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Community-level initiatives will play a key role in meeting greenhouse gas reduction targets. This paper examines the experience gained in applying a targeted social marketing approach to foster local-scale community pro-environmental behavioural change in the City of York, UK. This involved determining the neighbourhood carbon footprint, identifying residents that had access to appropriate infrastructure and were receptive to green issues. Six community teams were recruited from the selected neighbourhoods and provided with information, advice and mentoring on how to reduce their carbon footprint over a six-month period. A statistically significant reduction in carbon emissions was achieved. Each participant achieved a mean reduction in their carbon footprint of 2.0 tonnes of CO_2e/year. The largest reductions were achieved in the areas of shopping and home energy. In addition, it helped to foster community spirit. Based on the experience gained from implementing this approach, a cost-effective model of community engagement is proposed.

Keywords: behavioural change; carbon footprint; community; social marketing; targeted approach; City of York

Introduction

The global nature of climate change and resource scarcity has resulted in a progressive shift towards governing environmental issues at the regional and local levels (Barr *et al*. 2011). This has resulted in a focus on the resource consumption of organisations, communities and individuals (Owens 2000). Many activities that contribute to greenhouse gas emissions result from the choices made by individuals, households, businesses and other stakeholders at the local community level (Ostrom 2009). If the UK national target of 80% reduction in greenhouse gas emissions is to be met then we will need to change the way communities consume and produce goods and services (Mulugetta *et al*. 2010). Many sections of the community are still yet to be convinced of the need to change. Therefore, additional effort will be required to promote sustainable lifestyles and foster pro-environmental behavioural change at the community level (Heiskanen *et al*. 2010).

A number of factors shape pro-environmental attitudes and behaviour. These include knowledge (e.g. how individuals interpret information based on existing beliefs), psychological factors (e.g. values, attitudes and emotions that affect behaviour and give a sense of responsibility), habits (e.g. behaviour that contributes to carbon emissions is often habitual and routine), structural conditions (e.g. infrastructure – or lack of it – can lead to "lock-in" situations providing an obstacle to behavioural change) and socio-demographic patterns

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(e.g. the influence of these factors vary with individual circumstances) (Kollmuss and Agyeman 2002, Sanne 2002, Haq *et al*. 2008).

In designing engagement strategies, information provided should enable practical action (e.g. personalised carbon reduction plans); impacts of behaviour should be made visible (e.g. use of smart meters); new behaviours should fit within existing routines (e.g. targeting people at different life stages such as retirement/moving home); provide feedback and rewards on the changes made; target a whole community or neighbourhood to instil collective change and take account of the rebound effect (e.g. money saved on energy being used to buy new energy-using devices) (Owens 2000, Bedford *et al.* 2004, Abrahmse *et al*. 2005, Jackson 2005).

Local authorities have a key role to play in fostering the development of low carbon communities and reducing *per capita* carbon dioxide (CO_2) emissions. Until recently, UK local authorities were assessed against three national performance indicators which focused exclusively on climate change (CLG 2007). Although National Indicator 186 on "Per capita reduction in CO_2 emissions" in the local authority area was seen as being imperfect it was acknowledged for successfully raising the profile of carbon emission reductions in local authorities (Audit Commission 2009). In October 2010, the UK Coalition government abolished national performance indicators and placed greater emphasis on a localist approach giving new powers to local councils, communities, neighbourhoods which it encapsulated in the notion of the "Big Society" with a focus on citizen-consumers, where individuals must act as "good" citizens exercising "choice" in the market place (Clarke *et al*. 2007).

A memorandum of understanding between the Department for Energy and Climate Change (DECC) and the Local Government Group (LGG) commits both partners to "help and encourage all local councils to take firm action – underpinned by local and ambitious targets and indicators". DECC and LGG acknowledge that "policies set at national level affect the ability of councils to act a local level, and that local action affects the ability of national government to meet it targets" (DECC/LGG 2011).

The promotion of a localist agenda together with a reduction in the public sector budget and the requirement to meet CO_2 emission reduction targets mean local authorities will need to be more targeted in their approach and use limited resources more effectively.

Box 1. City of York.

The City of York is situated in the northeast of England in the region of Yorkshire. It has a population of approximately 180,000 people. It has a historic centre surrounded by a medieval wall. In recent years York has become a recognised tourist destination attracting 7 million visitors a year, York is still an industrial, commercial and transport city, with a tradition of major companies in the fields of chocolate manufacturing, construction, engineering and scientific products. Today, there is substantial office employment in insurance, financial services, health care, telecommunications and the railway industry, while the tourism and retail industries are major economic sectors. (City of York 2012). The city now supports more than 80,000 jobs and contributes £3bn of value to the national economy.

In York and North Yorkshire, 51% of employment is spread amongst four main industries: wholesale and retail (16.5%), manufacturing (12.7%), health and social work (11.4%) and real estate and business activities (10.4%). York also has a higher than average proportion of residents employed in the public sector (33% of total employment). In York, 65% of residents are aged 16–64 years and 2.2% of the whole population are from ethnic minorities compared to an average 8.7% for England and Wales (ONS 2003).

This paper examines the experience gained in applying a targeted social marketing approach to foster local-scale community pro-environmental behavioural change in the

City of York, UK. The York Green Neighbourhood Challenge was a community engagement initiative conducted in the period May 2009 to September 2010 and was funded by the Local Area Agreement Delivery Fund (see Box 1). The first phase of the initiative involved determining the spatial distribution of household carbon emissions across the City of York and identifying residents that had access to appropriate infrastructure and who were also receptive to green issues. The aim of the York Green Neighbourhood Challenge was to achieve a measurable reduction in household carbon emissions, raise public awareness of low carbon lifestyles and to foster community cohesion.

