



Segmenting for sustainability: The development of a sustainability segmentation model from a Welsh sample



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ABSTRACT

Wales is one of the few countries in the world that has adopted sustainability as a central organising principle for public policy. This paper describes the development of a sustainability segmentation model that can be used to engage the public across different sustainability policy areas. A nationally representative survey ($n = 1538$) was conducted containing questions on the three pillars of sustainable development, human values, perceptions of climate change and energy security, and self-reported behaviours in the domains of household energy use, travel and transport, waste and recycling, and water use. A series of cluster analyses identified six segments of the public that relate differently to sustainability. Even if the segments were solely constructed on the basis of thirteen distal psycho-social indicators, they had distinct socio-demographic profiles and diverse patterns of self-reported environmental behaviour. A 15-item screening tool was developed to replicate the segments with an average 72% accuracy.

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1. Introduction

1.1. Background

Sustainable development has become a major policy goal for governments, businesses, and communities around the world. Although the principles of sustainable development were discussed as early as in 1972 at the United Nations Conference on Human Environment in Stockholm, it only received widespread attention after the publication of *Our Common Future* in 1987 (Brundtland Commission, 1987). The Brundtland report launched the now widely accepted definition of sustainable development as “development that meets the needs of current generations without compromising the ability of future generations to meet their own needs”. Sustainable development is not only about maintaining environment quality, but involves the overall capacity of a society to sustain itself. This requires the creation of social, environmental and economic conditions that allow each person to reach their full potential – for present as well as future generations (e.g. OECD, 2001).

Wales is one of the few countries in the world that has adopted sustainability as a central organising principle for public policy. The Welsh Government has a statutory duty to promote sustainability in all its policy areas and functions, as set out in the *One Wales: One Planet* sustainable development scheme (Welsh Assembly Government, 2009). The Welsh Government conceptualises sustainable development as enhancing the economic, social and environmental wellbeing of people and communities, achieving a better quality of life for present and future generations in ways that promote social justice and equality of opportunity, while respecting the limits of the earth's resources (ibid). The Welsh approach thereby covers and integrates the three ‘pillars’ of sustainable development.

One of the greatest challenges in the pursuit of sustainability is the development of effective policies and communications that foster meaningful and lasting behaviour change. Various scholars and practitioners have argued that the limited success of environmental policies to establish behaviour change is in part due to these policies not recognising individual differences and circumstances (Corner & Randall, 2011; Darnton, 2008; McKenzie-Mohr, 2000). Generic policies are likely to produce sub-optimal outcomes, as not all individuals will respond favourably to interventions or communications that have been designed for the ‘statistical everyman’ (Darnton, 2008). It is well known that the public experience

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barriers that hinder their engagement in environmental issues in a number of ways (Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007). The argument of *social marketing approaches* is that policies are more likely to be accepted if they can be designed to fit around individuals' existing lifestyles rather than the other way around (Corner & Randall, 2011). Social marketing approaches try to apply marketing concepts and techniques to achieve beneficial outcomes for society as a whole (e.g. Lee & Kotler, 2011; Kotler & Zaltman, 1971). This includes, but is not limited to, the identification of different 'publics' or 'interpretative communities' using market segmentation techniques (e.g. Barnett & Mahony, 2011).

1.2. Environmental segmentation models

Over the past decade, various attempts have been made to profile the public according to their environmental views and behaviours. The best known segmentation model within the environmental domain is probably the *Department for Environment, Food and Rural Affairs' (Defra) framework for pro-environmental behaviours* (Defra, 2008). This model has been widely used by different UK government departments (Zimmerman et al., 2012), NGOs (Horton & Doran, 2011), and academics (Miller, Rathouse, Scarles, Holmes, & Tribe, 2010). However, while the model has made policy-makers aware of the need to design tailored campaigns, there is only limited information available about its rationale and development, making it difficult to determine in what way the different segments differ from one another and thus how they should be approached to achieve the greatest behavioural change. Furthermore, a recent review of the model found that users thought it lacked any sensitivity to respondents' context and was too limited by only focussing on pro-environmental motivations (Darnton, 2013).

Other segmentation models have focused on specific environmental issues, such as climate change (e.g. Maibach, Leiserowitz, Roser-Renouf, & Mertz, 2011), or behavioural domains, such as energy (Sütterlin, Brunner, & Siegrist, 2011) or travel and transport (Anable, 2005). There has been a particular interest in the use of social marketing principles to improve climate change communications. In an extensive review of the literature, Hine et al. (2014) identified over 25 climate change studies employing a range of segmentation methodologies. This includes the *Global Warming's Six Americas* model developed by the *Yale Project on Climate Change Communication* (Leiserowitz et al., 2012; Maibach et al., 2011), a climate change communication model developed by Ashworth, Jeanneret, Gardner, and Shaw (2011), and a study conducted to identify different *climate change interpretive communities* in Australia (Hine et al., 2013).

The *Global Warming's Six Americas* model found six unique segments of the public that engage with global warming/climate change in distinct ways (Leiserowitz, Maibach, Roser-Renouf, & Hmielowski, 2012; Maibach et al., 2011). The segmentation was based on a comprehensive set of attitudinal factors specific to climate change, including beliefs about the reality of climate change, involvement in the issue, self-reported behaviours and actions, and policy preferences for climate mitigation. The six segments, ranging from the *alarmed* to the outright *dismissive*, can be positioned alongside a single attitudinal continuum reflecting the degree of concern and engagement with climate change. The *Six Americas* model was replicated in a number of other countries (Leiserowitz, Thaker, Feinberg, & Cooper, 2013; Morrison, Duncan, Sherley, & Parton, 2013) and repeated over time (e.g. Leiserowitz, Maibach, & Roser-Renouf, 2010; Leiserowitz, Maibach, & Roser-Renouf, & Hmielowski, 2012; Leiserowitz, Maibach, Roser-Renouf, & Smith, 2011). Hine et al. (2013) identified five similar 'interpretive communities' that were given the labels of *Dismissive*, *Doubtful*,

Uncertain, *Concerned*, and *Alarmed*, respectively. Just as the *Six Americas* model, the resulting segments can be positioned alongside a coherent attitudinal continuum reflecting the level of engagement and concern with the issue. Ashworth et al. (2011) segmented a representative Australian sample using a narrower range of climate-relevant variables (belief in climate change, climate change perceptions and concern, and knowledge of climate change). They found that the four clusters (*engaged*, *concerned* and *confused*, *disengaged*, and *doubtful*) could be ordered alongside a knowledge and concern dimension.

Domain-specific models have been used to gain a better understanding of the motivations and perceived barriers of different consumer groups with respect to a specific type of behaviour, usually with the aim to explore which groups are the most likely to change these behaviours and how different groups need to be approached to achieve behaviour change. In contrast to issue-specific segmentation models, which tend to be based on cognitive variables that have previously been shown to underlie responses to the issue (Hine et al., 2013), domain-specific are generally built around recognised determinants of behaviour and behaviour change (e.g. Sütterlin et al., 2011).

