sectors. As centres of research and knowledge, universities should adopt an approach to reducing their contribution to climate change based on the best available evidence and behavioural changes have among the greatest potential to achieve this[5]. If national, and international energy policy targets on energy consumption are to be achieved, behaviour change interventions must play a central role in emission reduction strategies.

The academic literature on non-domestic energy behaviour interventions is relatively sparse[1; 5] but contains firm evidence in support of this paper's recommended behavioural interventions. A larger body of literature focuses on change in domestic energy behaviours. Those findings are not necessarily relevant to non-domestic settings, where individual users are not financially responsible for energy costs and where very different social processes operate. The scope of this report was therefore limited to studies of non-domestic settings.

DESIGNING BEHAVIOUR CHANGE INTERVENTIONS

Michie, Atkins, & West's The Behaviour Change Wheel: A Guide to Designing Interventions[3] outlines a framework for designing behavioural interventions in institutional settings and brings together two models: the Capability, Opportunity and Motivation behavioural model (COM-B) and the Theoretical Domains Framework (TDF). The Behaviour Change Wheel was developed out of a comprehensive review of existing behaviour change frameworks, none of which were found to be sufficient alone[3]. Here, components relating specifically to university policymakers, sustainability practitioners and individuals implementing behaviour change interventions are signposted.

The Behaviour Change Wheel ensures that intervention strategies targeting energy consuming behaviours are planned methodically. Using this framework, interventions can be developed using an eight-stage process, from identifying specific behavioural targets, through to considering how to alter these behaviours effectively, and how best to implement the interventions.

"Using this framework, interventions can be developed by identifying specific behavioural targets."

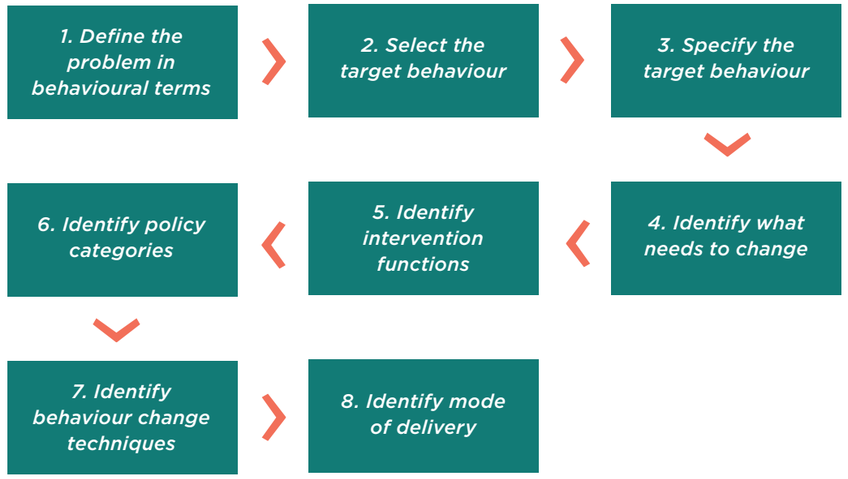


Figure 1: The Behaviour Change Wheel's eight-stage process for designing behaviour change interventions (3).

USING THE BEHAVIOUR CHANGE WHEEL

1. DEFINE THE PROBLEM IN BEHAVIOURAL TERMS

What is the behaviour, where is it performed and who is doing it?

2. SELECT EXISTING BEHAVIOUR(S)

Consider all relevant behaviours performed by target group(s). If one behaviour is dependent on others, this should be taken into account. Select target behaviours which:

- Have potential for significant impact
- Are easily changed
- May have wide impacts if changed
- Have measurable impact

3. SPECIFY TARGET BEHAVIOUR:

- Who should perform the behaviour?
- What behavioural changes need to be made by the target individuals?
- When will they do the behaviour?
- Where will they do the behaviour?
- How often will they do the behaviour?
- With whom / what will they do the behaviour?

4. IDENTIFY WHAT NEEDS TO CHANGE

Questionnaires or interviews can be used to identify what needs to change, in order to meet all of the Capability, Opportunity and Motivation behavioural model criteria. When selecting target behaviours, competing behaviours should be considered. Table 1 is an example of a decision-making process to identify which Capability, Opportunity and Motivation behavioural model components need to change in a successful computer switch-off behavioural change intervention. These can then be subdivided into Theoretical Domains Framework domains, as a more specific means of identifying what needs to change [3].

5. IDENTIFICATION OF INTERVENTION OPTIONS

Intervention functions are the means by which interventions can change behaviour. This is particularly useful for university sustainability teams and those designing behaviour change interventions. Michie, Atkins, & West[3] identify nine intervention functions, which are defined in table 2. The table also demonstrates how intervention functions correlate to the Capability, Opportunity and Motivation behavioural model and Theoretical Domains Framework components selected in the previous stage. Having noted all potential intervention functions, the APEASE criteria can be used to distil these to the most promising. This selects interventions that are:

- Affordable
- Practicable (and achievable in the situation)
- Effective and cost-effective
- Acceptable (appropriate to stakeholders and only restricts individuals' agency for serious problems)
- Side effect free (minimises negative side-effects or safety concerns)
- Equitable (considers impacts on differences between living standards, wellbeing or health between different groups)

Behavioural components	What needs to happen for the target behaviour to occur?	Is there a need for change?	What TDF Domain does this correspond to? *Example question*	Consider changing (tick)
Physical capability *The skills and strength required*	Have the physical skills to turn off computers at the socket at the end of the day	No change needed as university staff have these skills	**Physical skills** *Are you able to do x?*	
Physical capability *Knowledge of how to do the action*	Know the correct method to turn off computer at the socket at the end of the day	No change needed as knowledge of computer operation is sufficient	**Knowledge** *Do you know about x?*	
			Cognitive and interpersonal skills *Do you know how to do x?*	
			Memory, attention and decision processes *Is x something you usually do?*	
			Behavioural regulation *Do you have systems that you could use for monitoring whether or not you have carried out x?*	
Physical opportunity *A working environment with the time and resources required, and any barriers removed*	Have the wall socket accessible	Change may be needed as some sockets may not be accessible	**Environmental context and resources** *To what extent do physical or resource factors facilitate or hinder*	✓
Social opportunity *Interpersonal connections, social cues or cultural norms which encourage the target behaviour*	See managers, colleagues and peers turn off electronic devices at the socket	Change needed as staff do not always see managers and colleagues turning off devices at the socket	**Social influences** *To what extent do social influences facilitate or hinder x?*	✓
Reflective motivation *Conscious planning to do the behaviour, rather than to engage in competing behaviours*	Hold beliefs that turning off computers at the socket reduces energy use and that reduced energy use is a desirable outcome	Change may be needed as not all staff know that this behaviour reduces energy use or that energy use should be reduced	**Professional / social role and identity** *Is doing x compatible or in conflict with professional standards / identity?*	
			Beliefs about capabilities *How difficult or easy is it for you to do x?*	✓
			Optimism *How confident are you that the problem of implementing x will be solved?*	
	Believing that consistent computer switch offs will require changes to individuals' self-regulation skills	Change needed as staff do not necessarily recognise the value of these skills.	**Beliefs about consequences** *What do you think will happen if you do x?will be solved?*	✓
			Intentions *Have they made a decision to do x?*	✓
			Goals *How much do they want to do x?*	
Automatic motivation *Desire and reflex responses to complete the behaviour*	Have established routines and habits for switching off computer at the socket	Change needed to establish routine and habit formation	**Reinforcement** *Are there incentives to do x?*	✓
			Emotion *Does doing x evoke an emotional response?*	✓
Behavioural diagnosis of the relevant COM-B components	Physical and social opportunity, and reflective and automatic motivation need to change in order for the target behaviour to happen			

Table 1: Using the COM-B and TDF models to identify what needs to change in order for university staff to turn off computers at the socket at the end of work days (devised for this report, based on Michie, Atkins, & West, 2014, pp. 74, 88-90, and 113-115).

