Los Angeles, London, New Delhi
and Singapore
http://www.sagepub.com

ISSN 0734–242X
Waste Management & Research
2010: 28: 193–219
DOI: 10.1177/0734242X10361506

Household waste prevention – a review of evidence

Jayne Cox, Sara Giorgi
Brook Lyndhurst, London, UK

Veronica Sharp
The Social Marketing Practice, Didcot, UK

Kit Strange
Resource Recovery Forum, Skipton, UK

David C. Wilson
Research Managing Agent, Defra Waste and Resources Evidence Programme, and Department of Civil and Environmental Engineering, Imperial College London, London, UK

Nick Blakey
Department for Environment, Food and Rural Affairs, Food and Rural Affairs (Defra), London, UK

This paper reports a synthesis of policy-relevant evidence on household waste prevention, based on a UK portfolio of primary research and a broad international review. Waste prevention was defined as strict avoidance, reduction at source (e.g. home composting) and reuse (for the product's original purpose) – recycling was excluded. A major focus was on consumers. Waste prevention is not one but many behaviours; the review revealed a general hierarchy in their popularity, from donating goods to charity at the top; through small reuse behaviours around the home; to activities involving changes in consumption habits at the bottom; one estimate is that 60% of the public does at least one of these activities, some of the time. Barriers to engaging householders include both modern consumer culture and a genuine confusion that waste prevention is equivalent to recycling. The public can be engaged through local or national campaigns, with a wide range of interventions and communications approaches available. On the products and services side, the primary opportunity within the scope of the review was identified as increasing reuse. The barriers included operational difficulties (funding, capacity, logistics) and consumer attitudes towards second-hand goods. The main opportunities are to ensure more strategic planning for reuse by local authorities and better co-ordination and joint working with the third sector. The review examined the impact or potential of various policy measures designed to influence household behaviour directly or the products and services provided to them. Overall, the international evidence suggests that waste prevention benefits will be derived from a 'package' of measures, including, for example, prevention targets, producer responsibility, householder charging, funding for pilot projects, collaboration between the public, private and third sectors, and public intervention campaigns. UK evidence suggests that the greatest tonnage diversions can be achieved on food waste, home composting and bulky waste. The principal evidence gaps relate to robust and comprehensive quantitative data. Better evidence is needed of what actually works, and what outcomes (weight, carbon and costs) can be expected from different measures. More sensitive and effective monitoring and evaluation is needed to provide the evidence required to develop the necessary basket of future policy measures at local and national level.

Keywords: waste prevention, household waste, evidence, behaviour change, reduction, reuse

Corresponding author: Jayne Cox, Brook Lyndhurst, London House, 271–273 King Street, London W6 9LZ, UK.
E-mail: Jayne.Cox@Brooklyndhurst.co.uk
Received 5 August 2009; accepted in revised form 29 November 2009
Figures 1–3, 5 appear in color online: http://wmr.sagepub.com

Introduction

Background

The UK Department for Environment, Food and Rural Affairs (Defra) established what is now known as its Waste and Resources Evidence Programme (WREP) late in 2003. WREP aims to deliver a robust waste and resources evidence base, to facilitate its use for policy purposes, and to ensure effective communication with all stakeholders. WREP works within the framework of Defra's model for the flow of evidence within the policy process (Figure 1: Defra 2006). The term 'evidence' is expanded on below.

The new programme set out to take a strategic overview, for the first time, of the overall waste and resources research needs of the UK as a whole. A multi-stakeholder Waste and Resources Research Advisory Group (WRRAG) was convened to take a 10-year forward look and develop, through a consultative process, an initial 3-year R&D strategy, which was launched in September 2004 (Defra 2004). A retrospective look at progress over the first 3-year strategy period is available (Blakey *et al*. 2007), as is the second 3-year evidence strategy (Defra 2007a).

At the time of the first strategy in 2004, there were perhaps 30 UK organizations that were active players in waste and resources research in the UK (Blakey *et al*. 2007), so WREP were selective in focusing their efforts on those research areas which were seen as a particular gap, and which were either then current, or would likely become, policy priorities for Defra.

One focus area selected by WREP was household waste prevention. An initial scoping review was commissioned to assemble existing evidence on behaviour change aspects (secondary research, corresponding to the lower ellipse in Figure 1) (Sharp 2006). A total of 18 further projects were commissioned in 2005 or 2006, in areas ranging from understanding consumer behaviour in relation to household waste prevention, through investigating how different initiatives work in practice, to the assessment of available policy measures. These were a mix of secondary and primary research (corresponding to the upper ellipse in Figure 1), with timeframes up to 3 years.

As anticipated, waste prevention was highlighted as a priority in Defra's Waste Strategy for England (Defra 2007b). This priority is further reinforced by the new Waste Framework Directive, which requires all the EU member states to put in place their own national programmes for waste prevention by December 2013 (EU Directive 2008). In addition to the research led by Defra's WREP, the UK Waste and Resources Action Programme (WRAP) (which exists to promote action on recycling and resource efficiency) has gradually expanded its scope beyond developing recycling markets, and has also carried out relevant evidence work on household waste prevention. When WREP's portfolio of household waste prevention projects were all nearing completion in late 2008, the time was judged to be right to pull all this work together.

Defra's WREP therefore commissioned a major synthesis review project with the aim of providing an accurate and up-to-date picture of existing policy-relevant evidence about household waste prevention and associated pro-environmental behaviour. The project followed the lower arrow in Figure 1: scoping the research questions of interest, pulling together the existing and emerging evidence, and working with policy makers and other stakeholders to interpret the results, both to inform policy options and to identify remaining gaps in the evidence. This paper reports the

