ENERGY SYSTEM TRANSITION THROUGH STAKEHOLDER ACTIVATION, EDUCATION AND SKILLS DEVELOPMENT

ENTRUST

Identification and Characterisation of Energy Behaviour Change Initiatives

Deliverable D4.4

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About the ENTRUST Project

ENTRUST is mapping Europe's energy system (key actors and their intersections, technologies, markets, policies, innovations) and aims to achieve an in-depth understanding of how human behaviour around energy is shaped by both technological systems and socio-demographic factors (especially gender, age and socio-economic status). New understandings of energy-related practices and an intersectional approach to the socio-demographic factors in energy use will be deployed to enhance stakeholder engagement in Europe's energy transition.

The role of gender will be illuminated by intersectional analyses of energy-related behaviour and attitudes towards energy technologies, which will assess how multiple identities and social positions combine to shape practices. These analyses will be integrated within a transitions management framework, which takes account of the complex meshing of human values and identities with technological systems. The third key paradigm informing the research is the concept of energy citizenship, with a key goal of ENTRUST being to enable individuals overcome barriers of gender, age and socio-economic status to become active participants in their own energy transitions.

Central to the project will be an in-depth engagement with five very different communities across Europe that will be invited to be co-designers of their own energy transition. The consortium brings a diverse array of expertise to bear in assisting and reflexively monitoring these communities as they work to transform their energy behaviours, generating innovative transition pathways and business models capable of being replicated elsewhere in Europe.

For more information, see **http://www.entrust-h2020.eu**

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Executive Summary

The overall aim of WP4 is to use the insights gathered from WP2 (relating to energy technologies) and WP3 (regarding socio-economic analysis) to formulate a best practice policy toolkit for EU member states. As such, it will serve as a key input for WP6 to define innovative energy pathways, for WP7 to integrate this work package's outputs in the energy portal, and for WP8 to stimulate dialogue at the national and EU level. This deliverable is an output for Task 4.3 that identifies and characterises the suite of energy behaviour change initiatives across a range of European Union countries. Section 1.2 provides an overview of the aims and objectives.

With reference to several case studies across Europe, this deliverable has provided insights on success factors and commonly encountered barriers to energy behaviour change initiatives. Through an evaluation of a number of identified and characterised initiatives across the UK, Ireland, Spain, France and Italy, energy behaviour change initiatives are noted as being the 'holy grail' of sustainability which have the potential to influence the ways in which people use technologies as part of their everyday practices (Jackson, 2005). It is well noted that behaviour, practices and culture constitute a powerful human factor in the energy system; in particular the interactions between technologies, practices and norms that lock individuals in to certain patterns of (often inefficient) energy use. The result has been an increasing focus in behaviour change research, particularly on the social contexts in which people live, the routines they shape, and the extent to which people feel empowered to change them. This deliverable has identified, and characterised, a series of behaviour change initiatives, indicating the factors contributing to their relative success in influencing energy actions. The projects reviewed here illustrate a snapshot of current practices in this area, and while these projects do not represent an exhaustive list, it is from these understandings that a number of conclusions can be drawn. As such this deliverable has contributed to providing:

- A deeper understanding of the different models and delivery tools employed to change energy-related behaviour;
- An insight into the critical success factors that underpin best practice and successful interventions; and
- A "what works in practice" overview of different ways to change behaviour and the interventions to apply based on different contexts to avoid applying measures that do not work to modify behaviour change.

Section 2 examined the existing academic literature relating to energy use and behaviour change which is by now a well-established research area. The literature review examined how existing studies have evaluated the effectiveness of different intervention strategies and different conceptual approaches that have sought to explain and understand human behaviour and practices in relation to energy consumption behaviours, and in order to promote energy conserving behaviour change. Different conceptual models of understanding behaviour and encouraging behaviour change illustrate that energy behaviour change initiatives aim to influence different elements of the preceding variables that influence behaviour such as attitudes and awareness, or seek to change the contexts within which people act.

The conceptual approaches identified have been used to provide a better understanding of energy related behaviours; the range of theories lends credence to the claim that no single approach can exclusively

explain and predict behaviour and consequently no single approach can explain nor change people's behaviour. Collectively these cross-disciplinary insights (from a range of psychological, economic and sociological approaches) contribute towards helping to unravel the complexity of energy related behaviours and the multitude of factors that shape them. It has also been identified that there are many tensions between theories which by the same token arguably suggest that the different models and perspectives offer complimentary viewpoints on the same theme of energy behaviours. Hence, it is observed that policies on behaviour change appear to take a pragmatic line by combining a mixture of theories in public policymaking across different EU countries to change individual and consumer behaviour across many spheres of behaviour, specifically relating to energy consumption and in dealing with the low-carbon and sustainability agenda. The theoretical approaches to behaviour change presented in Section 2 have informed public policymaking on this topic.

This deliverable provided an overview of the policy backdrop of the case studies chosen from across EU countries. Thus, elements of Europeanisation and internationalisation of energy conservation policies emanating from the EU level have shaped the national policymaking on energy for the case study countries, and has been the case for many years. Broadly, in practice what is apparent of many policy instruments in relation to energy behaviour change is that they have developed incrementally at the national member state level, and the progress in policy at European level seems to require more voluntary cooperation by member states. However, the emphasis of the policy context review sought to demonstrate why energy use behaviour change mattered in relation to the international and national level policy agendas of the different countries. Existing research suggests that individual behaviour change can make a significant contribution in reducing energy consumption. Although there is substantial disagreement over how much; ranging from 10% to 50%. This research reinforces suggestions that there is a real need to encourage households to change energy consumption behaviour.

Furthermore, recognition in existing research and policy that household consumption practices create considerable pressures on the global environment, including on climate change (Whitmarsh *et al.*, 2013; Axon, 2016a). As a result, behaviour change at the household and individual level has gained traction amongst policymakers as a key area of intervention (Moloney *et al.*, 2010; Axon, 2016a). Behavioural change is difficult to achieve, therefore an understanding of how, why and where behaviours change is an important prerequisite for making progress (Verplanken & Roy, 2016) . Reducing carbon emissions at the household level and within the housing sector comprises a combination of both technical (*e.g.,* retrofitting housing) and behavioural solutions (*e.g.,* reducing room heating, changing tariffs). In particular, government policy is primarily reliant upon the voluntary take-up of solutions as the regulatory and mandatory framework identified is limited in its scope to influence to encourage households to change behaviours to reduce their energy demand and consumption. Overall, policy instruments for tackling energy conservation amongst individuals, households (largely as rational consumers or end-users) acknowledge that whilst both behavioural and technological solutions are important, it is the technical and technological solutions/interventions that have often been more dominantly promoted and implemented in practice rather than behavioural change (Axon, 2016b).

Therefore, the existing policy landscape review suggests that energy conservation behaviour change have not received the relatively strong policies that exist for new and existing building's energy efficiency (*e.g.,*

building regulations on energy efficiency). The case studies reviewed in this deliverable illustrate that in relation to individual behaviour change there is a predominant use of incentives (*e.g.,* grants) and voluntarism (*e.g.,* nudges) and combined with social marketing tools which dominate this policy arena. This softer non-mandatory policy approach can be criticised for not providing the right push at the right time. Nevertheless, the policy landscape for energy conservation or behaviour change suggests that it relies on a mix of tools and with different scopes across the various countries included in this review and thus reflected in the diversity of intervention case studies examined in this deliverable.

The case studies presented as part of this deliverable can be summarised as follows:

- **Community-based interventions combining peer-to-peer and information advice** case studies (*e.g.,* Green Doctors - UK; Energy Champions - Stockbridge Village**)** show that some approaches need to be targeted at individuals to be effective, predominantly in low income areas. They also focus on the core idea of peer-to-peer led activities, yet rely on a mixture of tools. It also appears to be a relatively hands-on intensive approach as they offer tailor made solutions and advice. This approach addresses the individual and material contexts of behaviour.
- In particular, **peer-to-peer activities** (*e.g.,* 'Energy Champions or Captains') are used to foster trust between local stakeholders, i.e. people are more likely to trust other residents or others they can identify with rather than someone who is an official from a local council or housing association. However, peer-led support and activities have been supplemented with information and advice, and including those offering challenges, rewards and competitions (e.g. Power of One) are key tools for stimulating, and motivating individuals into energy conservation. The examples also suggest that the highly personalised and tailor made solutions which are often delivered to a small number of individuals ranging from 10 to a few hundred, are likely to hold financial/funding implications for those delivering them on a larger scale.
- Many cases (*e.g.,* Green Doctors; SuperHomes) suggest that behaviour change needs to be accompanied by building specific physical interventions that information/awareness raising activities alone cannot address. In practice, thus these are often accompanied by energy efficiency retrofitting and the installation of micro-generation technologies for an effective and household level energy reduction strategy. This demonstrates that **technology adoption and behaviour change go-hand-in-hand** for an effective strategy.
- **Eco-districts** are area based exemplars or demonstrators but attempt to reach long term and sustainability goals beyond mere energy efficiency or conservation. They try to move an entire community (mix of users and building uses) to change behaviour. This approach addresses more holistically the individual, social and material context of behaviour. These approaches seek to change the social contexts of behaviour and break-way from existing mainstream social norms and conventions to promote a more sustainable way of life for working and living in. However, in practice, such schemes are rare and appear confined to a niche form of development.
- **Open homes events** (*e.g.,* Nearly Zero Buildings; SuperHomes) place emphasis on building specific solutions yet provide social learning, however predominantly emphasise technology adoption and address building specific energy efficiency, in these approaches behaviour change is less explicit and perceived as a desirable outcome in the long-term that could follow from occupants living in a

more energy efficient home. It provides a form of peer-to-peer learning too but particularly focused on building specific solutions. This approach mainly addresses the individual and material context of behaviour and one off curtailment behaviours.

- **Collective energy switching** seems to functions as a form of market intervention that seeks to rationally motivate individuals as consumers (through the provision of greater choice) to seek the best energy tariffs to save money. These rely on mass media information and awareness raising campaigns to get residents to take-up the cheaper tariffs. This approach is largely driven by the state but requires voluntary take-up through offering consumer choice. It mainly addresses the individual context of behaviour.
- **Smart technologies** mainly emphasise technology adoption as a tool to provide users (which can be both residential and non-residential) with greater awareness and accountability on day to day energy consumption which should ideally stimulate better energy management. The key components of the smart meters are that they are not used in isolation but appear effective when accompanied by a range of innovative tools which provide feedback and information on energy consumption and are an integral part of their success. There are a mixture of debates on the effectiveness of this tool - studies have highlighted they could perpetuate rebound. This approach addresses the individual context of energy behaviour.

In Section 4, 15 detailed cases studies of energy use behaviour change initiatives are presented. The case studies have been classified as falling to one of 6 types of interventions: community based interventions, information and advice; eco-districts; open home events; collective energy switching and smart technologies. The report covers two community based peer-to-peer inventions, the Familles à énergie positive in France and Stockbridge Village Energy Champions in the UK. It also sets out details of two community based advice and information initiatives: Green Doctors in the UK and The Power of One, in Ireland. For community-based interventions, both peer-to-peer interventions and information and advice initiatives, these are largely targeted at individuals in low income areas. They provide a relatively hands-on, intensive approach that can offer tailor made solutions and advice. This approach addresses the individual and material contexts of behaviour. In particular, peer-to-peer activities (*e.g.* 'Energy Champions or Captains') are used to foster trust between local stakeholders. This is supplemented with information and advice. The case studies point towards the challenges of scaling these highly personalised and tailor made solutions for delivery to a large population. The case studies suggest that behaviour change needs to be accompanied by building specific physical interventions that information/awareness raising activities alone cannot address. These case studies suggest that **technology adoption and behaviour change go-hand-in-hand** for an effective strategy.

The report presents two case studies on eco-districts, the Cloughjordan Ecovillage, Ireland and the The Darwin project, Bordeaux, France. These Eco-districts are area based exemplars or demonstrators but attempt to reach long term and sustainability goals beyond mere energy efficiency or conservation. They try to move an entire community (mix of users and building uses) to change behaviour. This approach addresses more holistically the individual, social and material context of behaviour. These approaches seek to change the social contexts of behaviour and break-way from existing mainstream social norms and conventions to promote a more sustainable way of life for working and living in. However, in practice, such

schemes are rare and appear confined to a niche form of development. There are two case studies of open home events, Nearly Zero Energy Buildings Open Door in Ireland and SuperHomes in the UK. These initiatives place emphasis on building specific solutions yet provide social learning. However, they predominantly emphasise technology adoption and address building specific energy efficiency, in these approaches behaviour change is less explicit and perceived as a desirable outcome in the long-term that could follow from occupants living in a more energy efficient home. It provides a form of peer-to-peer learning too but specifically focused on building concrete solutions. This approach mainly addresses the individual and material context of behaviour and one off curtailment behaviours.

The UK also features in the two case studies of collective energy switching, the power to Switch Campaign and the Big London Energy Switch. Both function as a form of market intervention that seeks to rationally motivate individuals as consumers (through the provision of greater choice) to seek the best energy tariffs to save money. These rely on mass media information and awareness raising campaigns to get residents to take-up the cheaper tariffs. This approach is largely driven by the state but requires voluntary take-up through offering consumer choice. It mainly addresses the individual context of behaviour. Finally, there are five case studies, one from each case study country for Smart technologies: Nice Grid, France; Power Off & Save, Ireland; Sports Center FIDIA Cesano, Italy; Carrega't d'Energia, Spain; and Smart Meters Smart People, UK. The case studies emphasise technology adoption as a tool to provide users (which can be both residential and non-residential) with greater awareness and accountability on day to day energy consumption which should ideally stimulate better energy management. The key component of the smart meters is that they are not used in isolation but appear effective when accompanied by a range of innovative tools which provide feedback and information on energy consumption and are an integral part of their success. There is a mixture of debates on the effectiveness of this tool - studies have highlighted they could perpetuate rebound effects. This approach addresses the individual context of energy behaviour.

A large proportion of the intervention case studies were selected on the basis of how they engaged with individuals (typically households) on energy consumption behaviour change. This included those that engaged on behaviour change alone, and some engaged by encouraging both behaviour change and energy efficient retrofitting (technology adoption) or those that were technology or building focused in order to deliver energy conservation goals. Therefore, a large proportion of case studies sought to target the individual context of behaviour change. However, what most do have in common is that any intervention despite their core approach, cannot rely on a single tool but often need to supplement with multiple tools; and again typically include some form of technology adoption and user behaviour change. This is a well-known approach to encourage behaviour change, through blending interventions and initiatives to sustain meaningful pro-environmental actions (Abrahamse *et al.*, 2005). The complexity in energy consumption has resulted in interventions having to respond to multiple factors influencing everyday energy consumption as discussed in Section 4 and 5.

Consequently, the case study interventions reviewed in Section 4 and 5 indicate the many different ways (*e.g.,* campaigns, tools) and stakeholders involved in interventions across the EU case study countries. For example, interventions including stakeholders working in partnerships from across national, regional and local governments, and other public sectors organisations, private sector businesses and civil society or

community groups. Within these case studies, there are attempts to target behaviour change issues from the top-down and bottom-up approaches.

This deliverable has classified energy-related behaviour change initiatives into 6 broad categories (community-based interventions; information and awareness based interventions; eco-districts; show-case events; energy switching; and smart-technology focused interventions) and then further categorising the interventions within the context of policy categorisations and the function of the initiatives using the Behaviour Change Wheel in Figure 4 (Michie, van Stralen, & West, 2011). In so doing, this report has outlined that there are significant gaps between what is known to work to engage individuals in behavioural changes and what is currently being employed within initiatives reviewed here. An over-reliance on education and awareness-raising projects illustrates that such projects are not aiming for sustained behavioural changes and with no projects incorporating fiscal measures, regulations or legislation to drive behaviour change reflects a reluctance to engage widely with the diverse approaches that can drive behaviour change.

Due to the disparate nature of the case studies (selected for their diversity and not like-for-like comparability), it is challenging to discuss the carbon emission savings many of these interventions may have delivered. Many projects do not measure or monitor such outcomes coherently and such information is not available in the public domain. The mix of interventions deployed in many cases adds to the problem of measuring the impact of specific interventions and the tools deployed. On one hand, a mixed methods approach holds the strength that acknowledges that energy consumption embodies a complex relationship between people, their everyday practices and the buildings they occupy. Therefore, the use of multiple tools could aid stakeholders and practitioners in behaviour change to tackle multiple social challenges (e.g. fuel poverty, energy security, sustainable lifestyles) at different levels. From the case studies presented in this Deliverable, the following key lessons for the success of initiatives were identified as follows:

- Creating a sense of collective interests and achievable goals;
- Fostering strong leadership and continued support by the intermediaries (as shown by the 'Captains');
- A focus on energy management;
- Relying on a mix of tools;
- Targeting the individual context of behaviour.
- The challenges of measuring the individual impacts of tools; and
- Measuring short-term to long-term benefits and knock-on effects of interventions.

This connects with international research into behaviour change interventions targeting energy use in the household which strongly indicates that combining interventions such as feedback, monitoring and rewarding shows greater results than adopting a single strategy (Abrahamse *et al.*, 2005). However, the same research also argues that combined interventions are more difficult to evaluate as it is less easy to pin-point how different elements are contributing to overall energy use behaviour change. Despite this, combined interventions offer the potential for sustained behavioural changes.

1 Introduction

1.1 *Overview of Work Package 4*

Work Package 4 of the ENTRUST Project focuses on the policy landscape of energy transitions in the European Union. In this work package, the policy analysis provides an overview of policies and regulations impacting on the energy system in a range of European countries and an assessment of the potential "Europeanisation" of the energy policy landscape. In so doing, national dialogues, the main focus of public discourses, and the main barriers to deploying low-carbon energy measures are analysed, taking into account the different stakeholders identified in Work Package 2. WP4 contains four tasks:

- T4.1: Mapping of policy and regulation landscape;
- T4.2: Assessment of Europeanisation in national policy dialogue;
- T4.3: Identification and characterisation of energy behaviour change initiatives; and
- T4.4: Policy tool-kit – Typology of approaches.

The overall aim of WP4 is to use the insights gathered from WP2 (relating to energy technologies) and WP3 (regarding socio-economic analysis) to formulate a best practice policy toolkit for EU member states. As such, it will serve as a key input for WP6 to define innovative energy pathways, for WP7 to integrate this work package's outputs in the energy portal, and for WP8 to stimulate dialogue at the national and EU level.

This deliverable is an output for Task 4.3 that identifies and characterises the suite of energy behaviour change initiatives across a range of European Union countries. Section 1.2 provides an overview of the aims and objectives.

1.2 *Aims and Objectives*

Task 4.3 of the ENTRUST project identifies and characterises behaviour change initiatives, highlighting the factors contributing to their (relative) success in influencing energy actions. Following from the overall aim of Work Package 4, this deliverable indicates what works in practice, and highlights the common enablers and barriers attributed to the range of behaviour change initiatives reviewed herein. The results of this task will feed into T3.2, the intersectional analysis of energy practices in the communities of practice.

Behaviour, practices and culture are increasingly recognised in the literature as constituting a powerful human factor in the energy system; in particular the interactions between technologies, practices and norms that lock individuals into certain patterns of (often inefficient) energy use are highlighted as being of critical importance by researchers. As a result, there has been an increasing focus on behaviour change research, particularly on the social contexts in which people live, the routines which shape behaviours, and the extent to which people feel empowered to change their own and their households' behaviours. In this deliverable, an analysis of energy behaviour change initiatives is provided to offer insights into success factors and commonly encountered barriers to change. This is achieved through an evaluation of a range of case studies across selected European countries.

1.3 *Scope and Approach of Deliverable*

1.3.1 Scope

This report reviews case studies of household 'energy use' behaviour change interventions and in doing so provides a 'snapshot' of current activity on this issue. Deliverable 4.4 does not provide an exhaustive list of behaviour change initiatives across EU member states or of those applied at the EU level. Rather, the deliverable illustrates a series of exemplar case studies that focus on individual and household related energy use and behavioural change initiatives that aim to reduce energy consumption. Through describing these representative exemplars, the deliverable aims to provide an overview of the typology and characteristics of those schemes and initiatives which are currently being applied across the EU, and to provide a basis for a robust evaluation of the successes and limitations of these initiatives.

The review specifically focuses on interventions that are perceived to be driven by energy and/or carbon reduction goals, and less on the wider spectrum of behaviour change initiatives encompassing sustainability and lifestyle issues. While behaviour change interventions focusing on wider sustainability issues are also related to the climate change agenda, many of these interventions are focused on a wider environmental imperative, including for example, waste reduction and recycling, sustainable transport, and local food initiatives. To the extent possible, the deliverable concentrates on energy-related behaviour change initiatives. Deliverable 4.4 is sub-divided into the following sections:

- A review of background information on household 'energy use' behaviour change and the different range of approaches and interventions that have recently been used in individual and household behavioural change initiatives (Section 2);
- The policy context of each country that is represented in this deliverable is provided – with reference to the main policies that have to date influenced energy behaviour change initiatives (Section 3);
- Detailed case studies are presented from five European Member States (the UK, France, Italy, Spain and Ireland). These highlight the representative interventions applied to modify energy-related behaviours (Section 4);
- In-depth case studies are presented that provide a deeper analysis of the diverse factors that act as enablers of, and barriers to, energy behaviour change initiatives (Section 5);
- Section 6 presents an overview of common success factors and synthesises and overview of commonly reported and encountered limitations to behaviour change initiatives. This section provides a closer analysis and evaluation of the case studies presented in Section 4;
- The deliverable concludes with a synthesis of the main findings, summarising the factors leading to the success of behavioural change initiatives and the primary barriers encountered (Section 7).

1.3.2 Approach

A secondary data analysis of existing examples of energy behaviour change initiatives is applied in deliverable 4.4. A range of case studies are characterised with the aim of producing a detailed profile of the interventions applied. Case studies are collated from a range of European countries (France, Ireland, Spain, Italy and the UK) to provide a broad overview of the types of energy behaviour change initiatives that are applied across the EU. Consortium organisation partners collected the data, which is analysed by LJMU,

UCC and LGI. While a comprehensive review of the literature provides a state-of-the-art, the analysis of case studies has emphasised practical rather than theoretical and conceptual dimensions; this was purposively elected as the preferred approach to better facilitate the integration of this research into real-world policy and practical contexts and thereby to actively support the wider aims and objectives of the ENTRUST project.

Deliverable 4.4 is developed from analysis of a database of over 40 case studies of behaviour change from across the EU. Included behaviour change case studies seek to promote energy conservation and efficiency through behaviour change approaches. Through analysis of real-world examples, deliverable 4.4 aims to help stakeholders from policy domains, and the energy and community sectors to gain:

- A deeper understanding of the different models and delivery tools employed to change energy-related behaviour;
- An insight into the critical factors that underpin best practice and successful interventions; and
- A synthesis of common success factors and barriers identified based on the range of policy and practice contexts encountered in studied EU member states.

Data for this review were collated from publicly available sources. From a long list of over 40 case studies, 15 cases are selected to outline the inner workings of the interventions and to highlight their strengths and weaknesses. From this broader long list of examples, a sample of 4 initiatives were chosen for further in-depth study (discussed in Section 5) to indicate the enablers of, and barriers to, energy behaviour change initiatives. These were selected for their particular insights they offered and hence deserving further examination.

2 Energy Use and Behaviour Change

2.1 *The importance of behaviour change*

The Intergovernmental Panel on Climate Change (IPCC) has repeatedly called for governments, businesses, and communities to tackle the dual challenge of addressing climate change: mitigation and adaptation (Axon, 2016b). The recent Paris agreement outlines a global deal to limit global temperatures "well-below" 2 degrees above pre-industrial levels, with the ultimate objective to reduce this to 1.5 degrees (UNFCCC, 2015). These targets have substantial implications for individual lifestyle choices and behaviours, as well as the social contexts and governance structures within which these take place (L. Whitmarsh, O'Neill, & Lorenzoni, 2013). With over one-third of many developed nations' carbon emissions attributed to domestic energy use and private travel, both individuals and communities have a key role to play in the transition to a low-carbon future (Axon, 2016a, 2016b; L. Whitmarsh *et al.*, 2013).

Since the energy crises of the 1970s, much effort to reduce energy consumption and/or the environmental impact of energy consumption has focused on technological aspects, for example on designing energy-efficient technologies and developing renewable sources of energy (Maréchal, 2010). However improvements in technical efficiency are subject to the rebound effect and have regularly been overtaken by increased consumption (Galvin, 2013; Maréchal, 2010). Timm & Deal (2016) argue that a failure to recognise a human behavioural component can ultimately result in significantly higher energy consumption patterns, even in the presence of large-scale conservation efforts. In fact, the evidence shows that despite

widespread policy and technological focus on energy efficiency, overall consumption of energy has continued to rise in advanced economies. Technological solutions have not resulted in the expected energy efficiency gains (Moloney, Horne, & Fien, 2010a). A survey of advanced economies across a 1995-2005 time-horizon reports that energy efficiency gains were more than offset by increased household demand for energy during this time (Duarte *et al.*, 2013). The International Energy Agency predicts that world energy demand will continue to increase in all scenarios modelled to 2040 (IEA, 2015). Changing the behaviour around final energy consumption is therefore becoming a focus for policy and research (Kok *et al.*, 2011), as well as an important instrument in present and future energy management.

Energy consumption in buildings accounts for 40% of the end-use of energy in the EU, and reductions in this consumption are a key to achieving the substantial reductions in CO_2 emissions that are part of the EU-2020 target (Kirsten Gram-Hanssen, 2014). Even where buildings have been retrofitted to high thermal standards or incorporate energy-efficient technologies, ingrained patterns of behaviour mean that many households continue to consume more energy than expected (Galvin, 2013; K. Gram-Hanssen, 2011). Increasingly, as technological improvements reduce the potential energy footprint of a building for example, behavioural components become more significant in determining energy use patterns and capacity for energy savings (Timm & Deal, 2016). Lindén, Carlsson-Kanyama, & Eriksson, (2006) report that household behaviour may affect residential energy use to the same extent as equipment and appliances. Further, Gram-Hanssen (2004) reports that behaviour may cause residential energy use to differ by a factor of two, when equipment and appliances are controlled for. Households therefore clearly constitute an important target group for action for energy reduction goals (Revell, 2014).

This emerging focus on behaviour change has tended to concentrate on the demand side of the energy system, in accordance with a supply-demand framing /understanding of energy. In the energy sector, the dominant paradigm to date has been characterised by a model where supply is split from demand, with technological efficiency favoured for performance gain on the supply side and behavioural improvements favoured on the demand side (Strengers, 2012). In this paradigm, Governments, non-government organisations and energy utilities increasingly employ a range of behavioural strategies to curb energy demand, including informative websites and books about how to save energy, and educational programs and campaigns designed to assist people in making more resource-efficient decisions and investments about their consumption (Strengers, 2012). Numerous programs have been employed in an attempt to shift the behaviour of individuals and households on energy, for example greater uptake of demand-side management technology, increased use of renewable energy, and better responsiveness to new tariffs (e.g. dynamic pricing), to name but a few.

2.2 *Behaviour change efforts to date & rationale for study*

Behaviors related to household energy conservation can be divided into two categories: efficiency and curtailment behaviors (Abrahamse *et al.*, 2005; Gardner & Stern, 2002). Efficiency behaviors are one-shot behaviors and entail the purchase of energy efficient equipment, such as insulation. Curtailment behaviors involve repetitive efforts to reduce energy use, such as lowering thermostat settings. Studies reviewed in this paper were aimed at both efficiency and/or curtailment behaviors, with the latter seeming somewhat overrepresented. This is striking, because the energy-saving potential of efficiency behaviors is considered greater than that of curtailment behaviors (Abrahamse *et al.*, 2005; Gardner, 2002). For instance,

households may save more energy by properly insulating their homes than by lowering thermostat settings (Abrahamse *et al.*, 2005). Table 1 provides a summary of household energy-related behaviors, across a matrix describing frequent and infrequent actions, and low-cost high-cost interventions.