The travel behaviour model by Anable (2005) segmented a population of day travellers on a range of psycho-social factors that are thought to influence travel behaviour. The value of this segmentation was shown by the finding that the same travel behaviour may take place for different reasons. For example, while *die-hard drivers* believe in the right to drive cheaply and freely, *aspiring environmentalists* have already substantially reduced their car use but still appreciate the practical advantages of owning a car. This shows that interventions or communications need to be responsive to baseline behaviours, motivations, and acceptable alternatives for the different groups in order to establish meaningful and lasting behaviour change.

The model developed by Sütterlin et al. (2011) aimed to profile different types of energy consumers in Switzerland. Input variables were selected on the basis of an extensive literature review of the determinants of energy-saving behaviours. Sütterlin et al. (2011) identified six distinct energy consumers that differed in terms of their energy use and willingness and (perceived) ability to save energy, ranging from the highly-engaged and empowered *idealistic energy-savers* to the *convenience-oriented indifferent* who do not feel personally responsible for their energy consumption and are mainly driven by personal comfort and convenience. Other models within the environmental domain have attempted to segment the public in terms of their waste management and recycling practises (Barr et al., 2013), travel and transport behaviours (Barr & Prillwitz, 2012), and demand for low emission vehicles (Morton, 2013).

Some of the environmental segmentation models have been based on a small set of profiling variables and/or focused on a single topic or domain, which may lead to poorly differentiated and unidimensional models. Furthermore, models limited to a single topic or domain may be less useful to policy makers and practitioners with a wider remit to promote sustainability and behaviour change. Developing a model for each and every topic or domain is not only costly, it may lead to inconsistencies across the different domains. Policy makers and practitioners may therefore benefit more from a broader segmentation model spanning multiple sustainability and/or behavioural domains. A further consideration for the development of a segmentation model is its ease of use in identifying different publics. Government or civic society organisations do not always have the funds to replicate a full model each time they are planning an intervention or campaign. Segmentation models are more likely to be taken up by third parties if there is a screening tool available that allows the segments to be identified with a

limited number of questions. Hitherto, only Maibach et al. (2011) have developed such a screening tool within the environmental domain.

1.3. The sustainability segmentation model

The current study set out to develop a comprehensive *sustainability segmentation* model, spanning social, environmental and economic aspects of sustainability, that can be used by the Welsh Government and other organisations to engage the public across different sustainability-relevant policy areas. The ultimate aim of the model is to support the development of tailored communications and behaviour change initiatives across different sustainability-relevant domains.

The sustainability segmentation model was based on an *a priori* selected set of *distal psycho-social variables* that have been found to be linked to environmental behaviours across different domains. This included general antecedents of environmental behaviour, such as *human values, views on sustainability, and concern about sustainability-relevant issues*. Values are generally defined as desirable *trans-situational* goals, varying in importance, that serve as guiding principles in people's life (Schwartz, 1992). Values were considered relevant for the sustainability segmentation model, as they are relatively stable and predictive of a broad spectrum of environmentally significant behaviours (see e.g., Gifford & Nilsson, 2014; Stern, 2000; Steg, DeGroot, Dreijerink, Abrahamse, & Siero, 2011).

As the segmentation model was to support the Welsh Government in its obligation to promote sustainability in all its policy areas and functions, the model needed to cover *attitudes to environmental, social and economic aspects of sustainability*. The literature has repeatedly shown that *'ecological' worldviews* are consistently, if sometimes weakly, associated with self-reported and observed environmental behaviours in different domains (Dunlap, 2008; Poortinga, Steg, & Vlek, 2004; Steg et al., 2011). However, little is known about public views on social and economic aspects of sustainability and their importance for environmental behaviours. Various scholars have argued that *social capital and place attachment* can be used as indicators of social sustainability (Uzzell, Pol, & Badenas, 2002), as these forms of social organisation contribute to the resilience of communities and their overall capacity to endure in the face of adversity and environmental risk (Lehtonen, 2004). Indeed, there are indications that social capital can facilitate pro-environmental actions (Thoyre, 2011; Uzzell et al., 2002), and that place attachment is associated with various low and high effort pro-environmental behaviours (Ramkissoon, Smith, & Weiler, 2013; Uzzell et al., 2002). Place attachment has further been shown to be important in responses to low-carbon developments (Devine-Wright, 2009) and climate change as an environmental threat (Devine-Wright, Price, & Leviston, 2015). To date very few studies have explicitly measured public attitudes to economic development per se and/or how economic development should be balanced with environmental protection (cf., Leiserowitz, Kates, & Parris, 2006). The study was unique in setting out the development of a number of items to capture these aspects of the sustainability agenda.

The third and final part of the sustainability segmentation model focused on *concern about climate change and energy security*. Climate change has emerged as the greatest environmental challenge and main driver of sustainable development initiatives. Concern about the issue has been shown to translate into a greater willingness to change behaviour in different environmental domains, including energy, waste and recycling, travel and transport, and activist and non-activist behaviours in the public sphere (Anable, Lane, & Kelay, 2006; Poortinga et al., 2004; Poortinga,

Spence, Demski, & Pidgeon, 2012; Semenza et al., 2008; Spence, Poortinga, Butler, & Pidgeon, 2011; Whitmarsh & O'Neill, 2010). The issue of energy security has become increasingly important within recent energy debates as a result of declining oil and gas production and increasing dependence on foreign energy imports (see e.g., Demski, Poortinga, & Pidgeon, 2014). The main challenge of current energy policy is to mitigate climate change alongside delivering reliable and secure energy supplies, which is also known as the 'energy trilemma'. Recent work has shown that concern about energy security is negatively associated with the willingness to change behaviour, and rooted in a different value system than concern about climate change (Poortinga et al., 2012).

The sustainability segmentation model had a number of distinct features that sets it apart from previous models. First and foremost, the model spanned the three main dimensions of sustainability as well as a number of sustainability-related topics, rather than focussing on a single issue or domain, such as the original Defra segmentation with a singular 'green' focus. A broader sustainability approach was considered more appropriate for the Welsh policy context, as there is a statutory duty to promote sustainability in all policy areas and functions in Wales. This approach taken ensures that the model can be applied across different sustainability policy areas to support initiatives in different behavioural domains. Second, in contrast to a number of other studies in which segments were differentiated with both attitudinal and behavioural variables (e.g. Maibach et al., 2011; Sütterlin et al., 2011), the current model was constructed on the basis of thirteen *distal* psycho-social indicators. Third, the model was subsequently validated with a wider and more diverse range of behaviours than any previous segmentation models within the field. A fourth distinguishing feature is that, instead of relying on individual items, multi-item scales were used to measure the different segmentation variables (cf., Hine et al., 2013). Multi-item scales are generally preferable when trying to measure complex constructs (Hine et al., 2014).