INTERVENTION FUNCTIONS / *Definition* / Examples	CAPABILITY, OPPORTUNITY AND MOTIVATION BEHAVIOURAL MODEL	PHYSICAL CAPABILITY	PSYCHOLOGICAL CAPABILITY				PHYSICAL OPPORTUNITY	SOCIAL OPPORTUNITY	REFLECTIVE MOTIVATION						AUTOMATIC MOTIVATION	
	THEORETICAL DOMAINS FRAMEWORK	PHYSICAL SKILLS	KNOWLEDGE	COGNITIVE AND INTERPERSONAL SKILLS	MEMORY, ATTENTION AND DECISION PROCESSES	BEHAVIOURAL REGULATION	ENVIRONMENTAL CONTEXT AND RESOURCES	SOCIAL INFLUENCES	PROFESSIONAL / SOCIAL ROLE AND IDENTITY	BELIEFS ABOUT CAPABILITIES	OPTIMISM	BELIEFS ABOUT CONSEQUENCES	INTENTIONS	GOALS	REINFORCEMENT	EMOTION
EDUCATION *Increasing knowledge or understanding.* E.g. Providing information to about impact of energy use.		●				●		●	●	●	●	●	●			
PERSUASION *Using communication to induce positive feelings or stimulate action.* E.g. Awards publically given to teams making large energy use reductions.								●	●	●	●	●	●			●
INCENTIVISATION *Creating an expectation of reward.* E.g. Awards publically given to teams making large energy use reductions.													●	●	●	●
COERCION *Creating an expectation of punishment or cost.* E.g. Providing on-screen prompts for computer users to turn off their computer at end of day.													●	●	●	●
TRAINING *Changing the physical or social context.* E.g. Providing on-screen prompts for computer users to turn off their computer at end of day.		●		●	●	●	●								●	
RESTRICTION *Using rules to reduce the opportunity to engage in a target behaviour.* E.g. Thermostat settings prevent building users from changing temperature outside of a specific range.							●	●								
ENVIRONMENTAL RESTRUCTURING *Changing the physical or social context.* E.g. Providing on-screen prompts for computer users to turn off their computer at end of day.					●		●	●								
MODELLING *Proving an example for people to aspire to or imitate.* E.g. Management always turn off lights / computer and wear warm clothes rather than using central heating						●		●	●	●	●	●	●	●	●	●
ENABLEMENT *Increasing means / reducing barriers to increase capability or opportunity* E.g. Allowing individuals to access plug sockets to turn					●	●	●	●	●		●	●		●		●

Table 2: Links between COM-B, TDF and intervention functions. Intervention function definitions (italicised) and examples are also given (based on Michie, Atkins, & West, 2014, pp. 111-115 and devised for this report).

The following is a summary of findings of the nine behaviour change intervention functions:

EDUCATION. Increasing knowledge or understanding

- Specific advice is more impactful. For office workers, emails are more effective than posters or leaflets[1]. In other environments, one-on-one discussions may be a more successful means of interaction with intervention participants. Peer education is particularly successful: information provided by peers is more likely to be acted on as they are relatable and share similar values and needs[6].
- Education alone may have limited impact, but it plays an important role in multi-dimensional behaviour change interventions[1].

PERSUASION. Using communication to induce positive feelings or stimulate action

- Persuasion tends to feature as one component of successful behaviour change interventions. This includes the manner in which behaviour change interventions are communicated, for instance as 'avoiding losses' in energy bills, rather than an optional action[6].

INCENTIVISATION. Creating an expectation of reward

- This may be component of successful behaviour change interventions, although many of the best performing studies in the literature review done by Staddon et al. did not rely on incentivisation[1]. Competitions, although widely used by universities, were not considered to be successful in producing lasting energy use reductions. Likewise, 'gamification' interventions which combine energy saving actions with games in the workplace, tended to be technically demanding, saw declining involvement of participants over time and saw few energy use reductions maintained following the completion of the intervention.
- Social rewards (those not based on financial or material gains) tended to outperform small monetary rewards, and public recognition was a more successful strategy than private incentivisation[1].
- A very successful behavioural intervention at two London hospitals rewarded good behaviour with a tin of biscuits for the ward and publicised the group's actions in leaflets with photos of the staff.

ENVIRONMENTAL RESTRUCTURING. Changing the physical or social context

- Environmental restructuring may include signs or posters, electronic feedback devices and dashboards, retrofit technology, and technology automation.
- Feedback devices may support behaviour change interventions but on their own are insufficient to create long term changes[2, 7]. When individuals do not believe that they have the potential to make a significant difference, feedback can be important, especially when data is aggregated at the level of social groups[8].
- Dashboards offering online controls of equipment and automated switch off of devices enabled large energy use reductions, particularly for inefficient users. However, efficient users saw limited reductions in energy use and it was seen as making individuals dependent on the system and energy savings were limited to the extent that the system allowed. Those without automation features tended to put more effort into understanding their consumption and acting to reduce energy waste, irrespective of their previous energy efficiency[9].
- Technology and building fabric upgrades can play a role in changing behaviours. This is a visual symbol of institutional commitment to improved environmental performance and provides transformative moments of change in which new social norms may develop[2]. Without environmental restructuring, individuals may be disinclined to engage in energy saving behaviours without visible commitment to carbon reduction, or due to a belief in the futility of engaging in energy use reductions in inefficient buildings[10].
- However, behaviour change following environmental restructuring should be carefully managed as the 'rebound effect' threatens energy use reductions as building users may increasingly rely on the efficiency of the building and reduce their motivation to engage in energy saving actions[11].

Modelling: Proving an example for people to aspire to or imitate.

- Modelling is a component of many of the more successful behaviour change interventions studied, although it is difficult to attribute energy use reductions specifically to its use. It is particularly effective when done by role models such as senior researchers or managers. Modelling may also include information on norms which normalises energy saving behaviours[6].

• When combined with education, feedback, and other intervention functions in holistic initiatives, modelling is particularly important for ensuring the longevity of behavioural changes[6].

MODELLING. Proving an example for people to aspire to or imitate

• Modelling is a component of many of the more successful behaviour change interventions studied, although it is difficult to attribute energy use reductions specifically to its use. It is particularly effective when done by role models such as senior researchers or managers. Modelling may also include information on norms which normalises energy saving behaviours[6].

• When combined with education, feedback, and other intervention functions in holistic initiatives, modelling is particularly important for ensuring the longevity of behavioural changes[6].

ENABLEMENT. Increasing means / reducing barriers to increase capability or opportunity

• Providing individuals with the opportunity to influence energy use is a component of most successful interventions studied, although it is often difficult to attribute energy use reductions solely to enablement.

• This strategy may include energy dashboards which allow staff and students to automatically control electronic devices at their desks, and other forms of environmental restructuring such as giving staff access to plug sockets.

• Enablement may also include policy changes to permit energy use reductions, for instance through equipment shut downs or relaxed dress codes to permit flexibility of building temperatures with the seasons[1].

• Flexibility in schedules and routines, including allowing staff to work from home, can be an important aspect of enabling staff to contribute to energy saving measures. Ensuring low carbon activities are part of organisational routines, with allocated time within the working day to enable employees to take part encourages and makes possible staff participation[2; 12]

COERCION. Creating an expectation of punishment or cost

• This technique has been poorly studied, largely to avoid negative reinforcement. Some universities have introduced charging schemes for departments which do not make energy use reductions. There is no significant evidence of the impact of these schemes, in which penalties are unlikely to be felt on an individual level.