Social marketing and pro-environmental behavioural change

Climate change mitigation will require public support for pro-environmental policies and targets and will need communities and individuals to adopt pro-environmental behaviours. Social marketing has been successful in fostering specific behaviour changes related to public health such as smoking, alcohol consumption and exercise (Turning Point 2003). Kotler and Roberto (1989) define social marketing as "the use of marketing principles and techniques to influence a target audience to voluntarily accept, reject, modify or abandon behavior for the benefit of individuals, groups or society as a whole". Social marketing combines knowledge from psychology and marketing with audience segmentation being a key component (Geller 1989). Segmentation involves understanding and identifying the individuals that make up a particular target group and developing appropriate and tailor-made communication messages, information and incentives. Social marketing also uses socio-psychological tools to motivate change, such as "prompts", which are visual or audio aids designed to remind people to behave in certain ways. It also provides incentives to motivate people to engage in different actions (Kassirer and McKenzie-Mohr 1998, McKenzie-Mohr and Smith 1999, McKenzie-Mohr 2000, Haq *et al*. 2008). Social marketing approaches tend to empower the individual to make an informed and conscious choice, which to some extent is self-reinforcing (McClaren 1998). Implicit in social marketing is that behavioural change can only emerge within existing dominant discourses of consumptions especially in the "home". Social marketing initiatives have been used to foster the adoption of low-carbon lifestyle changes with regard to energy, waste and recycling (Staats and Harland 1995, Hobson 2003) and travel (e.g. personalised travel planning) (Socialdata 2000, Australian Greenhouse Office 2006, Haq *et al*. 2008). These have been aimed at the individual, household and community level and have been popular with the UK Department for Food, Environment and Rural Affairs which has embraced the notion of citizen-consumers and has adopted a social marketing approach to sustainable lifestyles.

Critics have argued that social marketing initiatives are unambitious as they focus on marginal small-scale actions which are insufficient to address the magnitude of the environmental challenges that lie ahead (Peattie and Peattie 2009). Corner and Randall (2011) outline the key limitations of social marketing. Focusing on the differences between individuals using segmentation and individual messages and approaches has been seen as inhibiting the potential of social networks to influence behaviour and runs the risks of exacerbating differences (Haythornthwaite 1996, Fell *et al*. 2009). Tailoring messages to individual beliefs, values and preferences could make pro-environmental behaviour less likely in the long term and in other domains (Crompton and Kasser 2009). For example, people who hold strong self-enhancing materialistic values are less likely to engage in pro-environmental behaviour for collective well-being (Kasser *et al*. 2007).

There is also little evidence to suggest that affecting one's lifestyle choices in the household area necessarily leads to positive behaviour changes in another area (i.e. the "Spillover

effect") and in some cases it can be negative whereby the reverse effect is observed (Crompton and Thøgersen 2009). Barr *et al*. (2011) have highlighted the importance of the social and spatial context in which individual behaviours are performed. While individuals are committed to pro-environmental behaviour in and around the home they may be unwilling to reduce other more carbon-intensive activities such as flying. Therefore, differences exist between household and touristic contexts. For example, when on holiday, consumption is not challenged; this has the potential to result in an inversion in behaviours between and the home and holiday location. Therefore, social marketing needs to be adapted to address more carbon-intensive activities although small-scale change is still perceived as not being enough.

Involve/DEA (2010) examined three broad approaches to influencing pro-environmental behavioural change: "nudge" based on Thaler and Sunstein's (2008) "nudge theory"; "think" using deliberative engagement (e.g. information and education) and "shove" using legal compulsion and penalty to restrict behaviour and choice. Thaler and Sunstein's (2008) "Nudge theory" suggests that positive reinforcement and/or suggestion can influence the motives, drivers and decision-making of groups and individuals. "Nudge" does not seek to engage or influence people's values and attitudes but can be just as efficient if not more than direct instruction, legislation or enforcement. The UK government's Behavioural Insights Team was set up in 2010 to finds ways to encourage, support and enable people to make better choices for themselves and was strongly influenced by "nudge" theory. The team has covered a number of issues including public health, consumer empowerment and growth, energy efficiency and climate change. Involve/DEA (2010) argue that these different approaches depend on each other for their effectiveness and an optimal mix should be used to transform social values and attitudes. Here we examine the "think" approach using social marketing techniques based on information, education and deliberative engagement to foster pro-environmental behaviour.

Methodology

In order to target York neighbourhoods that had the greatest potential for behavioural change, data on the carbon footprint, environmental attitudes and local infrastructure were used and disaggregated at the neighbourhood level. The UK government uses Super Output Areas (SOAs) as a unit of geography for statistical analysis. There are three layers of SOAs based on three different but related geography boundaries where each layer has a specified minimum population. The minimum OA size is 40 resident households and 100 resident people. Due to their small size, OAs allow for a finer resolution of data analysis. However, in order to overlay data from other sources, the study used Lower SOAs (LSOAs) which consists of a larger population size. These have a minimum size of 1000 residents and 400 households, but average 1500 residents. Data from OAs are aggregated according to geographic area defined for each LSOA and also include proximity measures to render each area with a compact shape. The boundaries of these also match those of electoral ward areas. The LSOA was used to provide a detailed assessment of the neighbourhood carbon footprint.

Neighbourhood carbon footprint

In order to satisfy our functional needs and desires we consume goods and services which result in emissions of greenhouse gases including CO_2. The total quantity of emissions resulting directly and indirectly from our consumption determines our carbon footprint.

A number of variables influence our environmental impact. These include income, household size, location, car ownership, food consumption patterns, geographic location and housing type (Tukker *et al*. 2010). In the UK a quarter of household emissions result from recreation and leisure activities (including personal aviation), with a considerable amount of CO_2 being locked into basic household activities to meet basic subsistence, protection and communication needs (Druckman and Jackson 2009, Gough *et al*. 2011).