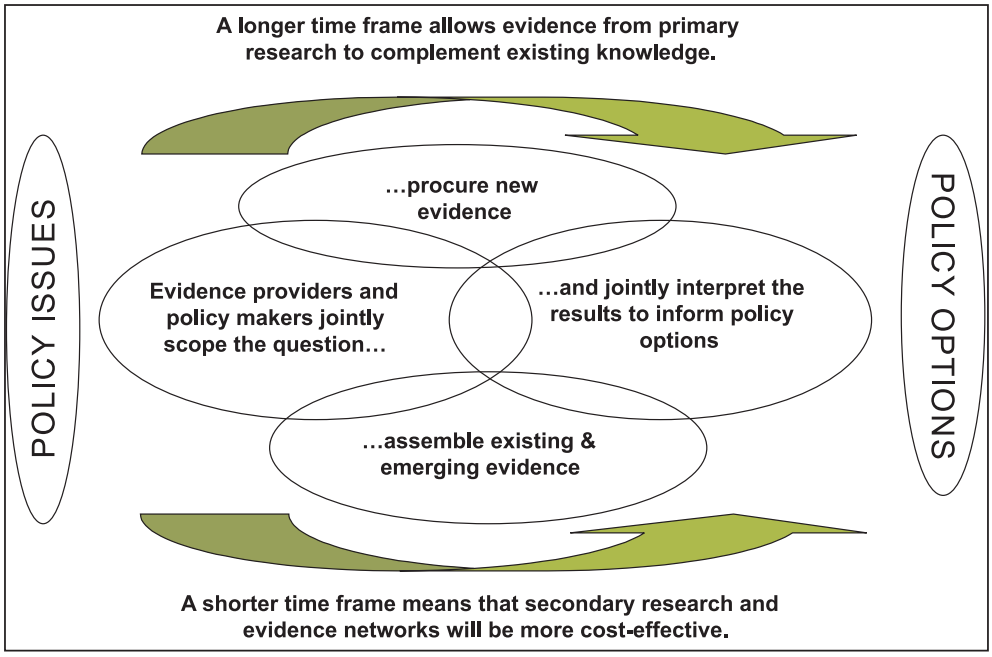

Fig. 1: The flow of evidence in the policy process (Defra 2006). [Crown copyright. Reproduced by kind permission of Defra].

Table 1: Statistics on household waste management in England, to assist the reader in placing the case study examples and tonnage diversion impacts into context (Defra 2009c).

	All data per annum	
	2008/09	2000/01
Household wastes generated	24.3 million tonnes	25.1 million tonnes
	473 kg person^{-1}	510 kg person^{-1}
	1072 kg household^{-1}	1184 kg household^{-1}
Household wastes as a proportion of total municipal solid wastes	89.0%	89.4%
Household waste growth rate	2007/08–2008/09 –3.8% (a *decrease* of 3.8%)	2003/2004–2007/08 –0.4% (average annual *decrease*)
Household waste recycling, composting and re-use	37.6%	11.2%
	9.1 million tonnes	2.8 million tonnes
	178 kg capita^{-1}	57 kg capita^{-1}
	403 kg household^{-1}	132 kg household^{-1}
Residual household waste (after recycling, composting and re-use)	295 kg person^{-1}	453 kg person^{-1}
Municipal solid wastes landfilled	50%	79%
Municipal solid wastes incinerated with energy recovery	12%	9%

results of that review (Brook Lyndhurst, SMP and RRF 2009 [WR1204]).

A particular focus of the review was on WREP, WRAP and other UK governmental evidence work, but a decision was taken to broaden the scope to include both other 'grey literature' (including that provided by stakeholders), and also a systematic trawl for other internationally available, policy-relevant evidence. The review is thus international in its coverage of published and peer-reviewed work, but is inevitably more UK (and indeed English) focused in terms of its use of more detailed examples taken from government and other grey literature reports. Table 1 provides some statistics on household waste management in England, to help the reader in relating those examples, and in particular the estimates of the impact on waste quantities of particular waste prevention measures, to their own situation.

Defining household waste prevention

The evidence review used the definition of waste prevention set out by the OECD (2002), encompassing: strict avoidance (not generating waste in the first place); source reduction; product reuse (in its original form); as well as reducing the hazardousness of waste. This definition excludes all forms of recycling – including food collection and commercial composting – and remanufacturing. The latter are sometimes included in a broader definition of 'waste minimization' and it is worth noting that stakeholders involved in the review sometimes did not make a clear distinction between recycling and prevention.

The Waste Framework Directive (which came into force part-way through the review) in Article 3 Clause 12 and 13 declares that 'prevention' means measures taken before a substance, material or product has become waste, that reduce (EU Directive 2008):

a. the quantity of waste, including through the re-use of products or the extension of the life span of products;
b. the adverse impacts of the generated waste on the environment and human health; or
c. the content of harmful substances in materials and products and that "'re-use' means any operation by which products or components that are not waste are used again for the same purpose for which they were conceived".

The Directive lays down the five-step hierarchy of waste management options, with waste prevention as the preferred option, and then in descending order, reuse, recycling, recovery (including energy recovery) and safe disposal.

The scope and extent of the evidence reviewed

Defra's focus in WREP and its other research and evidence programmes is on developing 'policy-relevant' evidence; two of the current authors previously explored developing the international evidence base for waste and resources policy in a previous paper in this journal (Wilson *et al*. 2007). This review adopted Defra's definition of 'evidence' (Defra, undated-a):

> We can say that evidence is any information that Defra can use to turn its policy goals into something concrete, achievable and manageable. It can take many forms: research, analysis of stakeholder opinion, economic and statistical modelling, public perceptions and beliefs, anecdotal evidence, and cost/benefit analyses; as well as a judgement of the quality of the methods that are used to gather and synthesize the information.
> Evidence for policy has three components. First is hard data (facts, trends, survey information) but the second component is the analytical reasoning that sets the hard data in context. Third, an evidence base comprises

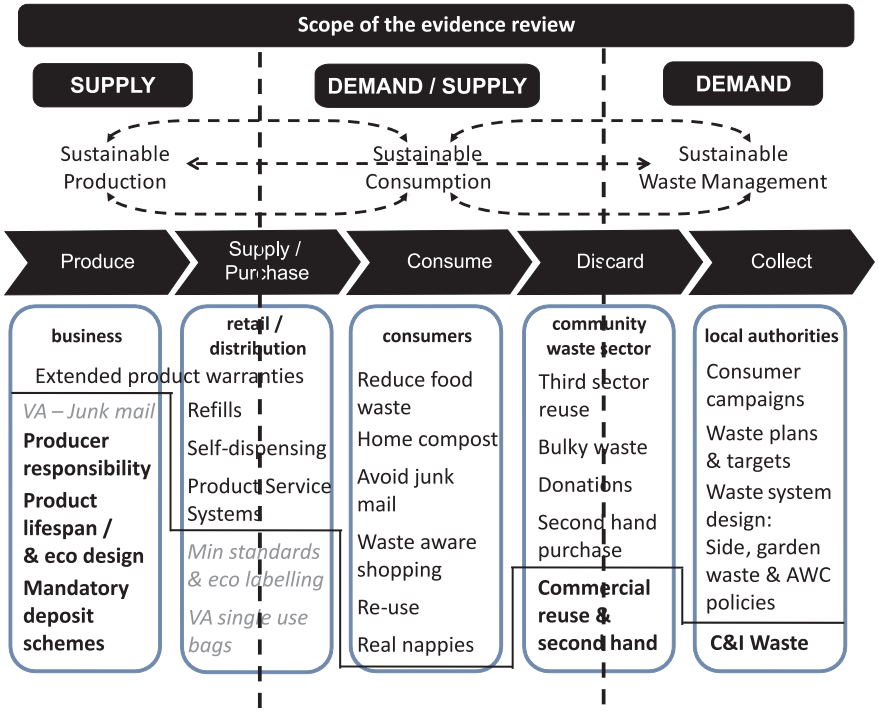

Fig. 2: Scope of this review of household waste prevention, in the context of a product's life cycle (Brook Lyndhurst, SMP and RRF 2009).