TRAINING. Imparting skills

• Few proposed behavioural changes require significant changes in physical capability, and skilled actions relating to energy behaviours are generally limited to building or facilities managers.

RESTRICTION. Using rules to reduce the opportunity to engage in a target behaviour

• There has been little research on this technique which was studied for this paper.

• Behaviour change interventions can also involve altered occupancy hours, as it requires energy to keep a building open and operational all night[10].

INTERVENTION FUNCTIONS: KEY POINTS

• Behaviour change interventions should be holistic, and any one-intervention-function approach is likely to fail. Peer-education, publically awarded social incentives, enablement, environmental restructuring, and social persuasion, have all demonstrated strong potential.

• Enablement can be a particularly successful component of behaviour change initiatives which make use of a wide variety of intervention functions. Enablement includes social opportunity and influences of others which impact perception of behaviours[1]. All behaviours operate within a social context[13].

• Environmental restructuring interventions, especially technology automation, have considerable potential for achieving energy reductions. A restructured environment may create a context and altered social norms or working ethos in which energy saving behaviour can take place.

• Social dynamics are vital to increasing individuals' motivations to act and social norms ensure behaviours are maintained over longer periods of time[1].

• Interventions should target pre-existing groupings. A sense of community is important for maintaining energy saving behaviours.

• Appointing a dedicated energy/ sustainability manager is important, and the further away from the leadership they are, the less likely environmental management is to take place[6].

• Behaviour change interventions should be based on the best available evidence.

	INTERVENTION FUNCTIONS								
POLICY CATEGORIES THAT COULD DELIVER INTERVENTION FUNCTIONS *Definition* EXAMPLES	EDUCATION	PERSUASION	INCENTIVISATION	COERCION	TRAINING	RESTRICTION	ENVIRONMENTAL RESTRUCTURING	MODELLING	ENABLEMENT
COMMUNICATION / MARKETING *Using print, electronic, telephonic or broadcast media* E.G. CONDUCTING MASS MEDIA CAMPAIGNS	●	●	●	●				●	
GUIDELINES *Creating documents that recommend or mandate a practice* E.G. PRODUCING AND DISSEMINATING POLICY	●	●	●	●	●	●	●		●
FISCAL MEASURES *Using the tax system to reduce or increase the financial cost* E.G. INCREASING PREMIUMS ON ENERGY COSTS			●	●	●		●		●
REGULATION *Establishing rules or principles of behaviour or practice* E.G. ESTABLISHING VOLUNTARY AGREEMENTS ON ENERGY USE.	●	●	●	●	●	●	●		●
LEGISLATION *Making or changing policy* E.G. PROHIBITING EQUIPMENT USE OR A BEHAVIOUR.	●	●	●	●	●	●	●		●
ENVIRONMENTAL / SOCIAL PLANNING *Designing and / or controlling the physical or social environment* E.G. REQUIRING CONSISTENCY IN DESIGN OF WORKING ENVIRONMENTS.							●		●
SERVICE PROVISION *Delivering a service.* E.G. ESTABLISHING SUPPORT SERVICES IN WORKPLACES, COMMUNITIES	●	●	●	●	●			●	●

Table 3: Linking BCW intervention functions to policy categories (3 pp. 135-137).

6. IDENTIFY POLICY CATEGORIES

Step six of the Behaviour Change Wheel is designed specifically for individuals in policymaking positions and may not be relevant to those implementing the behavioural interventions. Michie, Atkins, & West identify seven key policy categories, explained in table 5, which each correspond to intervention functions, as shown in table 6.

Once the appropriate policy categories have been identified, Michie, Atkins, & West[3] recommend using the APEASE criteria once more to determine which to select.

7. IDENTIFY BEHAVIOUR CHANGE TECHNIQUES

Step 7 identifies the specific actions required to achieve the intervention function, such as setting a goal for performing a certain behaviour. Michie, Atkins, & West identify 93 different techniques, that fall into 16 categories. The APEASE criteria should again be used to decide between all available options.

The 16 categories are as follows:

- Goals and planning
- Feedback and monitoring
- Social support
- Shaping knowledge
- Natural consequences – the impacts of the behavioural changes
- Comparison of behaviour
- Associations – including nudges, prompts, removal of adverse stimuli, associative learning
- Repetition and substitution
- Comparison of outcomes – with and without making changes, with evidence from a credible source
- Reward and threat
- Regulation
- Antecedents – environmental changes and distraction
- Identity – modelling and beliefs
- Scheduled consequences – including reward and punishment according to pre-agreed criteria
- Self-belief – persuasion about ability
- Covert learning – draw attention to positive feelings towards other staff who do actions and consider the negative results of not performing specified behaviours.[3 pp. 259-283]

Each intervention function and policy category may encompass multiple behaviour change techniques from more than one of the sixteen categories and these should all be considered. These categories should also be considered in evaluating the success of any behaviour change intervention.

8. MODE OF DELIVERY

The final stage of the framework proposed by Michie, Atkins, & West[3] concerns how the behaviour change techniques are disseminated to the targets of the intervention. Michie, Atkins, & West advise considering all possible modes of delivery, including face-to-face, TV, radio, billboard, poster, newspaper, leaflet, internet, mobile phone app, phone helpline, mobile phone text and individually accessed computer programmes. The choice of mode of delivery can be made using the APEASE criteria.

Many behaviour change interventions at universities are designed with the mode of delivery selected before the behaviour change techniques. Michie, Atkins, & West[3] advise against this strategy.

ANNEX I: Example of a behaviour change intervention to reduce energy use in a university

Designing a behavioural intervention: ensuring com puters are turned off at the plug at the end of the day.

1. DEFINE THE PROBLEM:

What? Computers are not turned off at the plug at the end of the day.
Where? Workspaces across the University.
Who? Students, researchers, university staff.

2. SELECT THE TARGET BEHAVIOUR

Individuals turning off their computer at the plug at the end of the day.
Individuals turning off all computers at the plug in their workspace at the end of the day.

3. SPECIFY THE TARGET BEHAVIOUR

- Who should perform the behaviour? All building users who use computers.
- What behavioural changes need to be made by the target individuals? Remember to turn off computer at plug before leaving work.
- When will they do the behaviour?At the end of the space.
- Where will they do the behaviour? At their work day.
- How often will they do the behaviour? Every day.
- With whom / what will they do the behaviour? Individually / with colleagues.

4. IDENTIFY WHAT NEEDS TO CHANGE

- Analyse what needs to change to address the target behaviour. See Table 4.