The footprint analysis examined the direct and indirect environmental consequences of what people buy and use throughout the whole supply chain. This form of accounting transcends territorial boundaries and takes into account the impact of products produced in other areas or countries but consumed in York. It excludes the impacts of goods and services manufactured in York and exported to other areas or countries.

Carbon footprint data by local authority for the year 2006 produced by the Stockholm Environment Institute (Dawkins *et al*. 2010) were used to determine the footprint of individual neighbourhoods in tonnes of CO_2 equivalent (CO_2e) per person. The calculations were based on the spending of UK adults on goods and services. It is assumed that generally children do not spend money (e.g. pocket money items are subsumed into parents' spending habits).

In order to determine the variation in consumption patterns at the neighbourhood level, four types of national data were used and disaggregated to the local level:

1. The Household Expenditure Survey (Dunn and Gibbins 2007).
2. Vehicle occupancy and distance travelled by mode and purpose by region published in the National Travel Survey (DfT 2007a) and Transport Statistics Great Britain (DfT 2007b).
3. Mosaic consumer classifications for the UK provided by Experian. Mosaic classifies all consumers in the UK into 61 types, aggregated into 11 groups. Mosaic UK uses over 400 data variables, 46% of which are built from non-Census-sourced information that is updated annually. This enables Mosaic to monitor changes in consumer behaviour and incorporate these each year within the classification
4. Household Energy Consumption Data (BERR 2006).

Box 2. Average carbon footprint of a York resident.

The average York resident has a carbon footprint that can be broken down into themes of housing, transport, food, consumables and services:
- *Housing* (4 tonnes) covers gas, electricity and fuel use in the home but also includes construction, rental and maintenance of dwellings.
- *Transport* (4 tonnes) incorporates car use and maintenance as well as that of other private vehicles and public transport.
- *Food* (3 tonnes) covers spending on food and drink and includes catering, eating out and alcoholic beverages.
- *Shopping/consumables* (2 tonnes) covers spending on 17 categories of household items such as clothing, tobacco, newspapers and household appliances.
- *Services* (1 tonne) covers spending on 13 categories of service from insurance to financial advice to private education.

An additional 3 tonnes of CO_2e is added to every individual's footprint to complete the total footprint. This covers government and capital spending (e.g. on the building of roads, hospitals and schools and on employing teachers, doctors and nurses) which are not addressed by the other themes above.

The footprint analysis showed that the average York resident has a carbon footprint of 17 tonnes CO_2e (Box 2). The top 10 York neighbourhoods which have the highest footprints tend to be in commuter areas, urban centres or rural areas. Conversely, the 10 neighbourhoods with the lowest footprint tend to be in areas described as "disadvantaged urban communities" or areas with high concentrations of students (Figure 1). Dringhouses and Woodthorpe ward which represents the central area of Dringhouses had the largest *per capita* footprint of 19 tonnes CO_2e per person. The lowest footprint of 12 tonnes CO_2e per person was in the Heslington ward.

Housing and transport together make up approximately 60% of a typical York resident's footprint. Low housing footprints are found in the rural west part of York and in the areas of Fulford (2 tonnes/person), Heslington (2 tonnes/person) and Wheldrake (2 tonnes/person). A low housing footprint indicates that households are consciously using less energy to heat and power their homes or that the home is very energy efficient and does not require much energy to power it. In contrast, Hull Road (4.5 tonnes/person) and Osbaldwick (4.5 tonnes/person) have the highest housing footprint in the city. Housing footprints may be larger than average because residents are wasting energy or
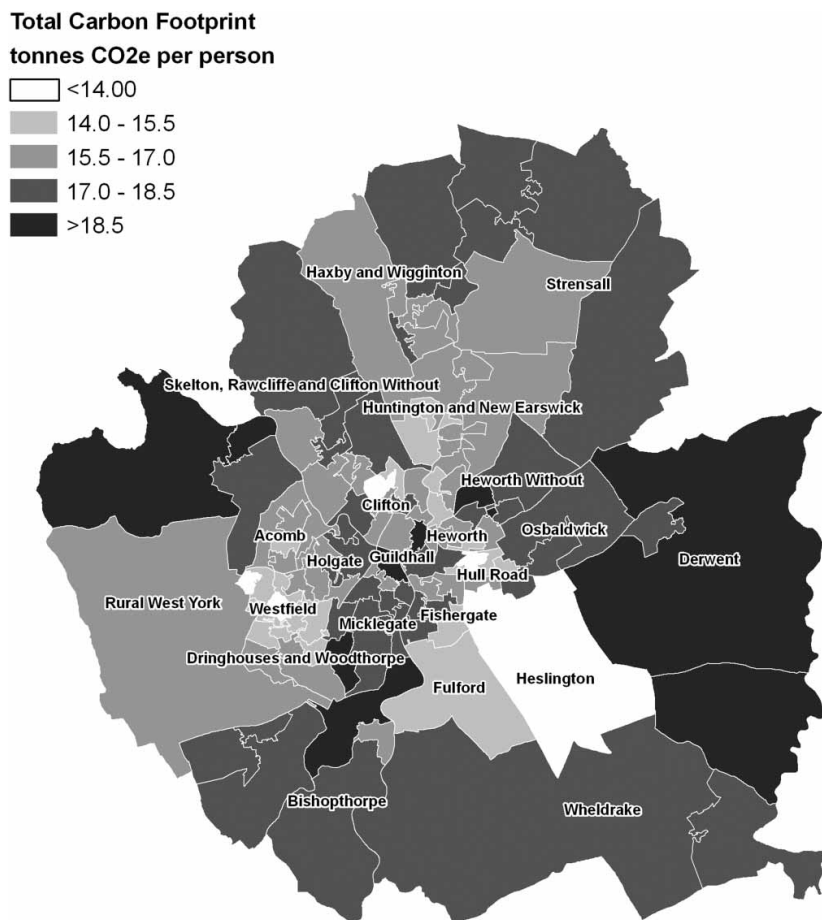

Figure 1. Neighbourhood carbon footprint of the City of York.

because their homes are inefficient at conserving heat. Carbon footprints are described as a per-person variable. This means that a large housing footprint may arise because the house is under-occupied. The energy consumed in heating and powering the home is shared between too few people.