Table 1: Household energy-related behaviour (after Laitner *et al.*, 2009 cited in Hiller, 2014)

	Infrequent	**Frequent**
No/Low Cost	Stocktaking behaviour • Energy-efficient lighting (LEDs) • Draught Proofing	Habitual Behaviour and Lifestyles • Appliances off stand-by mode • Air-dry laundry • Low-temp clothes washing
Higher Cost / Investment	Consumer Behaviour • Energy-efficient white goods/appliances • Energy efficient windows • Renewable energy technology	

While Table 1 may present a clear and simple summary of potential energy related interventions, the actual process of arriving at the point (for an individual or household) of changing their energy behaviour has proven to be complex, difficult to easily attribute to single drivers and influenced by a myriad of factors. As a starting point, the 'problem' of human behaviour with associated environmental impacts needs to be placed within the wider contexts where social practices are undertaken (Moloney, Horne, & Fien, 2010b). Achieving a 'step-change' in energy efficiency behaviours will require enhanced knowledge of behavioural drivers, and translation of this knowledge into successful intervention programmes (Stephenson *et al.*, 2015). Wicker & Becken (2013) list factors such as risk perceptions and concerns, attitudes, knowledge, norms, empowerment, and context as key influencers of behaviour. However, simple explanations are not particularly useful or accurate. For example, the Energy Cultures framework described by Stephenson *et al.* (2010) suggests that even at a fundamental level, consumer energy behaviour can be understood by interactions between cognitive norms (e.g. beliefs, understandings), material culture (e.g. technologies, building form) and energy practices (e.g. activities, processes). For example, behaviour relating to home heating can be characterised in part by the values, aspirations, beliefs and understandings of the consumer; in part by the construction of the house, the presence of insulation, types of heating devices and fuel types; and in part by such things as how many rooms are heated, heat control settings, times that heating is used, and maintenance of technologies (Stephenson *et al.*, 2015). Norms and values shape practices, and so do

infrastructures, institutional arrangements and systems of governance (Moloney *et al.*, 2010b). Any transition to a low carbon energy system therefore requires an understanding of community practices, as well as the technologies, infrastructures and institutions associated with and accessed by communities (Moloney *et al.*, 2010b).

To date, the effectiveness of behaviour change interventions has been generally limited, or even unknown, due to weaknesses in program design and evaluation of program impact on behaviour (Frederiks, Stenner, Hobman, & Fischle, 2016). According to Wicker & Becken (2013), the drivers of consumer behaviour have not yet been analysed systematically, *i.e.* it is not known what concerns (energy availability, climate change) drive the support of particular energy-related behaviours and policies. Further, methods used to design, implement, and evaluate the impacts behavioural strategies have not always systematically addressed the reliability and validity of results reported in some studies (Frederiks *et al.*, 2016). Regardless of the preferred approach to behaviour change and the proliferation of associated programmes interventions and initiatives, the impact of behaviour change on energy use is simply not occurring to the depth and widespread level required to address the climate issue (Moloney *et al.*, 2010b).

Behavioural change is difficult to achieve, therefore an understanding of how, why and where behaviours change is an important prerequisite for making progress. Section 2.3 reviews the academic literature on how behaviour is conceptualized followed by identified methods and interventions used to encourage and motivate changes in behaviour.

2.3 *Behaviour Change – State of the Art*

2.3.1 Understanding energy use behaviour

For the purpose of this deliverable it is important to precisely define what is meant by the term 'behaviour' in relation to energy consumption. Energy use behaviours relate to everyday use of energy in the home, for example the use of central heating to heat rooms, use of boilers for hot water and heating, or the use of hot water for showering, *etc*. Behaviour change can be viewed as the use of behavioural theory to modify actions in order to create a desired change in behaviour (Heimlich & Ardoin, 2008). This idea of influencing behaviour has been used in a variety of contexts but particularly within the public health sector in order to reduce negative outcomes of lifestyles, for example campaigns against smoking and drinking alcohol (Michie & Johnston, 2012). More recently, a behavioural approach has also been applied to energy consumption (Jackson, 2005; Moloney *et al.*, 2010a), as discussed in Sections 2.1 and 2.2.

Broadly, 'behaviours are considered to be complex, non-linear and affected by numerous factors' (e.g. psychological, social, contextual) (Darnton, Elster-Jones, Lucas, & Brooks, 2006: 5). Human behaviour is complex and refers to the way people act socially within a given environment. It encompasses "combinations of our emotions, morals, habits, social and normative factors and changing any of these can be challenging" (Martiskaïnen, 2007: 56). It is widely accepted that most energy consumption related behaviours are based on habits and routines (*e.g.,* lighting and heating rooms) and less about one-off behaviours (purchase of particular goods) (Heimlich & Ardoin, 2008; Martiskaïnen, 2007; The Parliamentary Office of Science and Technology (UK), 2012b).

The act of consuming energy can be considered to be a form of behaviour (Abrahamse *et al.*, 2005; Martiskaïnen, 2007). Within a household energy-related behaviour relates to everyday activities that often

require the use of energy, e.g. turning lights on or off, adjusting thermostat levels, using electric appliances, cooking, washing, etc. (Martiskaïnen, 2007). As discussed in Section 2.2, household energy saving behaviours can be divided into two simple groupings, 'efficiency behaviours' and 'curtailment behaviours' (Abrahamse *et al.*, 2005; Gardner, 2002; Martiskaïnen, 2007).

First, efficiency behaviours are considered to be one-off behaviours that require occasional actions. Examples include one-off purchases or transactional 'investment' decisions (e.g. installation of loft insulation, cavity insulation, double glazing). Second, curtailment behaviours are those behaviours that require 'operational' use and 'repetitive efforts' or habitual behaviours (e.g. turning lights off, closing curtains, turning appliances off, or not leaving things on standby) to reduce energy use in homes (Gardner, 2002; Martiskaïnen, 2007; The Parliamentary Office of Science and Technology (UK), 2012b). To date, policy interventions have largely favoured one-off actions to improving housing energy efficiency, based on prioritization of technical interventions likely to help reduce direct emissions from the housing sector (Darnton *et al.*, 2006; DEFRA, 2005; Energy Saving Trust, 2011; RAND Europe, 2012).

In the context of addressing climate change and rising energy use, engaging the public in energy use behaviour change has gained prominence as an instrument amongst policy makers. Behaviour change has also received increasing attention in the academic literature (Heimlich & Ardoin, 2008; Moloney *et al.*, 2010a). As such, appeals to reduce individual impacts on the environment are widespread, including calls to measure one's own carbon footprint, recycle more, buy green products, use energy-efficient lightbulbs, walk and cycle more, and drive by car less (Axon, 2016a; Moloney *et al.*, 2010a). Despite these appeals, while public support for addressing climate change is high, willingness to change personal behaviour and lifestyles is limited by a number of perceived individual, social, and structural barriers (Ockwell & Whitmarsh, 2015). Furthermore, actions that are commonly taken are usually those that are straight-forward to integrate into the existing structure of individual lifestyles (*e.g.* recycling more) and are rarely those with the largest energy or environmental impact (*e.g.* driving less, eating less imported meat, and flying less) (Axon, 2015; Lorraine Whitmarsh, Haxeltine, & Wietschel, 2007).

Policy-makers have utilised a range of theoretical models originating across different disciplines to understand behaviour and behaviour change. These have predominantly originated from psychology and sociology, as well as behavioural economics, environmental psychology, neuroscience, social marketing, etc. In general, theories on understanding behaviour and behavioural change can be grouped into four broad categories: **economic, psychological, sociological and educational**. The range of models and disciplinary perspectives provides a variety of theoretical lenses into the topic of domestic energy use behaviour (Chatterton, 2011). Theories derived mainly from economic and psychological theory take the individual position as a focus whereby energy use behaviours are a product of deliberation, and rationalistic decisions (Chatterton, 2011: 7). Models of this type have been used extensively in policy intervention across a range of domains to date, whereby individuals are seen to "make decisions on the basis of information and prompts. Prompts can be explicit such as pricing structures or the provision of explanatory literature or other information" (Chatterton, 2011: 7-8). The Theory of Planned behaviour (one of the dominant psychological theories) has been used by policy makers and theorists to not only explain pro-environmental behaviour but also to change, manage and develop interventions to encourage pro-environmental behaviour (Ajzen, 1991).

Rational choice theory posits that individuals make choices about their behaviour. As such, many theories have developed from this perspective on behaviour change. A rational choice perspective frames a 'value-action' gap that describes the difference between how individuals intend to act and how they actually act. Fujii and Gärling (2003) developed a hybrid of this model using stated preference and attitude theory to provide a framework for analysis with travel policy. Within this they discuss what is known as the 'value-action' gap between how commuters intended to act and how they actually did. However, Shove (2010) argues that the use of **Attitude, Behaviour, Context (ABC)** models to influence policy is ineffective as it places the focus on individuals to modify their behaviour and deals with issues, such as climate change, in isolation. The implication is that ABC approaches are often not consistent with what is happening in other areas of policy making. This is also discussed by Blake (1999) who found a 'value-action' gap to be present in environmental policy in how policymakers at a national level thought individuals would act ideally and what was actually happening in practice. More recently, individualist approaches are explored by Barr & Prillwitz (2014). Barr & Prillwitz (2014) report that the use of individualist approaches towards understanding and framing behaviour for the formulation of environmental policy fails to account for the potential social transformations that are needed to create desired change. Specifically studying the issue of mobility, they also found that unsustainable behaviours were linked to other important factors such as physical environment, infrastructure and social practices which are largely ignored through the use of rational choice based models. The rational choice model contains inherent limitations when applied to understand the level and extent of behaviour change required at the large-scale necessary for societal transformation. In contrast, Shove (2010) argues that widespread societal innovation requires the erosion of current rules and questioning of the status quo in favour of more sustainable regimes, a transformation outside of the agency of any one single actor.

In addition to the rational choice model of understanding behaviour, there are a multitude of socio-psychological conceptual frameworks that seek to understand pro-environmental behaviours in relation to environmental attitudes, alongside situational and local contexts (Hogg & Vaughan, 2009). Conceptual models such as the **Theory of Planned Behaviour (TPB)** (Ajzen, 1991) and the **Conceptualisation of Environmental Behaviour** (Barr, Ford, & Gilg, 2003) illustrate the social, psychological and contextual antecedents of behaviour and the drivers of behavioural change (Axon, 2015; Heimlich & Ardoin, 2008). Within these models, the concept of 'utility' or 'subjective expected utility' designates the expectation of the perceived value of a behavioural outcome (Ajzen, 1991; Verplanken, 2011). According to these models, specific perceptions of costs and benefits associated with a behavioural choice (e.g. price, comfort or usefulness) lead to the formation of an attitude. Theories such as the TPB suggest that attitudes guide behaviour through the operation of behavioural intentions (Ajzen, 1991). Intentions are also determined by the felt pressure from the social environment, such as expectations from family or friends, which may be represented as a social norm. TPB also suggests that perceptions of control over behaviour can determine intentions. In addition, if the perception of control aligns with actual control, perception of control can determine the behaviour directly (Madden, T.J., Ellen, P.S., Azjen, 1992; Verplanken, 2011). These relationships are illustrated in Figure 1.

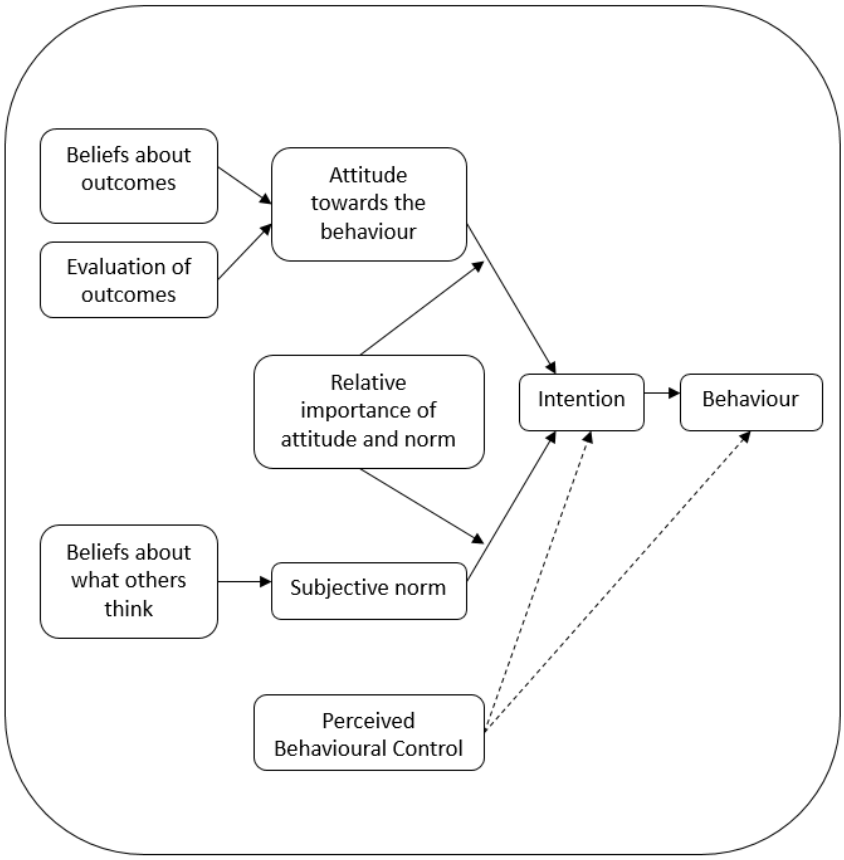

Figure 1: The Theory of Planned Behaviour (Ajzen, 1991)

There are a number of limitations associated with the TPB. Firstly, TPB suggests that all influences on behaviour are routed left to right in the model shown in Figure 1. However, evidence suggests that behaviour may be influenced by factors not considered by the model or may in fact be mediated by other variables such as impulsive or non-conscious processes (Axon, 2015). Other models of pro-environmental behaviour are based on TPB, and can be considered extensions of TPB theory. Such extensions may include the addition of personal norms (Harland, Staats, & Wilke, 1999); self-identity (Terry, Hogg, & White, 1999); or extend to the **norm-activation theory of altruistic behaviour** (Schwartz, 1977). **The norm-activation theory** asserts that altruistic actions are driven by personal norms (a sense of obligation), which are associated with fundamental values. This theory proposes a casual chain of variables that leads to pro-environmental behaviour (Axon, 2015; Verplanken, 2011). In **norm-activation theory,** the chain starts with relatively stable altruistic personal values and beliefs about the relation between humans and the environment, and is activated when individuals are confronted with environmental conditions that violate these baseline values and beliefs (Schwartz, 1977; Verplanken, 2011). In this theory, confrontation activates beliefs that valued objects are threatened, beliefs about the individual's ability to act and the felt responsibility to act, which may then lead to a choice of pro-environmental actions (Schwartz, 1977; Verplanken, 2011).

A range of models predicated on **norm-activation theory** have recently been integrated into the value-belief-norm (VBN) theory of environmentalism (Figure 2) (Stern, 2000). VBN stipulates the importance of altruistic personal values and an ecologically friendly worldview for pro-environmental behaviour (Stern, 2000; Verplanken, 2011). The VBN is a useful framework as it suggests ways to promote pro-environmental behaviours amongst segments of the population who hold pro-environmental values, but who do not

translate these into action VBN also further highlights the difficulty of changing ecologically unfriendly behaviour (Axon, 2015; Verplanken, 2011). Values do not easily translate into action, and are only enacted if they are central to an individual's self-concept and are cognitively activated (Verplanken, B., & Holland, 2002; Verplanken, 2011).

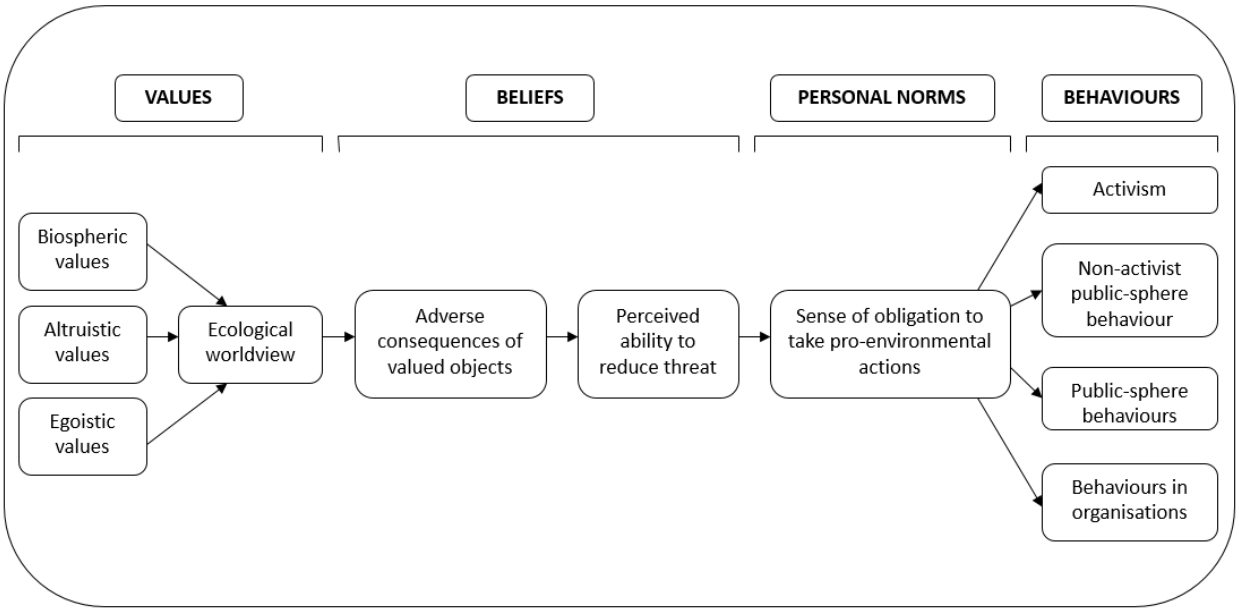

Figure 2: The Value-Belief-Norm theory of environmentalism (Stern, 2000)

According to VBN, pro-environmental values *per se* do not necessarily lead to pro-environmental action even when the opportunity to act in an environmentally friendly way arises, and drawing people's attention to pro-environmental issues leads to action only if pro-environmental values are part of a person's self-identity (Axon, 2015; Verplanken, B., & Holland, 2002; Verplanken, 2011). The VBN model therefore seems to apply to those who prioritise pro-environmental values and to actions that are clearly marked as serving pro-environmental goals (Verplanken, 2011). Pro-environmental values may drive energy conservation behaviour (Black, Stern, & Elworth, 1985) but often low-carbon choices are motivated by non-environmental considerations such as money, convenience and health benefits (Brandon & Lewis, 1999; Verplanken, 2011).

2.3.2 The 'complex ecology' of behaviour

Further to Section 2.3.1, it is evident that energy conservation actions and energy use are typically a product of a complex ecology of motivations and external influences, resulting in little consistency in apparently 'low-carbon' behaviours across multiple contexts such as home, work, travel and leisure (Axon, 2015; Darnton, 2008; Verplanken, 2011). Therefore, the models reviewed in Section 2.3.1 do not comprehensively represent the dynamic nature of behaviour, and do not fully incorporate the repeated and habitual nature of many actions (Axon, 2015; Verplanken, 2011; L. Whitmarsh *et al.*, 2013). Habits are repeated behaviours that have become automatic responses in recurrent and stable contexts (Heimlich & Ardoin, 2008). Maréchal (2009) explores the role of habits in energy consumption and reports that behavioural 'lock-in' happens due to habits not being a fully conscious form of behaviour. This finding contradicts the rational choice perspective and Maréchal argues that the 'value-action' gap may happen without individuals even realising they have acted in a different way than they intended. Following up this

research Maréchal (2010) found that a change in context creates a disruption to the habit and makes individuals more receptive to energy efficient behaviour. Habits have three key features (Verplanken, Aarts, & VanKnippenberg, 1997):

- **Repetition:** Habits form by successfully repeating behaviour. 'Successfully' should be interpreted in a wide sense, and not confined to what objective observers define as desirable. Habits may be successful from a personal perspective because they provide comfort or status, but such habits could also be unhealthy, asocial or environmentally unfriendly from an outsider's perspective (Verplanken, 2011).
- **Automaticity:** 'Automaticity' can be broken down into features such as an absence of conscious intent; lack of awareness; the difficulty of control; and the fact that habitual behaviour does not tax cognitive resources (Bargh, 1996; Verplanken *et al.*, 1997)
- **Execution:** Habits are executed in stable contexts, and are more or less done at the same time and at the same location. Verplanken (2011) states that an important caveat here is that habitual behaviours are under the control of the environment where the acts take place, to a large extent. For example, one may execute a habit because it is 8am or because one passes by a particular shop, and not because of a conscious intention or willpower. It is these cues that appear to regulate behaviour, rather than our attitudes or intentions (Verplanken, 2011).

The mechanisms above indicate that habits do not follow the processes applied in theories such as the TPB or VBN. Ouellette and Wood (1998) indicate that behaviour correlated less strongly with intentions when it was frequently performed. Intentions were less or not at all predictive of behaviour when strong habits had been formed (Verplanken *et al.*, 1997). Other studies suggest that habits lead to 'tunnel vision' whereby habitual judgements and choices are based on little information and simple choice rules (Verplanken, 2011; Verplanken *et al.*, 1997).

The resistance of habits to change initiatives is a clear theme which emerges from the literature one energy behaviour change. Interventions to change every day behaviours often attempt to change people's beliefs and intentions (Axon, 2015; L. Whitmarsh *et al.*, 2013). Yet these interventions are unlikely to be an effective means to change behaviours that have become established habits (Verplanken, 2011; Lorraine Whitmarsh & O'Neill, 2010). Research carried out by Huebner *et al.* (2013) found that habitual behaviour is directly related to domestic energy consumption and that habits can be considered to be a barrier to behaviour change. Huebner *et al.* also note that other factors such as comfort and knowledge of the heating system, for instance, were also important drivers in energy consumption behaviours, highlighting that there is no singular determining factor for behaviour. Successful habit changing interventions involve disrupting the contextual factors that automatically cue habit performance. Old carbon-intensive habits can be broken and new low-carbon habits embedded, such as providing informational inputs at points when habits are naturally vulnerable to changes (For example during times of disruption and dramatic change, such as moving house, having a baby or changing jobs) (Axon, 2015; Heimlich & Ardoin, 2008; Verplanken, 2011; Lorraine Whitmarsh & O'Neill, 2010). Consequently, Verplanken (2011) argues that the formation of sustainable attitudes and actions should be embedded through the formation of more sustainable habits through targeted behaviour change interventions. While models such as the TPB and VBN are useful and valid in many contexts, habits therefore form boundary conditions to their validity (Verplanken, 2011).

Sociological theories put "emphasis on the context and structures that determine, interact with and are created by the ways in which people behave and do the things they do" (Chatterton, 2011: 8). These approaches acknowledge the role of different actors, objects and practices involved in the processes determining how people use energy. They focus on "how social, institutional, materials, and infrastructural contexts and individual's past histories "can all determine peoples' decisions and energy use behaviours" (Chatterton, 2011:8). Norm-guided behaviour and Social Practice Theory fall under this category of behaviour change theories.

Norm-guided behaviour considers behaviour from the perspective that individuals act according to social norms regardless of personal preference. Lindenberg & Steg (2013) reviewed this within the context of pro-environmental behaviour by utilising goal-framing theory. **Goal-framing theory** states that there are three goals; hedonic, normative and gain and that one of these is always dominant in decision-making. Support mechanisms are required in order for **normative goal** to be dominant and can be categorised as **social values, the presence of other people, the behaviour of other people and a capacity to self-regulate** (Lindenberg & Steg, 2013).

Shove & Pantzar (2005) looked at consumption from a practice theory perspective in the case of Nordic Walking and found that practices are dynamic and continue to develop and evolve, though in context within which they are used. Domestic heat consumption has also been analysed through a social practice lens by Gram-Hanssen (2010). This research found that the main components influencing practices were technologies, embodied habits, knowledge and meaning; ultimately the findings were that behaviour can account for up to three times higher energy consumption of heating, when equipment and appliances were controlled for. Gram-Hanssen (2011) also states that the use of practice theory has shifted the focus of consumer studies from an individualist to a collective approach. Energy consumption practices are typically mundane and often linked to other practices. Further, Hargreaves (2011) suggests that practices are interlinked and should not be viewed in isolation. In addition, there are also external social and power dimensions involved in practices that can either sustain or restrict the replication of these practices. Through looking at energy saving from a practice perspective Sweeney *et al.* (2013) found that the 'value-action' gap came from an inability to financially afford the investment cost of more energy efficient items rather than out of choice, *per se*.

As a consequence of the perceived limitations of either purely individualistic or purely socially focused models, a number of integrated models and frameworks of behaviour and behaviour change have been developed. Broadly these seek to reduce the limitations from individual approaches, by combining conceptual models. There are wide range of models or frameworks currently in use which can be categorised in this group, each comprising and emphasising a specific set of factors, e.g. **"4 E's" model** (DEFRA, 2008)), **MINDSPACE framework** (Dolan, Hallsworth, Halpern, King, & Vlaev, 2010), **'Energy Cultures'** (Stephenson *et al.*, 2010), and the **'Behaviour Change Wheel'** (Discussed further in Section 4) (Michie *et al.*, 2011).

Integrated Models typically draw on cognitive and social practice and on socio-technical systems theories (Sweeney, Kresling, Webb, Soutar, & Mazzarol, 2013b). DEFRA uses a 4-part model to represent the process of lasting behaviour change: **Engage** (get individuals involved through communication campaigns); **Encourage** (give the right signals i.e. through the tax system); **Enable** (make pro-environmental behaviour

by providing services and facilities); and **Exemplify** (by showing consistency in policies) (Axon, 2015; Darnton, 2008; DEFRA, 2008). This model illustrates a whole systems approach and highlights the importance of addressing individual-scale, social and structural barriers to behavioural change (Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007; The Parliamentary Office of Science and Technology (UK), 2012b). Similarly the MINDSPACE approach (Dolan *et al.*, 2010) also strongly focuses on the individual consumer decision-making and cognitive processes. However, whilst there is some limited recognition of 'context' it does not take into account the wider socio-structural influences on behaviour (Jackson, 2005; Verplanken, 2011). **The 'Energy Cultures' framework** provides a multi-disciplinary and a more integrated model of behaviour change. It highlights the interaction of three important dimensions: between **(internal) cognitive norms, material culture, and energy practices (external)** which result in energy behaviours (Stephenson *et al.*, 2010). Nevertheless Energy Cultures still highlights the importance of the agency of individuals in conjunction with wider social structural influences.

While such integrated models seek to mitigate the limitations of 'conceptually pure' approaches, there are questions as to whether attempts to integrate individual behavioural models with social and technical theories can be truly meaningful due to their inherent 'contrasting paradigms' and whether such paradigms can be meaningfully reconciled (Shove, 2010). According to Jackson (2005: 23) the reduction and condensation required in the integration process runs the risk of reducing the complexity of represented behaviour and therefore the ultimate usefulness of the developed integrated models.

The conceptual models of behaviour reviewed in this Section have been applied to interventions employed by policymakers and practitioners to change individual and consumer behaviour across many spheres of behaviour, but specifically relating to energy consumption. Consequently, how behaviour is represented in the models in this Section reflect what interventions and initiatives attempt to change in order to encourage behavioural change. Section 2.3.3 presents an overview of typical interventions that have been applied in the energy behaviour space to date, and links these with the framing theories and concepts presented in Sections 2.3.1 & 2.3.2.

2.3.3 Intervention strategies in practice

While the need to take responsibility for personal actions is a common key message of behaviour change programmes, there is little agreement about the most effective strategies for achieving a transition through behaviour change (Moloney *et al.*, 2010b). In recognition of the complexity and unpredictability of people's energy intensive consumption practices, a range of behaviour change focused interventions have been targeted by various policy initiatives over time. These interventions have included a mix of regulatory and non-regulatory mechanisms, e.g. providing information or awareness raising campaigns; taxation and or legislation; nudge interventions (STSC, 2012). These strategies have been usefully classified by the UK Parliamentary Office of Science & Technology into a 'ladder of interventions' where the 'higher up the ladder' the intervention sits, the 'more restrictive' it is likely to be and the 'greater the justification needed to ensure public support for it' (The Parliamentary Office of Science and Technology (UK), 2012: 2).

Furthermore, non-regulatory interventions, such as the use of social norms marketing and the 'nudge' approach (Cialdini & Goldstein, 2004; Thaler & Sunstein, 2008) have been increasingly endorsed by a range of national governments, for example (STSC, 2012), with a focus in particular on electricity consumption reduction (Allcott, 2011). Moreover, other strategies include: feedback mechanisms (Brandon & Lewis,

1999); financial or fiscal incentives (e.g. Green Deal; feed-in-tariffs) and the use of Smart Meters (with customer displays) to manage habitual energy use (Gifford, Kormos, & McIntyre, 2011); further adaptations combine on-line checking of heating costs (via energy suppliers), with prompts, goal setting, social comparisons, real-time personalised feedback (Brandon & Lewis, 1999).