The development of the segmentation model consisted of a number of subsequent phases and related objectives. First, the study set out to identify distinct publics based on their views on sustainability and sustainability-related issues. This was done by conducting a series of cluster analyses on thirteen indices that formed the conceptual framework of the study. Second, the study aimed to determine the socio-demographic profiles of the different segments, in terms of gender, age, household type, and social grade, as well as of neighbourhood deprivation and rurality. Third, the segmentation model was to be validated with a wide range of self-reported environmental behaviours in the domains of household energy use, travel and transport, waste and recycling, and water use. Fourth, the study attempted to develop a short screening tool that can be used to identify the segments without having to replicate the full model.

2. Method

2.1. The study

A nationally representative survey was conducted in which 1538 respondents were interviewed face-to-face. The interviews took place between 9 May and 26 July 2011. A multistage sampling strategy was used. First, Wales was stratified into six regions. One hundred and forty four (144) sample points were then randomly selected within these six regions.¹ Quotas were set on age, gender and work status for each sampling point to mitigate for known

¹ Each sample point was a Double Output Area (DOA) consisting of two adjacent Census Lower Level Output areas. Each DOA contains on average 250 households.

response biases. The rurality and level of deprivation of the sampling points were assessed using Defra's rural-urban classification and the Welsh Index of Multiple Deprivation (WIMD), respectively. The WIMD is the official measure of relative deprivation for small areas in Wales. It is designed to identify small areas where there are the highest concentrations of several different types of deprivation, relating to income, employment, health, education, geographical access to services, community safety, physical environment, and housing.

2.2. Segmentation variables

The segmentation analysis was conducted using thirteen indices. These scales were constructed from 47 items as described below. All thirteen scales were normalised by calculating their Z-scores. The full questionnaire can be found in the technical report of the segmentation study (Welsh Government, 2011).

Personal Values. Respondents were asked how important they found 23 values from Schwartz' Value Inventory (1992). They could respond using a 5-point scale ranging from "not at all important" to "extremely important". Scales were constructed based on the four value dimensions of *Self-Transcendence* (social justice, protecting the environment, being loyal, being forgiving, and being honest), *Self-Enhancement* (having authority, wealth, being successful, being influential), *Conservative Values* (honouring parents and elders, being obedient, family security, sense of belonging, and respect for tradition), and *Openness-to-Change* (exciting life, being curious, being independent, and enjoy life). A number of items were removed to improve the reliability of the scales. The reliabilities were sufficient for the analyses (.70, .68, .68, and .60, respectively).

Views on Sustainability and Sustainable Living. This section used existing scales and new items to elicit people's views on environmental, economic and social aspects of sustainability. *Environmental Sustainability* was measured using three items from the New Environmental Paradigm scale ("If things continue on their current course, we will soon experience a major environmental disaster", "The earth has very limited room and resources", and "When humans interfere with nature it often produces disastrous consequences"; Dunlap, Van Liere, Mertig, & Jones, 2000). The scale was internally consistent (Cronbach's $\alpha = .60$). *Economic Sustainability* was indicated by two items with a high level of correspondence between them ("It is very important for Wales to have a high level of economic growth" and "It is very important for Wales to have a stable economy"; Cronbach's $\alpha = .73$). Views on the *environment–economy trade-off* were indicated by a two-itemed scale with a just about acceptable internal consistency ("Economic growth and creating jobs should be the top priority, even though the environment suffers" and "There are much more important things for me to do than protect the environment"; Cronbach's $\alpha = .59$). *Social Sustainability* was captured by social capital, place attachment and attitudes to living in Wales items, as described in the 'Community and Place' section. Respondents were asked about their attitudes to *Sustainable Living* (e.g., "Being green is an alternative lifestyle; it's not for the majority"). The internal consistency of this scale was low (Cronbach's $\alpha = .55$) but could not be improved by adding or removing items.

Attitudes to Climate Change and Energy Security. Respondents' *perceptions of climate change* were captured by their responses to five questions (e.g., "The seriousness of climate change is exaggerated" and "My local area is likely to be affected by climate change") that were previously used by Spence et al. (2011). The resulting scale was internally consistent (Cronbach's $\alpha = .73$). *Concern about energy security* was measured by asking respondents how concerned they are that in the future (a) electricity will become unaffordable, (b) supplies of fossil fuels (e.g. coal and gas)

will run out, and (c) power cuts will become more frequent. These items were selected from Demski et al. (2014). The scale was internally consistent (Cronbach's $\alpha = .72$).

Attitudes to Community and Place. Social capital, place attachment, and attitudes to living in Wales were taken to reflect important components of social sustainability (cf., Uzzell et al., 2002). The *Social Capital scale* (Cronbach's $\alpha = .63$) used three items ("I borrow things and/or exchange favours with my neighbours", "If I needed advice about something I could go to someone in my neighbourhood", and "I would be willing to work together with others on something to improve my neighbourhood") from the adapted version of Buckner's (1988) neighbourhood cohesion scale (Fone, Farewell, & Dunstan, 2006). *Place Attachment* was measured with five items from a scale developed by Venables, Pidgeon, Parkhill, Henwood, and Simmons (2012). The scale was internally consistent (Cronbach's $\alpha = .73$). *Attitudes to living in Wales* were measured with items such as "I am proud of living in Wales" and "I am happy to pay a little extra for goods that are produced in Wales". The four-item scale was internally consistent (Cronbach's $\alpha = .73$).

2.3. Validation variables

A wide range of self-reported environmental behaviours were included in the survey to cover the domains of household energy use, travel and transport, waste and recycling, and water use. Exploratory factor analyses showed that, in line with previous research (e.g. Barr & Gilg, 2006; Whitmarsh & O'Neill, 2010), the environmental behaviours mainly clustered according to domain. It was decided to make a further distinction between *curtailment and efficiency measures*, as these have been shown to have different psychological properties (Gardner & Stern, 2002; Poortinga, Steg, Vlek, & Wiersma, 2003). Most of the original response scales of the items were based on the *stages of behaviour change model* (Prochaska & Velicer, 1997). The stages-of-behaviour-change response scale were used to allow comparisons with previous segmentation exercises (e.g. Defra, 2008). In this study, responses were dichotomised to simplify the analyses.

Energy Curtailment. The energy curtailment scale was made up of eight behaviour changes that can save energy at home (turning off the heating when everyone is out for a few hours in the winter, hanging the washing up to dry rather than using a tumble dryer in summer, switching off lights when no one is in the room, only boiling the kettle with as much water as you need, shutting down your laptop overnight rather than leaving it on standby, switching off your TV rather than leaving it on standby, putting on a jumper or extra layer when you are cold rather than turning up the heating, washing clothes at 30° or less). The internal consistency of the eight energy curtailment behaviours was somewhat low (Cronbach's $\alpha = .57$), but could not be improved by excluding behaviours.