The areas with the highest transport carbon footprints are found on the outskirts of York in the areas of Bishopthorpe (4.5 tonnes/person), Rural West York (4.5 tonnes/head) and Wheldrake (4.5 tonnes/head). However, the more urban areas of Dringhouses and Woodthorpe (5 tonnes/head) and Holgate (4 tonnes/head) in the city also have a high footprint. A high transport footprint could occur in those places where there is a lack of public transport, where residents commute long distances to work and there are few local services within walking distances. Often, these conditions are met in rural and suburban areas. Other travel impacts such as holiday and air travel could partly explain why more inner city neighbourhoods had a high transport footprint despite being near local facilities and having access to public transport.

Since housing and transport together make up over half of a typical York resident's footprint, those neighbourhoods with high housing and transport impacts were targeted. The project set out to focus on ways of reducing the carbon impacts from home energy and private car use.

Local infrastructure

Local infrastructure plays a key role in influencing whether residents of a particular neighbourhood are likely to adopt green lifestyles. Therefore, the condition and structure of housing and accessibility of transport infrastructure needs to addressed if carbon emissions are to be reduced. Infrastructural barriers to reducing carbon emissions include both the structure of the house itself and the tenure of ownership.

Energy Saving Trust "Home Energy Checks" data for over 22,000 homes in York provided the percentage of homes which have been surveyed that have:

- unfilled wall cavities which could be insulated
- 50 mm depth or less of loft insulation
- under one quarter of their windows double glazed
- a boiler that could be replaced with a more efficient condensing boiler.

Neighbourhoods that contain large numbers of homes requiring these types of measures will be neighbourhoods where the infrastructure is conducive to footprint reductions. If the homes were already reasonably energy efficient, making reductions in energy use would be harder. The physical structure of the home can be a barrier to a low home-energy footprint. Another type of infrastructural barrier is the ownership of the home. Owner-occupiers have more control over any structural changes that can be made to the house compared to residents of council or housing-association-owned homes.

Residents who have local services nearby potentially have less need to travel. A measure of the neighourhbood accessibility can be determined by measuring the road distance to services such as doctor's surgeries, primary schools, post offices and supermarkets. This measure indicates the availability of local services and whether facilities are within walking or cycling distance. A number of indicators were used to determine neighbourhood accessibility to local services. These are neighbourhoods where the:

- local primary school is less than 1 km away;

- local doctor's surgeries, post office and supermarket are less than 2 km away;
- average distance travelled to work is less than 10 km.

Those neighbourhoods where the average distance travelled to work is less than 10 km could feasibly be neighbourhoods where residents could be persuaded to commute by bus or bike.

Neighbourood green attitudes

York residents not only have diverse carbon footprints but also different attitudes to green issues. Using Experian Green Aware data (Experian 2009) each neighbourhood in York was classified according to its attitudes towards green issues. This classification provides an indication of the predominant attitude held in each neighbourhood which range from "eco-evangelists" to "wasteful and unconvinced". By scoring attitudes on a scale of 1–10, it was possible to provide each neighbourhood with an overall numerical value that reflects the predominant level of greenness. A score close to 10 indicates strong greenness while a score close to one indicates weak greenness (Figure 2). The neighbourhoods in York city centre contain the highest proportions of residents with very green attitudes; the surrounding rural and suburban areas contain residents in the middle part of the green spectrum. There were distinct pockets of residents in the poor inner surburbs which were classified as "wasteful and unconvinced". They have low disposal income, limited finances and also tend to be reluctant to make lifestyle changes.

There is a tendency for those neighbourhoods which have a strong level of greenness to also have a larger carbon footprint. This indicates that while there is understanding of the importance of green issues and a willingness to be green this is not necessarily translated into action. This inconsistency is known as the "value-action" gap and is where attitudes to pro-environmental behaviour differ from actual behaviour (Barr 2004, Barr *et al*. 2005). There is evidence to suggest that the correlation between pro-environmental attitudes, knowledge and actual behaviour is often weak. Environmental attitudes are therefore not always a reliable predictor of subsequent behaviour (Ajzen 1991, McKenzie-Mohr 2000, Bamberg 2003). Those neighbourhoods that held pro-environmental attitudes but had a high carbon footprint action were identified as being more likely to engage in pro-environmental actions.

Selection of neighbourhoods

Using data on neighbourhood carbon footprint, local infrastructure and green attitudes it was possible to identify those neighbourhoods which could offer the greatest potential for behavioural change (Figure 3). These were neighbourhoods where the residents were receptive to green issues but had a high carbon footprint and where there was greater potential to reduce home energy and transport footprints due to access to transport links and energy efficiency of the housing stock. Based on this analysis, the following neighbourhoods of York were targeted for recruitment of participants: South Bank Central (Micklegate) and Holgate East (Holgate).