4. IDENTIFY WHAT NEEDS TO CHANGE

Behavioural components *Definition*	What needs to happen for the target behaviour to occur?	Is there a need for change?	What TDF Domain does this correspond to? *Example question*	Consider changing (tick)
Physical capability *The skills and strength required*	**Have the physical skills to turn off computers at the socket at the end of the day**	**No change needed as university staff have these skills**	**Physical skills** *Are you able to do x?*	
Physical capability *Knowledge of how to do the action*	**Know the correct method to turn off computer at the socket at the end of the day**	**No change needed as knowledge of computer operation is sufficient**	**Knowledge** *Do you know about x?*	
			Cognitive and interpersonal skills *Do you know how to do x?*	
			Memory, attention and decision processes *Is x something you usually do?*	
			Behavioural regulation *Do you have systems that you could use for monitoring whether or not you have carried out x?*	
Physical opportunity *A working environment with the time and resources required, and any barriers removed*	**Have the wall socket accessible**	**Change may be needed as some sockets may not be accessible**	**Environmental context and resources** *To what extent do physical or resource factors facilitate or hinder*	✓
Social opportunity *Interpersonal connections, social cues or cultural norms which encourage the target behaviour*	**See managers, colleagues and peers turn off electronic devices at the socket**	**Change needed as staff do not always see managers and colleagues turning off devices at the socket**	**Social influences** *To what extent do social influences facilitate or hinder x?*	✓
Reflective motivation *Conscious planning to do the behaviour, rather than to engage in competing behaviours*	**Hold beliefs that turning off computers at the socket reduces energy use and that reduced energy use is a desirable outcome**	**Change may be needed as not all staff know that this behaviour reduces energy use or that energy use should be reduced**	**Professional / social role and identity** *Is doing x compatible or in conflict with professional standards / identity?*	
			Beliefs about capabilities *How difficult or easy is it for you to do x?*	✓
			Optimism *How confident are you that the problem of implementing x will be solved?*	
	Believing that consistent computer switch offs will require changes to individuals' self-regulation skills	**Change needed as staff do not necessarily recognise the value of these skills.**	**Beliefs about consequences** *What do you think will happen if you do x?will be solved?*	✓
			Intentions *Have they made a decision to do x?*	✓
			Goals *How much do they want to do x?*	
Automatic motivation *Desire and reflex responses to complete the behaviour*	**Have established routines and habits for switching off computer at the socket**	**Change needed to establish routine and habit formation**	**Reinforcement** *Are there incentives to do x?*	✓
			Emotion *Does doing x evoke an emotional response?*	✓
Behavioural diagnosis of the relevant COM-B components	**Physical and social opportunity, and reflective and automatic motivation need to change in order for the target behaviour to happen**			

Table 4: Using the COM-B and TDF models to identify what needs to change in order for university staff to turn off computers at the socket at the end of work days (devised for this report, based on Michie, Atkins, & West, 2014, pp. 74, 88-90, and 113-115).

"Interventions should aim to change social norms through holistic and multi-pronged approaches."

5. IDENTIFY INTERVENTION FUNCTIONS

Possible intervention functions:

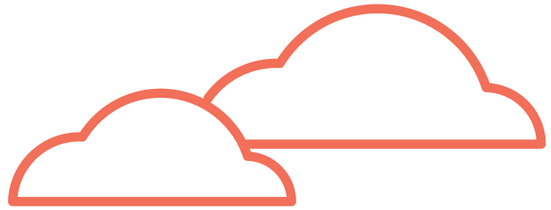
- Environmental context and resources: training, restriction, environmental restructuring, enablement.
- Social influences: restriction, environmental restructuring, modelling, enablement.
- Beliefs about capabilities: education, persuasion, modelling, enablement.
- Beliefs about consequences: education, persuasion, modelling.
- Intentions: education, persuasion, incentivisation, coercion, modelling.
- Reinforcement: training, incentivisation, coercion, environmental restructuring.
- Emotion: persuasion, incentivisation, coercion, modelling, enablement.

Consider these intervention functions using the APEASE criteria.

Number of Theoretical Domains Framework domains covered by intervention functions:

- Modelling: 5
- Enablement: 4
- Persuasion: 4
- Education: 3
- Environmental restructuring: 3
- Coercion: 3
- Incentivisation: 3
- Training: 2
- Restriction:2

Coercion may not be acceptable and may have negative side effects, and therefore the APEASE criteria discourages its implementation in the behaviour change intervention. Education, persuasion, incentivisation, environmental restructuring, modelling and enablement are identified by the literature review in Annex III as being successful intervention functions and are therefore implemented, according to the APEASE criteria.



6. IDENTIFY POLICY CATEGORIES

Key policy categories for this intervention are guidelines, regulation, legislation, service provision and communication / marketing. When considered using the APEASE criteria, legislation is unlikely to be highly effective or acceptable in this intervention, leaving four policy categories in which efforts should be concentrated.

7. IDENTIFY BEHAVIOUR CHANGE TECHNIQUES

Consider the behaviour change techniques which are most relevant to the identified intervention functions and policy categories.

- Goals and planning
- Feedback and monitoring
- Social support
- Comparison of behaviour
- Associations – including nudges, prompts, removal of adverse stimuli, associative learning
- Repetition and substitution
- Comparison of outcomes – with and without making changes, with evidence from a credible source
- Reward and threat
- Regulation
- Antecedents – environmental changes and distraction
- Scheduled consequences – including reward and punishment according to pre-agreed criteria
- Covert learning – draw attention to positive feelings towards other staff who do actions and consider the negative results of not performing specified behaviours.

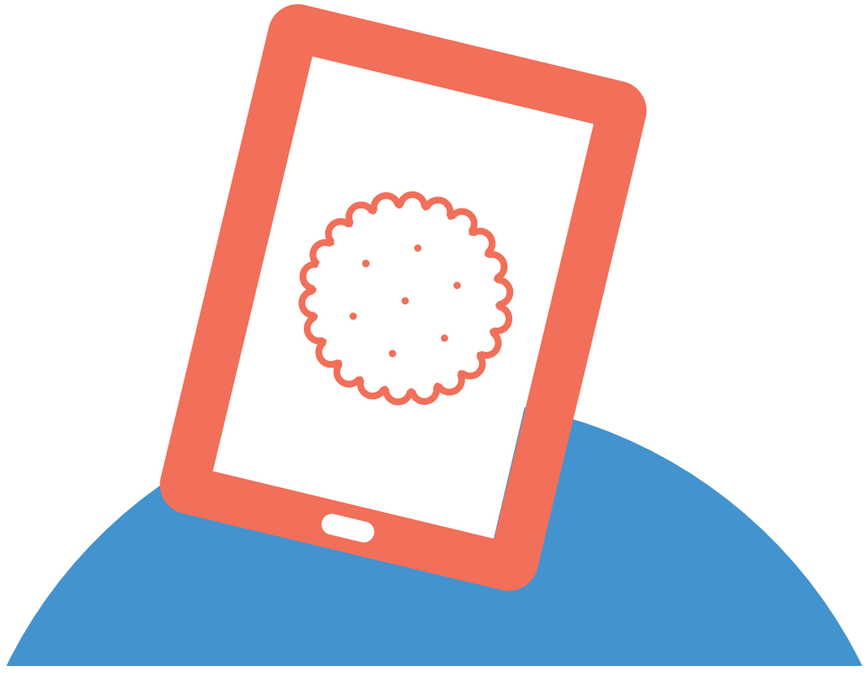
8. IDENTIFY MODE OF DELIVERY

Mode of delivery should be tailored to the specific environment in which the intervention is being implemented. It may be appropriate to use a range of different modes of delivery to best suit different university environments. This choice is made using the APEASE criteria.

"Social rewards can act as strong incentives for energy-reducing behavior change."

In the example of encouraging students and university staff to switch off computers at the plug, above, an appropriate intervention might include the following:

- Plug sockets are made accessible to building users (environmental restructuring).
- One-on-one conversations or presentations in meetings are organised to inform managers and enthusiastic students of the energy and cost reductions possible if these behavioural changes are made. These individuals will then model the behaviour and educate and persuade their peers about the benefits of switching off devices at the plug. Managers can indicate institutional expectations to engage in energy saving behaviours (persuasion, modelling, enablement).
- Reminder posters are designed to be engaging and placed prominently on doors so they are noticed as building users leave (education).
- Work groups are given targets to ensure all non-essential devices are turned off at the plug and the performance of groups is publicised and compared (incentivisation).
- Stickers are given for use to indicate essential devices which should not be turned off, facilitating others to turn off devices (enablement).
- A tin of biscuits is given to the best performing groups and their performance acknowledged publically in meetings or newsletters (incentivisation).
- Regular reminders of the initiative are provided in an accessible manner, tailored to the recipients – by email, in person, on computer screensavers or through posters, depending on what is deemed most appropriate for the group (education).
- Annual rewards and recognition given to groups performing best (incentivisation).