Energy behaviour change interventions have been largely underpinned by economic approaches and accompanied by feedback and personalised advice strategies which originate from sub areas of psychological theory; for example, policy that advocates that individuals take responsibility (through consumer 'rationalistic' choice) through the take-up of financial incentives and tailored information. Recently, sociological approaches have increasingly informed interventions such as social comparisons and collective pledges or community actions. Moreover, in recent years, social practice theory (SPT) has been applied to frame and understand sustainable behaviours associated with domestic energy use, transport, waste and recycling (The Parliamentary Office of Science and Technology (UK), 2012b). The key criticisms of most of these strategies is that to date they have largely failed to foster largescale 'mainstream' behaviour change and also that many of these behavioural strategies they do not appear to contain a clear framework for how behaviour could change and through which means (Janda, 2011; Wilson & Dowlatabadi, 2007).

There remains considerable debate over which interventions work, demonstrating an 'information gap' in policy understandings of what influences human behaviour, which interventions work and how to best apply behaviourally targeted policy at community level (STSC, 2012; The Parliamentary Office of Science and Technology (UK), 2012b). This lack of clarity or understanding is largely attributed to the complexity of factors that shape people's energy use in buildings which is often idiosyncratic and unpredictable (Janda, 2011), thus effective policies will inevitably need to use a range of interventions if they are to succeed (STSC, 2012). There are calls to develop a stronger evidence-base for evaluating and monitoring policy interventions in their design and their impact beyond the life-span of the intervention, all of which continue to create challenges for policymakers (STSC, 2012; The Parliamentary Office of Science and Technology (UK), 2012b)

Fujii & Gärling (2003) state that a hybrid of stated preference and attitude theory should be adopted by policy makers. Gram-Hanssen (2011) suggests that practice theory should be used in order to get consumers to reflect on and amend behaviour through the use of information and campaign dissemination. Lindén *et al.* (2006) agree with this, reporting that information campaigns and applicant labelling were an effective way of fostering energy efficient behaviour in Sweden. However, they did also discover that this method left many homes remaining energy unaware. In contrast Blake (1999) argues that an 'information deficit' approach to policy making on environmental issues is ineffective. There is an argument that the use of information campaigns does not provide a broad enough perspective and is therefore not enough to encourage sustained behaviour change (Barr & Prillwitz, 2014; Lindén *et al.*, 2006).

Another issue, highlighted by Owens & Drifill (2008), is that there needs to be a more consistent approach to policy making across all policy spheres. They also offer some practical advice in that better deliberation between multiple stakeholders is required; such as decision-makers, communities and technical experts within the context of energy. This could go some way to moving away from the individualist approach aimed at promoting sustainable mobility which fails to address the wider societal changes needed (Barr & Prillwitz, 2014). Not only does the literature show that there are disagreements over the most effective

approach to making policy but also in how best to design intervention. Kok *et al.* (2011) investigated the use of intervention mapping in the promotion of energy conservation and found that this could be effective and also provide a knowledge base for more consistent policy design.

The approaches to behaviour change presented in Section 2 have informed public policymaking on this topic. The presented theoretical approaches have been used to provide a better understanding of energy related behaviours; the range of theories lends credence to the claim that no single approach can exclusively explain and predict behaviour. For example, psychological approaches can help policymakers to identify the factors that influence behaviour and understand the conflicting nature of people's intentions and actions in terms of energy use and energy saving behaviours. Second, sociological approaches reveal the social embeddedness of consumption patterns over time and their resistance to change. Collectively these cross-disciplinary insights contribute towards helping to unravel the complexity of energy related behaviours and the multitude of factors that shape them and therefore reinforcing the view that there are no 'one-size fits all' approach (Abrahamse *et al.*, 2005; Jackson, 2005).

Furthermore, such behaviours also sometimes interact paradoxically with each other, emphasising the complexity of human behaviour and practices. Whether the approach is individualistic or sociologically focused, each model appears to offer a specific position in the problem of understanding people's behaviour. Equally in this discourse, whilst previous studies and theories help contribute to a part of our understanding of behaviour change in the sphere of household energy use, currently there is no single model that can claim to be inclusive of all relevant behavioural factors.

As is clear from the literature reviewed to this point in Section 2.3, there is no obvious agreement on the most effective strategy for behavioural change. However, terms/approaches which do present regularly in the energy behaviour literature include **community involvement; multi-agency responses; normalising pro-environmental behaviours; and a rejection of individualistic approaches**. These techniques are frequently used within **community-based carbon reduction strategies** (CBCRS) (Axon, 2015; Axon, 2016a), and suggest that responses at the community level can incorporate a 'behavioural wedge' as a key strategy in low carbon transition (Axon, 2016b).

Although there are tensions between theories the different models and perspectives do offer complimentary viewpoints on the same theme of behaviours. By and large, policy appears to take a pragmatic line by combining a mixture of theories in public policymaking around energy as evidenced by the way the different theoretical models that have been used across different departments dealing with the low carbon and sustainability agenda.

3 Policy contexts of energy behaviour change interventions

In order to better situate this deliverable within the context of the case studies collected, Section 3 illustrates the policy contexts of each EU member state where information on energy behaviour change initiatives have been identified and characterised. Section 3 outlines the policy context at the international and European level from the last 20 years followed by the policy contexts of the 5 member states within the EU that comprise case studies in this deliverable. These are the UK, France, Italy, Spain and Ireland.

3.1 *Policy Context of included case-studies*

A number of international commitments such as the United Nations Framework Convention on Climate Change (1992), the linked Kyoto Protocol (1998) and the Copenhagen Accord (United Nations 2009) set the global milestone of 'keeping global warming under 2 degrees Celsius' for all nations in the world, setting the basis for subsequent national level policies (Wetherill, Swan, & Abbott, 2012: 2).

At the European level, EU law sets requirements for member states in a wide range of areas, including electricity and natural gas markets, emissions of greenhouse gases and air pollutants, energy efficiency and renewable energy. The European Climate Change Programme, formed mainly in order to meet the EUs obligations under the Kyoto Protocol, has established a number of Directives that aim to reduce greenhouse gas emissions. Member States are therefore bound to give legal effect to EU Directives specifically relating to energy efficiency and housing i.e. Climate and Energy Package, Emission Trading System (EU ETS), Directives on the Energy Performance of Buildings, Eco-design of Energy-related products (ERP) Directive (Wetherill, Swan, & Abbott, 2012: 2). For example, the Directive on the Energy Performance of Buildings sets out a 20% reduction in CO_2 by 2020 and 20% renewable energy target for 2020 (European Comission, 2002).

Table 2: Overview of Policy Measures

Level	Name
International	United Nations Framework Convention on Climate Change (1992)
	Kyoto Protocol (1998)
	Copenhagen Accord (2009)
	Paris Climate Change Agreement (2015)
EU	European Climate Change Programme (EU 2006), directives: Climate and Energy Package EU Emissions Trading System (ETS) Directive on the Energy Performance of Buildings Eco-design of Energy Related Products (ERP) Directive

The EU commission is seeking an 'Energy Union' with member states as it seeks to address a number of energy issues. It seeks to reduce 'dependence on fossil fuels and reduce greenhouse gas emissions, and the affordability of energy and the competitiveness of energy prices are of increasing concern to households and businesses'. It is for this reason 'the Framework Strategy for the Energy Union' sets the vision for the future and integrates a series of policy areas into one cohesive strategy'.

The European Union's Third Energy Liberalization Package sets as one of its main goals the installation of "intelligent metering systems in 80% of Member State households by 2020". It has been spurred by both concerns over increases in consumer demand for electricity (especially at increasingly congested peak times) and the associated increases in carbon emissions. The UK and Ireland both have a mandated rollout plan, and both have completed large-scale pilots to assess whether and how residential customers can achieve the requirements for demand reduction during peak times. However, many obstacles hamper the achievement of this "80% installation by 2020" goal. Among these obstacles is a "disappointing demand" from consumers, who are doubtful of the public and personal advantages of domestic smart metering (Giglioli, Panzacchi, & Senni, 2010). This stems partly from concern over the security of personal data, and

partly from public cynicism about the vested interests of large utility companies, since smart technology offers Utility companies profitable opportunities for limiting customer choice, especially through time of use tariffs. Whilst these may be presented to the public in terms of opportunities to cut household energy bills, savings are modest and can only be achieved through changes in lifestyle and routine that some find objectionable (Darby, 2008). However, at least some public scepticism has its origins in a palpable lack of effort made thus far to engage public interest in smart technology. The smart meter conversion target is binding on Member States, and can conceivably be viewed as a matter about which public opinion or enthusiasm is largely irrelevant.

3.1.1 UK Policy Context

The backbone to national UK energy policy or relevant to the residential sector is legislated in two key instruments, e.g. the Climate Change Act (2008) and Energy Act (2011). For example: Climate Change Act (2008) which sets legally binding 'carbon budgets'; targets to cut emissions by 34% by 2020; and by 80% by 2050; and the Energy Act 2013 which sets legislation designed to deliver energy efficiency, with particular focus on tools/initiatives for the deliver home energy efficiency and reducing heating costs. In response to these, the UK Government has developed a number of policies to deliver policy goals and targets, e.g. Energy Company Obligations (ECO); Smart Meters; Energy Performance Certificates (EPC); Feed-in Tariffs (FITS); Renewable Heat Incentives (RHI); Tariff information requirements; local authority energy saving grants or offer for local residents to install energy efficiency; London Boiler Cashback Scheme (£400) - available in England. Although, there are various more regionalised variations of schemes available in Wales, Northern Ireland and Scotland (Jones, Lannon, & Patterson, 2013; The Parliamentary Office of Science and Technology (UK), 2012a, 2012b).

Table 3: The key national government-led interventions for 'energy' behaviour change at the household level are summarized:

Type of Interventions	Name of intervention	Influence/outcomes
Regulatory	Energy Performance Certificates (EPC)	Only required if selling or renting a residential property
Standards/Labelling	A-G energy efficiency labelling of white goods	Helps inform consumers of the energy performance – gives consumers choice only
Fiscal incentive	Feed-in-Tariff (FiT); Renewable Heat Incentive (RHI)	Only available to households with renewable technologies adopted
Fiscal incentive	Boiler scrappage schemes	Is often means tested and offers a small discount to those seeking to change their boilers
Government public information provision	Energy Saving Trust (government endorsed Website)	'free' information available to all households

Type of Interventions	Name of intervention	Influence/outcomes
Government public information/ Mass media campaign	Energy Switching and Smart Meter ('Gaz & Leccy' Adverts)	Offers 'nudge' to switch to best energy tariff or adopt smart meters but is not mandatory to do so
Technical/Feedback & Information provision	Smart Meter roll-out	Adoption of smart meters not mandatory – offers feedback to customers/energy company suppliers

Key UK policies include ECO, Feed-in Tariff (FiT) and the Renewable Heat Incentive (RHI). Introduced in January 2013, the Energy Company Obligation (ECO) was designed to support the domestic sector. This was designed to run in conjunction with the now defunct Green Deal to provide additional support in the domestic sector. In particular, it intended to provide support for improvements in *hard to treat* homes, and to deliver '*Affordable Warmth'* to those in fuel poverty. Additionally, ECO was designed with particular obligations to be delivered both by social landlords in the social housing sector as well as to those on low incomes who could also be private owner-occupiers. In terms of delivery, energy suppliers either provided the ECO directly to customers, or by organisations working together through pre-approved arrangements. The Feed-in Tariff (FiT) and the Renewable Heat Incentive (RHI) were both designed to primarily encourage the adoption of small scale renewable energy sources within all sectors of housing. Both schemes whilst essentially similar, e.g. the FiT aimed to reward with payment from energy companies to anyone generating their own electricity from renewable low carbon technologies (e.g. sun, wind or water) or through the RHI when producing clean, green heat (Ofgem, 2015). A prerequisite of eligibility for either FIT or RHI was that before renewable energy systems were installed it was essential to make the home energy-efficient (through insulation, boiler upgrading, etc.); therefore, requiring all applicants to complete a government recognised home energy assessment. Launched in 2010, the FiT scheme is often considered to be the more successful of the two policies due to its longer presence and significantly higher uptake levels by households. The scheme required the installation of a renewable energy technology before a household could either qualify for free energy and cashback for every unit of energy generated and more for any surplus supplied to the national grid. The policy was underlined by the government's view that the production of energy from renewable sources was sustainable and supported energy security goals (Friends of the Earth, 2011; Ofgem, 2015). The RHI was originally launched in November 2011 as a financial incentive scheme designed to encourage uptake of renewable heating among domestic consumers, aimed mainly at owner-occupied homes that were off the gas grid. The scheme was re-launched in April 2014 and extended to cover all single domestic dwellings (to any homeowners, as well as private landlords, social landlords and self-builders) and non-domestic building components (industry, businesses and public sector organisations) (DECC, 2015; Ofgem, 2015).

Reducing carbon emission at the household level and within the housing sector comprises a combination of both technical (e.g. retrofitting housing EET) and behavioural solutions (e.g. reducing room heating, changing tariffs). In particular, government policy is primarily reliant upon the voluntary take-up of

solutions (EET adoption) as the regulatory and mandatory framework identified is limited in its scope to influence to encourage households to change behaviours to reduce their energy consumption. An examination of the existing policy framework (discussed here) suggests it is one that is reliant more upon voluntary uptake of largely technical solutions (such as 'efficiency' behaviours). Even though there is recognition to deliver on UK energy policy that any method to encourage energy use related behaviour change will require both technical and behavioural interventions, which includes habitual and one-off actions.

3.1.2 France Policy Context

France is part of the 8 EU member states that are currently not on track to achieve their 2020 targets regarding energy efficiency (European Environment Agency, 2015). Yet the issue has been addressed in several legislative instruments for the last ten years as shown in Figure 3.

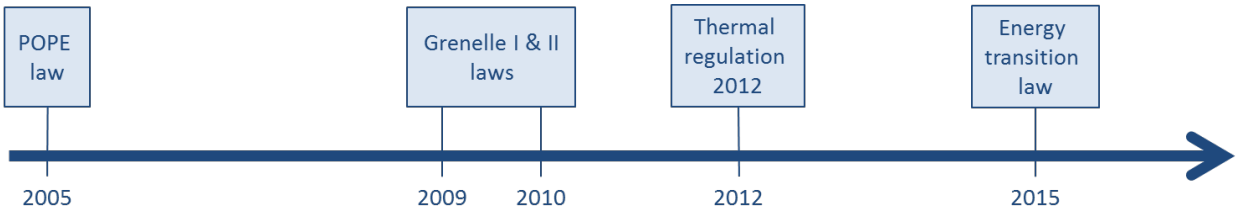

Figure 3: Main French legislative instruments addressing energy efficiency issues

In 2005 the **POPE law** laid down the main guidelines of the French energy policy. As stated in the third article the first of the four pillars concerned the control of the energy demand and the support to energy savings. The first sector affected is the buildings one, both housing and business premises. The text gives two quantitative objectives related to the sector:

- Increase by 40% the energy performances of new buildings by 2020
- Divide by four CO_2 emissions related to existing buildings by 2050

However, the POPE law does not provide much details about the way to achieve these goals.

The **Grenelle 1 law** released four years later gathers 268 commitments issued during a conference on environmental problems held in September and December 2007. It set up high level objectives related to environment protection in several sectors, among which included the building sector. The main objectives listed in the first Grenelle law were: reinforce the thermal regulation for new constructions, reduce the energy consumption of existing buildings and create a professional training dedicated to energy efficiency. **The Grenelle 2 law** developed these goals into more precise measures such as the "Diagnostic Performance énergétique" (DPE) to new buyers or tenants about the energy performances of their buildings as well as an upper limit regarding greenhouse gases emissions in new buildings.

In parallel the thermal regulation is regularly updated to increase standards. The latest update, **the RT2012**, requires new buildings to consume less than 50 kWh / m2 / year. The next update, the RT2020, will decree that all new constructions shall be exclusively positive energy buildings.

The latest energy related law, the **Transition Energétique law** was released in 2015. In line with the previous ones it details several measures related to new constructions or refurbishment projects. It set up

new quantitative objectives for energy efficiency renovation works, make the refurbishment compulsory when the energy consumption exceeds a certain level, and promote the use of bio-sourced materials for constructions. In response to these laws and objectives, the French government launched a series of tools to encourage citizens to adopt more sustainable behaviours. Table 4 lists the most important ones:

Table 4: The key national government-led interventions for 'energy' behaviour change at the household level

Type of Interventions	Name of intervention	Influence/outcomes
Regulatory	Diagnostic Performance énergétique (DPE)	Required if selling or renting a residential property
Regulatory	Régulation Thermique (RT 2012)	Defines energy efficiency standards for building constructions or refurbishments
Regulatory	Smart Meter roll-out	Mandatory for DSOs to deploy smart meters for all customers
Fiscal incentive	Le crédit d'impôt développement durable (CIDD), recently replaced by the crédit d'impôt transition énergétique (CITE)	Available to households installing renewable and/or more energy efficient technologies
Financial incentive	Feed-in-Tariff (FiT)	Available to households installing energy production technologies based on renewable sources
Financial incentive	L'éco-prêt à taux zéro (éco-PTZ)	Available to households installing renewable and/or more energy efficient technologies. Can be cumulated with the CITE.
Informative	Espaces infos énergie (EIE)	Provides advices on energy efficiency to tenants and householders
Standards / label	Reconnu Garant de l'Environnement (RGE)	Only available for companies that followed a dedicated training and passed the examination
Informative	RGE directory	Available to any citizen to find a RGE

Despite the use of these instruments France is not successful in reaching its objectives in terms of energy efficiency. One of the most important obstacles remains the low price of energy in France, one of the lowest in Europe, which does not encourage citizens to change for more sustainable behaviours.

3.1.3 Italy Policy Context

The national energy system in Italy has evolved substantially over the years, and is influenced by rulings coming from the European Union and the overarching goal of achieving sustainable growth. This has been pursued largely through improvements in legislation and in terms of promoting market competitiveness in the system. However, there are a number of significant barriers hindering the promotion of a more sustainable energy system: these include:

- Higher than average energy prices from a European perspective, which has stalled the pursuit of a more competitive market
- Barriers in creating a stable energy supply system that is independent
- Ensuring the financial viability of enterprises working on the energy sector

An example of these difficulties can be drawn from the National Energy Strategy (NES). This is a significant energy policy plan in Italy, which oversees the creation of an internal market for gas. The NES strategy has been in place since 2005 and aims to enhance competitiveness of the system by lowering prices. However, these goals were not achieved. Indeed, from 2005 to 2016, the price of electricity in Italy increased from 15.53 c € / kWh to 17.91 c € / kWh, despite the collapse in commodity prices. Additionally, Italy's security of supply and energy independence is at particular risk. In 2012, 82% of national demand (163 Mtoe) was met by net imports, with national production from renewables, gas and oil accounting for only 11.1%, 4.3% and 3.5% respectively. This compares with an average import level of roughly 55% for other EU member states.

Despite this negative context, Italy can count on several strengths. Italy is one of the countries with the lowest energy intensity levels (-19% of primary energy intensity vs. -14% in the Eurozone in 2011). Final energy use has been declining in recent years (equivalent to 199 Mtoe in 2012, 2% less than 2011). This is largely due to the economic crisis, although a 5% decrease since 2005 can be attributed to improvements in electric generation performance, as well as the active adoption of numerous energy efficiency measures (fiscal, white certificates, etc.). The American Council for an Energy-Efficient Economy (ACEEE) placed Italy in third place in 2011, just behind England and Germany, in recognition of these efforts (ACEEE, 2011).

3.1.4 Spain Policy Context

It can be argued that the energy policy context in Spain has been highly influenced by rulings and guidelines advanced by the European Union in the form of different Directives, namely the Internal Market in Electricity Directive 2009/72/EC, the Gas Directive 2009/73/EC, the Renewable Energy Directive 2010/31/UE and the Directive regarding energy efficiency in buildings 2012/27/UE. By and large these rulings have led to the development of policy and political structures to tackle issues related to energy. This includes political reform, creation of regulatory authorities to oversee the formation and implementation of new rules and systems in terms of energy supply. Furthermore, these directives have also emphasised the need to oversee consumer rights regarding energy systems.

It can also be argued however that Spain has been somewhat reactive when it comes to the modification of the internal legislation, especially when transposing European Union directives. A number of examples suggest this including the Spanish government's demonstrated passivity towards reform and a lack of political will to make the necessary changes needed within its internal policy frameworks. For example, issues around the transposition of the Internal Market in Electricity Directive 2009/72/EC are illustrative of

current national political barriers and the pressures exerted by traditional utilities in advancing new legislation. These would often translate into losses in acquired privileges for new actors in this market. Another significant factor, which has affected the development of energy policy in Spain in recent years, is associated the economic downturn since 2008. Most notably, this has led to a significant tariff deficit in the electricity sector and the fact that the government does not want to lose existing competences linked to the regulation sector.

Nevertheless, there are positive elements associated with the development of alternative energy sources in Spain, specifically research has shown that the diffusion of on-shore wind power in Spain since the late 1990s has shown impressive results, and compete with much larger, more advanced economies such as Germany and the USA (del Río & Unruh, 2007). In addition, solar energy has also seen a large increase in investment in recent years. There are a number of reasons highlighted for these successes which include the gradual promotion of a market that has proved to be very appealing to investors in the Spanish context. Also, a recent commitment to participate in energy reforms has strengthened stability in both development and implementation of these alternative energy sources (del Río González, 2008).

3.1.5 Ireland Policy Context

Irish energy policy has been deeply integrated into the wider European energy policy frameworks and all the key energy policy actors in Ireland are informed by the European Commission's strategic vision as set out in its 2015 Energy Union strategy. The Department of Communications, Climate Action and Environment (DCCAE) is the state actor responsible for energy policy in Ireland, and it engages with other organisations tasked with contributing to national policy dialogues including the Sustainable Energy Authority of Ireland (SEAI), the National Economic & Social Council (NESC) and The Economic and Social Research Institute (ESRI). In December 2015 the DCCAE published their latest energy policy framework, the White Paper on Energy Policy in Ireland, following on from the Green Paper on Energy Policy in Ireland, which was published in May 2014 after a lengthy consultative process with contributors from both in and outside of parliament. The 2014 Green Paper also highlighted the key policy developments that took place over the period 2007-2014, as well as informed the development of the 2015 White Paper. The Irish government's previous energy policy paper, published in 2007, has essentially been the foundation document for Ireland's energy policy over the medium-term. The current White Paper gives energy planners in the Ireland a policy vision to 2020 – in keeping with the European Union's 2020 objectives – and certainty to those that engage in the energy markets here. It also sets down a broad-ranging framework of action plans, support schemes, guidelines, legal instruments and a variety of investment programmes.

The DCCAE is now preparing new energy policy documents for Ireland out to 2030 – with a longer-term view towards 2050. In keeping with the narrative set down in the 2015 White Paper a key theme of new energy policy in Ireland is around 'transition' and the low-carbon energy system envisaged for 2050. Government discourses around energy policy also continue to express Ireland's intention to adhere to the three EU pillars of energy policy, i.e. security, sustainability and competitiveness. It should also be noted that the Irish government published another significant policy statement on the Strategic Importance of Transmission and other Energy Infrastructure in 2012, which "affirms the imperative need for development and renewal of our energy networks, in order to meet both economic and social policy goals"

(MerrionStreet.ie, 2012), and contributed to the department's other policy documents in the intervening years to the present.

4 Case studies of behaviour change

4.1 *Characterisation of behaviour change initiatives*

There is considerable debate about why different behaviour change interventions work or do not work. Existing research supports the view that behaviour is most likely to respond through the implementation of a mixture of tools and types of interventions. An examination of some key practical case study examples selected here for the diversity they represent illustrate the different contexts and interventions, and specifically in relation to energy related behaviour change. Key lessons from the selected case studies are also discussed. Each Case Study is presented using the following structure: Background; Intervention Model & Evaluation. In order to group and categorise behaviour change interventions, the 'behaviour change wheel' model developed by Susan Michie *et al.* (2011) was referenced. While not explicitly focused on energy *per se*, this model is framed around nine intervention functions aimed at addressing deficits in one or more of three conditions, **capability, opportunity, and motivation**. The outer layer of the behaviour change wheel is comprised of seven categories of policy types through which behavioural interventions are directed (Michie *et al.*, 2011). Figure 4 presents an adaptation of the behaviour change wheel. This Figure (and associated definitions in Table 5) is applied throughout Section 4 to indicate the broad policy and intervention categories into which each of the respective case studies falls.

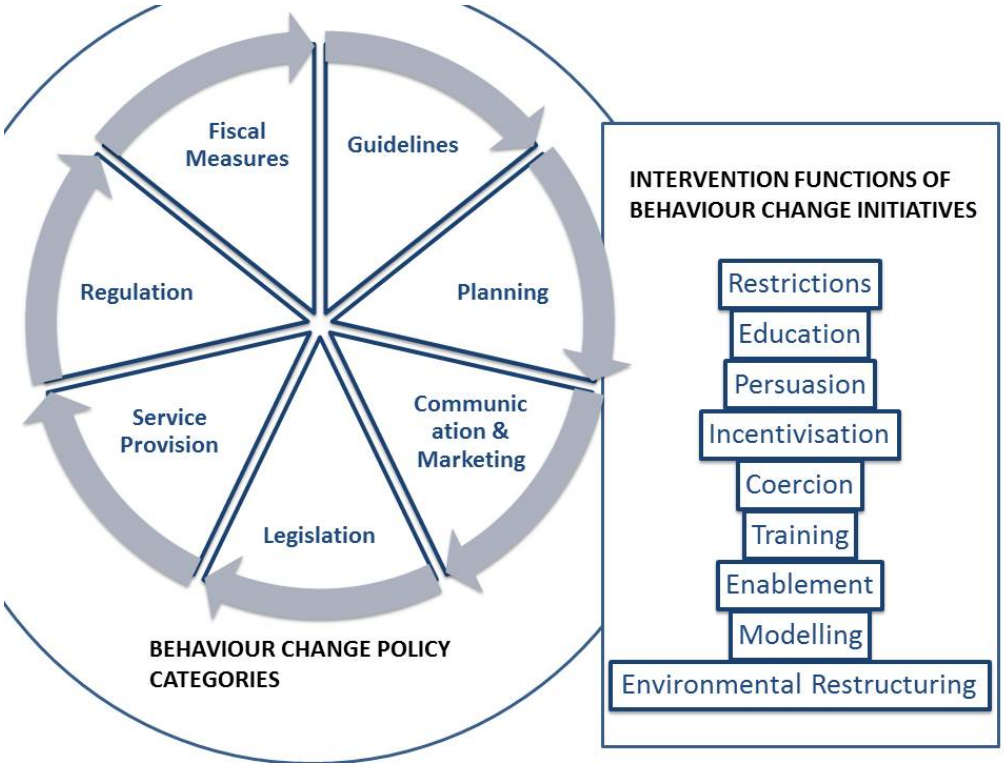

Figure 4: Behaviour Change Wheel (after Michie *et al.*, 2011).

Table 5: Definition of interventions from Behaviour Change Wheel, after (Michie *et al.*, 2011).

Intervention	Definition
Education	Increasing knowledge or understanding
Persuasion	Using communication to induce positive or negative feelings or stimulate action
Incentivisation	Creating expectation of reward
Coercion	Creating expectation of punishment or cost
Training	Imparting skills
Restriction	Using rules to reduce the opportunity to engage in the target behaviour / Increase target behaviour by reducing opportunity to engage in competing behaviours
Environmental Restructuring	Changing the physical or social context
Modelling	Providing an example for people to aspire to or imitate
Enablement	Increasing the means / reducing the barriers to increase capability or opportunity

As the framework presented in Figure 4 was developed for application in a public health context, 6 additional groupings of behaviour change initiatives were developed, with more direct relevance to the energy behaviour change context. These were developed using a grounded approach, based on a thematic analysis of those collated case studies and applying a cross-reference of key characterising features. From this process, the following classes of energy behaviour change intervention emerged.

i. Community-based interventions;
ii. Information and Awareness based interventions;
iii. Eco-districts;
iv. Show-case events;
v. Energy Switching; &
vi. Smart-Technology focused interventions.