Energy Insulation. Energy insulation behaviours are one-off actions that increase the energy-efficiency of houses. The scale included installing cavity/solid wall insulation, loft insulation or top-up loft insulation, double or secondary glazing, and draught proofing. The energy insulation scale was internally consistent (Cronbach's $\alpha = .79$).

Energy-Efficient Heating. The energy-efficient heating scale included four one-off actions that improve the efficiency of the heating system: having thermostat controls fitted on individual radiators, installing a hot water jacket to insulate your hot water tank, replacing an old boiler with a high efficiency condensing boiler, and installing pipe work insulation. The reliability of the scale was adequate (Cronbach's $\alpha = .65$).

Transport Curtailment. The transport curtailment scale included five behaviour changes that can save energy for transport

purposes (switching to public transport instead of driving for long journeys, switching to walking or cycling instead of driving for short journeys, driving in a more fuel-efficient way, minimising the number of car journeys, and choosing local destinations for leisure trips or shopping). The resulting 6-point scale was sufficiently reliable (Cronbach's $\alpha = .60$).

Energy-Efficient Car. Respondents were asked if they had switched to a smaller/more fuel-efficient car. This was the only efficiency measure within the transport domain and was therefore included as a single item. The response scale was dichotomised.

Number of Flights. Respondents were asked how many flights they had taken in the last 12 months for leisure/holidays purposes, or for visiting friends and family. A majority had taken no flight at all (64%); 24% had taken 1 or 2 flights; and 12% had taken 3 or more flights in the past 12 months.

Waste Reduction. Nine behaviours were included that could reduce the amount of household waste: deciding not to buy something because it has too much packaging, reusing items, taking your own shopping bag when shopping, composting household food and/or garden waste, taking a shopping list with you and sticking to it, hiring or borrowing an item to avoid buying something new, repairing or maintaining an item to avoid buying something new, buying less stuff, and avoiding buying single-use disposable items. The scale was internally consistent (Cronbach's $\alpha = .66$).

Waste Recycling. Waste recycling was measured with a single item. The distribution across the original 4-point scale allowed the item to be dichotomised to compare "I recycle everything that can be recycled" to all other responses.

Food Waste. Self-reported food waste was indicated by the item of "how much eaten food would you say you end up throwing away" with the response option of: "none", "hardly any", "a small amount", "some", "a reasonable amount", and "quite a lot".

Water Curtailment. Seven water curtailment actions were included in the survey: turning off the tap when brushing teeth, fixing leaking taps, washing up in bowl rather than running water, taking a shower rather than a bath, taking shorter showers, reducing the number of loads of washing by running only full loads. The Cronbach's α was low (.58) but could not be improved by adding or removing items.

Water Efficiency. The survey included four water efficiency measures (e.g. dual flush toilet, hippo water saving device). These measures were excluded from the analyses due to a very low uptake in the sample and a lack of internal consistency.

3. Results

3.1. Selection of the segments

The study combined *hierarchical* and *k-means clustering* to determine the optimal number of segments. First, hierarchical clustering analyses were conducted for 2 to 15 cluster solutions. Ward's method with squared Euclidean distances was used to determine the number of clusters. The number of clusters was validated visually by the *Elbow method* in which the variance explained was plotted against the number of clusters. Multiple 'elbows' were identified at five, six, and nine cluster solutions.

After the analyses were completed, a number of 'naming workshops' were organised to generate meaningful labels for the segments. This conforms to the good-practice principle that an effective segmentation model is also judged by its users, and not only by internal statistical measures (Anable et al., 2015). The workshops were attended by representatives of different Government departments and civil society organisations from Wales who

partner with the Welsh Government on sustainability-related issues. The participants of the workshops were invited to generate names that could describe the different segments. The names were then discussed by the project partners after which a decision was reached. The segments were named in both English and Welsh. The process intended to include stakeholders in the naming of the segments and create ownership among potential users of the model.

3.2. Description of the segments

A *MANOVA (Multivariate Analysis of Variance)* with *post-hoc comparisons (Tukey's b test)* was conducted to describe how the six segments scored on the thirteen input variables. As may be expected, the segments differed significantly across all 13 indices, $F(65, 7385) = 71.774, p < .001, \eta^2 = .39$. The segments' mean scores on the input variables are presented in Table 1.

Enthusiasts (Y Brwd) stood out as the most positive segment. Enthusiasts appeared engaged with virtually all issues raised in the survey. Members of this segment had positive views on all aspects of sustainability (environmental, economic and social sustainability, and sustainable living); and were also the most concerned segment about climate change. Enthusiasts further reported the highest levels of social capital and place attachment, and had very positive views on living in Wales. The segment scored highly on three out of four personal value dimensions.

Pragmatists (Pragmatwyr) showed slightly lower levels of engagement. Pragmatists were relatively concerned about climate change; thought that the environment should take priority over the economy; and expressed positive views on sustainable living. However, they only engaged moderately with environmental sustainability and energy security issues. Moreover, members expressed negative views on economic sustainability. In contrast to Enthusiasts, Pragmatists scored low on all personal value dimensions. The segment reported moderate levels of social capital, place attachment, and views on living in Wales.

Aspirers (Yr Uchelgeisiol) scored average on most indices. The segment stood out in terms of their self-enhancement and openness-to-change values, as well as their endorsement of economic sustainability. Aspirers expressed one of the lowest levels of concern about energy security and reported low levels of social capital and place attachment.

Community Focused (Pobl eu Milltir Sgwar) can be characterised as conservative and engaged with their community. The segment reported some of the highest levels of place attachment and social capital, and had very positive views on living in Wales. Although Community Focused endorsed both environmental and economic sustainability, they thought that economic growth and jobs should take priority over the environment. The segment expressed low concern about energy security issues.

Commentators (Y Sylwebwyr) were the least engaged with environmental sustainability. They were the least likely to endorse pro-environmental beliefs; the most likely to prioritise the economy over the environment; and the most likely to say that a sustainable lifestyle is a low priority compared to other things in their life. Commentators were the least concerned of all the segments about climate change, but the most concerned about energy security. The segment scored highly on self-enhancement, openness-to-change, and conservative values.

Self-Reliant (Yr Hunanddibynnol) were almost the complete opposite of Enthusiasts. They were disengaged with most issues raised in the survey. Members of this segment scored low on all personal value dimensions, and had negative views on environmental sustainability, sustainable living, and economic sustainability. Overall, Self-Reliant prioritised the economy over the

Table 1
Means and standard deviations of the thirteen standardised segmentation indices for the six segments.