stakeholder opinion on an issue or set of issues. The reason for this tripartite approach is: if there is any weakness in the hard data on which you are basing a policy option, then you will need to fall back upon the analysis that underpins the data. If there is any weakness in the analysis, or any risk that others could bring an alternative interpretation to the table, then you need to go back to your stakeholder base in order to understand the different interpretations that could give rise to different analyses of the same set of data.

Actions to prevent waste can be taken at many of the steps in a product's life cycle. As the focus of this review was on household waste prevention, the research focused on the middle part of the life cycle – the key 'touch points' with the consumer (i.e. supply/purchase, consume and discard). As shown in Figure 2, not all the topics under these three steps in the life cycle are directly relevant to household waste prevention, whereas some under the preceding step of 'produce' and the following step of 'collect' are relevant. The review focused on those areas highlighted as 'above the line' in Figure 2; those areas 'below the line' were either *excluded* (shown in dark type) because they were outside the scope of the review, or were *touched upon* (shown in light type and italics), for example, voluntary agreements (VA) and minimum standards and eco-labelling, because the project steering group saw some merit in their inclusion. The excluded areas include commercial and industrial waste prevention, producer responsibility and product lifespan and eco-design, all of which were seen by the steering group to be major topics in their own right; and mandatory deposit systems, which were the subject of a parallel Defra research project (ERM 2008 [WR1203]).

Behaviour change

A central theme of this evidence review is on consumer behaviour change. Figure 3 shows Defra's Behaviour Change Framework, known as the '4Es', which was first introduced in the UK Sustainable Development Strategy (Defra 2005). The 4Es evidence-based framework tells us that, for each behaviour there are many factors which need addressing simultaneously to facilitate change. Behaviour change interventions need to reflect this complexity by providing a 'package' of measures (Darnton *et al*. 2006). The framework focuses on the need for the following actions.

- *Enable* – People need help to make responsible choices, for example infrastructure, support, guidance and information.
- *Engage* – People need to be involved early on in order for them to understand and take personal responsibility. There is a need to get to know your audience, understand their issues, and how to target them effectively, in order to develop 'social norms'.
- *Encourage* – Consider the appropriate role of taxes, economic instruments and incentives. The benefits are important as is regular feedback which is a proven incentive.
- *Exemplify* – What can be done to exemplify the behaviour and reinforce commitment from others?

Methodology

The methodology used in the evidence review is shown schematically in Figure 4. The four main inter-related and often

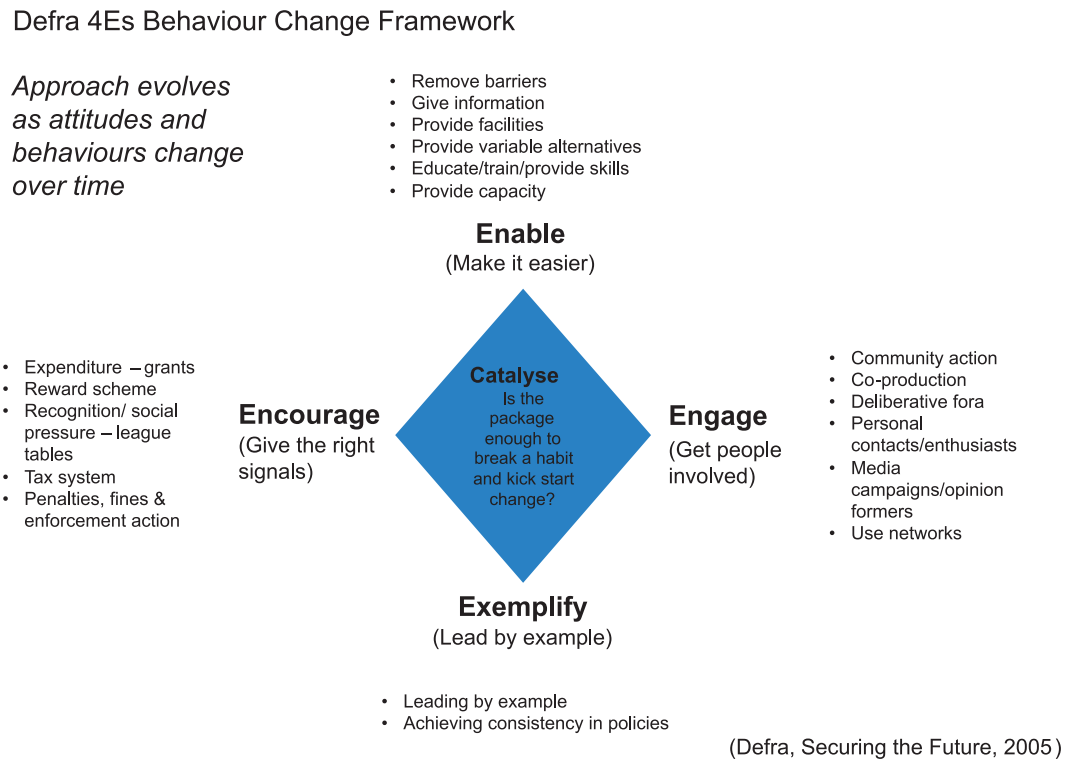

Fig. 3: Defra UK Sustainable Development Strategy, Securing the Future (Defra 2005).