These broad and simple categories are used to structure the presentation of case-studies in Section 4. For each case study, the behaviour change wheel is first presented, with shading indicating where the policy and interventional focus of each respective behaviour change initiative is weighted.

4.2 *Summary of the case studies presented*

The case studies presented as part of this deliverable can be summarised as follows:

- **Community-based interventions combining peer-to-peer and information advice** case studies (e.g. Green Doctors - UK; Energy Champions - Stockbridge Village**)** show that some approaches need to

be targeted at individuals to be effective, predominantly in low income areas. They also focus on the core idea of peer-to-peer led activities, yet rely on a mixture of tools. It also appears to be a relatively hands-on intensive approach as they offer tailor made solutions and advice. This approach addresses the individual and material contexts of behaviour.

- In particular, **peer-to-peer activities** (e.g. 'Energy Champions or Captains') are used to foster trust between local stakeholders, i.e. people are more likely to trust other residents or others they can identify with rather than someone who is an official from a local council or housing association. However, peer-led support and activities have been supplemented with information and advice, and including those offering challenges, rewards and competitions (e.g. Power of One) are key tools for stimulating, and motivating individuals into energy conservation. The examples also suggest that the highly personalised and tailor made solutions which are often delivered to a small number of individuals ranging from 10 to a few hundred, are likely to hold financial/funding implications for those delivering them on a larger scale.
- Many cases (e.g. Green Doctors; SuperHomes) suggest that behaviour change needs to be accompanied by building specific physical interventions that information/awareness raising activities alone cannot address. In practice, thus these are often accompanied by energy efficiency retrofitting and the installation of micro-generation technologies for an effective and household level energy reduction strategy. This demonstrates that **technology adoption and behaviour change go-hand-in-hand** for an effective strategy.
- **Eco-districts** are area based exemplars or demonstrators but attempt to reach long term and sustainability goals beyond mere energy efficiency or conservation. They try to move an entire community (mix of users and building uses) to change behaviour. This approach addresses more holistically the individual, social and material context of behaviour. These approaches seek to change the social contexts of behaviour and break-way from existing mainstream social norms and conventions to promote a more sustainable way of life for working and living in. However, in practice, such schemes are rare and appear confined to a niche form of development.
- **Open homes events** (e.g. Nearly Zero Buildings; SuperHomes) place emphasis on building specific solutions yet provide social learning, however predominantly emphasise technology adoption and address building specific energy efficiency, in these approaches behaviour change is less explicit and perceived as a desirable outcome in the long-term that could follow from occupants living in a more energy efficient home. It provides a form of peer-to-peer learning too but specifically focused on building specific solutions. This approach mainly addresses the individual and material context of behaviour and one off curtailment behaviours.
- **Collective energy switching** seems to functions as a form of market intervention that seeks to rationally motivate individuals as consumers (through the provision of greater choice) to seek the best energy tariffs to save money. These rely on mass media information and awareness raising campaigns to get residents to take-up the cheaper tariffs. This approach is largely driven by the state but requires voluntary take-up through offering consumer choice. It mainly addresses the individual context of behaviour.
- **Smart technologies** mainly emphasise technology adoption as a tool to provide users (which can be both residential and non-residential) with greater awareness and accountability on day to day

energy consumption which should ideally stimulate better energy management. A key attribute of smart meters is that they are not used in isolation but appear effective when accompanied by a range of innovative tools which provide feedback and information on energy consumption and are an integral part of their success. There is a mixture of debates on the effectiveness of this tool - studies have highlighted they could perpetuate rebound. This approach addresses the individual context of energy behaviour.

Table 6: Summary of analysed case studies

Case study	Scale	Delivery	Target	Techniques
Community-based Peer-to-Peer				
Case Study 1: Familles à énergie positive (France)	N	S / M / CS	Household residents	Energy team 'Captain'; peer-to-peer model; seasonal demand reduction; promotes behaviour change (BC) & technology adoption (TA); mix of tools
Case Study (2): Energy Champions - Stockbridge Village (UK)	L	CS	Household residents	"Energy Champion"; peer-to-peer model; promotes BC & TA; mix of tools
Community-based with Information & Advice				
Case Study (1): Green Doctors (UK)	L	CS	Household residents	tailor made information and advice; promotes BC & TA; mix of tools; including peer-to-peer model and energy audit.
Case Study (2): Power of One - Ireland	N	S / CS	Residents, businesses, schools	A multi-sectoral mass media campaign; BC only; mix of tools; including peer led activities; motivational challenges;
Eco-Districts				
Case-Study (1) Cloughjordan Ecovillage, Ireland	L	CS / I	residents and non-residential users	Holistic; Area based; sustainable development and living; BC & TA
Case-Study (2) The Darwin project – Bordeaux, France	L	CS / I	Commercial users mainly with some residential users	Area based; relies on BC; and technology for energy management
Open home Show-case events				
Case Study (1) Nearly Zero Energy Buildings Open Door (NZEB Open Door Ireland)	N	S / CS	residents	Relies on TA; exhibitions and retrofitted visiting homes; multi-media; mix tools. Building standard development
Case Study (2) SuperHomes – Green Open House events, UK	N	S / CS / I	residents	Relies on BC & TA; exhibitions and retrofitted visiting homes; multi-media; mix tools.

Case study	Scale	Delivery	Target	Techniques
Collective Energy Switching				
Case Study (1): The Big London Energy Switch, UK	R	S / CS / M	residents	Relies on BC; mass media campaign; energy tariff switching
Case Study (2) The 'Power to Switch' campaign, UK	N	S / CS / M	residents	Relies on BC; mass media campaign; energy tariff switching
Smart-Technology				
Case Study (1) Power Off & Save (Ireland)	N	S / M	1,500 Customers of energy companies (volunteer)	Mix of strategies Information, advice, feedback and incentives
Case Study (2) Smart Meters Smart People (SMSP) – Northern Ireland (UK)	R	S / M / CS	56 low income households with smart meters with IHD's	Mix of strategies: Information, advice, feedback and incentives
Case Study (3) Nice Grid (Caros, France)	C	S / M / CS	Less than 170 solar energy HH's; targeted for load shifting Daytime and seasonal variations	Mix of strategies: Advice/info; tariff incentives; smart water tank; remote control; electric heating control
Case Study (4) Carrega't d'Energia (Barcelona, Spain)	C	S / M / CS	residents	Both TA & BC; Mix of tools; smart meters; information & advice; personalised Billing;
Case Study (5) Sports Center FIDIA Cesano, Rome (Italy)	L	S / M / CS	Building specific - Sport Centre	Smart meters; TA; focus on energy management

Legend: N: National R: Regional C: city L: Local S: State CS: Civil Society M: market

4.3 *Community-based Peer-to-Peer interventions*

4.3.1 Community-based Peer-to-Peer Case Study (1): Familles à énergie positive, France

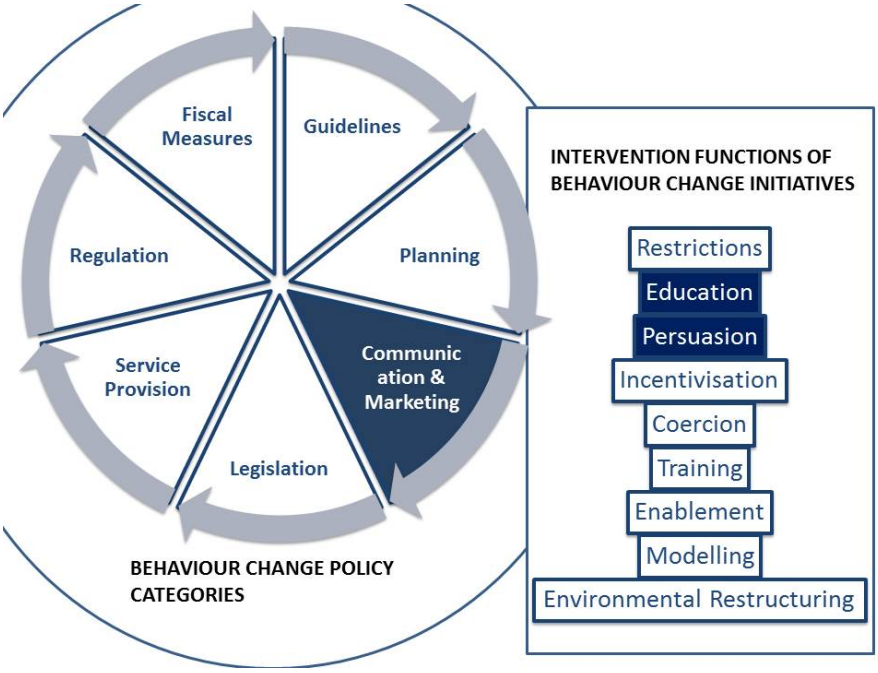

Figure 5: Behaviour change wheel, case study 4.3.1

Background: This was a nationwide scheme, unfolding over the last 8 years, and was spear headed by government department funding and executed in partnership with a range of municipal and civil society stakeholders. The project is co-ordinated by Prioriterre a non-profit organisation whose central purpose is to help every citizen to reduce their environmental footprint and preserve the natural resources of the planet. Its central role is to: provide advice and information; ensure the technical maintenance of the central and local websites; to manage the various local organisers that work in partnership with communities; and to support families in the use of tools, and update the local website (news, interviews, and useful information) (Familles à énergie Positive, 2016).

The central objective of the "Familles à énergie positive" project is to demonstrate that people can collectively tackle the problems of GHG emissions by carrying concrete and measurable actions. It required voluntary participation, and a willingness to reduce household energy consumption by at least 8%, especially during winter periods (Familles à énergie Positive, 2016). In order to do this no financial investment is required in any form of energy efficient electric appliances or equipment nor in smart monitoring systems. The whole project is reliant upon on individuals adopting environmentally friendly behaviours in their everyday lives.

The Intervention Model: The essential element of the approach requires the development of a team of between 5 and 10 people. Within the team, a captain is nominated and trained on energy savings and the associated website use. Their central role is to help supervise, encourage and support team members. It is not targeted at any particular socio-demographic group and thus is open to anyone (family, friends, colleagues, etc.).

To supplement, the 'eco' team, there is a dedicated website, which is the main tool to engage and motivate participants. It is used to track energy consumption of the team and to measure progress. Here, all

participants can find information about the challenge; list of teams and their rankings, tips on energy saving, FAQs, etc. In addition, the local organiser (often an energy specialist) is another important channel to communicate and offer hands-on support to participants. They are responsible for training the 'Captains' and in assisting families especially throughout the winter to help them to save even more energy. The project targets all aspects of everyday energy consumption behaviours at the household level, i.e.: insulation, ventilation, heating & cooling, hot water, and use of electric equipment (TV, Hi-Fi, washing machine, lighting, cooking etc.).

Table 7: Key tools used to support the teams include:

For all participants	For the captain
A flyer to introduce the project and recruit new participants A quiz on 20 main environmental-friendly behaviours to evaluate the level of engagement A monthly newsletter Events in November, February and May	A "log book" to introduce the role of Captain A weekly mail to highlight surprising results reported by participants

Evaluation - Learning from the Case Study: The project was self-monitored as participants enter their consumption data on the website themselves and are responsible for it. The project was reported as successful in so far as it achieved some of its stated objectives. For example, during the 2014/2015 period, it reported:

- An average 12% reduction in the energy consumption of participants;
- 8.5 million kWh saved, corresponding to the consumption of 1900 dwellings;
- 1400 tonnes of CO_2 equivalent avoided; and
- Approximatively €200 savings per team without any initial investment.

Its perceived success has meant it has been rolled out across France and in the past 8 years 29,395 teams have already participated in the project. The project started in France in the Haute-Savoie department in the winter of 2008/2009. Since 2011 more and more cities, departments or regions have taken the challenge. The 2015/2016 period involved: 11 regions; 81 departments; and 2400 towns (Familles à énergie Positive, 2016). The fact that more areas are taking up the initiative is perceived by those delivering it as a sign of success. The key strength of this type of project relies on a peer-to-peer model of intervention and draws on the influence of social norms. Existing research suggests that support from family, friends and colleagues can help with mutual motivation to change behaviour based on what participants discuss and see each other do (Phillips, R., & Rowley, 2011) . The information from this case study suggests that this model is gaining in popularity in France and also is becoming commonplace across the UK (housing associations, schools and offices). The success of this approach is supplemented and supported by a range of essential tools (e.g. information, advice, guidance, web-based materials). In summary, the following key lessons of the success of this initiative were as follows:

- Creating a sense of collective interests through group commitments;

- Creating a sense of collective interests and achievable goals;
- Strong leadership and continued support of the intermediary (as shown by the 'Captains');
- Focuses on seasonal variation addressed through emphasis on winter month energy; management (this is when most energy use occurs);
- Relies on a mix of tools; &
- Mainly targets the individual context of behaviour.

The key weaknesses of this type of approach include challenges associated with measuring the individual impacts and measuring short to long term benefits and knock-on effects.

4.3.2 Community-based Peer-to-Peer Case Study (2): Stockbridge Village Energy Champions, UK

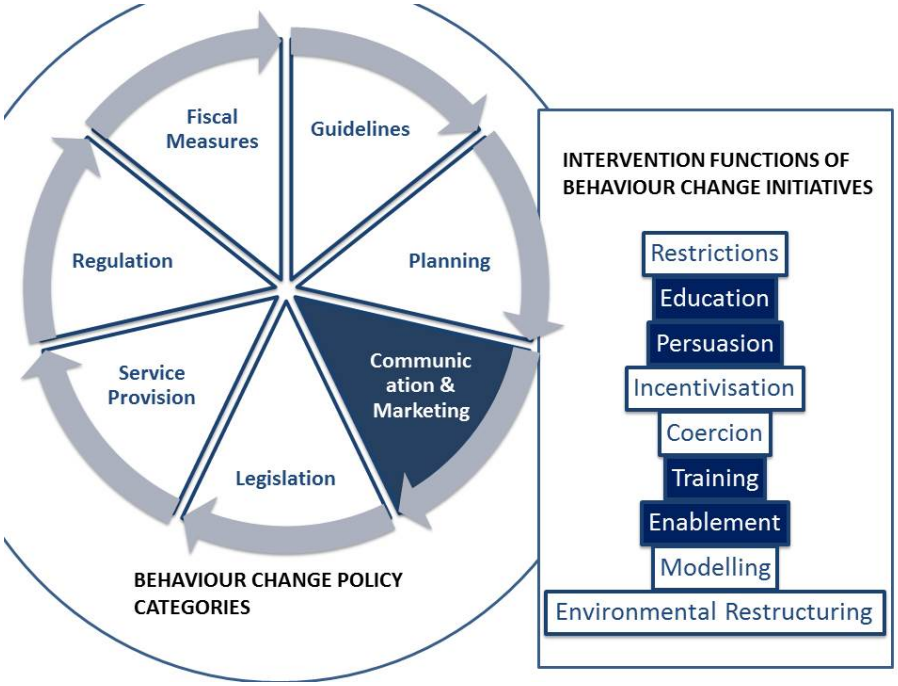

Figure 6: Behaviour change wheel, case study 4.3.2

Background: Current research exploring the role of key individuals in environmental and sustainability related projects defines the characteristics and behaviours of such leaders within a variety of community and business oriented contexts, for example (Howell & Boies, 2004). In Stockbridge Village (Knowlsey, UK), an 'energy champions' initiative sought to use residents within the community to become involved through peer-to-peer working to support other individuals with reducing their energy consumption. The scheme is supported by the Big Energy Saving Network (BESN), which aims to provide support to individuals to reduce their energy consumption and change their energy suppliers.

The Intervention Model: The 'energy champions' initiative supported residents in Stockbridge Village through individually discussing measures of how to reduce the energy consumption of residents; and in particular actively seeking to change social norms in the community to become more accepting of energy conservation issues in their everyday life. The 'energy champions' initiative proactively recruits local residents and trains them up to offer other fellow residents energy conservation advice and support. This personal approach of face-to-face delivery of support enabled behavioural change messages to be acted upon more meaningfully and effectively. Energy champions have helped residents in the community through supporting switches to more (cheaper and) efficient energy tariffs; identifying where individuals

can take measures to reduce their energy consumption, e.g. switching off appliances and using smart meters; and raise awareness of public engagement events that are focused on energy issues. Energy champions in Stockbridge Village have reportedly engaged hundreds of residents in these ways.

Evaluation - Learning from the Case Study: The Energy champions indicated that training for their role was essential to make the largest impact in engaging residents with energy conservation and sustainability issues in the local community. Yet, the training received was an initial event that provided energy champions with how to support other individuals with switching to cheaper and more efficient energy tariffs. Consequently, energy champions required training that was appropriate, relevant, and continuous that is related around public engagement, energy and climate issues (Axon, 2016b). Secondly, it was suggested that the level of engagement in Stockbridge Village was considered to be low and that this was a persistent problem for public participation exercises. It is recommended that energy champions need to continuously engage with individuals and residents in the communities. To facilitate this and support continued engagement, residents and individuals have to feel excited at the prospect of becoming involved. In order to do this, a programme of events and activities that bring together community members would illustrate a collective approach and reflects the needs and values of residents (Axon, 2016a; Steg & Vlek, 2009). Thirdly, energy champions considered that they had a limited impact in the wider sustainability transition within Stockbridge Village (see section 5.3 for further analysis). While these perspectives confirm understandings that there are multiple actors and interventions that can be employed, there is substantial uncertainty regarding the impact energy champions have. As such, there is a need to evaluate the impact of the contributions energy champions make towards sustainability transitions in local communities (Axon, 2016a).

4.4 *Information & Advice based interventions:*

4.4.1 Community-based information & Advice Case Study (1): Green Doctors, UK

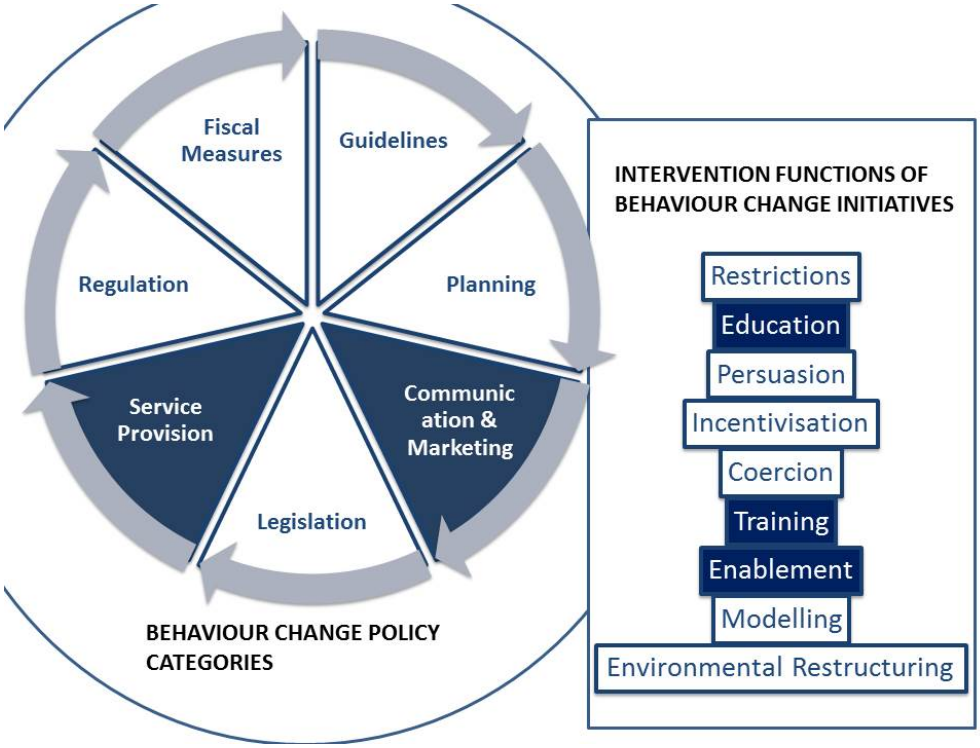

Figure 7: Behaviour change wheel, case study 4.4.1

Background: The Green Doctor service is an award winning service model originating from Groundwork an environmental charity. The Green Doctor service is a well-known and established brand that is delivered by Groundwork in partnership with other agencies. Other examples of the scheme across the UK include, e.g.: Green Doctor in Manchester; Green Doctors in Tower Hamlets, London. A key focus of the scheme is to provide independent, impartial domestic energy experts who provide tailor made solutions to families to make their homes warmer, cut fuel and water bills and reduce their carbon footprint. Each Green Doctor initiative and role varies, but the aim is always the same: to provide free, impartial one-to-one sustainability advice to residents (Groundwork, 2016).

For example, Southway Housing Trust (a registered social landlord (RSL)) in partnership with Groundwork delivered a Green Doctor Service to its residents. The project was aimed at helping tenants reduce their energy bill and save money; reduce their energy use and household carbon emissions, and to some extent build skills through volunteering for some. It targeted those most at risk of fuel poverty and/or from various welfare reform. The 'Energy Doctor Service' (a service pioneered by Groundwork) provided energy saving support in the form of home energy assessments and energy switching advice undertaken by qualified energy assessors for RSL tenants (Groundwork, 2016; Southway Housing, 2016).

The Intervention Model: Typically, as part of the service, the Green Doctors via their expertise offered residents a range of simple energy efficiency measures including low energy light bulbs, draught proofing, and water saving devices. They also signposted residents if eligible to government and energy company grants that could help them to install more significant energy saving measures, such as loft or solid/cavity wall insulation and boiler replacements. They offered residents debt assistance and also offered energy tariff or company switching advice. Another important part of the service is advising residents about simple behavioural changes that could help them take control of their energy use, e.g. heating rooms individually, using energy saving light bulbs and washing at 30 degrees.

The key notable features of the interventions included a mix of both behavioural and technical measures:

- It was delivered over the course of a year (between June 2012 and May 2013) - It is claimed 976 residents benefitted from behavioural change projects, run with the charity Action for Sustainable Living, and physical property improvements.
- The energy doctor service was promoted by text messages, telephone calls and events, resulting in 216 tenants receiving a home energy audit from a trained advisor and an energy monitor. It is claimed residents saved a total of £26,977 and 98 tonnes of carbon.
- Southway retrofitted three homes with energy and water efficiency measures, including PV panels, internal wall insulation and A***-rated electrical goods, and provided 79 tenants, who had reported problems with condensation and mould, with a washing line or rotary drier for drying clothes.
- Twelve residents, who gained training as tenant energy champions, provided 112 people with energy and money-saving advice. The team also engaged 666 tenants through 30 community advice sessions and a door-knocking exercise.

Evaluation - Learning from the Case Study: The Energy Champions model is based on an offering of bespoke tailor made information and advice on energy conservation. However, this is supplemented by a mixture of

other tools to tackle the behavioural and material contexts of energy consumption. Notably, it also relies upon the peer-to-peer working approach similar to the Stockbridge Village case study. Furthermore, the community-based partnership delivery model enabled the support of a significant number of tenants in fuel poverty, offering them a very high quality and personalised advice service. The Green Doctor model is perceived a successful approach and has been delivered in partnership with many towns, cities, Boroughs and Housing Associations. It offers bespoke programmes to tackle fuel poverty and the associated poor health in vulnerable residents, often as part of government directed Warm Homes, Healthy People programmes. The project was awarded an 'Energy Saving Initiative of the Year' accolade in the annual Sustainable Housing Awards of 2013. This was awarded on the basis of its strong holistic and community engagement approach.

4.4.2 Community-based Information & Advice interventions Case Study (2): Power of One (Ireland)

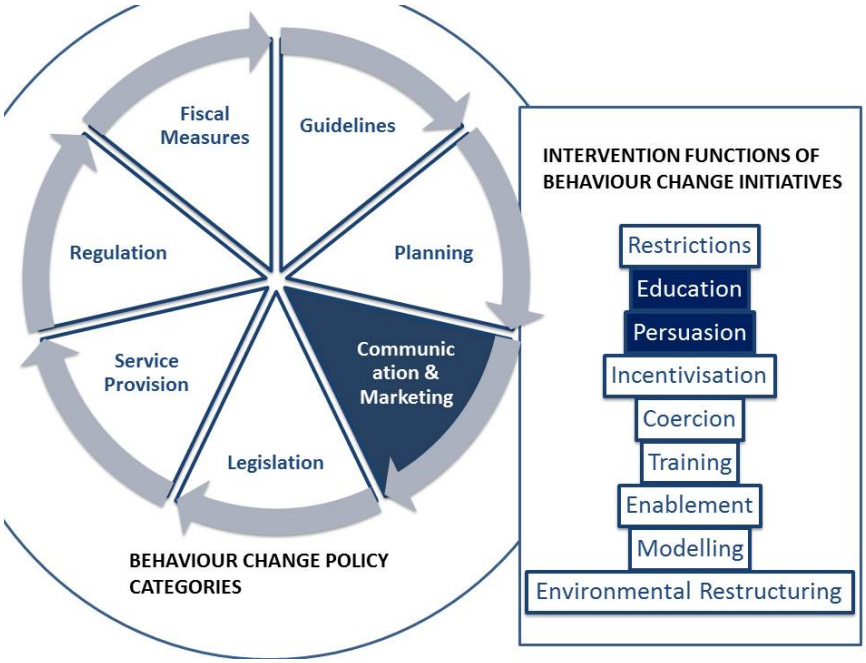

Figure 8: Behaviour change wheel, case study 4.4.2

Background: The Power of One was a National Multi-Sector 'Communications' Campaign which was launched in September 2006 by the Irish Government. This was a national campaign which targeted energy consumption in the home and at work. The campaign initially targeted people through the main Irish media channels, both TV and Radio. The campaign was launched by the Department of Communications, Energy and Natural Resources (DCENR). The campaign is still on-going and is currently being developed further by the Sustainable Energy Authority of Ireland (SEAI). The overarching aim of the campaign consisted of a multi-sectoral approach which targeted homeowners, SMEs and schools, and focused in particular on behavioural changes associated with everyday energy use in the home and at work, and on influencing habitual practices (Sustainable Energy Authority of Ireland, 2016). The scope of the campaign has shifted over the years. Initially the programme consisted of a broad communication strategy which entailed deployment on a variety of media such as TV, radio, and online communications, as well as outdoor activities and other media initiatives. In 2009 this focus shifted considerably, entailing a move away from

mass media and towards more localised and peer led activities (Sustainable Energy Authority of Ireland, 2016).

The Intervention Model: the main interventions carried out to date include:

- **Irish Media Campaign:** The main media used were advertisement campaigns on the TV and radio. Other communication channels used included billboards, internet ads, brochures and leaflets, and ads in the press and movie theatres. The TV campaign consisted of topical monthly advertisements which focused on specific issues. For example, the advertisements in November 2006 focused on peak time consumption, in December they focused on energy efficient Christmas lights, and in January they looked at home heating habits. Most of these outputs concentrated on making people use appliances more efficiently (Diffney, Lyons, & Malaguzzi Valeri, 2013).
- **Dedicated webpage:** The Power of One webpage is seen to have a central role in terms of generating updates concerning the campaign's activities. The webpage content includes an interactive energy survey, a free home energy manager application, a range of tips and suggestions regarding energy efficiency in the home, at work and while travelling, and a repository of the TV adds produced during the initial stages of the campaign. A Report from the Department of Communications, Energy and Natural Resources from 2014 indicates that there were 800,000 impressions on these web pages.
- **Power of One Street:** this intervention consisted of documenting the experiences of 13 households, one school and a GAA (Gaelic Athletic Association) Club, as they attempted to take on more energy efficient practices (SEAI, 2016). For example, the selected households that participated in this initiative undertook an energy survey whereby they identified consumer preferences and practices relating to lighting, use of appliances and personal transport habits. A series of energy reduction targets and challenges were proposed to household owners in terms of making homes more energy efficient. The challenges took place between 2007 and 2008 (SEAI, 2016). The progress of these families was recorded and is now available as an enabling and empowering tool; with the hope this would encourage the promotion of similar behaviour change with the wider public. Figures advanced by SEAI (2016) indicate that on average the 13 families that took part in the challenge saved €500 in energy costs and reduced their CO_2 emissions by over two tonnes each. The school also reduced its energy bill by nearly €1,750 per year.
- **Power of One Community:** this initiative emerged as a continuation of the Power of One Street campaign. The key focus was to encourage householders to understand the value and impact of simple changes in everyday energy consumptions in terms of home heating practices, hot water etc. A significant part of this initiative puts the focus on community and group leaders to initiate these changes and for this purpose a 'Group Leader Resource Pack' has been produced (SEAI, 2016).
- **Power of One at Work**: It targeted employees and employers across all sectors, including the public. The initiative entailed giving advice and tips concerning energy efficiency which was mainly delivered in the form of posters and information packs. This initiative has been discontinued.