ANNEX II: BEHAVIOUR CHANGE INTERVENTION TEMPLATE

Behavioural components	What needs to happen for the target behaviour to occur?	Is there a need for change?	What TDF Domain does this correspond to? *Example question*	Consider changing (tick)
Physical capability *The skills and strength required*			**Physical skills** *Are you able to do x?*	
Physical capability *Knowledge of how to do the action*			**Knowledge** *Do you know about x?*	
			Cognitive and interpersonal skills *Do you know how to do x?*	
			Memory, attention and decision processes *Is x something you usually do?*	
			Behavioural regulation *Do you have systems that you could use for monitoring whether or not you have carried out x?*	
Physical opportunity *A working environment with the time and resources required, and any barriers removed*			**Environmental context and resources** *To what extent do physical or resource factors facilitate or hinder*	
Social opportunity *Interpersonal connections, social cues or cultural norms which encourage the target behaviour*			**Social influences** *To what extent do social influences facilitate or hinder x?*	
Reflective motivation *Conscious planning to do the behaviour, rather than to engage in competing behaviours*			**Professional / social role and identity** *Is doing x compatible or in conflict with professional standards / identity?*	
			Beliefs about capabilities *How difficult or easy is it for you to do x?*	
			Optimism *How confident are you that the problem of implementing x will be solved?*	
			Beliefs about consequences *What do you think will happen if you do x?will be solved?*	
			Intentions *Have they made a decision to do x?*	
			Goals *How much do they want to do x?*	
Automatic motivation *Desire and reflex responses to complete the behaviour*			**Reinforcement** *Are there incentives to do x?*	
			Emotion *Does doing x evoke an emotional response?*	
Behavioural diagnosis of the relevant COM-B components				

Table 5: Template for using the COM-B and TDF models to identify what behaviour needs to change to achieve a desired outcome, corresponding to stage 4 of the Behaviour Change Wheel (devised for this report, based on Michie, Atkins, & West, 2014, pp. 74, 88-90, and 113-115).

ANNEX III: Review of intervention functions

This chapter provides a summary of the impact of different intervention functions in instituting lasting behavioural changes. This is based on a review of available academic literature for non-domestic behaviour change interventions in institutional (although not exclusively university) settings. Behaviour change interventions should be designed to create social norms around energy saving behaviours which lock individuals into patterns of minimal consumption[14]. The interventions detailed in this chapter are categorised according to the nine intervention functions defined in Chapter 3, Table 2 and are derived from Michie, Atkins, & West's Behaviour Change Wheel framework[3]. The nine intervention functions are education, persuasion, incentivisation, coercion, training, restriction, environmental restructuring, modelling, and enablement[3]. The most comprehensive previous review of literature on this topic identified in this report is Staddon, Cycil, Goulden, Laygue, & Spence[1], although this report goes further.

1. EDUCATION

Mode of delivery should be tailored to the specific environment in which the intervention is being implemented. It may be appropriate to use a range of different modes of delivery to best suit different university environments. This choice is made using the APEASE criteria.

Education-based intervention functions seek to increase an individual's knowledge of energy saving actions and the reasons for energy use reduction, and also includes feedback on plug-load energy use and building audit results, through printed material and email and verbal communication. Education can be disseminated in the form of instructions, reminders, checklists or tips, as well as in feedback.

Key findings from existing literature:

- Specific advice is more meaningful than general, generic advice. For office workers, emails are more effective than posters or leaflets. Weekly emails are effective without annoying employees[1].
- Interventions which are related to making energy saving 'easy' tend to be more effective, especially if the reasons for saving energy are explained[6].
- Peer education was found to be more effective than direct information from sustainability managers. Peer education allows barriers to energy saving behaviour to be removed by offering students the opportunity to raise questions and concerns and for these to be addressed1. Further, information provided by peers is more likely to be acted on as they are relatable and share similar values and needs[6]. This is particularly the case when behaviours are visible to peers[15].
- Targeted information and knowledge passed on by peers tends to be more effective than generalised information such as posters and stickers[1]. In line with this, Cox et al[2] emphasise the importance of involving staff to lead and influence others. Interventions in which employee suggestions are sought gives ownership of the initiative. Active participation of staff, and especially senior managers, help change assumptions about how workplaces should operate and alter norms, integrating low carbon behaviours as part of employees' jobs[2]. This is supported by Bull & Janda1[6] and case study detail in which the largest energy savings resulted from initiatives designed by building users[17].
- Carrico & Riemer[18] similarly found that feedback with energy use data was much more effective when combined with peer education, where 7% and 4% reductions were achieved, whilst an intervention where only energy saving information was provided performed poorly, with an increase in energy use of 4%. The fact that behavioural changes occur in a social context is thought to be the reason behind this[18].
- Education must be delivered in the form most useful to the circumstances. In a hospital-based intervention, where electronic communication between staff was limited, staff received information about the intervention in person, and were reminded of actions to take with prompts such as pens with messages on and staff dressed as a light bulb to start conversations [19].
- A university based intervention in six buildings involved 'Carbon Catalysts' who spoke on-to-one with almost 500 people about energy use and led to annual savings of over £18,000 and 44.6 tonnes of CO2e. The individual-level, peer education approach taken by this scheme was found to be particularly effective[17].
- Provision of information is particularly useful during moments of change such as when new technological systems are being installed. This information should be contextualised and easily understood[1].
- Information should be provided from a trusted source with sufficient expertise).
- The Theory of Planned Behaviour emphasises the importance of perceptions of behavioural control, the perceived ease or difficulty of performing a specific behaviour. Belief in ability to make a difference can influence activity choices, and effort expanded on energy saving behaviours[20].

2. PERSUASION

Persuasion was found to be widely used, with 14 out of the 22 studies analysed in Staddon, Cycil, Goulden, Laygue, & Spence (2016) making use of communications devised to encourage action and positive or negative feelings towards a behaviour.

- Persuasion is typically a component of holistic behaviour change initiatives.
- Direct persuasion may include provision of information through graphs, tables, encouraging text, images and interactive displays, in printed or electronic material.
- Verbal communication is particularly effective when persuasive, such as in peer education.
- There is evidence that interventions which use the institution motto or ethos to galvanise support for environmental initiatives are effective[1]. It is also important to embed shared values of the importance of environmental sustainability[2].
- Energy use reduction can be encouraged at the higher levels of the university hierarchy through its representation as an opportunity to '[avoid] losses' rather than optional maintenance[6]. Similarly, Cox, Higgins, Gloster, Foley, & Darnton (2012) advocate minimising perceptions of inconvenience and creating positive perceptions of costs and benefits for employees to generate intial interest. Behavioural interventions on energy use may be more successful if framed as an opportunity for building users to make a positive contribution, rather than solving a problem[2; 16].
- Positive environmental behaviour is more likely to occur if individuals perceive it as something distinctive about themselves, and the case for doing so is directly related to the individual. Persuasion to perform energy saving behaviours also requires the belief that students and staff have some control over events, which may be enhanced by feedback[12].
- Persuasive functions tend to involve awareness campaigns with information about the negative impact of inappropriate behaviours. However, this is often not sufficient to deliver energy savings, and must be employed in conjunction with other techniques such as incentivisation, environmental restructuring, modelling, enablement and education[21].
- Persuasive visual information should be ambient (no major disruptions to people's daily life), aesthetic (attractive, provide visual comfort), emotionally-engaged (allowing people to engage with the system on an emotional level), and metaphorical (overcoming potential language barriers through the use of images and symbols)[22].
- When environmental issues are not a staff or student priority, additional benefits of energy saving measures can be emphasised. In one case study, employees were promised an improved working environment, due to a reduction in temperature and noise when unneeded equipment are turned off, and improved sleep quality of patients, producing a quiet environment for staff to work in if lights are turned off[19]. Whilst this initiative was located in a hospital setting, the concept remains applicable to other university settings.
- Persuasive interventions which draw attention to cognitive dissonance, the differences between actions and values, may be successful[1].