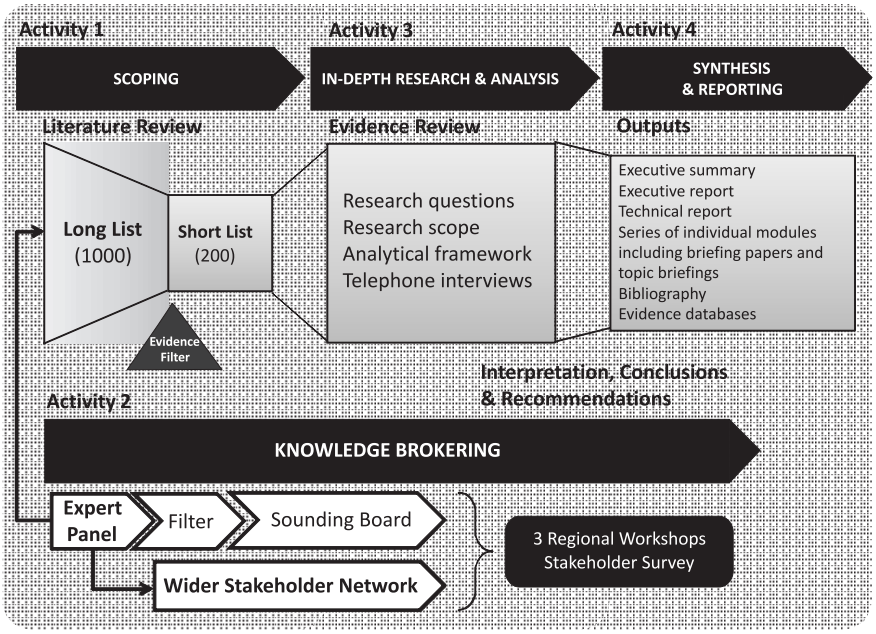

Fig. 4: Overview of methodology used (Brook Lyndhurst, SMP and RRF 2009).

parallel activities correspond to the specific objectives set for the work.

Activity 1: Scoping

The aim here was both to refine the scope of the evidence review, to conduct a wide 'trawl' through the literature to identify potentially relevant reports, and to screen those to identify a short-list of documents for more detailed review.

The initial desk research used a variety of complementary methods to identify potential documents. These included the literature reviews and bibliographies included in the various WREP reports; an electronic inquiry using the Resource Recovery Forum's mailing list, which yielded well over 100

Table 2: List of domain areas and terms used to guide internet searches.

Domain area (i.e. areas of household waste prevention selected as being of particular interest)	
More general terms	More specific terms
Incentives	Nappies
Waste policy and strategy	Food
Attitudes, motivations, behaviour and habits	Junk mail
Reuse	Home composting
Retail innovation	Single use products and long life
General waste minimization campaigns	Reusable bags
Terms used to guide internet searches	
Waste	Charity shop reuse
Waste prevention	Alternate weekly collections
Waste reduction	Consumer understanding of environmental labels
Waste minimization	Household waste, e.g. 'reuse'
Waste decoupling	Reuse, e.g. 'car boot sale'
Household waste prevention	Take-back producer responsibility

responses pointing to key documents (including many in the grey literature); and wide-ranging journal and internet searches (see the search terms in Table 2 below). The latter included several dedicated search engines, including the waste and resources research portal Wastenet (undated) and the Waste and Resources Research Repository (WARRR, undated), both developed by Defra; and the Waste Improvement Network (WIN, undated)), developed on behalf of UK local authorities.

This scoping research identified around 1000 potential sources. These were classified according to their coverage of particular 'domain areas' within household waste prevention (Table 2). They were further screened according to whether they contained either quantitative or qualitative 'evidence' (as opposed to e.g. general descriptions of what people had done), and to the perceived robustness of the available evidence. Priority for detailed analysis was given to peer-reviewed and quantitative material; other sources containing self-reported and qualitative material did also pass the initial screening, where they were identified as providing valuable input to the review, but they tended to be analysed at a less detailed level (see items (ii) and iii) below). Care was taken to ensure that the short-listed documents provided good coverage across all of the domain areas in Table 2.

The scale of the wider literature and the evidence on household waste prevention came as something of a surprise: the team had expected to identify 200 sources (actual: around 1000) and to review 50 key evidence sources (actual: 200+).

Activity 2: Engagement with stakeholders (knowledge brokering)

Stakeholders (e.g. academics, national, regional and local authorities, the third sector, consultants, waste managers) were engaged throughout in the evidence review process, with the aim of drawing their knowledge into the evidence base. The programme of engagement included the following activities.

- Two electronic inquiries, with stakeholders both within the UK and internationally, initially to identify evidence sources and later to test emerging insights.
- Three regional workshops in England.
- A meeting of the Waste Stakeholder Group which advises Defra on implementation of the Waste Strategy 2007.
- A total of 19 telephone interviews with key experts to address any evidence gaps and explore the next steps for the household waste prevention agenda.
- E-mail exchange and telephone discussions with some 40 further international experts.

Activity 3: In-depth research and analysis

Three levels of more detailed analysis were undertaken on the short-listed information sources.

i. Detailed reviews were carried out and summaries were written on a priority list of 88 documents (including the 51 reports from 19 WREP projects).
ii. A parallel 'international review' was carried out by the Resource Recovery Forum, which examined more than 100 sources. This review documented work by international institutions (e.g. OECD, European Commission) and international comparative studies (e.g. ACR+ 2006, 2008, Enviros 2004); it also compiled national profiles on household waste prevention policy and practice in 20 individual countries that have been more active, comprising 14 in Europe plus Australia, Canada, Japan, Kenya, New Zealand and the US (Strange 2009). The more 'evidence-rich' sources identified here were also included in the detailed review in (i) above.
iii. Around 50 further interesting sources were used to complement the more detailed reviews under (i).