Evaluation - Learning from the Case Study: Overall the Power of One has shown some beneficial outcomes in terms of small reductions in emissions resulting from the mass media campaign and in terms of increased awareness of how individual behaviour impacts on energy use and the environment (Diffney *et al.*, 2013). Existing evidence also suggests that the campaign has not been overly successful in terms of initiating and

securing long terms behavioural change towards more efficient energy use. While there is research focused in Ireland which shows that the Irish public are by and large willing and positively inclined towards developing more sustainable lifestyles it is not clear how best this is achieved and who the main actors should be in carrying out these changes - a perceived value-action gap exists which needs to be addressed (Lavelle & Fahy, 2014). Some commentators (Dulleck & Kaufmann, 2004) suggest that schemes like the Power of One campaign with its technical fix approach - focusing on adjusting and ensuring efficiencies in existing technologies in the home - may counter any necessity to significantly adjust behaviour and potentially limits people engagement with energy efficiency (Further discussed in section 5.1).

A key component of this project is that it relied on a mass media campaign which is accompanied by a number of streams of activities which contribute to the multi-sector element. Media campaigns rely on mobilising social attitudes, yet similar to many information based approaches are on the whole considered ineffective by themselves (Abrahamse *et al.*, 2005). Therefore to overcome such problems this project has used a number of tools e.g. websites, leaflets radio and TV campaign, etc. These are considered nevertheless the starting point to engaging people on behaviour change but need to be supplemented with other tools.

In this case the 13 households are a key innovative component of this programme. Following an 'energy survey' households were given targets and challenges to reducing energy consumption. The goal setting elements of this tool provide feedback, incentives and motivate users to change behaviours. Based on the 13 households it is too small a sample to determine for its wider potential for behaviour change across the general public. Overall, due to the multiple interventions it is difficult to evaluate the overall long term impact of this project. Other similar projects can be identified (e.g. Eco-Family, London) show how the households serve as a role model and for peer-to-peer learning, and how rewards and challenges can help motivate people to lower energy consumption. In particular, the tapping into the motivational side of human behaviour

4.5 *Eco-District Area based interventions*

4.5.1 Eco-Districts Case-Study (1): Cloughjordan Ecovillage, Ireland

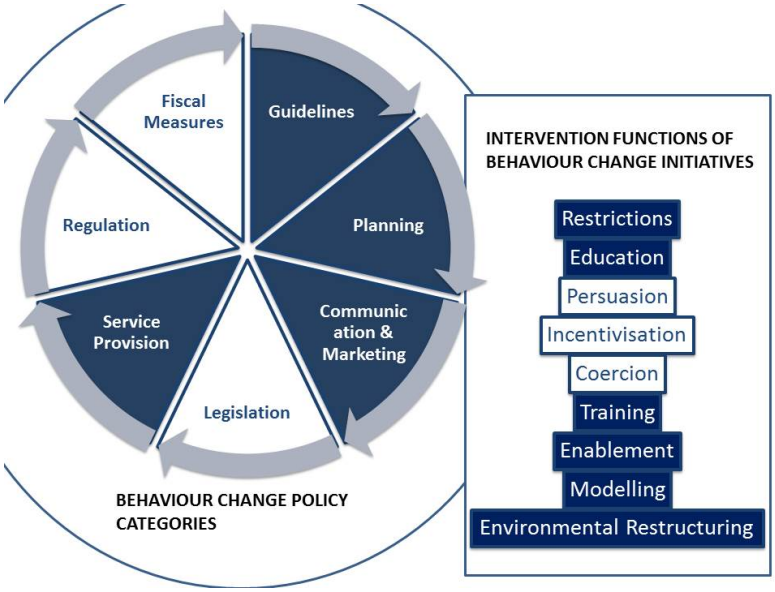

Figure 9: Behaviour change wheel, case study 4.5.1

Background: The Cloughjordan EcoVillage is a registered educational charity and an internationally recognised destination for learning about sustainable living. One of the main aims of the project is to share with the wider community the lessons learned during the first fifteen years of creating and managing Ireland's first 'eco village' concept. Founder members of the EcoVillage initially came together in 1999 to develop the Sustainable Projects Ireland Limited, which trades as The Village. This is a registered educational charity and international environmental NGO run along co-operative principles (Thevillage.ie, 2016)

The Intervention Model: The project through a holistic approach developed 130 high performance homes, renewable energy for heating, land for growing food and trees, an enterprise centre and community buildings. In this manner the EcoVillage model is championing community supported agriculture, exploring community currencies, introducing local democracy and governance systems and playing a part in the strengthening of the local and regional economy (Thevillage.ie, 2016). The EcoVillage targets people nationwide to become new residents of the community. It targets the wider community in taking part in their EcoLearn Programme which provides information on their model of sustainable living. Finally, it targets visitors from schools, families and individuals to visit the EcoVillage (Thevillage.ie, 2016).

The Cloughjordan EcoVillage strategy strives to be a centre of excellence for awareness raising and education in the areas of: energy conservation and production; reduction and recycling of resources; sustainable livelihoods; sustainable, local, food production; broad community understanding of the converging environmental, social and economic challenges and the need to develop resilience as the key response. These include teaching programmes, events, visiting opportunities as well as a range of online accessible materials. The project has also engaged with academia to improve on existing practices. An Eco-hostel was open to the public in 2011. An Eco-Enterprise Centre is currently under construction (Thevillage.ie, 2016).

The EcoVillage project provides an alternative style of living which adheres to sustainable living guidelines that lead to considerable changes in the way housing and food for example are secured that are substantially different from mainstream approaches. It also raises awareness of these same alternative practices through their visiting and training programme. It is seen to be a model of alternative living in terms of farming practices and sustainable living. As the first of its kind in Ireland it offers the community innovative insights in securing and promoting alternative practices see (Moore, McCarthy, Byrne, & Ward, 2014).

Evaluation - Learning from the Case Study: Cloughjourdan, like numerous other Eco-Villages has the same principals across the world within urban and rural settings. The main principle underpinning these is that they rely on the adoption of a holistic sustainable lifestyle approach at the community level. They advocate a simpler and a resource efficient lifestyle and even self-sufficiency in some. They often seek to maintain a local carbon footprint – seeking to trade locally and independently from existing infrastructures, whereas in the more urban settings they may seek integration with existing infrastructures. The Darwin project in Bordeaux, France is one such project which seeks to integrate with existing structures and is largely focused on creating an eco-business district (discussed in the next case study 4.5.2). Research conducted by Espinosa and Walker (2013) showed that there are some organisational problems with eco-villages, including: poor coordination, fragmentation of duties and functions, weak communication structures,

issues related to time commitments for full time workers with young families. Using the Viable System Model (VSM) the project has tackled some of these issues.

4.5.2 Eco-Districts Case-Study (2): The Darwin Project, Bordeaux, France

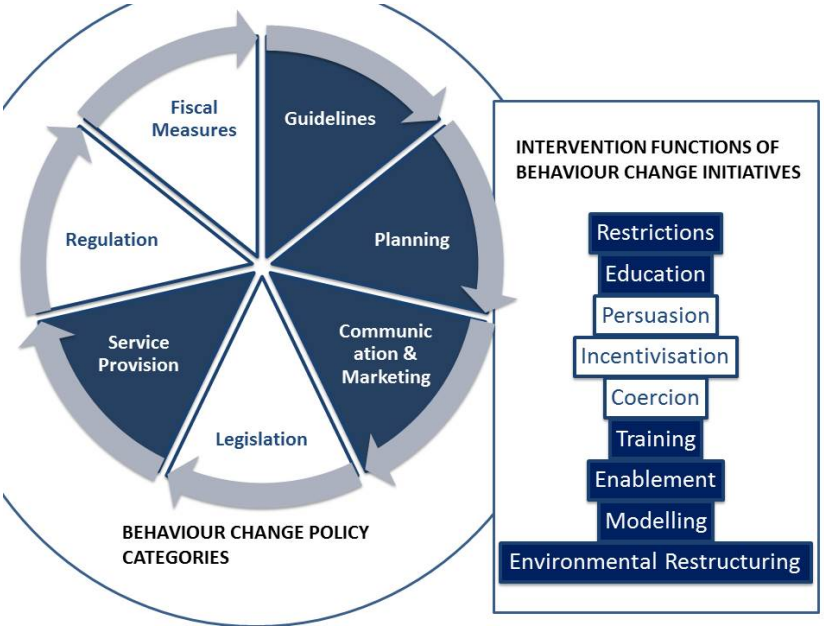

Figure 10: Behaviour change wheel, case study 4.5.2

Background: The Darwin project started in 2010, by a social enterprise through the purchase of 10,000m² of disused former military premises located in Bordeaux city centre. The project aimed to create an environment-friendly eco-system at the heart of Bordeaux. With a 10.000m²-area of offices, shops and studios it gathers active actors such as businesses or associations that are requested to be resolutely engaged in the ecological transition to be allowed to settle in the district. Nevertheless they are not left alone in this mission and are accompanied and supported by the 'Darwin' community (Darwin Camp, 2016).

The Intervention Model:

The project site was developed using the négaWatt common sense approach which is based on three main pillars (Negawatt.org, 2016):

- **Energy sobriety:** Give priority to fundamental energy needs in both individual and collective energy uses. For instance air conditioning is banned from all premises.
- **Energy efficiency**: Reduce the amount of required energy to fulfil these needs; offers advice on the conception and insulation of buildings, actions implemented to optimise the energy use: bioclimatic standards for office layouts, optimisation of natural lighting, and a specific attention of embodied energy during construction are only a few examples of methods used in Darwin.
- **Renewable energy:** Prioritise renewable energy sources to progressively replace fossil fuels. For its electricity supply Darwin subscribed to the Enercoop cooperative that provides 100%-green electricity. In addition it installed 480m² of photovoltaic roof for an annual production of 100 MWh.

The first aim of the project is to make business owners aware of their responsibilities. Whether they work in restaurants, food shops, repair workshops, urban gardens or art studio they all need to comply with sustainable rules. The second aim of Darwin is to raise environmental awareness among all citizens. The

district is open to the public and is a veritable showcase for best practises in sustainable management and especially in energy uses.

To enable all occupants to quantify the impact of their efforts on the environment DARWIN developed a platform called MIUSEEC (Smart metrology for efficient energy uses and eco-behaviours) that summarises in real-time and full transparency all ecological impacts of the on-site life. In order to do it, it couples the Building Management System (BMS) to a set of sensors and to manual data recovery procedures. Thus each DARWIN occupant is able to very concretely measure their contribution to fight against climate changes and initiate its own energy transition process. DARWIN develops a global method that considers a large range of behaviours: energy and water consumption, food and waste management, transport, etc.

Evaluation - Learning from the Case Study:

Energy management is central in DARWIN and seen as a collective responsibility and it does not focus on a specific activity or behaviour but promotes an overall efficient and efficient use of energy. The project is monitored by the project coordinator with the help of the MIUSEEC and all district actors. In sum, the responses for the impact are reported in Table 8:

Table 8: The Darwin project, Bordeaux city centre – Key Summary Data (Darwin Camp, 2016).

Economic Aspects	Environmental Aspects	Dissemination and Awareness
• 191 companies • 20 resident associations • 70 M€ of turnover • 500 jobs (including 200 newly created)	• 80 MWh of solar production consumed • 5 times less GHG emissions than average workers of the tertiary sector • Premises reached an annual consumption of 84 kWh/m²/year	• 500,000 visitors/years • 300 delegation received in 2015 • 70% of people working in the eco-district assure that they apply environment-friendly practices learned in Darwin outside of the office.

Traditionally, the focus of behaviour change initiatives has tended to focus on residential end-users, therefore this one is uncommon in that it starts working with primarily the business community since they are all significant energy end-users. Its model operates as a practical demonstrator – through its own set of office premises – as well as working in partnership – as an awareness raising actor – within the wider business community to promote sustainable business practices. It takes on a holistic approach through its focus on a large range of behaviours: energy and water consumption, food and waste management, transport, etc. The key innovative aspect is that it enables each occupant to quantify the impact of their efforts on the environment through a platform called MIUSEEC (using smart metre technology) that summarise in real-time and full transparency all ecological impacts of the on-site life. In order to do it, it couples the Building Management System (BMS) to a set of sensors and to manual data recovery procedures. Thus each DARWIN occupant is able to concretely measure their contribution to sustainable everyday practices.

4.6 *Open Home Show-case events*

4.6.1 Open Home Show-case Events Case Study (1): Nearly Zero Energy Buildings Open Door Ireland

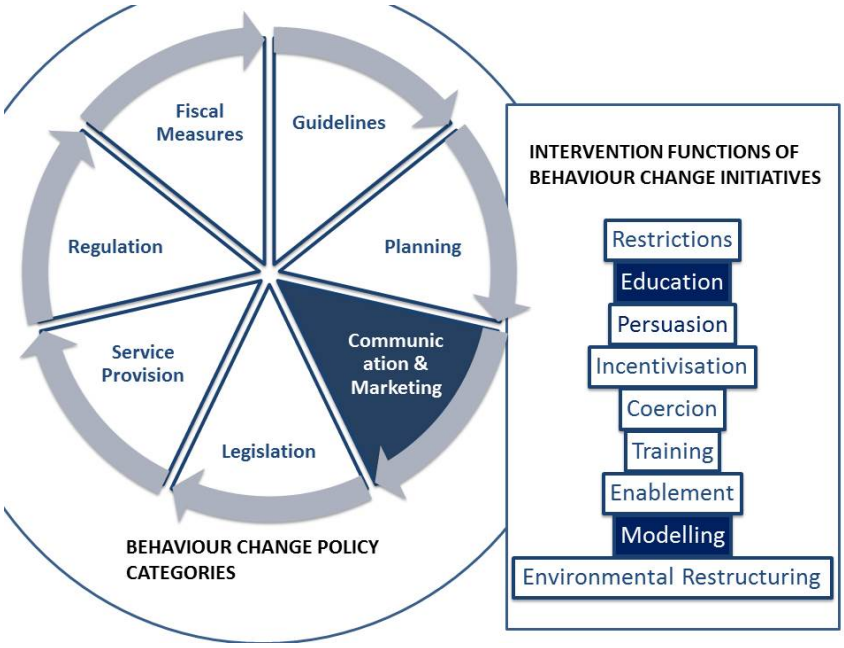

Figure 11: Behaviour change wheel, case study 4.6.1

Background: The NZEB Open Door Ireland is an annual event that was first launched in Ireland in November, 2013. This was initially based on the European NZB2021 'Doors Open Days' which included Belgium, Germany, Austria, Sweden, Ireland, Hungary, France, Malta, Slovenia and Poland (in 2013 and 2014) and ended in March 2015. However, some countries such as Ireland have continued on with the annual event. The fourth annual NZEB Open Doors will take place during the weekend of 11th – 13th November 2016. Sustainable Energy Authority of Ireland (SEAI) will be supporting a nationwide NZEB Open Doors campaign in Ireland again in 2017. This initiative has consisted of a numbers of events which were aimed to enable the public to visit and learn from good examples of 'Nearly Zero Energy Buildings'. By showcasing these good examples, it is expected that people will be both inspired to pursue similar approaches for their future building and renovation projects. It is also seen as a means towards gaining practical insights into these types of buildings by interacting with both home owners and builders that are showcasing their buildings (Passive Haus Association of Ireland, 2016).

The Intervention Model: The event took the form of a campaign of 3 days a year during which both the wider public and representatives of private companies were invited to visit new and refurbished houses. NZEB Open Doors Days were organised in Belgium, Germany, Austria, Sweden, Ireland, Hungary, France, Malta, Slovenia and Poland in 2013 and 2014. The main intervention type used were in the form of exhibitions where people are encouraged to interact with NZEB owners and builders to learn more about the benefits and the different processes involved in either building or refurbishing a low energy building. Supplementary tools used include:

- Mini-Documentaries showcasing NZEBs;

- Webpage provides additional information and with a registration option which allows NZEB owners to list and showcase their buildings online;
- The initiative looked to educate and enable access to information with regards NZEB standards and processes in building or refurbishing using these emerging technologies. The events were organized through IHER Energy Services an independent energy consultancy company. The project is seen to have an important national role in promoting the NZEB standard in Ireland in a practical and tangible way (Passive Haus Association of Ireland, 2016).

Evaluation - Learning from the case study: Existing figures show that in 2014 over 1,000 people visited more than 70 houses and public buildings in 21 counties around Ireland during the NZEB Open Doors campaign (Passive Haus Association of Ireland, 2016). In order for a building to acquire NZEB standard it needs to be in compliance with 2011 Irish building energy performance regulations (Goggins, Moran, Armstrong, & Hajdukiewicz, 2016). The NZEB standard will be in place EU-wide by 2019 for all new public buildings and by 2021 for all new buildings. The NZEB standard for dwellings in Ireland will be set at 45 kWh/m^2/year (an A2 rating) and is to be introduced in Ireland in 2017. SEAI administers the running of the project and oversees its progress. It offers the potential to see the physical reality of implementing energy efficiency measures and ask questions and find out about the experiences of living in an energy efficient home. A similar private homeowning sector led initiative – SuperHomes – is currently run in the UK and discussed in the next case study, 4.6.2.

4.6.2 Show-case events Case Study (2): SuperHomes Green Open House events (UK)

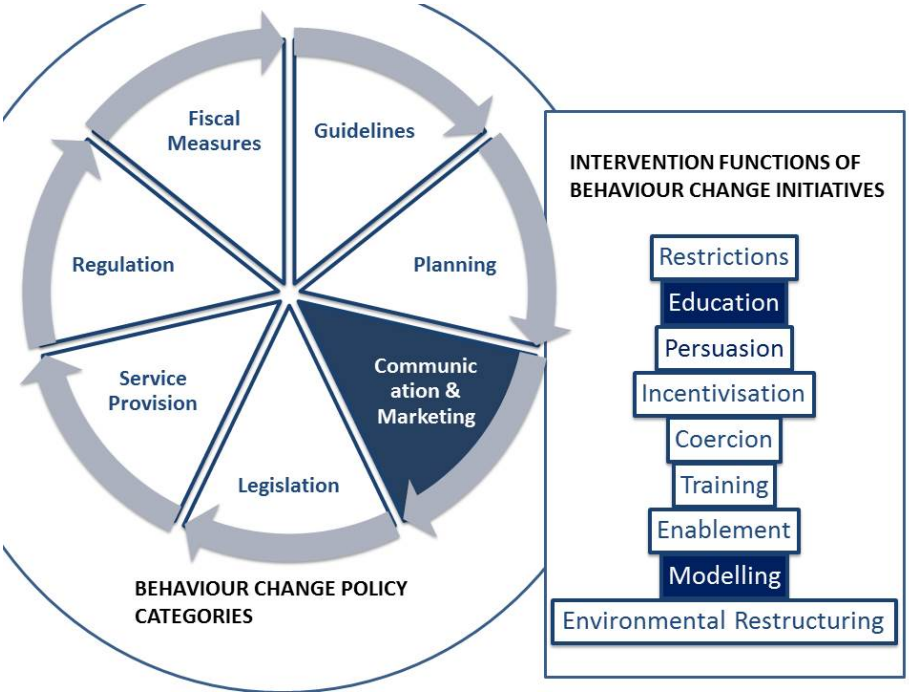

Figure 12: Behaviour change wheel, case study 4.6.2

Background: The Green Open House events are organised by the SuperHomes Network (a registered charity). The SuperHomes is an online network of 200 'energy aware' households. These pioneering homeowners promote green homes and living. All have refurbished their old homes to the highest standards of energy efficiency. Their 'eco' friendly, sustainable, low energy and low carbon – refurbished

houses aim to achieve at least 60% less reliant on fossil fuels. Their emphasis is on low energy refurbishment of residential buildings (Superhomes, 2016).

The Intervention Model: Typically over 50 SuperHomes open to the general public during SuperHome Open Days in September and other times of the year by appointment. The homes come in all shapes, sizes and styles from across the UK. To visit, people can register and book online. The online detailed profile of each house and the works they have undertaken is available. This online property profile serves as a database for best practice examples relating to different energy efficiency technological interventions (e.g. applying external cladding on walls). There is an opportunity to ask questions about home interventions either in the homes visits or by email later. The open home events are promoted via a newsletter or via online website, i.e. 'SuperHome Forum' (Superhomes, 2016). It also provides a network of green builders and advisors to help people overcome barriers. It also allows the opportunity for new members to join providing they have made their homes energy efficient. To achieve SuperHome status homes have to reduce their carbon emissions by at least 60% through refurbishment and verified through an energy assessment.

Evaluation - Learning from the Case Study: The SuperHomes network is administered via National Energy Foundation (NEF) an NGO which focused on improving the use of energy in buildings since 1988. SuperHomes has provides an educational role and impact. It claims to have 'helped over 70,000 Open Day visitors' on the potential for greening their own homes; more than 100,000 people have used their articles and videos on their website. NEF's key ambition is to 'build a network of 500 SuperHomes so one is accessible, within 15 minutes, to everyone in the country'. The main aim of these projects is to provide information and raise awareness through live practical demonstrations which combines a mixture of tools. In particular, it provides a form of peer-to-peer learning. For example, the home visits serve as a form of knowledge exchange for those visiting and a sense of the lived experiences of an 'eco' house for those contemplating renovating their homes (Superhomes, 2016).

It offers the potential to see the physical reality of implementing measures and ask questions and find out about experiences – hence 'people can see other homeowners like themselves with houses similar to theirs'. The core part of the intervention is targeted at homeowners in the private sector who are voluntarily seeking to self-fund works and retrofit their homes. It focuses on 'efficiency' one-off behaviours and technical interventions and less on the energy related behaviour change. However, inherent in the approach is that it does promote (through information leaflets and advice) the value that an eco-home in order to be so, is reliant upon the occupant and their efficient utilisation of the it and adapting lifestyle and everyday energy practices (e.g. in the efficient use of solar generated hot water) to deliver the full environmental potentials to embodies.

Both NZEB and SuperHomes have much in common through 'showcasing' of retrofitted buildings through energy efficiency technologies despite their different emphasis. It appears the key role of the open home events is to motivate, educate (provide learning) and stimulate behaviour change and encourage visitors to do the same. Existing research has shown amongst homeowners that had undertaken energy efficient retrofit measures in their homes many had also stated they had been motivated and inspired to do so by open homes events (Berry, Sharp, Hamilton, & Killip, 2014).

4.7 *Collective Energy Switching*

4.7.1 Energy Switching Case Study (1): The Big London Energy Switch, UK

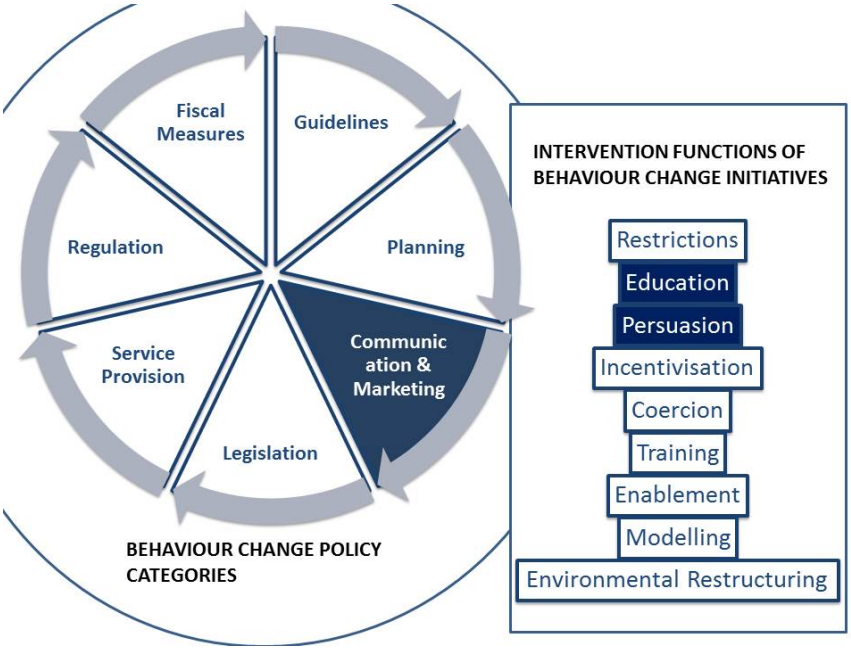

Figure 13: Behaviour change wheel, case study 4.7.1

Background: The Big London Energy Switch is a collective switching scheme run by over 20 London Boroughs. It worked by bringing together a large group of residential consumers and using this collective volume to secure better deals from energy suppliers in an auction process. In this process energy companies offer prices for the collective and a one day auction takes place. The initiative gets energy companies to compete to win customers by offering them the lowest gas and electricity prices as well as a customised tariff. Thus the company offering the lowest energy price wins. There are various examples of collective energy switching schemes across the UK often initiated by local authorities, civil society and or private sector organisations working with households as consumers of energy. A collective switching scheme may have different features for those in different regions of the UK (London Councils, 2013).

The Intervention Model: The rationale underpinning a London-wide scheme (collaboration with the London Assembly and London Councils) is provided by a social and fuel poverty agenda that are very spatially specific to London. Collectively councils in their role as local leaders, run schemes for their residents, with the support of switching providers, with the aim of getting residents a better deal. The scheme has a specific focus on vulnerable residents as these residents are in most need of support to reduce their energy bills. Evidence shows that the vulnerable, many of whom are in fuel poverty and are struggling to pay their bills, are the least likely to switch tariffs (London Councils, 2013).

There are typically four main steps towards a household consumer taking part (London Councils, 2013):

- **Registration:** The period of time during which consumers can express their interest in taking part free of charge and need to provide some information including on their current energy use and tariff (yet at no point not under obligation to actually go through with the switch at the end of the process).

- **Auction:** This is held with energy suppliers, in which they bid for the collective group's custom. Suppliers will often put forward cheaper deals during this auction than are typically offered on the market, as the business of a group of customers is worth more to them than individual switchers alone.
- **Personal offer:** Once the auction is completed, each person who registered for the collective switch will receive a personal offer. This will state in more detail what each participant's energy bill cost is likely to be based on their individual consumption habits and the best offer from the auction.
- **Acceptance period:** This is a pre-defined period of time in which a decision to accept the deal offered and take part in the collective switch is taken. The acceptance period will last a few weeks. Typically the tariff offered is fixed for a minimum of 12 months.

Evaluation - Learning from the Case Study: The key strategy employed by collective switching campaigns is their reliance on lengthy media campaigns as their core strategy to inform people, and in order to be effective they need to be combined with other tools (e.g. The Power to Switch, see next case study 4.7.2). The rationale behind such schemes has been to offer consumers more choice and support in getting the cheapest deals and not pay more than they need to for gas and electricity. The key strength is that they seek to target household consumers that may suffer most from fuel poverty and offer them a competitive tariff. The primary limitations of any form of energy switching include: not everyone will switch or be allowed to switch; switchers may not always get the cheapest deal; collective switchers have to wait and other factors may prevent households from taking part. This approach will not necessarily require energy efficient behaviour change.