"Combining intervention functions is often the best way to change social norms and create lasting behavioral changes."

- Nudge theory offers an alternative form of persuasion, in which positive, indirect suggestions are made towards a non-forced, desired behaviour[21].
- Michie, Atkins, & West[3] caution against persuasive techniques that make issues seem more significant than they are. This could give the perception that wasteful social norms exist with respect to energy use, causing individuals to engage less with energy saving behaviours[3].

3. INCENTIVISATION

Unlike in domestic settings, students and staff are not financially responsible for their energy consumption at universities[8; 11]. Behavioural interventions involving incentivisation look to address this barrier through creating an expectation of social or financial / material reward. Incentives are typically given for meeting predetermined targets for energy saving, although goal setting with no reward can also be considered to be a form of incentivisation[1]. This intervention function is widely used at universities, as indicated by the academic literature and the responses of sustainability managers to questions from the author of this report. Whilst some forms of incentive were successful in supporting positive behavioural changes, others were much less so and so the type of incentivisation should be critically considered before implementation. Incen-

tivisation typically requires groups of employees to work together and may develop a sense of competition and comparison, which is applicable in office settings or between university departments.

Key findings from existing literature:

- Publically given rewards outperformed those given privately[1].
- Social rewards (those not based on financial or material gains) tended to outperform small monetary rewards. One study achieved savings of 6.4% for public social rewards, but found an increase in energy use for a group offered private monetary rewards[23].
- A behavioural intervention at two London hospitals rewarded good behaviour with a tin of biscuits for the ward and publicised the group's actions in leaflets with photos of the staff. This was a component of a holistic behavioural intervention which produced a 6.6% reduction in energy consumption and £100,000 per year savings, following an initial cost of £90,000[19].
- One study relied particularly heavily on incentivisation as part of a holistic intervention with seven different behaviour change strategies and drew energy savings of 9%[24].
- Plank[12] indicates that the introduction of targets can be important in sustaining behaviour changes.
- Another experiment encouraged competition among employees through an online digital dashboard that allowed employees to access electricity use and CO2e emissions of their work clusters of 6-8 employees, displayed alongside the same data for all other work clusters. No rewards were offered beyond social recognition. Over a four-week period, energy savings of 6% were generated[25]. This intervention relied on education, environmental restructuring and incentivisation, but it is not clear whether these savings would have been retained over the medium to long term.
- Gamification-type interventions, in which energy use reductions were encouraged through participation in a specially designed game appeared to be fairly successful in the short term. One study organised an online game at a workplace but also saw energy saving behaviours cross into employees' domestic lives as they were encouraged to make energy use reductions at home. However, energy savings were largely lost following the end of the game[26].
- Another study used 'serious games', visual simulations of real-world activities that educate users and prompt behavioural change. A virtual pet game was introduced for 24 weeks in which energy savings led to increased egg production by chickens on a farm, which could be used to buy accessories for the farm. 13% reductions in energy use occurred, including 23% on non-work days and 7% on work days. Whilst many workers appeared to be more aware of their energy use during the game, energy use reductions did not persist following its end. This was partly due to conflict with institutional policies which prevented employees from turning off their computers at night and weekends for security reasons[27].
- Gamification is often more technologically demanding and expensive than other forms of incentive and may not be an appropriate choice when judged according to the APEASE criteria, including due to possible impacts on work productivity and privacy.
- None of the seven highest performing interventions studied by Staddon et al. employed incentivisation[1], and competitions did not feature as a particularly successful behaviour change technique in the literature considered for this report. Anecdotal evidence from universities indicated limited success of energy saving competitions.

4. COERCION

Coercion involves the creation of an expectation of punishment or cost, the effectiveness of which has been poorly studied by the literature. This is largely due to a desire to avoid negative reinforcement, concern over employee attitudes and productivity at work and the difficulty in reliably attributing energy use to individual employees which would be required if they were to be penalised[1]. Some universities have introduced charging and reward schemes at a departmental or building level in which departments failing to make energy use reductions face financial penalties. There is no significant evidence of the effectiveness of such schemes, particularly as the penalties are not felt on an individual level.

5. TRAINING

Training describes imparting skills. This was not analysed in the academic literature reviewed by this study, in part due to the fact that few proposed behaviour change techniques require significant changes in physical capability. Further, centralised energy management at universities means that staff and students rarely have the opportunity to engage in complex actions to reduce energy use. Skilled actions relating to energy behaviours are generally limited to building or facilities managers.

6. RESTRICTION

Restriction is the use of rules to reduce an individual's opportunity to engage in competing behaviours,

and therefore to increase the target behaviour[1]. Whilst there has been little research on this technique which was reviewed for this paper, one study reported a similar effect when 'Environmental Champions' monitored colleagues' behaviours. Whilst this was an unpopular strategy, as it was seen as spying, a 5.4% reduction in electricity use was achieved[28]. Behaviour change interventions can also involve altered occupancy hours, as it requires energy to keep a building open and operational all night[10].

7. ENVIRONMENTAL RESTRUCTURING

Environmental restructuring is an element of almost all studies reviewed for this report and involves changes to the physical or social surroundings to encourage a particular behaviour. This may be in the form of signs or posters, electronic feedback devices and dashboards, retrofit technology, and technology automation. Whilst the provision of information alone 'creates little impact'[1 p. 39] the addition of feedback devices and other environmental changes may produce more successful interventions. Cox et al.[2] found that most successful strategies to alter energy behaviour in the workplace employed technological and infrastructure upgrades.

Key findings:

- Feedback devices may support behaviour change interventions but on their own are insufficient to create long term changes. This is evidenced by an intervention using 'MyEcoFootprint', which provided employees with real time feedback on desk-based energy use, but saw declining engagement by staff with the device over time[7]. This is supported by anecdotal evidence from conversations held with university sustainability managers during the preparation of this report. Nonetheless, visual feedback on the impacts of behavioural changes was a component in many successful interventions, ensuring staff were aware that their changes made a difference[2].
- When individuals do not believe that they have the potential to make a significant difference, feedback can be important, especially when aggregated data is provided[8]. Engaging building users with energy data can also encourage individuals to question their agency and responsibility leading to creative solutions to reduce energy consumption. This is supported by innovative visualisation tools. Aggregated data at the level of social groups, such as research groups indicates the general attitudes of the group, representing a more valid measure of underlying behavioural disposition[20].
- A visual feedback system developed by Chen, et al. [29] produced energy savings of 9.93% and 13.57% in two labs through persuasive feedback interventions. This involved a screen showing an aquarium in which the visual conditions were reduced in response to increased energy use. The effectiveness of this was reduced over time, possibly due to user fatigue[29].
- One study provided web-based, socially comparative feedback to dormitory residents on energy and water consumption, combined with education and rewards. Over a 2 week period, a 32% reduction in energy use was recorded, including a 56% reduction in the winning dormitory. However, the short length of the study means that it is not possible to understand whether fatigue would become a factor, although low energy use appeared to be sustained following the competition period. The rewards were given to the dormitories which made the largest reductions in energy consumption, which were those with the high resolution live data monitoring systems. However, poor attendance at the reward suggested that it was factors other than the incentive which drove the behaviour changes[30].
- More complex dashboards, such as the Intelligent Dashboard for Occupants (ID-O) have features for self-monitoring, advice, comparison, and online controls. Combined with a Plugwise device, these dashboards can monitor and control each desktop technology's electricity usage.
    - o The ID-O displays energy usage in real time, using charts and over varying time scales to allow individual analysis of energy consumption. The ID-O also provides energy tips which users can follow immediately, includes predicted energy savings, and offers peer- and self-comparison to introduce competition and inspire more energy efficient behaviour. The data is presented as the ratio between optimal use of appliance and actual energy consumption and coloured red, yellow, or green to provide qualitative performance information.
    - o The ID-O also offers online controls which allow office devices to be switched off remotely, and automated controls with a calendar feature to permit scheduled turning on and off of devices.
    - o The results demonstrated that automation, online controls and feedback was highly effective, achieving 38% savings, compared with 25% for feedback and online control and 13% for feedback only. Savings of 7% were also made by the control group, thought to be the result of peer discussions on energy usage. Whilst automation clearly was helpful for inefficient users, it is much less effective for those who already use energy efficiently. Furthermore, it is thought to make users dependent on the system, limiting savings to the extent that the system allows. Those without automation features tended to put more effort into understanding their consumption and acting to reduce energy waste, irrespective of their previous energy efficiency. The desk-based energy use reductions were made over a period of 13 weeks[9]. It is not clear whether they would have been retained over a longer period of time.
- A further study compared energy savings from lighting with office occupants given switches, automated systems and no lighting measures as a control. The control group saw a 2.4% decrease in energy use, compared with a 12% decrease for those with switches and a 12.6% decrease for those with the automated system[31].
- Technological change through the introduction of automated systems is an effective means of achieving energy use reductions and a form of behavioural change as it requires altered behaviour and acceptance of technology. Without acceptance of technology, workers may bypass the technologies. Technological change can also alter social norms of employees by indicating a commitment to environmental initiatives[1]. Technology change may also require building users to become more knowledgeable about efficiency, as indicated by a study of Passive House residents in Sweden, in which several became experts in the technology to optimise the functioning of their homes[10].