Recruitment

Approximately 500 households were targeted in the two selected neighbourhoods and recruited on the doorstep in November and December 2009. Those contacted were

Modal Attitudinal Group

- Eco evangelist
- Convinced consumer
- Green but doubtful
- Confused but well-behaved
- Doing their best
- Sceptical libertarians
- Too busy to change
- Constrianed by price
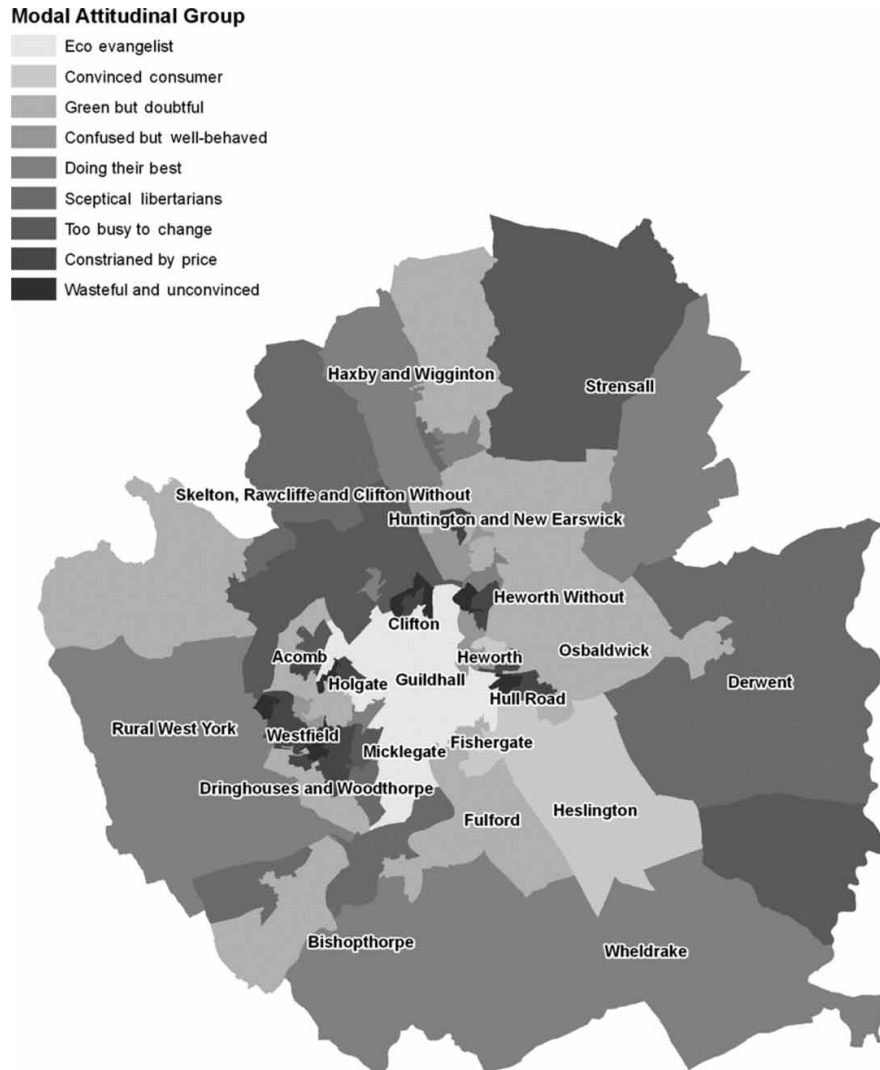- Wasteful and unconvinced

Figure 2.   Neighbourhood green attitudes in the City of York.

invited to a local workshop where their carbon footprint was calculated based on a completed questionnaire survey of household consumption over a 12-month period. The information provided a pre-intervention baseline. Those residents who could not attend the workshop were invited to return the completed questionnaire by post. All residents who had completed and returned their questionnaire survey were invited to a local team meeting where they received an assessment of their carbon footprint and a chance to meet fellow participants. In order to calculate domestic energy use participants were requested to provide details of their kilowatt (kWh) usage over the previous 12 months. Annual data would minimise the effect of seasonal variations in heating.
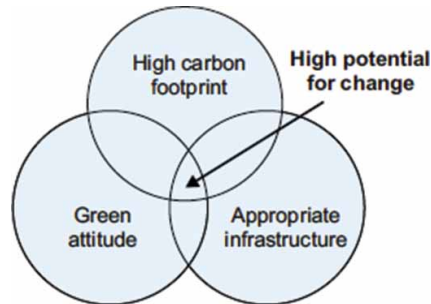
Figure 3. Selection of neighbourhoods with the greatest potential for behavioural change.

However, of the 49 questionnaires returned, only 25 gave details of their fuel bills. For the other participants, the kWh usage was estimated using published data derived from the National Housing Survey (DCLG 2010) based on house size, energy efficiency behaviour and other measures. The personalised carbon footprint showed their total carbon footprint and how they compared to others in the neighbourhood team. It also highlighted additional actions they could take to achieve a 10% reduction in their CO_2e emissions in 2010. Participants were asked to pledge to take a number of pro-environmental actions over a six-month intervention period to help reduce their household carbon emissions.

In addition to doorstep recruitment, participants were also recruited from existing communities including two primary schools and one church. Table 1 provides a summary of the recruitment process. The doorstep recruitment rate in the York Green Neighbourhood Challenge resulted in 20% (102/500) of the target population expressing an interest in the project. However, 48 participants did not wish to participate in the project and did not complete the first questionnaire. Therefore, the final participation rate from the doorstep recruitment that returned a completed questionnaire was 11% (54/500). Due to the general publicity about the project, one existing community from a local church contacted the project team requesting to be involved. Recruitment for existing communities (i.e. primary schools and church) resulted in a further 42 participants joining the project. A total of 96 residents therefore completed the baseline questionnaire. A further 7 participants decided to drop out of the project which left a total sample of 89 participants which formed six different neighbourhood teams.

Table 1. Summary of the York green neighbourhood recruitment process.