4.7.2 Energy Switching Case Study (2): The 'Power to Switch' campaign, UK

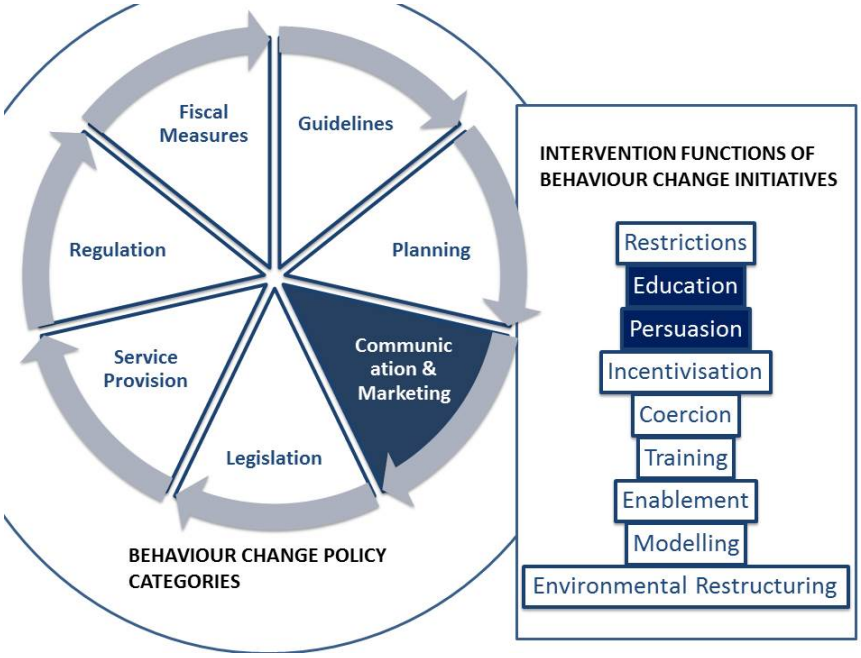

Figure 14: Behaviour change wheel, case study 4.7.2

Background: Many of the 'Big' energy switches have been running since 2012.The national driver to switch energy tariffs came from government departmental level such as the formerly Department of Energy and Climate Change (DECC, 2015). In particular, the funding for the Big London Energy Switch was derived from DECC's 'local authority funds dedicated for switching called "Cheaper Energy Together"'. This sits alongside,

DECC's own campaign - Power to Switch – which encouraged consumers to take control of their energy bills and switch at their dedicated website. The 'Power to Switch' campaign ran for four weeks and included a national, regional and online advertising, encouraging people to switch and save. As part of its marketing statement it suggested that "many people could save around £200 by switching energy supplier, some even more".

This has been accompanied by a number of high profile mass media campaigns by energy company and services providers, i.e. by British Gas. These use a mix of tools, i.e. TV, radio and newspaper, and online 'comparison' websites. They have all highlighted and helped to raise awareness of the benefits of switching in general. Numerous comparison websites (e.g. uSwitch) also offer individuals (residential/commercial consumers) options to switch directly too.

The Intervention Model: Collective purchasing refers to a group of consumers getting together via a third party to buy a specific plan from a gas and electricity supplier. The key idea is that as a group they will be able to negotiate better deals from the energy provider than an individual household could. The policy rationale behind the government campaign seeks to offer consumers more choice and support in getting the cheapest deals and not pay more than they need to for gas and electricity. It is reported that '£2.7 billion in total is being overspent by 13.5 million UK households, through failure to review the best deals on the market and switch suppliers'. In the government's recent programme to reform the energy market and give control to consumer it has made a number of changes:

- Working with Ofgem to make energy bills clearer;
- Increasing the number of suppliers in the market – there are now 26 in total;
- Halving switching times – from 5 weeks down to 17 days.

Evaluation - Learning from the Case Study: One of the advantages for the consumer signing up to a collective switching scheme is that they do not have to do anything other than register and trust switching organisation to hold the auction and negotiate on the best deal on their behalf. These changes are anticipated to make the energy market a fairer place for energy customers. Through this package it seeks to remove the perceived barriers that previously discouraged consumers from switching. For example, the inertia to switch and find a better deal served to perpetuate the dominance and benefit of the 'Big Six' energy companies in the UK. Thus, by switching annually this could be avoided, and forcing suppliers to fight for custom, and consumers will benefit from greater competition, more competitive rates and better customer service.

The number of switches completed as part of collective schemes are unavailable for the UK; whilst some provide a sense of numbers accepting the offered tariff there is no evaluation of whether any reduction or increased energy consumption (rebound effect) accrued as a consequence of a cheaper tariff. The figures of the numbers that have switched are also incomplete with different switching schemes report different figures. Figure 15 shows the fluctuation of energy switching from 2007 to 2016, for both electricity and gas customers for Britain, by quarter, showing a general trend of reduced rates of switching over this period.

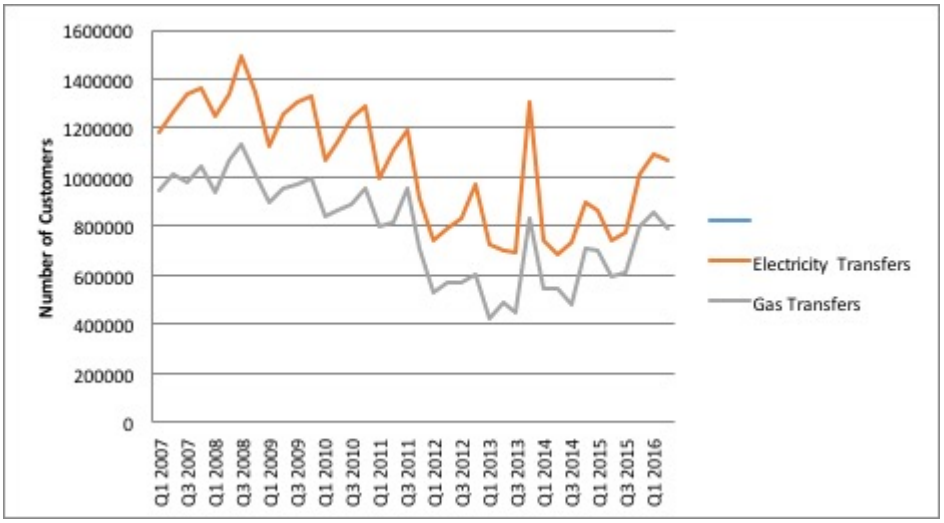

Figure 15: Transfer statistics in the domestic gas and electricity markets, Great Britain (DBEIS, 2016)

In addition, some switching schemes can be run by private commercial ventures, *e.g.,* Moneysavingexpert, which is owned by Money Supermarket – while others originate from the public sector like the Big London Switch are run by councils driven by a statutory obligations to target the fuel poor households .The Significant limitations characterise energy switching (as discussed earlier), for example, 'not everyone will switch or be allowed to switch; switchers do not always get the cheapest deal; collective switchers have to wait and the timing may not be good to join', furthermore any 'cash back scheme and/or Warm Homes that a person may be eligible for may or may not be affected'. A key component of The Power to Switch project is that it relied on a mass media campaign which by their nature rely on mobilising social attitudes, yet similar to many information based approaches also require the implementation of other tools to be effective, hence often accompanied by a mixture of tools, e.g. websites, leaflets radio and TV campaigns.

4.8 *Smart-Technology focused interventions.*

4.8.1 Smart Technology Case Study (1): Power Off & Save, Ireland

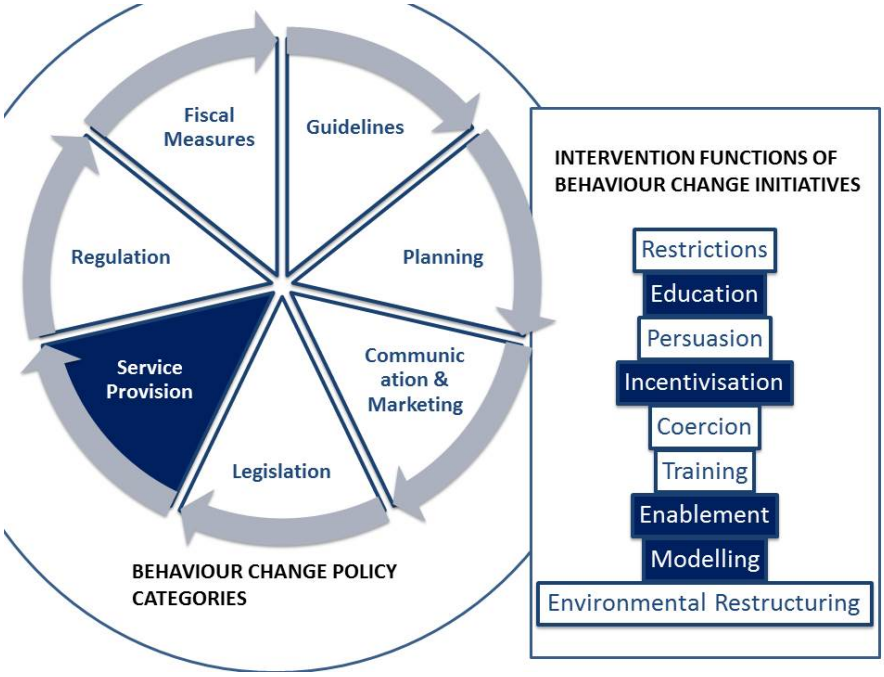

Figure 16: Behaviour change wheel, case study 4.8.1

Background: The Power Off & Save initiative was originally announced by EirGrid in November 2015. This is an 18-month pilot programme that was formally launched on the 15th June, 2016. The main people targeted for this pilot initiative were existing household customers from all electricity company providers and Electric Ireland taking part in the Smarter Living Panel Trials. The pilot consists of 1,500 volunteer customers. The main nationwide smart meters installation is expected to be rolled out nationally in 2018 extending to all households in the Irish state. The Power Off & Save programme is therefore currently a small pilot initiative which will in the future become a broad based and large programme.

The initiative was developed to tackle issues relating to peak use demand and delivery. Peak use demand is a global problem but is felt more acutely in Ireland due to its specific geographical context. Ireland as an island nation requires much larger than average reserves of energy to meet peak demand as it cannot currently rely on any additional supplies coming from abroad (Dulleck & Kaufmann, 2004). Electricity generated at peak times is generally inefficient, expensive and significantly increases green gas emissions. This is because the systems deployed to respond to peak demands such as open cycle gas turbines are significantly less efficient than the conventional methods of energy generation (McLoughlin *et al*., 2012). There is therefore a significant interest on the part of both energy providers and policy makers to significantly shift away demand from peak times.

The Power Off & Save pilot programme aims to reduce electricity usage when there is a peak in demand on the grid. It is expected that this will directly result in a reduction in CO_2 emissions. The smart technology was developed as part of the Electric Ireland's Smarter Living Trials and there are expectations that the implementation and use of this technology will change how electricity is used in the future. The initiative is therefore one which targets consumers of electricity in the residential sector.

The Intervention Model: The Power Off & Save pilot programme uses a monitoring technology system to identify peaks in energy demand. The information is captured by EirGrid in their control centre and it is passed on to service providers who will then contact the pilot participants. The stated aim of the pilot project is to incentivise people to reduce their energy behaviour during peak times. As part of the pilot programme, customers are asked to switch and reduce their electricity use for 30-minute periods, ten times over the course of the 18 months. This includes switching off appliances and lights in unused rooms, and checking to switch off TVs or other electric devices that may be on standby (Eirgrid, 2015).

Householders are initially engaged in the initiative through the use of an incentive scheme which entails a €100 reward for taking part in the pilot, a potential reduction on electricity bills is also communicated as an advantage in terms of taking part. Additional measures include the provision of feedback and information on their consumption behaviour. It is hoped that this supplementary measure based on feedback and information will educate householders on their energy use, and help promote energy efficient practices and thus reduce bills (Eirgrid, 2015).

Evaluation - Learning from the Case Study: Given the fact that this is a recent intervention there are limited materials available to consider the full extent of the impacts that this programme will have regarding overall energy use reductions and changes in consumer behaviour. It is however expected that the Power Off & Save programme will achieve peak reductions, overall consumption reduction and changes in the way electricity is used (further discussed in section 5.2). While there is limited information regarding the

ongoing Power Off & Save pilot there have been previous trials which provide some valuable insights (discussed in the next case study, 4.8.2).

4.8.2 Smart Technology Case Study (2): Smart Meters Smart People, UK

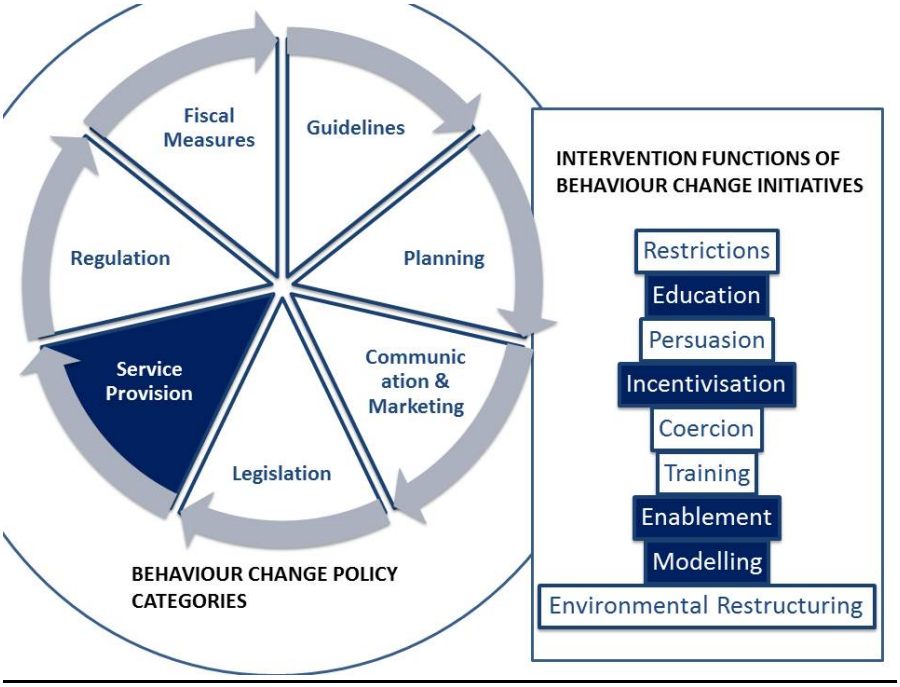

Figure 17: Behaviour change wheel, case study 4.8.2

Background: The Smart Meters & Smart People project was undertaken to trial Smart Meters in Northern Ireland. It was initiated by an energy utility regulatory body in 2010 and delivered jointly with the support of the University of Ulster and Carillion Energy Services. Due to the nature of the trial money saving was not its top priority although some tentative observations were made about this aspect. For example, in the pilot the 'customers were under no pressure or obligation to try and reduce their electricity bills and did not use incentives to save, nor did it employ time-of-use tariff incentives. Although, at the beginning it did provide energy efficiency advice through Carillion Energy Services' (energy advice expert), and also used the energy efficiency messages embedded in the Quarterly newsletters there was no real support for reducing consumption. The key aim of the Trial was to understand the experiences of customers vulnerable to the impacts of fuel poverty - especially in terms of the types of support they found beneficial and the sort of problems Smart meters created for them (University of Ulster, 2013).

The Intervention Model: The project regarded smart meters as an 'effective means for lower income customers to budget more effectively', to give them a greater sense of control and choice about how they managed their electricity spending. The trial selected 56 lower-income customers who were deemed vulnerable to the impacts of living in fuel poverty. The householders were given a package of measures as part of the trial:

- A home visit by Carillion Energy Services which carried out an energy efficiency audit for each household;
- An energy advice pack containing energy saving products such as a standby-off plug and EE light bulbs; and
- Smart Meter Trial and in-house display units (IHD's).

- Supporting mechanisms include: a telephone helpline, Facebook page, Small memorable prompts; monthly courtesy calls

Evaluation - Learning from the Case Study: This initiative was designed to influence existing energy use patterns; raise awareness of energy issues and how to reduce energy through behaviour change and information; and provide feedback on actual energy use in the home. It sought to address the individual and material contexts of behaviour change. The trial was based on a small number of household meters (e.g. with a year's data from 37 meters) was considered too small to establish scientifically significant findings about energy savings. It tentatively made the observations that some savings were evident amongst specific consumers. For example, 'higher energy consumers reduced their consumption significantly during the Trial, whilst amongst low consumers, by contrast, there was little evidence of seasonal changes in consumption'. In addition, nearly half of the customers believed that they were saving money and we were interested to learn from the database whether their consumption showed any evidence of this.

There was also evidence of the rebound effect, whereby certain customers decided they had saved enough during the week or fortnight to merit drying a load of washing in their tumble drier, or using a hot water wash to clean their clothes. For the group as a whole, the first 12 months of data give no indication that savings were made in aggregate (University of Ulster, 2013)).

Results stand in contrast to other trials and studies. For example, a smart meter trial carried out in the UK by DECC, for example, deployed 18,000 Smart meters (AECOM, 2011). In this to reported savings for customers who received a Smart meter and real time IHD averaged 3% (AECOM, 2011). It predicted by 2020 customers should be saving £23 a year on energy bills provided both gas and electricity meters are smart. The recent CER Trial in Ireland reported overall savings of 3% (The Commission for Energy Regulation (Ire), 2011). These results indicate the types of savings that could materialise and depend on a whole range of household factors that determine household level energy consumption.

4.8.3 Smart Technology Case Study (3): Nice Grid, France

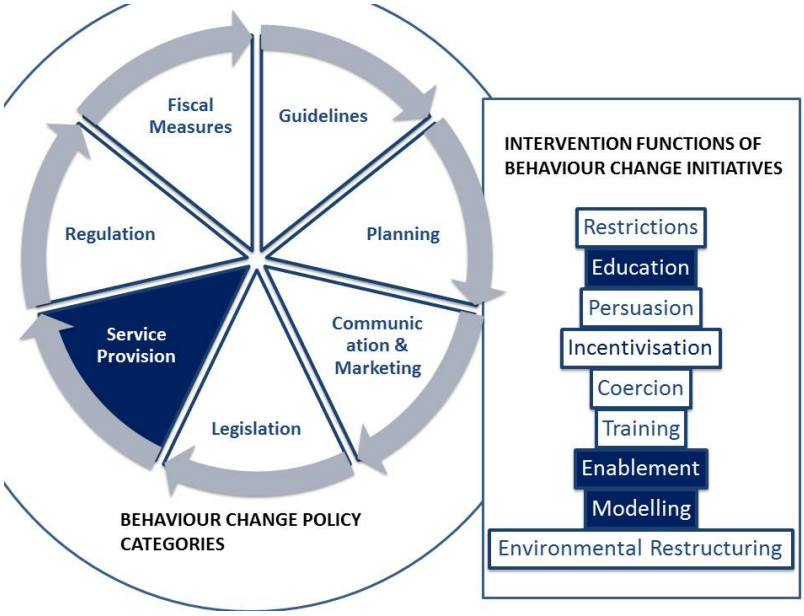

Figure 18: Behaviour change wheel, case study 4.8.3

Background: The project started in January 2012 and was expected to last until December 2015. However, it has been extended to December 2016 in order to carry out properly the remaining experimentations. The Nice Grid project is funded and delivered via a public-private partnership between Market-state and civil society. Nice Grid is one of the six demonstrators of the European GRID4EU demonstration project that is financed by the EU through the FP7 program and Nice Grid received an additional 7M€ from the European Commission. Its aim is to highlight and help remove barriers to the deployment of Smart Grids in Europe and is focused on how to manage electricity supply and demand (GRID4EU, 2016)

The case study, the city of Carros has two main characteristics. First, it is considered as a solar district as there is an important concentration of decentralised solar PV production. During summer periods local consumption is lower than the total amount of solar generated energy, which creates problems on the grid such as congestion. Second, it is located on a so-called “electric peninsula” as a single feeder is responsible for the supply of the whole region. During winter periods, electricity demand becomes too important for the single feeder to support it and curtailments have to be employed regularly.

The Intervention Model: Tools applied included public meetings and information booklets, a dedicated recruitment stage and the use of the following for the trial stage: Smart meters; Remote controlled equipment (heaters, hot water tanks, industrial equipment); Text messages and mails; Vouchers; Web interface to monitor consumption. The smart meter played a central role in these trials. On the one hand it allowed the remote control of downstream equipment such as heaters and hot water tanks. On the other hand it provided remote access to consumption data in order to monitor energy or power savings. The summer experiment aimed at raising the awareness of consumers regarding the intermittency of renewable sources such as the sun and encouraged them to plan their consumption when the electricity is abundantly available. The winter experiment aimed at raising the awareness of consumers regarding the peak-load periods and encouraged them to move forward or put back their “non-mandatory” consumption that usually occurs when the electricity demand is already high. The Nice Grid had several intervention approaches. The two main ones were aimed at giving consumers a more active role in the management of their electricity (GRID4EU, 2016):

Table 9: Seasonal Objectives of Nice Grid (France) Intervention Model

Summer Objectives	Winter Objectives
The objective is to ensure the production/consumption balance at district level during peak high summer PV production in the summer period (40 days are identified as "summer days"). Solar Bonus: Favourable electricity tariffs are set up between 12pm and 4pm. participating customers are warned the day before and encouraged voluntarily to shift their consumption within this period of time. Smart Water Tank: Hot water tanks of participating customers are remotely controlled between 2PM and 6PM.	The objective is to ensure a production/ consumption balance locally at district level during winter peak-load periods (6PM-8PM). Again, 40 days are identified as "peak days" and customers are notified the day before. Electric Heating Control: Thanks to the 'Linky Smart Meter' the electricity retailer (EDF) switch off or cut down the heating system between 30 mins and 1h30. Although no intervention from householders is needed they can take the control back anytime they want during the experimentation. Behavioural Load Management: No specific equipment is used and the experience relies on customer' volunteering only. A notification sent by mail or text message encourages them to decrease the heater set point or limit the use of electric equipment.

Evaluation - Learning from the Case Study: Customers considered that financial opportunities together with the wish to bring a contribution to a global effort were important drivers. The presence of skilled personnel and programmable equipment are facilitator factors. The fact that alerts occurred in an unpredictable way was not a barrier for customers. However, the important volatility from one day (+5 kW) to another (+25 kW) was an issue, with a challenge being to forecast the impact of the flexibility. The trial reports overall energy consumption reduction during its two seasonal phases. Firstly, during the summer trial, a 22% reduction and through the 'Smart Water Tank' a 56% reduction were obtained through the 'Solar Bonus' scheme. Second, during the winter less than 10% reductions were obtained for non-residential users whereas approximately 21% reductions were obtained for the residential consumers (see section 5.4 for further analysis).

4.8.4 *Smart Technology Case Study (4): Carrega't d'Energia, Spain*

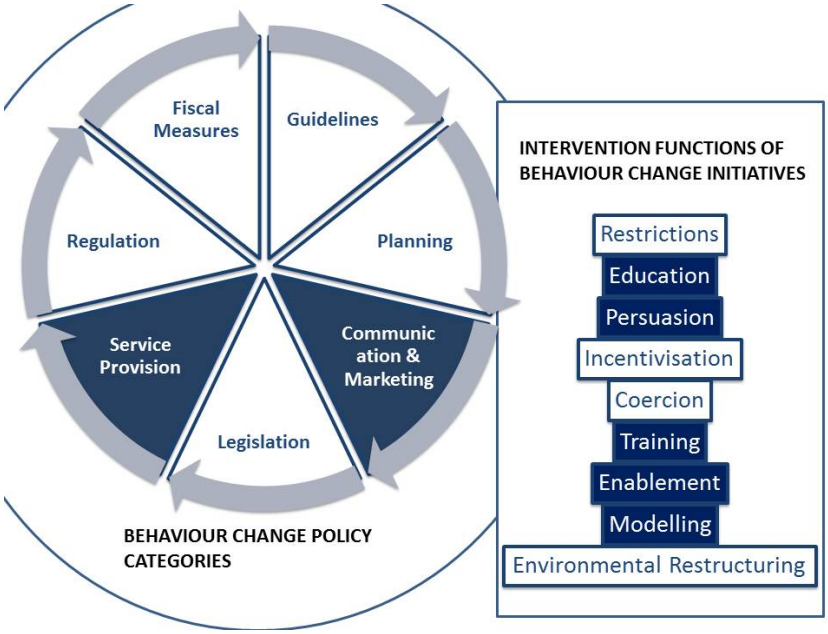

Figure 19: Behaviour change wheel, case study 4.8.4

Background: Barcelona municipality launched the "Autosuficiencia" project as part of its commitment to energy self-sufficiency. The scheme is based on the assumption that the sum of citizens individual actions will allow them to also pay less in energy bills. This strategy to reduce energy consumption and increase local renewable energy generation consists of two pillars (www.barcelona.cat, 2016):

- Generation: Increase local renewable energy by mapping the capacity of each area in Barcelona to install renewable energies, and partially subsidising RE projects.
- Efficiency: Provides a Virtual energy advisor that informs users and helps them to reduce electricity consumption.

The latter is called "Carrega't d'Energia", and is structured through a public-private partnership. Barcelona's residential electricity consumption comprises 30% of total energy consumed in the city and is therefore significant. The scheme required voluntary participation of any residential consumers in Barcelona city willing to join the project. So, collectively, they could reduce the energy needs of the city and associated GHG emissions (www.barcelona.cat, 2016).

The Intervention Model: The "Carrega't d'Energia" project allows any citizen living in Barcelona city to apply and become a user of the Virtual Energy Advisor (web-based and mobile app). This software allows users to control and monitor their energy consumption, with two different data frequencies, hourly data or monthly data. The Barcelona municipality sponsored 400 sub-metering devices for the first applicants, which a professional installer fitted in homes. The remaining applicants were only able to visualize monthly consumption from electricity bills.

Moreover, users receive a monthly newsletter (at the 15th), informing them about their current month's consumption, the forecasted consumption at the end of the month, their saving compared to the same month of the past year together with some information related to the energy activities in the city. In addition, face-to-face workshops are undertaken weekly on topics such explaining electricity bills or

providing information on low cost actions to improve energy efficiency at home; and on how to reduce the energy consumption through household practices, by giving tools and information to the users.

Evaluation - Learning from the Case Study: As it is still on-going, final conclusions on the project are still not possible. The number of participants is increasing weekly as it is still an open project, and to date, more than 500 citizens have applied. The first early metrics show that almost 2/3 of the users have reduced their energy consumption.

4.8.5 Smart Technology Case Study (4): Sports Center FIDIA Cesano, Rome, Italy

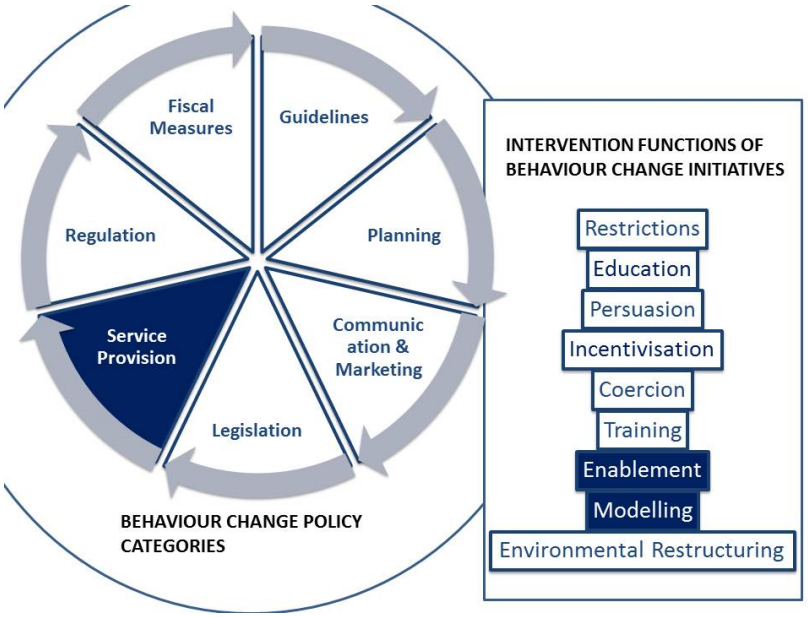

Figure 20: Behaviour change wheel, case study 4.8.5

Background: Fidia Sport was the Italian pilot in the European Project SportE2 "Energy Efficiency for European Sport Facilities". The project's aim was managing and optimizing the triple dimensions of energy flows (generation, grid exchange, and consumption) in Sport and Recreation Buildings by developing a new scalable and modular BMS based on smart metering, integrated control, optimal decision making, and multi-facility management (SportE2, 2013). The SportE2 modules are applicable to both new and existing structures. The Fidia pilot is a facility with no previous management system installed. The SportE2 system equipped it with all sensors and actuators necessary for allowing the activity of monitoring, control and optimization of the facility (SportE2, 2013).

The Intervention Model: The demonstration of the effectiveness of the SPORTE2 system and the validation of the provided solutions aimed at increasing energy savings and reducing CO_2 emissions. These have been organized in the FIDIA pilot as follows:

- Identification of the highest energy consuming areas of the facility and definition of the related use case scenario (air treatment in the swimming pool and swimming pool water pumps);
- Determination of the energy baseline through audit, whether available, or through the use of experimental data measured by the metering systems;
- Installation and commissioning of control and actuators;
- Establishment of the measurement and validation plan;

- Determination of the energy consumption of three specific reporting periods (winter, spring and summer);
- Determination of the energy savings;
- Report of the determined energy savings.