"A restructured environment may create a context and altered social norms in which energy saving behaviour can take place."

- Interventions using technology and infrastructure upgrades to facilitate changes in daily working practices tended to be particularly successful, especially if they provided a visual symbol of organisational commitment to improved environmental performance. Environmental restructuring also provides opportunities for transformative moments of change in which new social norms may be developed[2]. Without environmental restructuring individuals may be disinclined to engage in energy saving behaviours if there is no visual institutional commitment to carbon reduction, or due to a belief in the futility of engaging in energy use reductions in inefficient buildings[10].
- However, the 'rebound effect' threatens energy use reductions following changes to building fabric or technology as reduced energy costs may increase reliance on the efficiency of the building and decrease the motivation of individuals to engage in energy saving actions[11].
- Interventions which do not specifically refer to sustainability and instead ambiguously advocate certain energy saving actions can lead to awareness of energy saving activities. However, ambiguity was found to be generally unsuccessful as it failed to enourage users to start a conversation with each other, cast doubt on the functionality of the poster, thus acting as a barrier to persuasion[21].
- A Global Action Plan initiative in two hospitals in London brought a 6.6% reduction in electricity consumption using a range of simple intervention techniques, including a screensaver with the campaign messaging on. This included a message from the medical director endorsing the initiative, demonstrating institutional commitment to energy use reduction[19].

8. MODELLING

Modelling provides an example for people to aspire to or imitate. It is typically introduced as a component of holistic behaviour change programmes and whilst it is difficult to attribute energy savings specifically to modelling, it was an important part of interventions with considerable energy savings of 12%, 9% and 5.4% in different studies. Modelling is particularly effective when done by role models such as senior researchers or managers.

Modelling involves positive messages that reinforce group identity, which can offer further benefit to energy use reduction efforts. This can be achieved by bringing colleagues together to share stories or public displays. Further, modelling can also introduce comparison or competition between colleagues, either individually or in groups. Comparison in groups is likely to be logistically more feasible and reduces concerns about individual privacy[1]. When combined with instructions, feedback, justification for change and other intervention functions, modelling through information on or perceptions of norms is important for ensuring the longevity of behavioural changes[6].

Furthermore, Michie, Atkins, & West[3] emphasise that all behaviour change interventions operate within a social context. Since individual behaviour is influenced by social opportunity through immediate social contacts, modelling plays an especially important role.

9. ENABLEMENT

Enablement is the increasing of capability or opportunity, or removal of barriers to complete an activity. This intervention function was considered to be an important component of many of the best performing studies, although it is difficult to attribute success solely to its presence. This strategy may include energy dashboards which allow staff and students to automatically control electronic devices at their desks, and other forms of environmental restructuring such as giving staff access to plug sockets. Further, policy changes to permit energy use reductions can enable energy use reductions, for instance through equipment shut downs or relaxed dress codes to permit flexibility of building temperatures with the seasons. An additional strategy would be to alter organisational governance to permit financial savings to be reinvested in the department in which energy savings have been made[1]. Flexibility in schedules and routines, including allowing staff to work from home, can be an important aspect of enabling staff to contribute to energy saving measures. Finally, ensuring low carbon activities are part of organisational routines, with allocated time within the working day to enable employees to take part encourages and makes possible staff participation[2; 12].

To enable energy saving behaviours, the organisational strategy is highly important. Engagement around energy efficiency must happen within existing roles and teams, and it is very difficult for energy efficiency targets to compete with core business activities, jobs with high levels of stress and time constraints, and profitability[16]. One challenge to enablement is shared work settings, in which individuals may feel unable to turn off equipment as other individuals may also need to use it without waiting for it to turn on[8]. Palm & Darby propose that this conflict between individual and group needs can be resolved through enablement (including environmental restructuring) in which work practices change and individuals can specifically indicate when equipment in shared spaces must remain on[10].

Enablement strategies include remote control over electronic devices, individualised assistance to employees to reduce energy use of their working space, facilitating late-night workers to use a centralised office area (which would allow most other areas to be shut down) 'changing custodial practices', offering building managers greater control over energy systems (assuming engagement, education and other techniques are introduced in addition), and participation in governance of the organisation, offering ownership of the issues and benefits of energy use reduction[1].

INTERVENTION	CAPABILITY		MOTIVATION		OPPORTUNITY	
	Physical	Psychological	Reflective	Automatic	Physical	Social
Education		●	●			
Persuasion			●	●		
Incentivisation			●	●		
Environmental		●		●	●	●
Modelling		●	●	●		●
Enablement		●	●	●	●	●
Intervention Functions below are NOT represented in the studies reviewed in this paper but are included here for comprehensiveness						
Coercion			●	●		
Training	●	●		●	●	
Restriction					●	●

Table 6: Links between intervention functions and components of the COM-B (Capability, Opportunity, Motivation) behavioural framework, demonstrating the importance of holistic behaviour change interventions (1).

10. SUMMARY CONCLUSIONS

This chapter reviewed the available academic literature on behavioural interventions, focussing on reducing energy consumption in a university context. Key findings above include:

- Modelling, peer-education, public and social incentives, enablement, environmental restructuring and social persuasion tend to be associated with successful interventions. Successful behaviour change interventions will include all of these intervention functions. Any one intervention function on its own is much less likely to be successful[1; 2].
- Enablement appears to be a particularly successful intervention, particularly as a component of behaviour change initiatives which make use of a wide variety of intervention functions.
- Environmental restructuring interventions, especially technology automation have considerable potential for achieving energy reductions. A restructured environment may create a context and altered social norms or working ethos in which energy saving behaviour can take place. However the 'rebound effect' may also occur, leading to building users relying heavily of the building itself rather than making energy use reductions themselves.
- Providing individuals with the opportunity to influence energy use is a component of most successful interventions studied. This includes social opportunity, and the interpersonal influences which impact perception of behaviours[1]. All behaviours operate within a social context[13].
- Social dynamics are vital to increasing employee motivations to act and social norms ensure behaviours are maintained over longer periods of time[1].
- Interventions should target employees based on pre-existing groupings. A sense of community is important in maintaining energy saving behaviours.
- Whilst there has been much less research on the success of coercion, training and restriction interventions, it is not inevitable that these would see poor results[1].
- Many barriers to behaviour change are neither economic nor technical. Behaviour change initiatives should include a wide range of intervention functions[32].
- Appointing a dedicated energy / sustainability manager is highly important, and the further away from the leadership they are, the less likely environmental management is to take place[6].
- Behaviour change interventions should be based on the best available evidence.