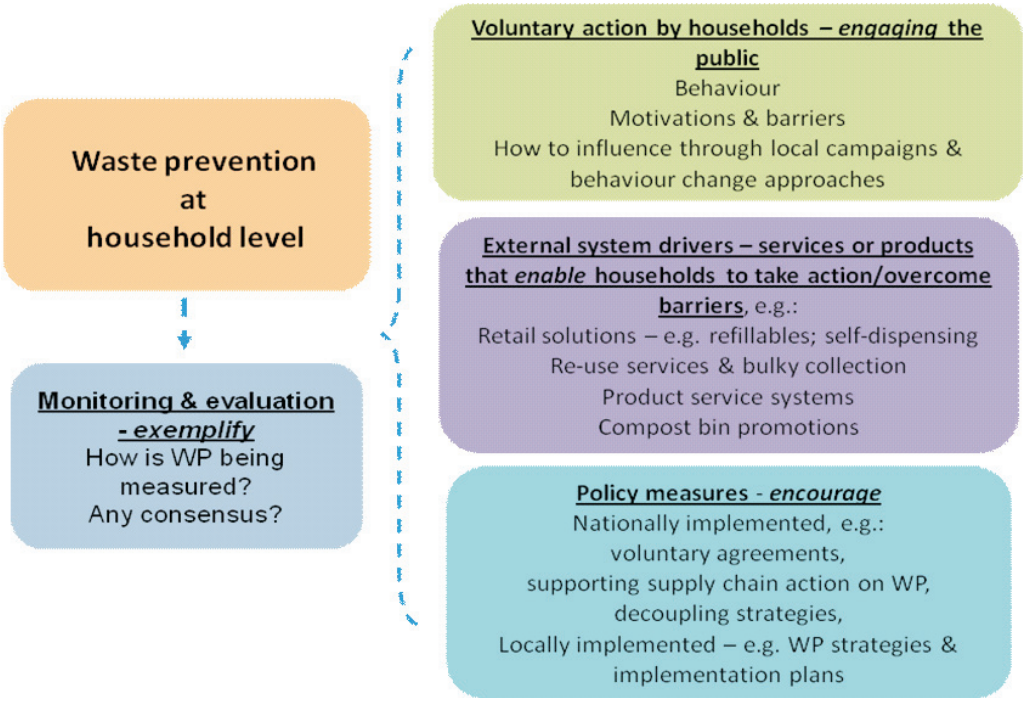

Fig. 5: Analytical framework (Brook Lyndhurst, SMP and RRF 2009).

The detailed review was carried out within a robust analytical framework (Figure 5). This sub-divided the review into four main themes, which corresponded roughly to the '4Es' of the behaviour change framework introduced earlier (Figure 3) and they are listed here.

- Consumers – *engaging* households to take voluntary actions to prevent waste;
- Third sector, retail and service stakeholders – *enabling* households to take action or overcome barriers, through the provision of services (e.g. access to reuse services) or products (e.g. refillable packaging solutions); and
- Policy measures – *encouraging* households to rethink their behaviour so as to reduce their waste generation.

The fourth theme identified in Figure 5, overarching the other three, is the need to consider how waste prevention impacts can be captured and *exemplified* through monitoring and evaluation.

Activity 4: Synthesis and reporting

This activity aimed to synthesize the findings into a series of tailored, policy-relevant reports and briefings. The original reports for Defra (Brook Lyndhurst, SMP and RRF 2009 [WR1204]) are organized into a series of modules that allow the evidence to be accessed at three different levels of detail, and in different packages. The intention is that users can drill down from the executive (level 1) reports to the particular detail of interest. The level 2 (overview) modules are synthesis reports which cover different aspects of household waste prevention. The level 3 documents provide both concise briefing notes on specific topics, and more detailed technical annexes.

In this paper, the results of the review are presented and discussed under the three main themes identified above – engaging, enabling and encouraging households. The fourth theme, monitoring and evaluation, is also covered briefly for completeness – a more detailed presentation is given in a parallel paper in this special issue of the journal (Sharp *et al.* 2010b). The final sections highlight the evidence gaps, and draw together the conclusions in the form of responses to a number of research questions agreed with the policy customers at the beginning of the research (see Figure 1).

Consumers – *engaging*

Engaging consumers and households to rethink their behaviour is one of the main ways in which waste prevention can be progressed. The evidence is summarized below for public participation in waste prevention, the motivations and barriers underlying behaviour and the contribution of public engagement initiatives to increasing action.

Options available and consumer participation

The review found that there is no standard set of behaviours which is widely accepted as comprising 'household waste prevention'. In practice, it covers anything from rejecting junk mail to reusing food leftovers; from home composting to donating electrical goods to charities; from buying second-hand clothes to avoiding single-use bags, and so on. Unlike recycling, which is a more singular act, prevention comprises many small individual actions. Furthermore, unlike recycling, prevention behaviour tends to be private and invisi-

ble, so there is much less likelihood of a social norm developing.

Data on the incidence of different behaviours are largely inconclusive, mainly because they come from surveys that relate to differing contexts (e.g. a specific area or group of people). A few nationally representative surveys are available, those in the UK being conducted mainly by WRAP (on food, nappies, home composting, junk mail and single-use bags). The only reliable time-series tracking data in the UK is currently held by WRAP (Gray & Toleman 2006, WRAP 2007b), while some questions in Defra's *Survey of Public Attitudes and Behaviours Toward the Environment* also cover waste behaviours (Defra 2008b).

From the literature, selected examples of the extent of practice for waste prevention behaviours include the following (a full tabulation, and a discussion of possible reasons for the wide variations reported, may be found in the corresponding detailed module of the original report (Brook Lyndhurst, SMP and RRF 2009 [WR1204] – Level 3, module 3-1).

- Home composting 14–35% (Barr *et al*. 2005, Gray & Toleman 2006, Parfitt 2006, Tucker & Douglas 2007 [WR0112], WRAP 2007a, b).
- Avoiding packaging 10–40% (Barr *et al*. 2005, Tonglet *et al*. 2004, Tucker & Douglas 2007 [WR0112], Defra 2008c).
- Committed to preventing food waste 14% (Ipsos MORI 2008a).
- Use own shopping bag 10–55% (Andrew Irving Associates 2005, Barr *et al*. 2005, Tonglet *et al*. 2004, Tucker & Douglas 2007 [WR0112], Ipsos MORI 2008a, Defra 2008b).
- Avoiding junk mail; for example, in the UK registering with the Mail Preference Service, 15% (Ipsos MORI 2008b, Tucker & Douglas 2007 [WR0112]).
- Buying second hand 2–69% (ACS undated, Watson 2008).

On reuse, a higher percentage generally donates [clothes, furniture or waste electrical and electronic equipment (WEEE)] than purchases second hand. However, new commercial channels (e.g. eBay) and community exchange services (e.g. Freecycle) may be beginning to change the traditional pattern of second-hand use and consumption: as an example, Freecycle membership is growing fast and is currently around one million members in the UK (Phillips 2009).

Up to 60% of people do at least one waste prevention behaviour (Tucker & Douglas 2007 [WR0112]) but behaviours tend to be practised sometimes rather than always, and some people will do one or a few but not a whole set of behaviours (Barr 2007). Willingness is consistently greater than the actual level of engagement in waste prevention behaviours (Barr 2007). Donating items is commonly reported as the most practised behaviour; private reuse of items around the home and other 'low effort' reduction behaviours tend to occupy an intermediate position; and those that require major changes in consumer habits are often least practised.

Practice varies across different socio-economic groups and the variations are often specific to the behaviour in question. In broad terms, however, waste prevention behaviours are more prevalent among individuals who are: older; middle to high income; female; living in detached properties; not living with children at home; and more concerned about the environment.