Evaluation - Learning from the Case Study:

Evaluation and Validation results have been performed against quantitative energy and end user's, and facilities owner's expectations. Actual targets fit with local benchmarks. The objective of the project was to guarantee energy savings and CO_2 emission reductions of about 30%. The determined energy savings obtained in FIDIA with the use of SportE2 solution are respectively of about 24% and 30% on electrical and thermal energy for the whole facility. The overall energy saving is approximately 27%, really close to the stated targeted goal of 30%. The determined energy saving obtained considering the swimming pool subsystem with the use of SportE2 solution are respectively of about 33% and 29% on electrical and thermal energy. The energy saving for the swimming pool is of about 31%. Finally, on the basis of the above energy savings, the overall reduction of CO_2 emissions is of about 26%. With reference exclusively the swimming pool subsystem, the reduction of CO_2 emissions is of about 29%, in line with the project targeted goal (SportE2, 2013). Although this end-user is a sports facility it importantly aided the effective management through smart technology feedback and enabled tailored responses for specific end-users and material conditions within the building site.

5 The enablers of, and barriers to, behaviour change

Further insights from the case studies illustrated that there were a number of enabling and inhibiting factors that affected energy-related behavioural change in some of the initiatives presented in Section 4. To demonstrate this more clearly, this Section 5 evaluated these factors in more depth with reference to 4 of the case studies presented above:

- Power of One campaign;
- Power Off and Save programme; and
- Stockbridge Village Energy Champions initiative;
- Nice Grid.

The insights provided by these case studies illustrate the interventions applied to encourage behaviour change, and highlight the enablers of, and barriers to, changing energy-related actions. In so doing, this Section begins to evaluate the success of such projects with respect to "what works" (Axon, 2016a). A "what works" approach is vital to interventions and projects that seek to alter individual behaviour to address climate change as this can provide insights that have policy-relevant and practical applications (Axon, 2016a).

5.1 *Assessing the Impact of the Power of One campaign*

Activities looking to effect change on the demand side of the electricity supply are increasingly seen as a means towards promoting and achieving greater reductions in energy use and associated CO_2 emissions (Dulleck & Kaufmann, 2004). Interventions targeting demand side energy use include consumer awareness

and information campaigns, peak load management, smart metering techniques and subsidies (Dulleck and Kaufmann, 2004). There has been some registered success with this form of intervention that targets energy users. However, while research does indicate some positive results, it also indicates that positive results are closely linked to how fine-tuned these interventions are. Furthermore, there is some uncertainty with regard to the impact of some of these interventions in terms of behaviour change (Bergaentzlé, Clastres, & Khalfallah, 2014).

The Power of One initiative consists of a range of interventions initially based on a campaign focused on providing information and raising awareness of energy consumption in the general public (see section 4.8.1). Between the years 2006 and 2007, the primary means of dissemination was through the mass media. Subsequently, the campaign shifted to other interventions with a more localised focus, which not only catered for the general public, but also looked to target more specific environments such as households, schools, and energy behaviour in the work place. While the focus on providing information was still evident in these interventions, the campaign also actively sought to provide training, and to enable and incentivise change through both peer led change and the mobilization of leadership in the community. The 'Power of One Street', the 'Power of One Community' and the 'Power of One at Work' are the interventions were the focus of this later stage of the programme.

Research funded by the ESRI (The Economic and Social Research Institute) aimed to establish the effectiveness of the Power of One mass media campaign in terms of raising awareness and contributing to behaviour change towards more energy efficient practices (Diffney *et al.*, 2013). The evaluation looked principally at the impact the campaign had on the consumption of natural gas which is largely associated with household use in terms of home heating practices (Diffney *et al.*, 2013). The main findings of this research indicate that the Power of One campaign interventions were significantly effective in terms of raising awareness and interest in energy related issues. This largely coincides with the core impacts identified by the Power of One self-assessments that communicate positive changes principally around a change in beliefs and attitudes towards individual consumer choices and their impact on the environment (SEI, 2009). However, there is also evidence to indicate that the campaign was not overly effective in terms of actual behavioural change (Diffney *et al.*, 2013). This study, while strongly suggesting that the Power of One mass media campaign produced very little change in the way people consume energy in the home, also cautions that this form of intervention, linked to mass media and advertisement, is typically difficult to evaluate and measure – specifically with regard to the long-term impact that these may have on the population (Diffney *et al.*, 2013).

There is similar research, also conducted in Ireland, which suggests some potential difficulties in actualizing changes in behaviour. This earlier study looked at the effectiveness of a consumer information campaign carried out by the main electricity provider in Ireland in the 1990s. The research suggests that on the whole consumers responded to and addressed the need to reduce energy consumption by purchasing energy efficient appliances rather than changing or reducing use in the home (Dulleck and Kaufmann, 2004). While the campaign indicates reductions of around 7% in general household electricity consumption, it attaches these reductions to long term investment in technology rather than behaviour change in terms of daily household practices. The study further contends that these types of programmes have limitations, and

while it is possible to achieve reduction in terms of energy demand on behalf of consumers, it is less easy to tie these in with significant behavioural changes in the home (Dulleck and Kaufmann, 2004).

There is limited empirical evidence to provide an evaluation of some of on-going or recently discontinued Power of one initiatives, and in particular, the most recent interventions which have adopted a more specific and localised focus, such as the family or the work place. However, a similar study carried out in the UK provides a lens for assessing some of the expected benefits and drawbacks of this form of intervention. The work of Gilg, Barr, & Ford(, 2005) focused on an evaluation of sustainable lifestyle behaviour in Devon. This research provides a valuable overview of some significant factors in understanding how behavioural change is significantly linked and tied in with three significant factors, these are:

- Environmental Values
- Socio-Demographic Attributes
- Psychological factors

Environmental values refer to individual held perceptions concerning socio-environmental relationships. These values can differ substantially across a range of people from those that strongly value the supremacy of humankind over nature, to those that have high levels of confidence in the capacity of technology to tackle environmental issues, to others that express concerns over the limits of human growth and development. Empirical research carried out in Devon has established clear links between distinct values and behaviour towards the environment. For example, those that believe strongly in the limits of human development are more likely to take action and change harmful behaviour. Interestingly there is also a gender variable in terms of values held. The study shows that there is a considerably higher percentage of males holding non-environmental values which are, in practice, linked to low levels of proactive behaviour such as buying local and recycling. Furthermore, committed environmentalists are much more likely to be part of a community based organization (Gilg *et al.*, 2005).

Socio-demographic attributes are defined as a range of characteristics that refer to age, gender, social class, ethnicity, educational attainment, living arrangements, and marital status, amongst others. Again, the Devon study shows that socio-demographic attributes are a significant factor with regard to adopting behavioural changes towards environmental issues. The study shows that, by and large, green consumer choices and behaviour is stronger amongst the wealthy, home owners, well-educated and female individuals (Gilg *et al.*, 2005). The authors of this piece of research add some cautionary notes in terms of developing simplistic interpretations of these patterns associated with greater environmental awareness and concern. The authors stress that some of these energy use trends are linked to a number of variables (therefore it is difficult to pinpoint specific causalities) however they also emphasize that the findings are statistically significant and merit consideration in terms of strategies looking to influence behaviour (Gilg *et al.*, 2005). While the Devon study is helpful in terms of considering some social aspects that influence behaviour, it also is limited in terms of exploring some of the social dynamics involved within this process. For example, linking pro-environmental values to wealthier homeowners can be problematic. It not unexpected to see that wealthier families may hold more sympathetic views towards environmental issues and making changes in the home, when taking into account that those that are wealthier and own their own home have more scope for decreasing energy consumption due to the fact that they often have greater superfluous consumer habits than lower income households (McLoughlin, Duffy, & Conlon, 2012).

Finally, psychological factors refer to levels of confidence, optimism and perceptions of responsibility over altering and adopting changes in individual behaviour and lifestyle. The Devon study is also enlightening regarding these factors and indicates that there are issues of trust regarding the information provided by governmental sources; confidence in self-adopted changes; and views on individual responsibility towards the environment all had a strong bearing on how behaviours change.

Overall we can conclude that while the Power of One has shown some beneficial outcomes in terms of small reductions in emissions resulting from the mass media campaign (Diffney *et al.*, 2013), and in terms of increased awareness of how individual behaviour impacts on energy use and the environment (Diffney *et al.*, 2013), there are significant limitations to highlight. Existing evidence strongly suggests that the campaign has not been overly successful in terms of initiating and securing long terms behavioural change towards more efficient energy use. Referring back to the Devon study (Gilg *et al.*, 2005), we argue that while the campaign has overcome some barriers associated with negative psychological factors – in terms of people's belief that individuals can play a role toward achieving energy efficiencies ¬ there are still, perhaps, some barriers to overcome in terms of developing mainstream values which are sensitive to contemporary issues around environmental pollution, and the best means to tackle these issues. While there is research focused in Ireland which shows that the Irish public are by and large willing and positively inclined towards developing more sustainable lifestyles it is not clear how best this is achieved and who the main actors should be in carrying out these changes, indeed there is a considerable value-action gap which needs to be addressed (Lavelle & Fahy, 2014).

In this instance the Power of One campaign with its focus on adjusting and ensuring efficiencies in existing technologies in the home may actually counter any necessity to significantly adjust behaviour. The technical fix is therefore as seen in previous research conducted in Ireland (Dulleck and Kaufmann, 2004) potentially the limited means by which people engage with energy efficiency.

5.2 *Insights from the Power Off & Save programme*

The specific aim of the Power Off & Save programme is to manage and decrease energy-use and demand during peak times, the programme focuses on the end-user as a way of achieving this goal (see section 4.4.2). It is therefore expected that the Power Off & Save programme will achieve peak reductions, overall consumption reduction and changes in the way electricity is used.

While there is limited information regarding the ongoing Power Off & Save pilot, there have been previous trials which provide some valuable insights; namely, the Irish 'Electricity Smart Metering Customer Behaviour Trials' (CBT). These trials were conducted by the Irish Commission for Energy Regulation (CER) between January 2010 and December, 2010; the final findings report was published in May, 2011. The main objective of these trials was to establish the potential of using smart metering technology to enable behaviour change in terms of energy use among household users. In particular, the trials looked to ascertain the level of reductions achieved through smart metering technology with regards to reductions in peak demand and overall electricity use. A subset of the study entitled 'The Residential Customer Behaviour Trial' consisted of a series of surveys and consumer focus groups with a sample size of just over 5,000 residents. A number of smart metering approaches were tested during these trials, such as different forms of dynamic pricing and informative billing/monitoring. The findings strongly suggest that the majority

of smart metering measures had an impact on peak consumer demand. Results also show that in terms of reducing peak usage, the combination of bi-monthly bills, energy statements and the use of an electricity monitor achieved the highest reduction of 11.3% compared with other measures which averaged at around 8.8%. There is thus a clear benefit in terms of peak electricity demand for deploying smart metering technologies. A breakdown in terms of demographic and behavioural attitudes further shows that 91% of participants (reflecting a considerable variety of different age groups, gender and socio-economic backgrounds) rated electricity monitoring as a significant measure to achieving peak usage reductions. The findings therefore suggest that these measures have a wide-ranging capability in terms of shaping behaviour and achieving some reductions in energy peak demand.

The role of household residents as key actors in actively shaping energy use demand patterns and expectations has been highlighted in recent research conducted in Ireland by Doyle and Davies (2013). This participatory study further stresses that greater control over home heating practices for instance is perceived by householders as a decisive means towards transitioning into more sustainable lifestyles. Smart metering practices rolled out nationally and greater educational initiatives are identified by the research participants as significant contributors to achieving greater energy reductions and behaviour change in the home (Doyle & Davies, 2013).

The policy context in terms of energy use in the residential sector has a number of key targets which have informed most of the state-led interventions such as the Power Off & Save programme. These policies include the development of building regulations to improve energy efficiencies; the application of a carbon tax on fossil fuels (including typical home heating fuel such as turf and coal) and the development of smart metering strategies (SEAI, 2013). Arguably a key strength in the development and implementation of these policies is the fact that the Irish public views these polices in a favourable light. Furthermore, it has also been noted that through smart monitoring tools domestic energy use becomes more visible in people's lives and these are a significant component in a process of transition towards more sustainable practices (Darby, 2008). A recent study in Ireland researching household consumption behaviour indicates that there is a degree of consensus between key policy objectives regarding domestic energy use and wider public aspirations for greater energy efficiency in the home (Lavelle, Rau, & Fahy, 2015). For example, it was noted in the study that Irish people communicated high levels of willingness for purchasing energy efficient appliances and for adopting more energy sustainable practices in the home. However, this study also suggests that there is a considerable 'value-action gap' in terms of stated high levels of concern linked to energy related impacts on the environment and actual behavioural practices to address these (Lavelle *et al.*, 2015).

While research demonstrates some beneficial elements within this type of behavioural change intervention, in terms of past success rates on trial experiments (The Commission for Energy Regulation (Ire), 2011) and a substantial degree of public support for these initiatives (Lavelle *et al.*, 2015), there remains a considerable gap between current aspirations in achieving greater energy efficiencies in the home and the actions of people to realise them. As discussed above, achieving a reduction in peak demand is of considerable interest to energy providers due to the expensive nature of producing energy during peak times and for policy makers also looking at CO_2 emission targets because these are usually less efficient methods of energy production and generate more emissions (McLoughlin *et al.*, 2012). However previous

research suggests that the immediate benefits of peak use reduction for end-users is not so clear (Hargreaves, Nye, & Burgess, 2010). Peak use reduction even when it is associated with a dynamic billing system that charges more during peak demand does not usually translate into major financial savings for end-users (Hargreaves *et al.*, 2010; The Commission for Energy Regulation (Ire), 2011). Furthermore, the authors argue, typical household rhythms associated with these peaks in demand are difficult to change as they reflect deep-rooted and elemental behaviour patterns associated with routines and daily life cycles. Financial factors in this instance appears as a strong motivating element for encouraging behaviour change (Hargreaves *et al.*, 2010; Lavelle *et al.*, 2015). Indeed, there is evidence from the UK to suggest that smart metering technologies do not translate into substantial direct savings to households, which in turn often actively dis-incentivise people from changing their routines around peak usage (Hargreaves *et al.*, 2010). This can be debated as a problematic feature of consumer led initiatives. These practices may limit and lock in people into consumer-based relationships, which can undermine other forms of engagement such as civic engagement and social responsibility. The dynamics established with service providers through consumer-based initiatives arguably fall short of promoting these deeper forms of social engagement.

Another significant aspect which hinders the promotion of standardized measures such as the Power Off & Save programme is the fact that electricity patterns found in Irish homes display often variable and uneven configurations (McLoughlin *et al.*, 2012). These differences ultimately mean that different households are either more or less equipped to carry the changes promoted by this programme. The CBT trials (2011) clearly show that there are significant variations in reduction levels related to socio-economic factors. For example, higher income households displayed a greater ability to make greater reductions overall and during peak demand. It is important to note in this instance that higher socio-economic households also normally use more energy and have more electrical appliances. Therefore, there is more scope for reducing some of this use of electricity (McLoughlin *et al.*, 2012). Other variables such as the presence of children, home ownership and employment status also appeared as influencing factors in terms of peak usage reductions.

Looking at this issue from the perspective of electricity usage linked to a range of practices in the home leads to a deeper understanding of some of the anticipated limitations of the Power Off & Save programme. As discussed above some of the variations across households can be explained through quantitative differences such as income, household composition and home ownership; however, there are a number of significant factors influencing behaviour which require a reference to cultural and normative notions and link these to practices in the home (Strengers, 2008). Practices include regular activities such as bathing, home heating, laundering, cleaning. These practices are arguably not just fulfilling basic needs but are also an expression and a manifestation of learned behaviour and values which emerge as specific notions of tidiness, cleanliness and comfort in the home (Strengers, 2008). This can be stipulated as normative behaviour that is tied in with socio-cultural differences some of which are gender based. Households therefore occupy a cultural space that is often overlooked by policy makers. Indeed, the difficulty with some of these experiential based norms and behaviours is that they often represent more tacit forms of household routines.

For example, opinions about how often and in what way laundry is done appear as a common example of gendered divide (Fine, 2010). Linking these influencing factors to energy there is evidence that indicates

that ideas of cleanliness have a very direct and significant impact on energy consumption (Strenger, 2008). Some findings relating to the role of female and male individuals in the home present some interesting insights. Females are seen to be more sensitive to mainstream norms around cleanliness and house comfort and usually they also play a dominant role in carrying out the necessary tasks associated with these practices (Strenger, 2008; Hargreaves *et al.*, 2010). Given the fact that there is little financial advantage associated with the Power Off & Save programme it can be argued that some of these behaviours will remain unchanged and they are likely to be established around routines that match existing energy peak demands. A common male role in the household, on the other hand, appears linked to managing the financial and structural elements within the household, this often extends to managing and monitoring electricity usage in the home. This means that the roles and functions men and women occupy in the home can be based on different notions of energy use and home management (Hargreaves *et al.*, 2010). Interestingly it has been noted that the promotion of the smart metering technologies can result in disputes between household members regarding energy use and household behaviour (Strengers, 2008; Hargreaves *et al.*, 2010).

Overall evidence suggests that in order to ensure the optimal development of smart metering technologies there needs to be a degree of segmentation which will be sensitive to the particular context in which it is being developed and to the different needs, expectations and perspectives of people being targeted (Stromback, Dromacque, & Yassin, 2011). Combining different techniques to achieve this result and maximize the potential of smart metering ideas is also suggested as best practice in previous research as a way of improving and catering communication to different audiences (Darby, 2006). As described above the Power Off & Save Programme uses a combination of monitoring of peak usage, which is conducted centrally through EirGrid, and feedback on peak usage in the monthly bill statements. Feedback has been noted as a valuable measure in different studies (DEFRA, 2006; Hargreaves *et al.*, 2010; CER, 2011) and while there is no current information regarding the level of feedback that is going to be used in the programme we would argue that it would be important to pay particular attention to this supplementary measure in terms of addressing and catering for some of the differences and potentially contrasting ways in which people use and perceive energy.

5.3 *Energy Champions: A behavioural intervention supporting sustainability transitions?*

Further from the case study highlighted in Section 4.3.2, this Section provides further insights into the engagement with energy champions in Stockbridge Village in Knowsley (near Liverpool), UK. The 'energy champions' initiative has sought to use residents within the community to become involved through a peer-to-peer model; energy champions aim to work to support other individuals to reduce their energy consumption. The scheme, supported by the Big Energy Saving Network (BESN), aims to provide support to individuals to reduce their energy consumption and change their energy suppliers. The 'energy champions' initiative has supported residents in Stockbridge Village through individually discussing measures of how to reduce the energy consumption of residents; and in particular actively seeking to change social norms in the community to become more accepting of energy conservation issues in their everyday life. The 'energy champions' initiative has recruited local residents and trains them to offer other fellow residents energy conservation advice and support. This personal approach of face-to-face delivery of support enabled

behavioural change messages to be acted upon more meaningfully and effectively. Energy champions have helped residents in the community through supporting switches to more (cheaper and) efficient energy tariffs; identifying where individuals can take measures to reduce their energy consumption, e.g. switching off appliances and using smart meters; and raise awareness of public engagement events that are focused on energy issues.

While, there are no explicit references of 'energy champions' as an intervention to change energy-related behaviours within the academic literature, the role that energy champions play in Stockbridge Village has similarities to a range of interventions that are employed to change energy behaviour. Consequently, that the energy champions model combines a number of behavioural interventions such as awareness raising, feedback and switching energy supplier. Behavioural interventions such as awareness raising and providing feedback are known to be successful in changing individual behaviours to transition to more sustainable lifestyles (as discussed previously). These informational strategies aim to change perceptions, motivations and knowledge, aiming to increase understanding of energy issues in the local community that specifically highlights the role of the environmental impacts of individual behaviour (Steg & Vlek, 2009). The key difference of energy champions is that these informational strategies to are employed face-to-face, and in many examples the individual seeking advice is a member of the same community.

The main implication of informational strategies used to change behaviour revolves around efficacy. It is assumed that new knowledge results in changes in attitudes that in turn will affect behaviour (Steg & Vlek, 2009), yet an 'information-deficit' model approach does not take into account that decision-making is often more complex than what linear models suggest (Ockwell, D., O'Neill, S., & Whitmarsh, 2010). New knowledge often does not correspond to changes in behaviour as individuals apply scientific knowledge to meet their particular needs, which results in a disparity between what individuals want to know and what scientists believe the public should know (Sturgis & Allum, 2004). Generally, information campaigns hardly result in behaviour changes. However, there can be multiple other outcomes that such informational strategies can result in. For example, influencing attitudes; strengthening altruistic and ecological values; and strengthening commitment to act pro-environmentally are outcomes that may result from the work of energy champions.

Given that the key distinction between applying awareness raising and feedback through print methods and energy champions delivering content face-to-face, the energy champions model of delivery of behavioural interventions supporting sustainability transitions in Stockbridge Village has a number of advantages. Energy champions are identified as having supported hundreds of individuals with switching energy supplier and advising on additional behavioural changes. This illustrates that energy champions are (1) trusted to provide tailored advice and to support to the needs of the individual; (2) role models that facilitate and strengthen new social norms around pro-environmental behaviours; and (3) can elicit commitments and/or intentions to take further action. This approach is based on a better understanding of how to engage people in terms that are personally meaningful within a community arena e.g. through bottom-up, non-expert climate perceptions rather than top-down, expert understandings (Axon, 2016a; O'Neill & Hulme, 2009; Ockwell, D., O'Neill, S., & Whitmarsh, 2010). Eliciting commitments and intentions to take further actions were outlined by energy champions as providing further advice to residents who wanted to make additional lifestyle changes. Such intentions and commitments, if acted upon, can be a

successful strategy for behaviour change if also followed up with a plan about how they plan to change particular aspects of their lifestyle (Steg and Vlek, 2009). Providing direct advice ensures that information is tailored the needs, wants and perceived barriers of individual residents. Previous research indicates that individualised social marketing approaches such as this have promising results for behaviour change (Abrahamse, Steg, Vlek, & Rothengatter, 2007).

Yet energy champions go further to suggest specific changes to behaviour that are convenient and not costly to residents. While these actions may not have the largest impacts on addressing climate change, these suggestions are effective for behavioural change as they are easily integrated within current lifestyle patterns in terms of money, time and effort that is often considered to be barriers to action (Perrin & Barton, 2001). Furthermore, energy champions are located at the interface between residents of the community and the housing association (landlord) where a substantial part of their role (not identified by energy champions themselves) is to listen to residents and understand their motivations and desires for energy conservation in their homes. Not only do energy champions empower residents to take action but also encourage involvement in public participation events. Participatory approaches are useful to understand numerous perspectives, particularly where multiple stakeholders are involved, to attract attention; garner support for further behavioural interventions; and increase public involvement in decision-making and policy making (Gardner, 2002).

5.4 *The importance of policy support – Nice Grid*

ENEDIS, the French Distribution System Operator (DSO), launched the Nice Grid project in January 2012 (see further details from section 4.8.3). Located in the city of Carros within the Alpes-Maritimes department, the demonstrator/showcase project aims at testing and validating advanced technologies and innovative services to tackle emerging challenges faced by incumbent players of the energy sector. Several approaches tested within the project scope are based on the customer engagement principle. Recognised for its contribution to address climate change issues, the project received important financing supports from both national and European level. The French agency for sustainable development (ADEME, 4M€) together with the European Commission through the FP7 program (7M€) account for one third of the total financing (GRID4EU, 2016). The demonstration was initially expected to run over 4 years until the end of 2015. It has now been extended for a further year to conduct another series of tests. Therefore it is still running at the time of this report and final results are not available yet (NiceGrid, 2016).

Overview and scope of the project/programme:

The French energy system is well connected to other EU member states. Indeed in 2014 cross-border cables were able to transmit 10% of the French electricity production to its neighbouring states (European Comission, 2015). France has already overcome the 2020 objective of 10% fixed by the European Commission. However, the country is not on track to reach its 2020 target on renewable energy (European Environment Agency, 2015) and the total share of renewable sources within the energy mix barely exceeds 14% in 2014. The situation is very similar when focusing on electricity only. With 18.3% of its production coming from renewable sources France is left almost ten points behind the EU average (Eurostat, 2016).

Nevertheless the French energy system is not homogenous. A further analysis at lower scale reveals that regional exceptions lie behind the national overview. The Alpes-Maritimes French department is located at

one extremity of the transmission system on a so-called "electric peninsula". Technically speaking it means that a single 400 MV feeder supplies the whole department (RTE, 2016). Whereas a new connection with the Italian network has been envisaged as a solution to strength the situation, none has been completed to date. Consequently when electric demand skyrockets during winter peak periods, the cable reaches its limit and is not capable to transmit more electricity. Under such conditions, the risk of blackout is significant and the distribution system operators (DSO) are obliged to perform partial curtailments to ensure grid stability.

The city of Carros chosen to host the Nice Grid project is considered as a solar district due to a relatively high solar PV capacity in comparison to the consumption at the district scale. Consequently and notably during summer periods, it is not rare that production exceeds consumption, inducing electricity quality issues for customers. To address these two seasonal problems, the Nice Grid project defined several experiments based on advanced technologies such as smart meters, with the human factor considered to be paramount in the project (GRID4EU, 2016). Several experimental approaches place the consumer at the core of the project with a more proactive role. The winter experience aims at investigating power reduction during peak hours (i.e. between 6pm and 8pm) thanks to various active demand approaches. Based on demand forecasts certain days are identified as "peak days" and customers are informed the day before via text message or email. The "Behavioural Load Management" is the most interesting case study regarding the ENTRUST project objective. Indeed, residential customers that signed such contracts are encouraged to decrease their consumption by either anticipating or postponing their "non-mandatory" consumption.

Table 10: Results of the winter experience,(GRID4EU, 2016)

	Winter 2013-2014	Winter 2014-2015
Number of participants	100	165
Number of days	17	14
Average power reduction	-12%	-9%

The summer experience aims at encouraging an increase of electricity consumption during high PV solar production periods. In a very similar way than the one applied for the winter experience the project mostly tests active demand approaches. Within the scope of the "**Solar Bonus**" case study involved customers are warned via text message or email that they will be offered an off-peak pricing for electricity consumption between noon and 4pm.

Table 11: Results of the summer experience (GRID4EU, 2016)

	Summer 2014	Summer 2015
Number of participants	28	28
Number of days	32	20
Average power increase in comparison to the baseline	+12%	+20%

The summer experience aims at encouraging an increase of electricity consumption during high PV solar production periods. In a very similar way to the one applied for the winter experience the project mostly tests active demand approaches. Within the scope of the "Solar Bonus" case study involved customers are alerted via text message or email that they will be offered an off-peak pricing for electricity consumption between noon and 4pm.

Interventions used to engage individuals/residents/employees:

The first action to be considered in both experiences was to engage a sufficient number of customers to ensure robust and valid results. At the beginning of the project, public meetings were led to introduce Nice Grid and to recruit customers (WebTimemedias.com, 2013). Online communication was also widely used with the creation of an official website for the project. This site provides a general overview of the project and explains challenges as well as experiments involved. A participant booklet dedicated to Carros citizens that clarifies the role they would play should they get involved, is available to download. Finally a 200m² showroom has been setup nearby the test site for educational purposes. Visitors can discover the various technical solutions implemented either on the grid or at customer premises.

During the operational part of the experience other means are used to engage customers. For the winter experience customers are informed of 'critical' periods by text message or emails. It is interesting to note that neither behavior or technical means to be used nor levels of curtailment to be reached are imposed on customers. Customers received a 50€ voucher at the beginning of the experience and will get a second voucher at the end if they effectively reduced their consumption when requested. In addition they have access to an online monitoring platform to follow their own consumption.

The summer experience is based on a similar approach. Customers are also informed via text message or emails and project partners relied on their willingness to participate. A comparable voucher-based reward system was setup and customers get offered a 30€ welcoming voucher at the beginning of the experience. At the end of each summer they also receive a reimbursing voucher that corresponds to twice the difference between the usual day tariff and the "off-peak" tariff they get offered. Although smart meters are not directly used to engage with customers as in case studies such as "controlled heating" or "Smart Hot Water Tank", they helped the DSO to monitor more precisely changes in electricity consumption, allowing a follow-up at household level.