Recruitment	
Doorstep	
Total contacted	500
Expressed interest in participation	102
Completed and returned pre-intervention questionnaire	54
Existing groups	42
Dropout	7
Total sample population	89
Total returned post-intervention questionnaire (49 completed both sections)	50

Participation

Each team was encouraged to meet on a monthly basis over the six-month intervention period. In addition, all six teams were invited to three milestone events that were held at the beginning, middle and end of the intervention period. Each team had access to a pool of experts who, on request, could attend local meetings and provide further advice on reducing their carbon footprint. Advice provided included energy saving in the home, micro-generation, locally sourced food, recycling and composting. Some teams embraced the spirit of the initiative and organised local awareness-raising events in addition to their monthly meetings, which further fostered a sense of community.

Meetings held by the teams were well attended by the participants although only half attended one or two meetings (see Table 2). A total of 7 out of the 50 participants did not attend any meeting while nearly a quarter attended more than five. Of the main York Green Neighbourhood events held in January and April, 20% attended the January event only, 18% attended the April event only and an additional 24% attended both while 20% attended neither. Time was the main reason why participants did not attend the meetings. Only three people said they had other commitments.

The participants were asked to complete a second questionnaire at the end of the intervention period. The post-intervention questionnaire survey examined activities of the last six months and this was standardised over a 12-month period to allow a comparison of change. The results therefore provide an estimate of the potential reduction in CO_2e emissions if the behavioural change achieved in the six-month intervention period were continued for the rest of the year.

A total of 39 participants did not return the second questionnaire at the end of the intervention period – a 44% dropout rate. The final results of the pilot study were therefore based on a total of 50 individuals from the intervention group who had returned both questionnaire surveys. However, one participant did not complete the section on the carbon footprint. Therefore, the changes in the carbon emissions are based on 49 participants. The intervention group was approximately evenly split between male and female respondents with over half aged below 50 years old and of the remainder, 16% were over the age of 65 years.

Results

The 49 participants who completed the challenge achieved an estimated average carbon footprint reduction of 2 tonnes of CO_2e/year. This is an average reduction of 11%. The largest reductions were seen in the areas of shopping and housing (i.e. heating and powering the home) with an average reduction of over 20% in both cases. Although expert advice on shopping was given to the groups the issue of consumption issues such as "mend and make do" and recycling were discussed at meetings. The area of food showed the smallest reduction (5%). The change in the impact of housing could be due to the fact that the initial survey was undertaken in summer.

A *t*-test was performed on the pre- and post-intervention data. This is a statistical hypothesis test to determine whether there was a statistically significant change in mean carbon footprint during the six-month intervention period. A paired-samples *t*-test was chosen because samples are not independent, each pair referring to the same person. No assumption was made about the direction of change over the period of the intervention and so the significance of the test was assessed using a two-tailed probability test.

Table 3 shows that the mean reduction in the carbon footprint was 2 t CO_2e with a 95% confidence interval of ± 0.9 t CO_2e. Thus, we can be 95% confident that on average,

Table 2. Events organised by neighbourhood teams.

Event	Description	Impact
Neighbourhood eco-evening	The neighbourhood eco-evening was held at a local venue with presentations on waste/recycling, home energy/insulation and composting. Easy and not-so-easy/more challenging actions were suggested by each of the three speakers	The event provided an opportunity to ask questions and to access further information on the practical matters relating to each topic. Stalls with information leaflets were available so participants could take home literature
Information stalls on a neighbourhood street corner	To mark World Environment Day and to promote the Challenge, information stalls was set up on a key road corner in the neighbourhood. The stalls provided information on energy efficiency and composting to local residents. It also provided the opportunity to recruit new members to the team. The two stalls gave away light bulbs, plants and cakes; ran a quiz; gave out leaflets and advice and raffled a wormery and compost bin	The information stalls generated a lot of interest from local people and resulted in 24 new households signing up to the team. The stalls helped to promote good relations with local shops (donated food) and raised awareness of home insulation, energy use and reducing personal emissions
Scarecrow Festival	A Scarecrow Festival was held in the local area over the Bank Holiday weekend. The aim of the event was to raise the profile of the Challenge and climate change issues. Streets in the local neighbourhood were leafleted inviting them to create an "Eco Scarecrow". A total of 40 household took part and 140 trails were sold. Each household taking part displayed a poster completing the sentence "We are doing our bit to save the planet by … " As people were doing the trail they read 40 different messages about what green actions they could take – ranging from " … growing our own vegetables", " … recycling our paper", " … giving up our car" to " … promoting hydropower"	The Festival raised awareness of climate change issues, showing people there are lots of little things which ordinary people can do. It also gave people an environmentally friendly activity to do in the area over the Bank Holiday and it helped to build community links as people walked around doing the trail. The money raised from the trails went towards buying fruit trees in the local park. The event was very popular with residents (many did the trail in the rain!) and local shopkeepers took part which encouraged good community bonding. It also brought the two local Green Neighbourhood teams closer (social invitations followed)
Eco-Fun Night	An Eco-Fun Night was held, attended by parents and pupils, where a range of activities were organised. Activities included junk modelling, recycling sorting activity, guess how many worms in the compost, pledge tree, eco quiz and refreshments	The Eco-Fun Night raised awareness of climate change issues and raised money to go towards environmental resources for the school
Recycling at the School Summer Fair	Each year the school holds a Summer Fair. The Green Neighbourhood team addressed the issue of what is done with the rubbish by putting out labelled bins so the rubbish could be sorted and more easily recycled	More of the waste from the summer fair was recycled
Allotment sharing	Through the team meetings one group discovered that a member of their team had an allotment and was struggling to manage it. Three people from the team agreed to share the allotment	Three people were able to grow their own vegetables as well as compost their food waste

Table 3.   The mean reduction in emissions of each community team.