Variables	Scale	Segments						p
		Enthusiasts (n = 257)	Pragmatists (n = 321)	Aspirers (n = 232)	Community focused (n = 304)	Commentators (n = 179)	Self-reliant (n = 244)	
Personal values								
Self-transcendence	Z	.76 (.65)a	-.35 (.80)d	.33 (.81)b	.13 (.85)c	.04 (.81)c	-1.19 (.91)e	<.001
Self-enhancement	Z	.11 (.85)b	-.71 (.78)d	.60 (.92)a	.26 (.91)b	.58 (.84)a	-.37 (.80)c	<.001
Conservative values	Z	.47 (.81)a	-.69 (.79)c	.18 (.84)b	.49 (.71)a	.40 (.82)a	-.79 (.86)c	<.001
Openness-to-change	Z	.37 (.93)a	-.53 (.86)c	.49 (.84)a	.10 (.84)b	.43 (.82)a	-.83 (.90)d	<.001
Sustainability								
Environmental Sustainability	Z	.67 (.74)a	.01 (.88)c	.12 (.79)bc	.29 (.73)b	-1.17 (.93)e	-.61 (.89)d	<.001
Economic Sustainability	Z	.43 (.76)a	-.37 (.99)b	.34 (.74)a	.38 (.72)a	.26 (.85)a	-.70 (.99)c	<.001
Environment–Economy Trade-Off	Z	.86 (.64)a	.45 (.68)b	-.04 (.78)c	-.52 (.86)d	-.81 (.76)e	-.64 (.78)d	<.001
Sustainable living	Z	.88 (.82)a	.34 (.75)b	-.06 (.72)c	-.49 (.78)d	-.79 (.90)e	-.63 (.66)de	<.001
Climate change & energy security								
Attitudes to climate change	Z	.98 (.60)a	.32 (.64)b	.14 (.70)c	-.15 (.72)d	-1.05 (.86)f	-.66 (.72)e	<.001
Concern about energy security	Z	-.40 (.82)d	.02 (.88)c	-.26 (.78)d	-.34 (.75)d	.91 (1.02)a	.33 (.90)b	<.001
Community & place								
Social capital	Z	.45 (.79)a	.11 (.79)b	-.78 (.89)c	.38 (.73)a	.06 (.92)b	-.68 (.94)c	<.001
Place attachment	Z	.47 (.63)a	.11 (.70)b	-1.09 (.94)d	.42 (.62)a	.38 (.56)a	-.53 (.86)c	<.001
Living in Wales	Z	.68 (.59)a	-.05 (.78)c	-.05 (.77)c	.43 (.63)b	-.23 (.92)c	-1.08 (.96)d	<.001

Note: all scales were normalised by calculating the Z scores; means in the same row with different subscripts differ from one another.

environment, were sceptical about climate change, and expressed high levels of concern about energy security. Together with Aspirers, Self-Reliant reported the lowest levels of social capital and place attachment. The segment had the most negative views on living in Wales.

3.3. Socio-demographic characteristics of the segments

Table 2 shows that the six segments differed significantly in terms of gender, age, household type, tenure, social grade, and Welsh Identity. The segments also lived in different places, both in terms of rurality and level of deprivation. *Enthusiasts* were more likely to be female, middle aged (between 35 and 64), and to have children. They were also more likely to have a high socio-economic background and to be a home-owner. The segment contained the lowest proportion of 16–24 year olds, singles, and social grade C2DE. *Enthusiasts* were among the least likely to live in deprived urban areas and to have a Welsh identity. *Pragmatists* had an average age profile, but were more likely to be male, home-owner, and to have grownup children. Just as *Enthusiasts*, *Pragmatists* were among the least likely to live in deprived urban areas and to have a Welsh identity. The segment was the least likely to be married or cohabiting without children. *Aspirers* were the youngest of all segments. The segment contained a high proportion of single men with a Welsh identity. Although *Aspirers* had an average socio-economic background, they were less likely to be home-owner. Members of this segment were among the most likely to live in deprived urban areas. *Community Focused* was one of the older segments of the study. Members were likely to be a home-owner and to live in a neighbourhood with low levels of deprivation. However, they were among the least likely to come from social grade AB. *Community Focused* had a strong Welsh identity and were likely to be married or cohabiting without children. *Commentators* were, together with *Community Focused*, one of the older segments. *Commentators* were among the most likely to be a home-owner and to live in a village with a low level of deprivation. Just as *Community Focused*, *Commentators* had a strong Welsh identity. *Self-Reliant* were likely to be male, single and married/cohabiting without children. *Self-Reliant* were the most likely to live in deprived urban areas and to be from social grade C2DE, and

the least likely to be a home-owner. The segment had an average age profile. It appeared that *Enthusiasts* were somewhat under-represented in South Wales, while *Pragmatists* were somewhat under-represented in the South East. *Aspirers* were predominantly based in the South East, but under-represented in mid and south Wales. The *Community Focused* segment could mainly be found in the South of Wales, but less likely so in the South East. *Commentators* could be found in all regions, but were somewhat over-represented in the North West. *Self-Reliant* could also be found in all regions, but were slightly under-represented in the South and South East.

3.4. Validation of the segments with self-reported environmental behaviours

Table 3 shows the average scores and standard deviations of the ten self-reported environmental behaviour scales for the six segments. The segments reported widely varying patterns of behaviour, $F(50, 7550) = 6.908$, $p < .001$, $\eta^2 = .05$. *Enthusiasts* were the most likely to behave in a sustainable way. The segment stood out in terms of their engagement in curtailment behaviours. The segment was also among the most likely to have insulated their house, taken actions to improve the efficiency of their heating system, and to have an energy-efficient car. *Pragmatists* were to a large extent comparable to *Enthusiasts*. The segment was similarly likely to curtail their energy use, transport and waste production. Furthermore, they were among the most likely to have insulated their home, to have taken actions to improve the efficiency of their heating system, and to have an energy-efficient car. The segment had taken the fewest flights of all. *Aspirers* were among the least likely to behave in a sustainable way. Members were particularly less likely to have insulated their homes, to have taken actions to improve the efficiency of their heating system, and to have recycled everything that can be recycled. *Aspirers* had taken the most flights in the past 12 months. The segment was average in regards of their engagement in curtailment behaviours. *Community Focused* scored average on most behaviour scales. Members of this segment were more likely to adopt energy-efficiency measures than to curtail their behaviour. *Commentators* were the most likely to have insulated their house, to have taken one-off actions that improve the

Table 2
Socio-demographic characteristics of the six segments (in %).