Policy-related enablers/strengths underpinning the programme:

- Impact on citizen engagement

The Nice Grid project team applied a dual approach based on qualitative and quantitative surveys to collect the sociological feedback of involved residential customers. One of the main outputs to date has been an analysis of the reasons that persuaded customers to engage in the program to begin with. Besides the willingness of reducing their energy bills, interviewed people expressed their desire to act for the benefit of the environment (GRID4EU, 2016). The level of environmental awareness participants and their ability to take into account sustainability while taking decisions were reflected in the analysis. In addition, participants frequently expressed a desire to strength the regional electricity supply (GRID4EU, 2016). Indeed inhabitants of the region are well aware of the instability of the power supply in the region as they are directly impacted by curtailments (demand exceeding the cable capacity) or black outs (incident on the

transmission line). This "energy peninsula" situation is due to a lack of investments in local electric infrastructures. To a certain extent, the lack of ambition of local energy policies has facilitated the engagement of local citizens. However it has to be noted that improvement works have been launched lately with the reinforcement of the French grid with backup transmission lines as well as a new interconnection with Italy (RTE, 2016).

- Impact on project financing

Such an innovative project requires the use of not totally mature technologies as well as new ways to engage customers that are not to date well-controlled, with associated cost implications. Nice Grid could not have been launched without important financial supports. The fact that the European Commission funded almost a quarter of the total project cost (GRID4EU, 2016) illustrates well this incentive dependency. However the EU institution does not finance all projects proposal but the most consistent and aligned with the EU's main orientations. Indeed Research and Innovation Programmes such as FP7 or H2020 are prepared through a strategic process that integrates EU policy objectives (European Comission, 2016). The smart meter rollout is one of these objectives as detailed in the 2009/72/EC directive. While the document explicitly suggests the deployment of the technology, it also specifies that it shall be done only if it has been assessed positively in economic terms. This prerequisite leaves the final decision to national governments as they are responsible for conducting (or delegating) the cost-benefits analysis. Although the rollout in French households was postponed at the end of 2015, the project itself has been launched by the French DSO on the initiative of the French energy regulator in 2007 (CRE, 2016), two years before the release of the EU directive. Therefore, the ambitious French policy on smart meters may have been an advantage for Nice Grid to raise EU funds.

- Impact on practical aspects

The policy on smart meters and more globally on smart energy equipment also facilitates the operational management of the project. Smart meters are considered as the first building block of tomorrow's grids (GRID4EU, 2016). On one hand project partners highly rely on data collected by smart meters to monitor the experience and its impact on the energy consumption of households. On the other hand, the presence of programmable equipment was perceived as a facilitating factor by interviewed participants (GRID4EU, 2016-2). It helped customers to deal with the unpredictable information sending process and with the fact that they were not always at home during critical periods, especially for the summer experience. The feed-in tariffs approach chosen by the French Government to incentivize renewable sources greatly influenced the launch of the summer experience. The accumulation of prosumers (consumers that became producers) in localised area such as the city of Carros may lead to grid constraints eventually. Consequently it becomes increasingly important to make customers aware of their responsibilities regarding energy management. Therefore the French renewable energy policy and notably the type of incentives used forced the French DSO to further engage customers in its experiment.

Policy-related barriers/limitations underpinning the programme

- Engagement

According to the survey conducted by the Nice Grid project team, the desire to reduce energy bills was an important driver to engage with the experience. Looking at electricity prices in France, they are quite low in

comparison with its neighbouring states. For instance, during the first quarter of 2016 French domestic consumers paid much less than citizens of the five other countries studied within the scope of the ENTRUST project(Table 12):

Table 12: Electricity prices comparison with the French baseline (Eurostat, 2016)

Country	Electricity price difference compare to France (2016-Q1)
UK	+16%
Spain	+30%
Ireland	+37%
Italy	+43%
Germany	+76%

These low prices combined to the rebound effect had an important impact on the winter experimentation: although a decrease of consumption has been observed during peak hours, the benefits for customers' energy bills remained limited (GRID4EU, 2016).

- Practical aspects

Within the scope of this study feed-in tariffs are viewed as a great opportunity for the French DSOs to more involve customers into its experience. However, this analysis was project-focused and limited to a short term period, and in addition, such schemes do not make citizens aware of their responsibilities. Taking a longer-term view, feed-in tariffs do not push customers to think further about their energy use. However, changes are currently occurring and this policy barrier is progressively being eliminated. Indeed, the 2015 Energy Transition Law addresses the topic of auto-consumption and draws the outlines of a new energy scheme in which the customer has a more active role.

6 Discussion of findings

6.1 *Summary of case studies analysis*

A broad observation based on the existing reports and studies of case studies relating to reducing energy use and mainly in homes suggests that most of the behaviour change interventions demonstrate particular characteristics. In particular, the community-based interventions with a peer led activities and tailored advice, are typically, implemented predominantly in low income communities, where the residents are largely social housing tenants; and often rely on a mix of interventions delivered through intermediaries, and implemented within a time limited period (incrementally), and appears 'pepper-potted' spatially across each country.

Furthermore, interventions often go beyond the low carbon agenda to address wider social agenda seeking to tap into heathy lifestyles, fuel poverty. In practice the case studies also demonstrate that efficient energy use is not necessarily the main purpose of interventions yet is part of a parcel of measures designed to help low income and socially deprived communities to lead more sustainable lives. The approaches target the individual, household and social levels as well their material contexts in interventions. Some case studies include non-residential end-users to show how energy efficiency behaviour change is being executed in those arenas (*e.g*. The Darwin project).

Section 5 discussed and evaluated some key practical case study examples of behaviour change interventions which were selected for further exploration for the diversity they represented, the different contexts and interventions, and specifically for their window in relation to energy related behaviour change challenges. An evaluation of the key lessons and issues from the selected case studies are discussed here.

The 15 Case study interventions predominately rely on some form or partnership working and funding to deliver the project goals; they are often short term actions (with the exception of Eco-districts); schemes vary in scale, size and geography, e.g. some schemes are targeted nationwide and others more localized and targeted at specific communities. The interventions are often initiated and delivered through partnership working and funding to deliver the project goals. The typical model works through a partnership between different civil society/community actors, partnership between the government and civil society or even state, market and civil society. Furthermore, a large proportion of the intervention case studies were selected on the basis of how they engaged with individuals – typically households – on energy consumption behaviour change. This included those that engaged on behaviour change alone, and some engaged by encouraging both behaviour change and energy efficient retrofitting (technology adoption) or those that were technology or building focused – in order to deliver energy conservation goals. Therefore, a large proportion of case studies sought to target the individual context of behaviour change. Nearly all cases sought to encourage or 'nudge' (rather than coerce, regulate, etc.) individual context of behaviour change, with interventions aiming to persuade, motivate, and activate through targeted actions. However, what most case studies do have in common is that that any intervention, despite their core approach, cannot rely on a single tool but often needs to supplement the core approach with multiple tools; typically this has involved some form of technology adoption and user behaviour change. The range of tools are varied and include the more conventional leaflets, newsletters, TV and radio broadcasts to more novel approaches; energy monitors, internet based tools and resources; online billing and tailor-made advice and information; online blogs, and so on.

Whilst most case studies have been chosen for their energy related behaviour change features they do so in very specific ways and addressing specific aspects of energy consumption. The complexity in energy consumption has meant interventions have to respond to multiple factors influencing everyday energy consumption as discussed in Section 2. The key features of the characterised case studies of energy behaviour change initiatives are evaluated in Section 6.2.

6.2 *Re-framing behavioural interventions for transition*

From the analysis undertaken, it is clear that the case studies discussed in Section 4 can be further categorised with respect to the Behaviour Change Wheel (Figure 4). While we have applied 6 broad types of energy behaviour change interventions (community-based interventions; information and awareness based interventions; eco-districts; show-case events; energy switching; and smart-technology focused interventions), further policy categorisations and the function of the initiatives are highlighted in Table 13.

Table 13: Features of studied energy behaviour change case-studies mapped against behaviour change wheel parameters

Broad Intervention	Case study	Tools/types of techniques	Behaviour Change Policy Category (From behavior change wheel, Figure 4)	Intervention Function Of Initiative (From behavior change wheel, Figure 4)
Community-based Peer-to-Peer	Case Study 1: Familles à énergie positive (France)	Energy team 'Captain'; peer-to-peer model; seasonal demand reduction; promotes BC & TA; mix of tools	a. Communication and Marketing	• Education • Persuasion
Peer-to-Peer	Case Study (2): Energy Champions - Stockbridge Village (UK)	"Energy Champion"; peer-to-peer model; promotes BC & TA; mix of tools	a. Communication and Marketing	• Education • Training • Persuasion • Enablement
Community-based with Information & Advice	Case Study (1): Green Doctors (UK)	tailor made information and advice; promotes BC & TA; mix of tools; including peer-to-peer model and energy audit.	a. Service Provision & b. Communication and Marketing	• Education • Training • Enablement
Community-based with Information & Advice	Case Study (2): Power of One - Ireland	A multi-sectoral mass media campaign; BC only; mix of tools; including peer led activities; motivational challenges;	a. Communication and Marketing	• Education • Persuasion
Eco-Districts	Case-Study (1) Cloughjordan Ecovillage, Ireland	Holistic; Area based; sustainable development and living; BC & TA	a. Guidelines b. Planning c. Service Provision & d. Communication and Marketing	• Restrictions • Education • Training • Enablement • Modelling • Environmental Restructuring
Eco-Districts	Case-Study (2) The Darwin project – Bordeaux, France	Area based; relies on BC; and technology for energy management	a. Guidelines b. Planning c. Service Provision & d. Communication and Marketing	• Restrictions • Education • Training • Enablement • Modelling • Environmental Restructuring

Broad Intervention	Case study	Tools/types of techniques	Behaviour Change Policy Category (From behavior change wheel, Figure 4)	Intervention Function Of Initiative (From behavior change wheel, Figure 4)
Open home Show-case events	Case Study (1) Nearly Zero Energy Buildings Open Door (NZEB Open Door Ireland)	Relies on TA; exhibitions and retrofitted visiting homes; multi-media; mix tools. Building standard development	a. Communication and Marketing	• Education • Modelling
Open home Show-case events	Case Study (2) SuperHomes – Green Open House events, UK	Relies on BC & TA; exhibitions and retrofitted visiting homes; multi-media; mix tools.	a. Communication and Marketing	• Education • Modelling
Collective Energy Switching	Case Study (1): The Big London Energy Switch, UK	Relies on BC; mass media campaign; energy tariff switching	a. Communication and Marketing	• Education • Persuasion
Collective Energy Switching	Case Study (2) The 'Power to Switch' campaign, UK	Relies on BC; mass media campaign; energy tariff switching	a. Communication and Marketing	• Education • Persuasion
Smart-Technology	Case Study (1) Power Off Save (Ireland)	Mix of strategies Information, advice, feedback and incentives	a. Service Provision	• Education • Incentivisation • Enablement • Modelling
Smart-Technology	Case Study (2) Smart Meters Smart People (SMSP) – Northern Ireland (UK)	Mix of strategies: Information, advice, feedback and incentives	• Service Provision	• Education • Incentivisation • Enablement • Modelling
Smart-Technology	Case Study (3) Nice Grid (Caros, France)	Mix of strategies: Advice/info; tariff incentives; smart water tank; remote control; electric heating control	a. Service Provision	• Education • Enablement • Modelling
Smart-Technology	Case Study (4) Carrega't d'Energia (Barcelona, Spain)	Both TA & BC; Mix of tools; smart meters; information & advice; personalised Billing;	a. Service Provision b. Communication and Marketing	• Education • Training • Enablement • Modelling • Persuasion
	Case Study (5) Sports Center FIDIA Cesano, Rome (Italy)	Smart meters; TA; focus on energy management	a. Service Provision	• Enablement • Modelling

Table 13 and Figure 21 both clearly show that energy related behaviour change interventions are heavily clustered to 'communication and marketing' and 'service provision' policy categories, and also concentrate mostly on education, modelling and enablement interventions.

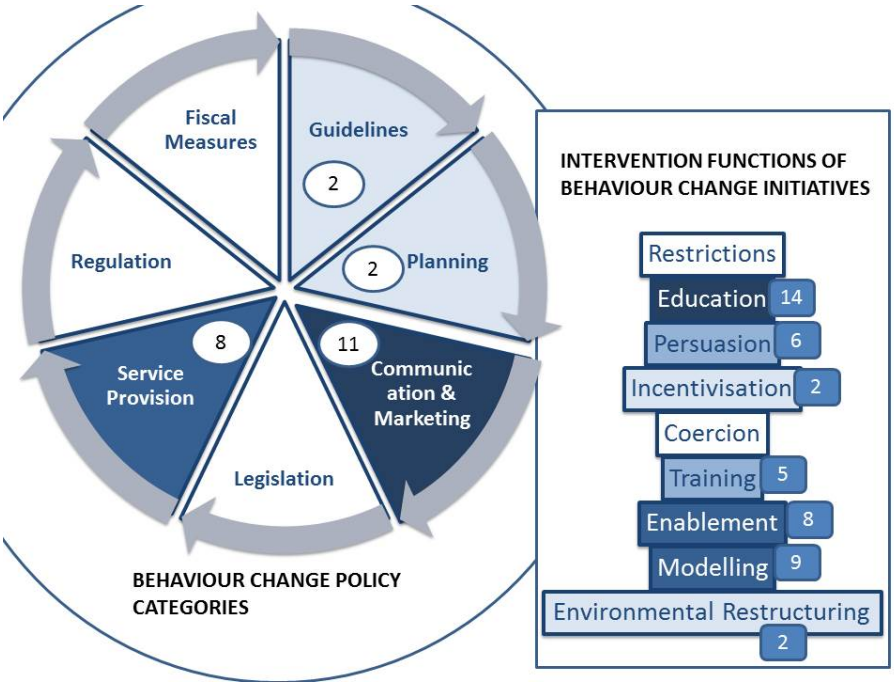

Figure 21: Where energy behaviour change initiatives cluster on the behaviour change wheel

Figure 21 reflects the broad trend whereby interventions to date are focused for the most part on communication and education aspects. While it is well-known that information alone does not lead to changes in behaviour (Moloney *et al.*, 2010b), the initiatives reviewed indicate that communication approaches are favoured when seeking to influence energy-related behaviours. While there have been significant advances in research on the topic of climate communication (Ballantyne, 2016; Bostrom, A., Bohm, G. and O'Connor, 2013), there is a divergence between what is known to work from best practice and the practical application of a wide range of behaviour change initiatives. Axon (2016a) highlights that initiatives to change behaviour need to be applied continuously and using multiple methods to successfully change lifestyles and for these changes to be maintained (Axon, 2016a). Narrow approaches towards behaviour change therefore limit the ability of initiatives to have wider sustainability related impact.

This point also raises further issues. The approaches identified in this deliverable indicate 2 broad challenges with current energy behaviour change interventions: (1) a neglect of wider social elements in practices, and (2) a lack of consistency with wider policy approaches. Given that there are a number of policies that significantly influence the energy system and individual lifestyle choices (see deliverable 4.1 of the ENTRUST project for a review), there appears to be a lack of consistency of using such policies as a platform for energy related behaviour change. The reluctance to apply regulation, fiscal measures and legislation approaches to influence energy behaviour reflects a widespread belief that a top-down influenced approach to changing behaviours is unpopular and may backfire (Verplanken, 2011). Yet there are studies that suggest changing behaviour through legislation and/or regulation may, unexpectedly, be received more positively than previously considered and may lead to negative attitudes and behavioural

responses towards unsustainable and other undesirable practices (Olson, J. M. and Stone, 2005). This reflects the concept of self-perception; that individuals infer their own attitudes from their behaviour (Bem, 1972). While being perceived negatively, the feeling of coercion that could result from legislation-driven changes will eventually fade and the conditions underpinning self-perception become favourable to consolidate sustainable actions and practices (Verplanken, 2011). Examples of this include the Ireland smoking ban in 2004 and the London Congestion Charge.

Furthermore, a neglect to incorporate the wider social elements within initiatives demonstrates that such projects fail to account for the socially grounded nature of human behaviour and practices (Ajzen, 1991; Jackson, 2005). Without appealing to the actions of others and incorporating this, behaviour change initiatives may lead to projects reinforcing feelings of 'powerlessness' (Aitken, Chapman, & McClure, 2011). Such a response reflects individuals feeling unable to have any impact upon issues such as addressing climate change or meaningful community change as a result of projects not integrating others' participation (Axon, 2016a). Yet successfully incorporating a broader social dimension, enables participants within projects to have more of an impact. By creating a sense of collective interest through communal participation, new social norms are developed that enable individuals to secure a space for sustainability transitions.

Figure 22 illustrates the interventions favoured in the energy behaviour change sphere, based on the limited, but indicative sample of case studies presented in this report.

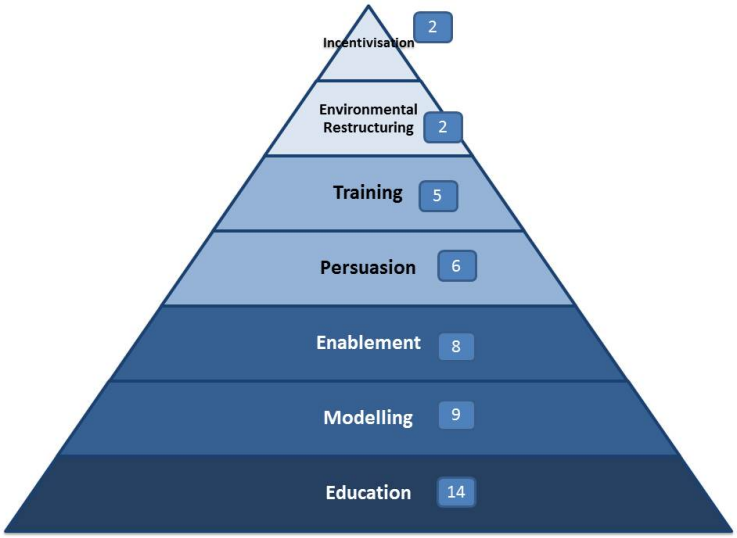

Figure 22: Hierarchy of interventions favoured in the energy behaviour change sphere

Figure 22 highlights the disproportionate concentrations of behaviour change initiatives across Europe predicated on the data collected for this deliverable. While there are few incentive-driven approaches, there is an overwhelming bias towards education and awareness-raising approaches. In conjunction with failing to recognise the socially grounded nature of behaviour and practices, these approaches suffer from a conceptual problem of methodological individualism (Heiskanen, Johnson, Robinson, Vadovics, & Saastamoinen, 2010). Individual decisions to save energy are framed by social dilemmas and individual efforts are useless unless others also participate (Ockwell, D., O'Neill, S., & Whitmarsh, 2010). Modelling behaviours and persuading wider parts of communities to engage with low-carbon practices (as community

members rather than as individuals) ensures that utilising education and awareness-raising approaches can overcome this barrier and enable more effective and sustainable behavioural changes. However, from the case studies reviewed here, only one initiative did not apply education as an intervention to encourage behavioural change. This illustrates that there is a disconnect between theories towards behaviour change and the practice of attempting to change energy-related behaviours.

The literature reflects that to date there has been a heavy emphasis on individual motivations, values, beliefs and ways of influencing them in many behaviour change programmes, predicated on the assumption that the right information will lead to environmental behaviour. Although information can be an important first step in prompting behaviour change, information alone is unlikely to motivate change (Barr and Gilg, 2005; Darnton, 2008; Moloney *et al.*, 2010; Axon; 2015). A reliance on the information deficit model of behaviour change fails to take into account the heterogeneity of messages, audiences and prior understanding of issues (Sturgis and Allum, 2004). While information can be an important first step in prompting behaviour change, information alone is unlikely to motivate change (Barr and Gilg, 2005; Darnton, 2008; Moloney *et al.*, 2010; Axon; 2015). Information is also unlikely to result in sustained behavioural change beyond the life of a given campaign, since enthusiasm for 'new' actions wanes and participation decays in the absence of continual reinforcement (Abrahamse *et al.*, 2005; Moloney *et al.*, 2010). There is an assumption that if people are presented with facts relating to how their behaviour is affecting the environment, they will respond rationally and change to more sustainable practices. However there is a risk that responses to such information could lead to disinterest, disempowerment, fear and scepticism (O'Neill and Nicholson-Cole, 2009; Moloney *et al.*, 2010; Whitmarsh, 2011; Axon; 2015).

Engaging individuals at a deeper level raises a number of questions about the choice of techniques used in behaviour change programmes including: the appropriate focus on the individual rather than the collective; the role of social norms; and the extent to which initiatives explore what is shaping and influencing behaviours they seek to change (Moloney *et al.*, 2010). The WWF (Crompton, 2008) recommends framing approaches around appealing to intrinsic values such as personal growth and community involvement. This potentially introduces social norms focused on sustainability issues, which recognises that behaviour is socially constructed and therefore needs to be considered at the collective or social level (Moloney *et al.*, 2010).

Considerations of finance and money are often used as motivators for pro-environmental behaviour (Lorraine Whitmarsh & O'Neill, 2010). Most of the desired interventions (typically include: incentives, information or education) that are targeted at affecting individual consumer choices. Yet it should be acknowledged that information alone does not result in lasting behavioural changes (Barr *et al.*, 2003). Critically, interventions focused on affecting consumer choices can inadvertently downplay the influence of the dominant (social, political, economic, environmental and technological/innovative) structural contexts on decision-making processes. This could be considered a weakness of the 4 E's model by DEFRA. Both the 4 E's and MINDSPACE models appear to be 'deliberative' policy tools designed to tackle and change particular sets of entrenched or habitual behaviour by government.

DEFRA adopts a social marketing approach with methods derived from business management targeting specific behaviours, immediate barriers and interventions to overcome these barriers (DEFRA, 2008). An approach by the WWF challenges the widely adopted social marketing approach to behaviour change

arguing that it does not go far enough in addressing the fundamental shifts required in policy and lifestyles necessary to respond to climate change (Crompton, 2008; Moloney *et al.*, 2010a). This approach rejects appeals to individualism, the personal benefits and social status resulting from adopting particular pro-environmental behaviours. Instead, it focuses on the motivations and values that are intrinsic to people i.e. personal growth and community involvement which it is argued are more likely to lead to pro-environmental behaviour (Crompton, 2008; Moloney *et al.*, 2010a). Research in the transitions literature argues for a deeper application and understanding of the "socio-technical context" of human behaviour and the resultant need for changes in structural and institutional environments. Framing behaviour in this way could more explicitly normalise pro-environmental behaviours through systems of incentives and convenience (Moloney *et al.*, 2010; Axon; 2015).

6.3 *Limitations of case study interventions*

Due to the disparate nature of the case studies (selected for their diversity and not like for like comparability) it has been difficult to discuss the CO_2 savings many of these interventions may have delivered or their efficacy in dealing with the challenges of behaviour change. As many projects do not measure nor monitor such outcomes coherently and this is confounded by the fact that such information is not available in the public domain. The mix of interventions seen deployed in many cases add to the problem of measuring the impact of specific interventions and their tools. On the one hand mixed methods holds the strength that acknowledges that energy consumption embodies a complex relationship between people, their everyday practices and the buildings they occupy. Therefore, the use of multiple tools could aid stakeholders to tackle complex social challenges at different levels. For example, low income communities that may be at risk at fuel poverty with potential lack financial resources to make their homes energy efficient – hence may be given insulation or offered a new boiler in addition to energy saving advice. In such situations it is difficult to measure the impact of individuals tools per se used and is outside the remit of this study.

Across diverse areas of public policy, behaviour change interventions are now commonly deployed in an effort to shift people's behaviour in desired directions—for example, toward healthier lifestyle choices, wiser financial decisions, and more environmentally-friendly practices. This extends to the specific domain of residential energy use, where a multitude of behavioural interventions and programs have been designed to shift the behaviour of consumers and households in some desired way, e.g., toward greater energy efficiency, lower total and peak electricity usage, optimal responsiveness to dynamic tariffs, greater uptake of renewables and low-emission technology (Frederiks *et al.*, 2016).

Yet in many cases, the efficacy (thus cost-effectiveness) of such programs remains unknown, and indeed, unknowable. This may be due to fundamental limitations in program design, methodology and/or analysis, as we have explained here. Most notably, it is often the result of failing to build into the design of a behaviour change program, from the very outset, the capacity to properly evaluate its success in a scientifically rigorous manner (Frederiks *et al.*, 2016).

7 Conclusions

The conceptual approaches identified have been used to provide a better understanding of energy related behaviours; the range of theories lends credence to the claim that no single approach can exclusively explain and predict behaviour and consequently no single approach can explain nor change people's behaviour. Collectively these cross-disciplinary insights (from a range of psychological, economic and sociological approaches) contribute towards helping to unravel the complexity of energy related behaviours and the multitude of factors that shape them. It has also been identified that there are many tensions between theories which by the same token arguably suggest that the different models and perspectives offer complimentary viewpoints on the same theme of energy behaviours. Hence, it is observed that policies on behaviour change appear to take a pragmatic line by combining a mixture of theories in public policymaking across different EU countries to change individual and consumer behaviour across many spheres of behaviour, specifically relating to energy consumption and in dealing with the low-carbon and sustainability agenda. The theoretical approaches to behaviour change presented in Section 2 have informed public policymaking on this topic.

A large proportion of the intervention case studies were selected on the basis of how they engaged with individuals (typically households) on energy consumption behaviour change. This included those that engaged on behaviour change alone, and some engaged by encouraging both behaviour change and energy efficient retrofitting (technology adoption) or those that were technology or building focused in order to deliver energy conservation goals. Therefore, a large proportion of case studies sought to target the individual context of behaviour change. However, what most do have in common is that that any intervention despite their core approach, cannot rely on a single tool but often need to supplement with multiple tools; and again typically include some form of technology adoption and user behaviour change. This is a well-known approach to encourage behaviour change, through blending interventions and initiatives to sustain meaningful pro-environmental actions (Abrahamse *et al.*, 2005). The complexity in energy consumption has resulted in interventions having to respond to multiple factors influencing everyday energy consumption as discussed in Section 4 and 5.

This deliverable has classified energy-related behaviour change initiatives into 6 broad categories (community-based interventions; information and awareness based interventions; eco-districts; show-case events; energy switching; and smart-technology focused interventions) and then further categorising the interventions within the context of policy categorisations and the function of the initiatives (see Table 5) using the Behaviour Change Wheel in Figure 4 (Michie *et al.*, 2011). In so doing, this deliverable has outlined that there are significant gaps between what is known to work to engage individuals in behavioural changes and what is currently being employed within initiatives reviewed here. An over-reliance on education and awareness-raising projects illustrates that such projects are not aiming for sustained behavioural changes and with no projects incorporating fiscal measures, regulations or legislation to drive behaviour change reflects a reluctance to engage widely with the diverse approaches that can drive behaviour change.

Due to the disparate nature of the case studies (selected for their diversity and not like-for-like comparability), it is challenging to discuss the carbon emission savings many of these interventions may

have delivered. As many projects do not measure nor monitor such outcomes coherently and such information is not available in the public domain. The mix of interventions deployed in many cases add to the problem of measuring the impact of specific interventions and the tools deployed. On the one hand, a mixed methods approach holds the strength that acknowledges energy consumption embodies a complex relationship between people, their everyday practices and the buildings they occupy. Therefore, the use of multiple tools could aid stakeholders and practitioners in behaviour change to tackle multiple social challenges (*e.g.*, fuel poverty, energy security, sustainable lifestyles) at different levels (Axon, 2016a). From the case studies presented in this deliverable, the following key lessons for the success of initiatives were identified as follows:

- Creating a sense of collective interests and achievable goals;
- Fostering strong leadership and continued support by the intermediaries (as shown by the 'Captains');
- A focus on energy management;
- Relying on a mix of tools;
- Targeting the individual context of behaviour.
- The challenges of measuring the individual impacts of tools; and
- Measuring short-term to long-term benefits and knock-on effects of interventions.

This connects with international research into behaviour change interventions targeting energy use in the household strongly indicates that combining interventions such as feedback, monitoring and rewarding shows greater results than adopting a single strategy (Abrahamse *et al.*, 2005). However, the same research also argues that combined interventions are more difficult to evaluate as it is less easy to pin-point how different elements are contributing to overall energy use behaviour change. Despite this, combined interventions offer the potential for sustained behavioural changes.

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