Behaviour change theories and waste prevention

A number of authors have used behaviour change theories either to explain or predict waste prevention behaviour (Tonglet *et al*. 2004, Gray & Toleman 2006) or have reviewed others' work in this area (Tucker & Douglas 2007 [WR0112]). One of the most widely tested is the theory of planned behaviour, which proposes that intention to act derives from three factors: a person's attitude, whether they feel able to act (known as 'perceived behavioural control') and wider social norms. Under the right external conditions (e.g. no limiting barriers), intention is expected to translate into action.

The theory of planned behaviour is just one of the many social psychological frameworks that are being examined and applied in pro-environmental behaviour change research [including Defra's programme on sustainable consumption (Defra, undated b; Jackson, undated; Darnton 2008)]. This body of applied theory identifies the following as being important considerations at a practical level (Tucker & Douglas 2007 [WR0112], Hampshire County Council and Brook Lyndhurst 2008 [WR0117]).

- *Personal values, norms and identity* – including whether I feel the issue is important, I feel responsible, I feel I am the kind of person who does this, and I feel I am able to do it, the perceived difficulty and costs;
- *Social norms and identity* – either whether I want to act because I see others do it (descriptive norm), or I feel obliged to do it because most people do it (injunctive norm), whether I get praise from others for doing it, or it gives me a sense of social 'belonging';
- *External conditions* – whether I have access to services or products, or whether there are other barriers that are outside my control;
- *Habits* – behaviours that occur regularly and repeatedly without conscious reflection are referred to as habitual and are not directly subject to the influence of values, norms and so on. Theoretical mechanisms have been described for breaking into habits and 're-freezing' new ones (e.g. 'cueing' of desirable habits, learning by doing etc.) (Defra 2009a).

Motivations for waste prevention behaviour

The motivations driving waste prevention are as many and varied as the diverse activities under the waste prevention umbrella: they cover many of the aspects flagged by theory; and are often specific to particular behaviours (e.g. food, home composting, reuse, etc.).

Importantly, research has suggested that waste prevention behaviours are poorly correlated with recycling, and are sometimes even negatively correlated (Tucker & Douglas 2007

[WR0112], Barr 2007) – such that recycling may become a reason for *not* doing more to reduce waste. This 'negative spillover' is also identified in Defra's evidence review of catalyst behaviours (Defra 2009b). The research also revealed a degree of confusion among the public between 'recycling' and 'reduction' and the two are often conflated in the public's mindset.

Studies that have tried to explain waste prevention behaviour through statistical models or testing of behavioural theory have generally found that their models have only weak explanatory power (Fell *et al*. 2010). Two of the main studies (Tucker & Douglas 2007 [WR0112], Barr 2007) found that some 70 to 85% of the variation in behaviour could not be explained. Difficulty in explaining waste prevention behaviour may be related to the fact that it is, in reality, not a single behaviour but many. Moreover, it is possible that there are missing inputs to the models which are drivers of behaviour but that do not relate either to waste, environmental values or world views [for example, the strength of purchase and food management drivers in WRAP's food waste research (WRAP 2007a)].

The difficulties faced by such modelling exercises lie, in part, in the fact that there is no consensus about behaviour change at a theoretical level. Nevertheless, various motivations are identified in the literature. The following are the most frequently mentioned in the studies reviewed (simply presented in the same order as theoretical drivers shown above because the literature does not provide the basis for a clear ranking).

- *Values – universalism and moral motivations.* Motivations for recycling are often described as more functional and influenced by external conditions (e.g. kerbside collection) than are those for waste prevention. Several authors link waste prevention behaviour to underlying personal values, including what are commonly termed 'universal' values [generally where an individual puts collective benefits ahead of their own personal gain (Tucker & Douglas 2007 [WR0112])]. The review has also found that moral and charitable motivations are drivers for reuse (especially donation); and an 'ethic of care' – a general sense of responsibility for the intrinsic value or on-going use of 'things' – has also been flagged (Watson 2008).
- *Personal responsibility.* Acceptance of personal responsibility is often cited as a primary requirement for prevention behaviour. It may be manifested, for example, as a sense of duty or obligation, satisfaction, embarrassment (or lack of it in relation to second hand goods), guilt, and active concern.
- *Self efficacy.* This describes the personal capabilities, confidence, know-how and skills needed to carry out a particular behaviour. Interventions or campaigns may address it by providing hands-on help or giving tips on how to perform an activity (e.g. the *Love Food Hate Waste* website (LFHW 2009) or several WREP projects (Global Action Plan *et al*. 2008 [WR0114], Dorset County Council *et al*. 2008 [WR0116], Hampshire County Council and Brook Lyndhurst 2008 [WR0117], Cox *et al*. 2009).
- *Costs.* Saving money through avoided or alternative purchase has been shown to be an important motivator – for example avoiding food waste (spending less on buying food), home composting (through subsidy of bins), carrier bags (charging), buying from charity shops, interest in refills, and switching from bottled to tap water. Money saving is a complex driver, however, and has to be set against the risk that consumers will perceive cheaper or alternative products as lower quality or sub-optimal options (see the section below on refillables).
- *Social norms.* Knowing or seeing that others are taking action can create a sense that individual contributions are worth the effort (Tucker & Douglas 2007 [WR0112]). A national survey in the UK, for example, indicated that 5–10% of home composters started due to encouragement from friends (Gray & Toleman 2006). Social norm effects and peer support are actively deployed in behaviour change interventions based around small groups working together and some have recorded significant reduction impacts among the individuals taking part (e.g. Global Action Plan *et al*. 2008 [WR0114], WRAP and the Women's Institute 2008).
- *Habits* can have either a negative or a positive effect on prevention behaviour: they can either block the take up of new behaviours where routines are so established that consumers never think to question them or help to maintain established 'good' behaviours (Tucker & Douglas 2007 [WR0112], Hampshire County Council and Brook Lyndhurst 2008 [WR0117]), OVAM 2008). The challenge for behavioural change interventions is to break into (or 'disrupt') routinized thinking and help consumers maintain new habits once they try something new. This can be done through repeat communication and hands-on support (e.g. Global Action Plan *et al*. 2008 [WR0114], Hampshire County Council and Brook Lyndhurst 2008 [WR0117]). A large scale study on the influence of habits on behaviour is currently underway for Defra (Defra 2009a).

Barriers to waste prevention behaviour

The barriers to waste prevention behaviour are equally diverse and almost mirror the motivations above.