Variable	Category	Segments						Overall (n = 1538)	p
		Enthusiasts (n = 257)	Pragmatists (n = 321)	Aspirers (n = 232)	Community focused (n = 304)	Commentators (n = 179)	Self-reliant (n = 244)		
Gender	Female	62	47	47	57	51	45	52	<.001
	Male	38	53	53	43	49	55	48	
Age group	16–24	8	12	28	13	16	18	15	<.001
	25–34	14	11	20	15	12	12	14	
	35–44	18	18	16	16	9	17	16	
	45–54	21	21	14	14	16	15	17	
	55–64	22	18	13	14	17	11	16	
	65+	18	20	9	30	30	28	22	
Household Type	Single	22	31	38	27	37	38	32	<.001
	Married/cohabiting, no children	26	18	26	32	26	31	26	
	Having children at home	33	33	29	29	24	22	29	
	Have children grown up	19	18	7	12	12	8	13	
Tenure	Non-home-owner	22	26	43	26	18	38	29	<.001
	Home-owner	78	75	57	74	78	62	71	
Social grade	AB	32	24	23	16	21	8	21	<.001
	C1	32	28	25	31	27	25	28	
	C2	12	19	20	20	26	25	20	
	DE	24	28	32	33	26	42	31	
Welsh Identity	No	48	42	30	28	30	38	36	<.001
	Yes	52	58	70	72	70	62	64	
Area Classification	Urban	60	57	72	56	61	74	63	<.001
	Town and fringe	14	20	16	17	13	15	16	
	Village	17	13	7	16	18	5	13	
	Hamlet and isolated dwelling	9	9	5	11	8	6	8	
WIMD ^a	Low	48	41	28	41	43	32	39	<.001
	Medium	35	40	36	36	40	42	38	
	High	17	19	37	24	17	26	23	
Region	South East	26	22	39	16	27	29	26	<.001
	West	12	11	8	11	9	7	10	
	North West	12	10	8	9	14	9	10	
	Mid	9	10	3	7	6	7	7	
	South	28	36	30	41	31	37	34	
	North East	13	12	11	16	13	11	13	

Note: not all values sum to 100% due to rounding.

^a Welsh index of multiple deprivation.

Table 3
Means and standard deviations of ten environmental behaviour scales for the six segments.

Behaviours	Scale	Segments						Overall (n = 1538)	p
		Enthusiasts (n = 257)	Pragmatists (n = 321)	Aspirers (n = 232)	Community focused (n = 304)	Commentators (n = 179)	Self-reliant (n = 244)		
<u>Household energy use</u>									
Energy curtailment	0–8	6.20 (1.47)a	6.04 (1.50)ab	5.80 (1.71)bc	5.62 (1.82)c	5.51 (1.68)c	4.96 (1.87)d	5.71 (1.71)	<.001
Energy insulation	0–4	1.73 (1.38)ab	1.68 (1.41)ab	1.32(1.43)c	1.73 (1.48)ab	1.98 (1.45)a	1.49 (1.44)bc	1.65 (1.44)	<.001
Energy-efficient heating	0–4	1.43 (1.31)ab	1.41 (1.26)ab	.90 (1.05)c	1.33 (1.20)ab	1.51 (1.32)a	1.19 (1.29)b	1.30 (1.25)	<.001
<u>Travel and transport</u>									
Transport curtailment	0–5	2.88 (1.44)a	2.69 (1.45)a	2.01 (1.36)bc	2.33 (1.45)b	2.26 (1.31)b	1.92 (1.32)b	2.37 (1.44)	<.001
Energy-efficient car	0–1	.37 (.48)a	.34 (.48)ab	.31 (.46)ab	.39 (.49)a	.38 (.49)a	.23 (.42)c	.34 (.47)	<.01
Number of flights	0–50	1.10 (1.68)ab	.72 (1.53)a	1.40 (2.41)b	.93 (1.86)ab	1.37 (4.32)b	.80 (1.67)a	1.01 (2.27)	<.001
<u>Waste and recycling</u>									
Waste reduction	0–9	5.53 (1.90)a	5.18 (1.95)a	4.10 (1.94)c	4.66 (2.05)b	4.06 (2.10)c	3.45 (2.13)d	4.57 (2.12)	<.001
Waste recycling	0–1	.70 (.46)a	.49 (.50)bc	.44 (.50)c	.59 (.49)ab	.55 (.50)b	.43 (.50)c	.53 (.50)	<.001
Food waste	0–5	1.80 (1.09)a	1.78 (1.17)a	1.89 (1.15)a	1.73 (1.07)a	1.70 (1.16)a	1.93 (1.17)a	1.81 (1.13)	n.s.
<u>Water use</u>									
Water curtailment	0–7	5.39 (1.42)a	4.96 (1.47)b	4.59 (1.67)b	4.86 (1.71)b	4.61 (1.60)b	4.21(1.75)c	4.79 (1.64)	<.001

Note:; means in the same row with different subscripts differ from one another.

efficiency of their heating system, and to have an energy-efficient car. However, they were less willing to engage in curtailment

behaviours. This segment had taken an average number of flights in the past 12 months. *Self-Reliant* were the least likely to have changed their behaviour to be more sustainable. Overall, members of this segment were the least likely to have reduced household and transport energy use, to have reduced or recycled waste, or to have curtailed water use. They were equally unlikely to engage in curtailment behaviours or to have taken energy-efficiency measures. *Self-Reliant* had taken relatively few flights.

Overall, the segmentation model was more successful in explaining curtailment behaviours (11%, 9%, 6% and 5% for transport curtailment, waste reduction, energy curtailment and water curtailment respectively) than owning an energy-efficient car, number of flights taken, and food waste (1% each).

3.5. The segmentation screening tool

The study further set out to develop a screening tool with as few items as possible to reliably replicate the segments. It was attempted to identify the fewest number of items to predict group membership with the greatest possible accuracy, while having all 13 input scales represented within the tool. Fifteen items were selected on the basis of a series of *discriminant analyses* (See Appendix A). The items could replicate the six segments with an average accuracy of 72% (see Table 4).² This is a great improvement as compared to the by chance accuracy rate of 17%. The Cohen's kappa (κ) for the classification accuracy is .68, which is close to the commonly used cut-off criterion of .70. The tool was verified through a 75%–25% split-sample cross-validation procedure. The discriminant analysis conducted on the *analysis subsample* ($n = 1118$) produced very similar results to the one conducted on

the whole sample. The resulting model could successfully predict 72% of group membership in the *holdout subsample* ($n = 420$).

The whole-sample discriminant analysis was used to summarise how the six segments differ from one another (see Table 4). The first *Environmental Sustainability* function combined self-transcendence values, concern about climate change, and a prioritisation of the environment over economic growth. There was a clear gradient in environmental sustainability from the first Enthusiasts segment to the last *Self-Reliant* segment. The second *Economic Sustainability* function was characterised by conservative and self-enhancement values together with a prioritisation of economic growth over the environment. This function mainly discriminated between Community Focused and Commentators on the one hand and Pragmatists and *Self-Reliant* on the other. The third function was dominated by place attachment and social capital. This *Social Sustainability* function sets Aspirers—who give it a very low priority—apart from all other segments. The fourth function can best be described as an *Energy Security* dimension. This function discriminated mainly between Community Focused and Commentators. The fifth function was the least important. This *Landscape Protection* dimension was a combination of finding protection of the Welsh landscape important and self-transcending values (finding preserving nature important). This dimension mainly discriminated between Pragmatists on the one hand (who find landscape protection important) and Enthusiasts and *Self-Reliant* (who find landscape protection less important), although the differences were generally small.