	Survey 1 mean footprint (t CO$_2$e)	Survey 2 mean footprint (t CO$_2$e)	Mean change in footprint $\pm$ 95% confidence interval	% reduction	Significance of difference between the two surveys
Bishopthorpe Road	19	17	3 $\pm$ 1.5	14	$p = .003^*$
Heworth Primary School	17	14	3 $\pm$ 2	17	$p = .018^*$
Holgate	16	16	0.1 $\pm$ 3	0.8	$p = .925$
Park Grove Primary School	16	16	-0.01 ± 3	-0.03	$p = .004$
Scarcroft Road	18	16	2 $\pm$ 2.5	13	$p = .071$
St Edwards Church	17	15	2 $\pm$ 2	11	$p = .022^*$

*If p is less than .05 then the result is considered statistically significant.

households reduced their carbon footprint somewhere between 1 and 3 t CO$_2$e/year. Statistical analysis showed this reduction to be highly significant.

When the five components that make up the carbon footprint are examined separately, the intervention achieved statistically significant reductions in the areas of activities, food, housing and shopping. However, the intervention did not achieve a statistically significant reduction in the carbon footprint for travel. When data for each neighbourhood team were analysed separately, three out of the six teams achieved a statistically significant reduction.

Overall, the Green Neighbourhood Challenge was effective in reducing the carbon footprint of the participants and achieved an estimated total emission reduction of 98 tonnes of CO$_2$e/year. Statistical analysis showed that there were significant reductions in residents' footprints by the end of the project. However, when these are divided into the constituent parts, not every aspect of the residents' lifestyles changed. When we consider the residents' transport impact, the change was not shown to be statistically significant. Similarly, when

Table 4.   Comparison between estimated and actual footprint of each community team.

Team name	York neighbourhood	Estimated footprint	Footprint from pre-intervention survey	
Bishopthorpe Road	South Bank Central Micklegate Ward	17	19	12%
Heworth Primary	Heworth North East Heworth Ward	18	18	0%
Holgate	Holgate South East Holgate Ward	17	17	0%
Park Grove Primary	The Groves Clifton Ward	17	16	-4%
Scarcroft Road	South Bank Central Micklegate Ward	17	20	17%
St Edwards church	Dringhouses Central Dringhouses and Woodthorpe ward	19	18	-6%

the project is considered by team not every team's footprint reduction was significant. Indeed, for one team (Primary School), the mean footprint actually increased slightly although this was not statistically significant.

Table 4 compares the estimated carbon footprint of York neighbourhoods with the measured footprint of those participants who completed the pre-intervention questionnaire. It shows that the estimated footprints and those calculated from the pre-intervention survey of participants' footprints are very similar for four out of the six areas. For the remaining two neighbourhoods the survey results are higher than the estimated footprint and could reflect more the particular consumption patterns of individual participants.

Discussion

The initiative used a targeted approach to engage community groups on green issues and to encourage them to take action to reduce their CO_2e emissions by 10% in 2010. The total projected reduction in CO_2e emissions achieved as a result of the project was 98 tonnes/year.

The profiling of different neighbourhoods combining carbon footprint, attitudinal and infrastructure data together provided a top-down assessment of the general responsiveness of neighbourhood to pro-environmental behavioural change initiatives. Estimates of the average carbon footprint with actual survey data are similar for four out of the six areas whilst for the other two neighbourhoods, the survey results were higher than the predicted footprint. A greater sample size would have been more effective in determining the accuracy of the top-down approach. However, it is not unexpected that top-down and bottom-up approaches do not always agree well. This is due to the "ecological fallacy" which highlights the dangers of drawing inferences about individual behaviour from aggregate data (Kramer 1983, Alexander *et al*. 2009). A doorstep recruitment campaign and feedback from residents gave a general impression that residents in the target areas were on the whole supportive of green actions even though they did not want to commit themselves to participating in the project.

An initial 102 people from the doorstep recruitment expressed an interest in participating in the project and were given information. However, only 54 people actually completed and returned the pre-intervention questionnaire survey. To some extent this confirms why these neighbourhoods were selected; people have a positive attitude to green issues but these are not always converted into action.

The doorstep recruitment aimed to form a community team of 10–15 people for each street. However, there was not enough interest to achieve this at a street level. Instead, participants formed a neighbourhood team with members from different streets. The doorstep campaign involved informing residents that recruitment was going to take place on a specific day. Despite this pre-notification many residents were unfamiliar with the project and did not read the information beforehand or were not at home when a recruiter called. While the recruitment of neighbourhood teams succeeded in bringing participants together, there are more cost-effective approaches to achieve this, utilising existing groups that could be used for future projects.

There were enthusiastic individuals in five out of the six teams who contributed to moving teams forward. However, in one neighbourhood team no natural leadership emerged and as a consequence it did not gain the same level of momentum. Participants were self-selecting and as a result some people who took the challenge were already undertaking a number of green actions. This meant that there were fewer additional actions they could take compared to the rest of the team. However, these experienced members were

Table 5.   Contact with residents of targeted neighbourhoods.

Main contact milestones	
Initial contact	Mail drop
Second contact	Door knocking (November and December 2009)
Third contact	Local team meeting (November and December 2009)
Fourth contact	Launch event for all teams together (January 2010) 50 people
Fifth contact	Mid-term event for all teams (April 2010)
Sixth contact	Final event and award ceremony (September 2010)

able to provide additional support, advice and insight to those less experienced and provided an informal level of mentoring in particular teams.

Each group was given access to a number of external experts with the initial idea of providing an input to their month meetings. However, one group wanted to have all the advice and information at the beginning of the intervention period rather than ongoing throughout the period. A local neighbourhood eco-evening was held with guest speakers and this event was open to all residents. Due to having a wide range of participants with different levels of knowledge some people found the advice given was too basic. All teams attended a milestone event where more detailed information was given at the request of the participants (Table 5). It would have been beneficial if all participants had received the same level of basic information at the start of the intervention period and then more detailed information given on request.