- *Apathy* or a general lack of interest in the idea of prevention has been identified as a general barrier (Tonglet *et al*. 2004, Hampshire County Council and Brook Lyndhurst 2008 [WR0117]), specifically in studies of junk mail, food and refillables.
- *It's someone else's responsibility*. Lack of interest is often compounded by a feeling that business and retailers are more responsible for the waste problem than consumers, commonly noted around packaging but also food waste (Obara 2005, Tucker & Douglas 2007 [WR0112], Hampshire County Council and Brook Lyndhurst 2008 [WR0117], WRAP 2007a, WRAP and the Women's Institute 2008).

- *Inconvenience* is commonly cited as a barrier, with specific mentions for home composting, refillable packaging and retail self-dispensing systems, product service systems, reusable nappies and donating for reuse. Non-participants can be put off by the *perception* of inconvenience without any actual experience (e.g. Gray & Toleman 2006, Brook Lyndhurst *et al*. 2010 [WR0209]). Behaviour change projects may address this by providing opportunities to see, or try out, activities in practice (*exemplify)* or by making it very easy to participate (*enable).* Examples include nappy or home composting demonstrations for *exemplifying* and providing sign-up forms for junk mail opt outs to *enable* action (e.g. Dorset County Council *et al*. 2008 [WR0116], Hampshire County Council and Brook Lyndhurst 2008 [WR0117]).
- *Cost* can be a motivator for buying low waste products where there is some price advantage (or subsidy); but where consumers perceive there will be little or no discount, or they think an alternative will be more expensive, this acts as a barrier (e.g. in relation to refills, product service systems and food purchase). Special offers on food have been shown to contribute to food waste by encouraging people to buy more than they need (WRAP 2007a, WRAP and the Women's Institute 2008, Salhofer *et al*. 2008).
- *Weak self efficacy and a sense of powerlessness*. Many people feel that their contribution, either to the waste problem or to the solution, is marginal. In particular, some specific prevention behaviours can be seen as too insignificant to be worthwhile (Tucker & Douglas 2007 [WR0112]). In addition, consumers may lack the know-how which would enable them to act differently, including what products to buy/use (e.g. nappies or home composting), how to manage wastage (e.g. on food or junk mail), or where to access services (e.g. reuse).
- *Social norms don't favour waste prevention.* This problem faces two ways: the prevailing social norm values mass consumption, rapid turnover of products and a personal identity built on the ownership of consumer goods (Hampshire County Council and Brook Lyndhurst 2008 [WR0117]); waste prevention is not a mainstream behaviour and may sometimes be seen as weird or different (e.g. buying second hand (Watson 2008)). Moreover, the actions that contribute to waste prevention are largely private and unseen, so there is no explicit social pressure to 'do the done thing' (Tucker & Douglas 2007 [WR0112]), nor a reminder to hang on to new prevention habits (Waste Watch 2006 [WR0105]) – as there is now for recycling.
- *Dominance of the recycling norm.* As we saw above, the recycling norm has become so strong that this is generally people's understanding when they are asked to 'reduce waste'. Intervention projects have found that people need to be educated about the specific actions they can take, and why these are worth doing, rather than relying on general exhortations to 'reduce waste' – it is suggested that many people believe they are already doing their bit through recycling (Hampshire County Council and Brook Lyndhurst 2008 [WR0117], Brook Lyndhurst and Waste Watch 2006 [WR0504]).

Although the above list of motivations and barriers provides a generic indication of the 'basics' that need to be considered when trying to engage the public in waste prevention, it does not do justice to the richness of the evidence base for specific prevention behaviours. Further detail and insight can be found in the related module (Level 3, module 3-2) of the original report (Brook Lyndhurst, SMP and RRF 2009).

Contribution of consumer behaviour change options to waste prevention

Approaches

Campaigns and interventions that tackle a full range of waste prevention behaviours are a relatively new area for local authorities, at least in the UK (Sharp *et al*. 2010a). 'Intervention' is a generic term referring to any activity or project intended to effect change: 'campaigns' comprise communication processes intended to raise awareness, encourage participation, promote change etc. The existing evidence in the UK comes from WREP projects (e.g. Global Action Plan *et al*. 2008 [WR0114], Dorset County Council *et al*. 2008 [WR0116], Hampshire County Council and Brook Lyndhurst 2008 [WR0117]), and a small number of authorities and community-led initiatives (e.g. Wickens 2005, Waste Watch 2006 [WR0105], Brook Lyndhurst and Waste Watch 2006 [WR0504], Changeworks and SisTech 2008, NLWA 2009). Two main approaches have been trialled so far.

- Doorstepping and providing information packs and advice, targeted at *all households in a defined area* (Dorset County Council *et al*. 2008 [WR0116]).
- Volunteer household campaigns/projects, where *individuals sign up to be part of a group* receiving a package of advice, challenge activities and (often) hands-on support (e.g. Waste Watch 2006 [WR0105], Global Action Plan *et al*. 2008 [WR0114], Hampshire County Council and Brook Lyndhurst 2008 [WR0117]), WRAP and the Women's Institute 2008, Cox *et al*. 2009).

In addition to these cross-cutting campaigns are local authority and other initiatives on *specific behaviours* such as nappy or compost bin promotions (e.g. Brook Lyndhurst and Waste Watch 2006 [WR0504], Salisbury *et al*. 2008) and projects in schools. All three approaches may involve champions or mentors (paid or voluntary) who help to support households in taking up new behaviours (e.g. WRAP's home composting advisors; Global Action Plan's Eco Team facilitators (Global Action Plan *et al*. 2008, Global Action Plan 2009).

National support for local activity in the UK has been principally through the activities of WRAP, including financial and communications support for compost bin promotion, and the *Love Food Hate Waste* campaign (LFHW 2009) which provides a key communications 'asset' for local authorities.

Table 3: Impacts achieved from waste prevention interventions and campaigns (Sharp et al. 2010a, Brook Lyndhurst, SMP and RRF 2009).

Waste prevention behaviour	kg household^{-1} week^{-1}	Source
Home composting[a] – WRAP	2.9	WRAP (2009d)
Home composting[a] – other literature review	3.5–3.8	Tucker and Douglas (2007 [WR0112])
Food waste[a]		WRAP (2009e)
• becoming a committed food waste reducer	1.46	WRAP and the Women's Institute (2008)
• Love Food Champion	2.50	
Bulky waste[b] – donate for reuse (NB per person)	~0.07	LCRN (undated) and Vandenbussche (undated)
Cross-cutting waste prevention campaign[b]	~0.5 to 1.0	Various 0.5 (est. from Dorset County Council *et al*. 2008 [WR0116]), 1.0 (est. from Changeworks & SisTech 2008)

[a] Data refer to impact of each individual recruited to an activity.
[b] Data averaged across all households in specified geographical area.