4. Discussion

Table 4
Results of the discriminant analysis (structure matrix and group centroids).

Item ^a	Structure matrix	Function				
		1	2	3	4	5
8	Environment–Economy Trade-Off	.41	-.21	.04	-.25	-.04
11	Attitudes to Climate Change	.40	-.19	-.06	-.04	-.07
9	Environment–Economy Trade-Off	.38	-.38	.06	-.24	.23
1	Self-Transcendence	.37	.25	-.06	-.05	.34
3	Conservative Values	.16	.48	-.10	-.12	-.19
2	Self-Enhancement	.05	.43	-.23	-.12	-.21
7	Economic Sustainability	.12	.41	-.15	-.04	-.15
4	Openness-to-Change	.12	.33	-.12	-.25	-.10
14	Place Attachment	.10	.16	.73	.02	-.29
13	Social Capital	.12	.21	.73	.10	-.04
5	Environmental Sustainability	.37	-.06	-.07	-.59	-.18
12	Concern about Energy Security	.23	-.01	-.10	.48	-.07
10	Sustainable Living	.26	-.25	-.05	-.35	-.09
15	Living in Wales	.31	.24	.05	.10	.67
6	Environmental Sustainability	.25	-.22	-.10	.11	-.31
		<u>Function</u>				
	Group Centroids	1	2	3	4	5
	Segment 1	2.26	.01	.22	.28	-.19
	Segment 2	.32	–1.15	.43	-.01	.20
	Segment 3	.24	.23	–1.60	-.00	.08
	Segment 4	.01	1.08	.43	-.63	.01
	Segment 5	–1.69	1.23	.44	.77	.08
	Segment 6	–2.14	-.97	-.09	-.12	-.23

Note: factor loadings of .30 and higher are in bold; items are recoded so that higher values represent higher levels of agreement.

^a Items are presented in Appendix A; function interpretations: [1] Environmental Sustainability; [2] Economic Sustainability; [3] Social Sustainability; [4] Energy Security; [5] Landscape Preservation.

² Segment 1 73%; Segment 2: 74%; Segment 3: 70%; Segment 4: 73%; Segment 5: 71%; and Segment 6: 71%.

This paper described the development of a sustainability segmentation model that can be used by governments and civil society organisations to engage the public across different sustainability-relevant policy areas. The study attempted to profile the general

public on their views on sustainability and sustainability-related issues, in order to be able to develop more tailored communications and behaviour change initiatives across different sustainability domains. The research took a psychographic approach in that the segmentation was based on a number of distal psychosocial variables that could be considered determinants across a wide variety of self-reported environmental behaviours.

The study identified six different publics who relate to sustainability in distinct ways. Members of the *Enthusiasts (Y Brwd)* segment were highly engaged with all aspects of sustainability and the most willing to behave in a sustainable way across the board. *Pragmatists (Y Pragmatwyr)* were, just as *Enthusiasts*, willing to engage in various efficiency and curtailment behaviours. However, they appeared less ideological than the *Enthusiasts* segment. This segment was therefore interpreted as being pragmatically engaged with sustainability issues. *Aspirers (Yr Uchelgeisiol)* represented the youngest segment of the analysis. Although this segment showed little involvement in environmental and social sustainability, they considered economic sustainability relatively important. They were also among the least likely to behave in an environmentally sustainable way. The *Community Focused (Pobl eu Milltir Sgwar)* and *Commentators (Y Sylwebwyr)* represented older segments of the Welsh population. Both were more engaged with economic and social sustainability than with environmental sustainability. However, there were some distinct differences between the two segments: whereas *Commentators* expressed very negative attitudes to climate change, combined with high levels of concern about energy security, *Community Focused* expressed more positive views on community and place. Both *Community Focused* and *Commentators* were more likely to adopt energy-efficiency measures than to 'curtail' their behaviour for environmental reasons, which may reflect their socio-economic position affording such energy-efficiency investments. The *Self-reliant (Yr Hunanddibynno)* segment was almost the complete opposite of the *Enthusiasts* segment. This segment was disengaged with all aspects of sustainability and the least willing to perform a wide range of environmental behaviours.

To our knowledge, this is the first comprehensive sustainability segmentation model, in the sense that it covered social, environmental and economic aspects of sustainability rather than a single environmental issue or domain. The broad approach resulted in a model with clearly differentiated groups that varied across a number of qualitatively distinct dimensions, most notably respondents' views on environmental, economic and social sustainability. This can be contrasted to the unidimensional solutions that are generally found for single-issue models (see e.g. Hine et al., 2014 for an overview on climate change models). The model was validated with a broader and more diverse set of self-reported environmental behaviours than any other segmentation models in the environmental domain. Furthermore, a 15-item screening tool was developed alongside the main model to facilitate the replication of the six segments, which will help policy-makers and practitioners to identify the different segments with a relatively small number of questions.

A particular weakness of the current model was the reliability of the newly developed sustainability scales, suggesting that more work is needed to capture attitudes to all three pillars of sustainability. Scales with lower reliabilities are problematic, as they will have larger measurement errors. This will affect the statistical power of the research. However, this can to some extent be offset by using larger samples with greater statistical power (Mueller, 1986). Others have argued that slightly lower reliabilities may be acceptable when the scales are in an early stage of development (Nunnally, 1978), which was the case for the sustainability scales. Furthermore, lower values can be expected from shorter scales. In

many cases it is not possible to lengthen an index, in particular where they are designed to be used in population surveys. This poses a trade-off between the length and internal consistency of a measure (Yusuf, Gherunpong, Sheiham, & Tsakos, 2006).

The study found that the segments have distinct socio-demographic profiles and behavioural patterns. A number of conclusions can be drawn from these findings. First, values and sustainability-related beliefs vary across different socio-demographic groups, and appear to change throughout a person's lifetime as experiences and circumstances change. The segments could even be interpreted as representing different life stages, with *Aspirers* being the youngest segment (cf., young adulthood), *Enthusiasts* and *Pragmatists* representing middle adulthood, and *Community Focused* and *Commentators* being more common among the older age groups (cf., late adulthood; Erikson, 1963). The disengaged *Self-Reliant* segment is equally distributed across the different life stages. The age differences in values and beliefs could reflect life-stage changes or could be considered attributes of different age cohorts, created by unique circumstances in which they grew up and aged (Ryder, 1965), although it is likely that both age and cohort effects play a role. The understanding that motivations and circumstances may change throughout a person's lifetime shows that there is a need for more dynamic models that can grasp such temporal processes, rather than assuming that the identified segments have fixed preferences over the life course. However, as with any model, it is best not to label segments according to their predominant socio-demographic characteristics, as they are not the only defining variables of the segments; each segment will always have its exceptions (Anable et al., 2015). Second, even if the segments were constructed using a number of generic, 'distal' psycho-social variables, they distinguished between all but one of the behavioural measures; although the effect sizes were admittedly small. While the associations with individual behaviours are generally smaller than for more behaviour- or domain-specific models, the segments of the current model are associated with a wider range of self-reported environmental behaviours.