It is inevitable that during the intervention period people would drop out of the project. Those teams that lacked leadership had the greatest dropout rate, indicating the importance of enthusiastic leaders. On the whole, the project achieved a measurable reduction in CO_2e emissions and surpassed the objective of a 10% reduction. The results were statistically significant. However, this significance varied by teams and by area – there was no statistically significant change for transport. Transport was only indirectly discussed in the project because City of York Council was unable to provide expert advice at the time of the project delivery. Where expert advice on other aspects of the footprint was given, a reduction in CO_2e emissions was achieved which further indicates the success of the approach.

The local meetings, helped by outside facilitation, allowed members of the team to bond and to share experiences and advice. A number of participants remarked that they felt they knew their neighbours more after being involved in the project. The survey also highlighted the barriers to change. Some participants were unable to attend local meetings with lack of time or other commitments being the main reasons given. The Green Neighbourhood Awards were given to those teams that had made the most progress. This has provided seed money to continue their work and to allow the teams to encourage more people to get involved.

Conclusion

Social marketing initiatives have been criticised for focusing on small-scale behavioural change and not recognising the true scale of the environmental challenge. Despite these criticisms social marketing initiatives do have a role to play. As indicated by Involve/DEA (2010) social marketing should be seen as a complementary "think" approach that uses information and deliberative engagement to foster pro-environmental change. It can be

argued that such initiatives contribute to increasing public acceptability of stricter national and/or local greenhouse gas reduction measures that may be adopted in the future.

From the experience gained from implementing the York Green Neighbourhood Challenge and the feedback received, a more cost-effective model of community engagement based on targeted social marketing principles can be proposed:

Go beyond carbon: While the focus is on CO_2 reduction, this will only appeal to a minority of the population. CO_2 reduction should be placed in the wider context of improving general quality of life and reducing inequalities. This can be presented in a way that attempts to demonstrate that particular actions can have economic, social and health benefits opportunities and are advantageous for the local neighbourhood.

Select the target audience: With limited resources it is not possible to target all audiences. The profiling of neighbourhoods can be a useful way to target specific groups especially those who have not translated held green attitudes into action, which could offer potential CO_2e reductions. Alternatively, it could be used to develop information-awareness campaigns in communities which have less interest in green issues.

Recruit from existing communities: While a doorstep campaign is beneficial in creating new team formations, targeting existing communities may provide a more cost-effective approach. Whether this is a local school, church, lunch club, business or youth club it provides an opportunity to maximise the use of existing networks.

Have a clear target: Having a clear target can provide focus and purpose to a team. It allows them to direct their efforts towards achieving a particular goal.

Establish a baseline: In order to determine the effectiveness of an initiative, a good baseline needs to be established. This should be a combination of qualitative and quantitative questions to determine current attitudes and carbon footprint. A pre- and post-intervention questionnaire survey should be conducted.

Get participants to pledge: Participants should be encouraged to pledge what actions they would like to undertake during the intervention period. This acts as a social contract between themselves and their team.

Use mentors and local champions: The use of paid mentors or volunteer local champions can be effective in facilitating, inspiring and motivating teams. Having an independent facilitator can be helpful in ensuring new teams develop a bond and common purpose.

Provide "foundation information": Providing all basic information on particular actions at the beginning of the intervention period (e.g. in the form of a booklet or seminar/workshop) will ensure that all participants are starting from the same point. It will also allow more detailed information to be given throughout the intervention period.

Outline a programme of activities: A programme of activities should be established at the beginning of the intervention period; this will inform teams in advance and will also act as an incentive to get them involved in the initiative. The activities should appeal to all sections of the community. Throughout the intervention period participants should be kept up-to-date on developments. Social media (e.g. Twitter, Facebook and Youtube) should be used to encourage to form an online community providing an Internet-based forum for discussion, whilst newsletters and publicity using local media should be available to those participants who do not have access to the Internet.

Provide incentive: Incentives should be provided to demonstrate that the initiative has benefits at the individual and neighbourhood level (e.g. seed money for teams that have made the most effort, smart meters).

Hold milestone events: A number of milestone events should be held throughout the intervention period (e.g. at the beginning, middle and end). These will provide an opportunity for all participants from different teams to join together. These events provide a chance to socialise, share experiences and reinforces a common purpose.

Provide feedback: Proving feedback during the intervention period enables participants to know whether they are on track to meet the set target and to take appropriate action if they are not making as much progress as they intended.

Reward success: The results of the pre- and post- questionnaire survey will determine change in behaviour and attitudes. This information should be used to determine which teams made the most progress. As well as results of the questionnaire survey, additional information on other activities that the teams have initiated on their own should be included in the final assessment. Those teams that have made the most progress (e.g. based on Gold, Silver and Bronze) should be rewarded to allow and inspire them to continue after the end of the project (e.g. seed money).

Follow-up: The long-term success of the initiative will depend on whether the participants have continued with their actions after the end of the project. Therefore, a follow-up of the participants after 12 months who have completed both pre- and post- intervention questionnaires would be worthwhile to determine whether changes have been short-lived or not. This would also provide further evidence to assess the "rebound effect". That is where economic savings achieved from reduced energy, car use and food has led to increased consumption in other aspects of life (e.g. buying more goods or going on holiday) (Druckman *et al*. 2011, Maxwell *et al*. 2011).

Some members of the public will always be receptive to green issues while others less so. As a consequence, many actions required to implement community-scale carbon-reduction initiatives and achieve more sustainable communities tend to be taken by a minority of people. If community-scale pro-environmental initiatives are to be successful then more holistic ways of engagement are necessary that are targeted and appeal to diverse members of the community groups. Carbon reduction would need to be placed in a broader context that focuses on improving quality of life – one that raises awareness of the scale of the environmental challenge and builds local resilience to future environmental change.

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