"Understanding the social context and interpersonal influences that impact perception of behaviours is important for designing opportunities for individuals to influence their energy use."

REFERENCES

1. Staddon S., C. (2016) Intervening to change behaviour and save energy in the workplace: A systematic review of available evidence. Energy Research & Social Science, 17:30-51.

2. Cox, A., Higgins, T., Gloster, R., Foley, B. (2012) The impact of workplace initiatives on low carbon behaviours. Scottish Government Social Research, 2012.

3. Michie, S., Atkins, L. & West, R. (2014) The Behaviour Change Wheel: A Guide to Designing Interventions. Silverback Publishing.

4. Lucon, O., et al. (2014) Buildings. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA : Cambridge University Press, 2014, pp. 671-738.

5. Stern, P., C., et al. (2016) Opportunities and insights for reducing fossil fuel consumption by households and organizations. Nature Energy, Vol. 1: 16043

6. Centre for Sustainable Energy & the Environmental Change Institute, University of Oxford. (2012) What are the factors influencing energy behaviours and decision-making in the non-domestic sector. London: Department of Energy and Climate Change.

7. Murtagh, N., et al. (2013) Individual energy use and feedback in an office setting: a field trial. Energy Policy, 62: 717-728.

8. Webb, L., et al. (2016) A Living Lab Co-creational Approach to Energy Demand Reduction in Non-domestic Buildings: Understanding the Organisation. Coimbra : 4th European Conference on Behaviour and Energy Efficiency, 2016. BEHAVE 2016.

9. Yun, R., et al. (2015) Beyond Eco-Feedback: Adding Online Manual and Automated Controls to Promote Workspace Sustainability. Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems. 1989-1992.

10. Palm, J. & Darby, S., J. (2014) The Meanings of Practices for Energy Consumption - a Comparison of Homes and Workplaces. Science & Technology Studies, 27: 72-92.

11. Darby, S. (2006) The Effectiveness of Feedback on Energy Consumption: a review for DEFRA of the literature on metering, billing and direct displays. Oxford : Environmental Change Institute, University of Oxford.

12. Plank, R. (2011) Green behaviour: Barriers, facilitators and the role of attributions. [ed.] Dean Bartlett. Going Green: the psychology of sustainability in the workplace. London : British Psychological Society. 47-58.

13. Michie, S., van Stralen, M., M & West, R. (2011) The behaviour change wheel: A new method for characterising and designing behaviour change interventions. Implementation Science, 6:42

14. European Environment Agency. (2013) Achieving energy efficiency through behaviour change: what does it take? Copenhagen : European Environment Agency, 2013.

15. Bedwell, B., et al. (2014) Apportioning energy consumption in the worklace: a review of issues in using metering data to motivate staff to save energy. Techology Analysis & Strategic Management. 26:1196-1211.

16. Bull, R., J., & Janda, K., B. (2016) The Wicked and Wild Challenges of Fostering Energy Efficiency Engagement in Private and Public Organisations. 4th European Conference on Behaviour and Energy Efficiency.

17. Carbon Catalysts Team, University of Edinburgh. (2011) Climate Action Plan: Carbon Catalysts Face-to-face engagement to reduce energy use, May through July 2011. Edinburgh : University of Edinburgh, 2011.

18. Carrico, A., R, & Riemer, M. (2011) Motivating energy conservation in the workplace: An evaluation of the use of group-level feedback and peer education. Journal of Environmental Psychology, 31:1-13.

19. Aldrich-Smith, L. (2014) Case study summary: Global Action Plan, UK. Fit for the Future.

20. Ajzen, I. (1991) The Theory of Planned Behaviour. Organizational Behaviour and Human Decision Processes, 50: 179-211.

21. Agha-Hossein, M., M., et al. (2015) Providing persuasive feedback through interactive posters to motivate energy-saving behaviours. Intelligent Buildings International, 7: 16-35.

22. Fang, W., C., & Hsu, J., Y. (2010) Design Concerns of Persuasive Feedback System. Atlanta, Georgia : s.n., 2010. Workshops at the twenty-fourth AAAI conference on artificial intelligence. pp. 11-15.

23. Handgraaf, M., J., J., van Lidth de Jeude, M., A., & Appelt, K., C. (2013), Public praise vs. private pay: Effects of rewards on energy conservation in the workplace. Ecological Economics, 86: 86-92.

24. Gustafson, C., & Longland, M. (2008) Engaging Employees in Conservation Leadership. ACEEE Summer Study on Energy Efficiency in Buildings, 2008.

25. Metzger, I., Kandt, A., & VanGeet, O. (2011) Plug Load Behavioural Change Demostration Project. Technical Report NREL/TP-7A40-52248. Golden, Colorado : National Renewable Energy Laboratory, 2011.

26. Kuntz, K., Shukla, R., & Bensch, I. (2012) How Many Points for That? A Game-Based Approach to Environmental Sustainability. ACEEE Summer Study on Energy Efficiency in Buildings, 126-137.

27. Orland, B., et al. (2014) Saving energy in an office environment: A serious game intervention. Energy and Buildings, Vol. 74, pp. 43-52.

28. Hargreaves, T. (2011) Practice-ing behaviour change: Applying social practice theory to pro-environmental behaviour change. Journal of Consumer Culture, 11: (79-99)

29. Chen, H., M., et al. (2012) Persuasive feedback model for inducing energy conservation behaviours of building users based on interaction with a virtual object. Energy and Buildings, 45: 106-115.

30. Petersen, J., E., et al. (2007) Dormitory residents reduce electricity consumption when exposed to real-time visual feedback and incentives. International Journal of Sustainability in Higher Eduction, 8: 16-33.

31. Owen, T., Pape-Salmon, A., & McMurchy, B. (2010) Employee Engagement and Energy Information Software Supporting Carbon Neutrality. ACEEE Summer Study on Energy Efficiency in Buildings, 7: 233-244.

32. Shove, E. (1998) Gaps, barriers and conceptual chasms: theories of technology transfer and energy in buildings. Energy Policy, (26) 1105-1112.

This report was funded by the International Alliance of Research Universities (IARU). The author would like to acknowledge the support of the eleven IARU member universities, including for providing case study details of past behaviour change interventions. The report was also supported by evidence provided by the University of Manchester, the University of Edinburgh, the University of London, Kings College London, Oxford Brookes University, the National Union of Students (UK) Student Switch Off campaign, the University of East Anglia, Oxford University Press, and University College London. These case studies were influential in assessing the findings of the literature review. The author would also like to thank Dr Lorraine Wild (University of Oxford) for her comments on the report. The research was completed at the University of Oxford, and I would like to extend particular gratitude to the Environmental Sustainability Team for their advice and hospitality during the writing of this report.

The International Alliance of Research Universities (IARU), established in 2006, is a network of eleven international research-intensive universities from nine countries across the globe. The eleven members share similar values, a global vision and a commitment to educating future world leaders. Central to these values is the importance of academic diversity and international collaboration as reflected in IARU's principles. The IARU Sustainable Campus Initiative was established in 2009 with the aims of exchanging ideas, fostering collaboration, and developing and testing best practices for university sustainability.

The IARU Members are the Australian National University, ETH Zurich, National University of Singapore, Peking University, University of California, Berkeley, University of Cambridge, University of Cape Town, University of Copenhagen, University of Oxford, the University of Tokyo, and Yale University.