There are however a number of methodological and practical limitations that relate to (a) the approach taken in the current study, (b) segmentation methodology in general, and (c) the use of audience segmentation for social marketing purposes. The broad approach of the current study is both a strength and a weakness. It is essential that an audience segmentation is fit for purpose. A key strength of social marketing is that it tends to focus on the motivations and barriers of a specific set of behaviours that then can be used to design a more effective intervention. Broad segmentations may be less suitable in that sense, as they are unable to capture the complexity of specific environmentally-related practices that may be needed to design an intervention to change them. Indeed, distal factors tend to explain less of the variance of individual behaviours than proximal variables. However, it would be impractical and costly to produce a model for each and every topic or behaviour, and would risk fragmenting sustainability policy. A strength of the approach taken in this study is that distal variables are more likely to be associated with multiple behaviours. While a specific model may be able to achieve greater gains in a single set of behaviours, a broader model can be used to achieve gains across a wider range of behaviours. It also has to be considered that segmentation models are essentially an analytical tool that help policy makers and campaigners to improve the efficiency of behaviour change and/or communication initiatives (Barnett & Mahony, 2011), and that even small improvements in efficiency could produce substantial gains at the population level.

The second point relates to cluster analysis as a strategy to segment the general public. Cluster analysis is an exploratory statistical technique that can recognise patterns in large data sets

(McDonald & Dunbar, 1995). The problem is that cluster analysis can find patterns in any dataset without providing an explanation or interpretation. For the model to be capturing meaningful 'publics', it needs to be based on a clear conceptual framework that is relevant to its purpose. While the current study, just like most other segmentation studies, is to some extent a-theoretical in the sense that it is not based on a single theory or behavioural model, it uses a coherent framework of factors that have been shown to predict self-reported environmental behaviours across a number of domains. The aim of the study was to develop a comprehensive model that can be applied in different sustainability policy areas to design more tailored communications and behaviour change initiatives. The observation that the six segments can be ordered along qualitatively distinct sustainability dimensions and associated with behaviours in the priority domains of the Welsh Government suggests the model is fit for that purpose.

The final point relates to practical difficulties in adopting and implementing segmentation models for social marketing purposes (Barnett & Mahony, 2011; McDonald & Dunbar, 1995). As argued before, it is essential for a segmentation model to provide a screening tool that can be used in further research and/or public engagement initiatives in order to avoid being left on the shelves. However, even with a screening tool the recruitment of segments can be challenging. A lack of a geographical grounding makes it difficult to identify and target them specifically, especially when it is not possible to screen the public beforehand. This could be (partly) solved by including geo-demographical indicators that can be used as a proxy in the absence of a screening tool. In this study the segments were described according to their socio-economic and demographic characteristics as well as a number of geographical variables, such as rurality, levels of deprivation, and region, which all can help to target the different segments.

The sustainability segmentation study was followed up by qualitative work to develop a more detailed understanding of the different segments' motivations, values and lifestyles, and explore how they understand and respond to different sustainability messages (Nash et al., 2012). This follow-up work confirmed that the segments talk differently about sustainability and are susceptible to different 'narratives' or messages about sustainability (Marshall & Darnton, 2014). The study further showed that life-stage plays an important part in how views on sustainability and sustainable development are constructed, and that 'place' matters more than is currently accounted for in the sustainability segmentation model (Nash et al., 2012). The segmentation model together with the messages developed and tested in the 'narratives' project were used to plan and design of a number communication initiatives in Wales, including the *Way To Go* campaign and the *Resource Efficient Wales Service* (Welsh Government, personal communication, 17 February 2015). The *Way To Go* campaign primarily targeted Aspirers through messages that were distributed via social media and radio stations popular with young adults. The *Resource Efficient Wales Service* designed specific messages for all six segments that are to be delivered in regions where the segments can be found, and distributed via media used by the segments. The screening tool itself was used as an instrument to engage the general public with the sustainability agenda during the 2014 Climate Week.

This study has shown that it is possible to segment the public according to their views on sustainability and sustainability-related issues in a meaningful way; and a segmentation model can be developed across different environmental policy priority areas. However, we would warn against a deterministic interpretation and use of the segments. The generic description of the segments may fuel a misperception that everyone conforms to the archetype of the segment. While the clusters represent relatively coherent publics, there still is considerable within-cluster variation, and

many respondents will be 'off-mean' rather than conforming to the 'average' segment type. Furthermore, the clusters are not fixed entities, but constructed through a complex decision-making process. The number, size and content of the segments are therefore dependent on a multitude of factors, including the content of the input variables, the choice of statistical criteria and algorithms, and personal judgements of the model owners. Ultimately, segmentation models, such as the one described in this paper, are practical tools for policy purposes. They will need to be made as useful, hence as accurate as possible, within the real limits of time and resources available to policymakers and practitioners that will use them in the field to promote sustainable development.

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Appendix

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The Welsh Sustainability Segmentation Screening Tool.

Item no	Scale	Item
1	Self-Transcendence	I am going to read out a list of different values. Please rate the importance of the following values to you personally: Protecting the environment (preserving nature). ¹
2	Self-Enhancement	I am going to read out a list of different values. Please rate the importance of the following values to you personally: Being influential (having an impact on people and events). ¹
3	Conservative Values	I am going to read out a list of different values. Please rate the importance of the following values to you personally: Sense of belonging (feeling that others care about me). ¹
4	Openness-to-Change	I am going to read out a list of different values. Please rate the importance of the following values to you personally: Being independent (self-reliant, self-sufficient). ¹
5	Environmental Sustainability	If things continue on their current course, we will soon experience a major environmental disaster. ²
6	Environmental Sustainability	People who fly should bear the cost of the environmental damage that air travel causes. ²
7	Economic Sustainability	It is very important for Wales to have a high level of economic growth. ²
8	Environment–Economy Trade-Off	There are much more important things for me to do than protect the environment. ²
9	Environment–Economy Trade-Off	Economic growth and creating jobs should be the top priority, even if the environment suffers. ²
10	Sustainable Living	Being green is an alternative lifestyle; it's not for the majority. ²
11	Attitudes to Climate Change	The effects of climate change are too far in the future to really worry me. ²
12	Concern about Energy Security	Supplies of fossil fuels (e. g. coal and gas) will run out: how concerned in the future? ²
13	Social Capital	I feel like I belong to this neighbourhood. ²
14	Place Attachment	If I were to move I would like to live in a similar place to where I live now. ²
15	Living in Wales	We should act to protect the Welsh landscape so it can be enjoyed by future generations. ²

Note: (1) response options: Extremely important, Very important, Fairly important, Not very important, Not at all important, Don't know; (2) response scale: Strongly agree, Tend to agree, Neither agree nor disagree, Tend to disagree, Strongly disagree, Don't know.

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