During 2009, WRAP has updated (WRAP 2009c) an existing waste minimization (now prevention) toolkit (NRWF 2004) and is revising existing monitoring and evaluation guidance (WRAP 2006).

Tonnage impacts

It is possible to piece together evidence of the impact of campaigns or interventions from the examples cited in the literature but the data come with important health warnings (see Waste Watch 2006 [WR0105] and Brook Lyndhurst and Waste Watch 2006 [WR0504] for further discussion):

- Monitoring and evaluation practice is not yet standardized so results are not necessarily comparable. The WRAP waste prevention toolkit and revised monitoring and evaluation guidance should encourage more standard practice in future (WRAP, 2006, 2009c).
- Methodologies and execution are sometimes flawed (though there are robust examples too).
- Not all evaluations differentiate between *increased recycling* and *waste prevention at source*, so that 'reduction' impacts may sometimes be overstated.

There is also a fundamental difference between generalized or doorstepping interventions and campaigns and those focused on groups of volunteer households (where there is currently more evidence). Results for the first are averaged over all households in an area regardless of whether people take up the advice or not; the second looks solely at the performance of those who volunteered to take part. There is some evidence (Global Action Plan *et al*. 2008 [WR0114], Cox *et al*. 2009, Hampshire County Council and Brook Lyndhurst 2008 [WR0117]) that these voluntary activities tend to attract individuals with greater than average environmental interest, so that their performance may not be generalizable to a more representative population.

These caveats have been borne in mind in calculating indicators of impact derived from the literature: these are summarized in Table 3, while more details may be found in a parallel paper in this special issue of the journal (Sharp *et al*. 2010a).

Some cross-cutting campaigns reported much higher impacts than the 0.5 to 1.0 kg household^{-1} week^{-1} shown in Table 3 but the results were judged to be either unrepresentative (i.e. they involved volunteer households) or to have significant flaws. *More evidence is required to substantiate these results*, especially on the impacts of cross-cutting campaigns. This would most usefully be gathered from new, robustly monitored campaigns in the future rather than piecing together more historic data of variable quality.

That said, the broad indicator for cross-cutting campaigns in Table 3 is slightly lower than previous UK benchmark estimates of waste prevention potential. Enviros (2004) suggested a 10% reduction is achievable (including reuse); the original NRWF toolkit indicated 3.2 to 7.4% (NRWF 2004). If the apparent impact of cross-cutting campaigns could be repeated across England it would imply prevention potential of 0.57 million to 1 million tonnes, which is equivalent to 2 to 4% of total household waste.

Third sector, retail and service stakeholders – enabling households to take action

This section turns to the contribution of particular stakeholders in supporting household action and their role in the service infrastructure for waste prevention. This is a potentially vast subject field, so the scope was limited to three specific topics, mainly driven by the coverage of the work undertaken for WREP (LDA and Brook Lyndhurst 2007 [WR0501], Lofthouse *et al*. 2007 [WR0113], Resources for Change *et al*. 2008 [WR0506], Hines *et al*. 2008 [WR0502], Open University 2009 [WR0211], Cook & Gottberg 2009 [WR0106], Gottberg *et al*. 2010). The review covered the following items:

- reuse and the third sector;
- retail solutions, focusing on refillables and retail self-dispensing systems; and
- product service systems.

The WRAP Retail Innovation programme was a further key source of evidence (James Ross *et al*. 2008a, b, Lee *et al*.

2008). Related issues not covered in the review include eco-design, packaging innovation, mandatory deposit schemes for refillables, remanufacturing, and product lifespan.

Reuse and the third sector

Three WREP studies examined the contribution of third sector organizations to the waste and resources sector and their support needs (Wickens 2005, Resources for Change *et al*. 2008 [WR0506], Hines *et al*. 2008 [WR0502]). A further study examined the contribution of community composting (Open University 2009 [WR0211]). The Belgian region of Flanders provides especially useful evidence on well integrated local authority and third sector working, together with a range of commercial retail franchises that offer well recognized consumer branding (Arold & Koring 2008, Vandenbussche undated). Evidence from these sources was supplemented by academic and practitioner literature and the international review (Strange 2009).

Current situation

The precise scale and character of the reuse sector in England is currently unknown (though it has been researched in depth for London (LCRN undated)). A best estimate based on the evidence is that approximately 500 000 tonnes is reused annually in England. This estimate is pieced together from various sources and excludes recycling. It comprises an estimated 270 000 tonnes bulky reuse (Curran *et al*. 2007) and around 230 000 tonnes clothing/textiles (there is no reliable source of data on textiles and estimates disagree – this figure should not be taken as definitive). WRAP have confirmed that our estimate of 500 000 tonnes *reused* (excluding recycling) is likely to be of a similar order of magnitude to that being developed in their current research (WRAP personal communication, 2009). This estimate *does not* include commercial channels such as eBay and car boot sales; nor does it include Freecycle, which is expanding very fast in the UK (Phillips 2009). Other key facts for the UK are listed here.

- Half to two-thirds of households dispose of bulky waste and WEEE each year, mostly to household waste recycling centres (HWRCs).
- Capture of bulky waste (including WEEE) for reuse may be in the order of 10 to 15% (LCRN undated, Curran & Williams 2007, Curran *et al*. 2007).
- Council bulky collections achieve an estimated 2% reuse rate and HWRCs 2–3%, whereas channels such as charity shops can achieve 80%+ of what they collect (although much of this is textiles) (LCRN undated, Curran & Williams 2007, Curran *et al*. 2007).
- Third sector collections in London achieved a 68% reuse rate of *bulky items* collected in 2006/7 (LCRN undated).
- Large appliances and bulky waste are more easily captured for reuse; most small WEEE goes to landfill, either because of low consumer recognition that it can be reused, or it not being accepted by collections or charities (Darby & Obara 2004).
- Between 800 and 1200 third sector organizations provide recycling and/or reuse services (LDA and Brook Lyndhurst 2007 [WR0501], Williams *et al*. 2005 (cited in Resources for Change *et al*. 2008 [WR0506]), Hines *et al*. 2008 [WR0502]); in addition there are 7500 charity shops in the UK (Charityshops 2009).
- Reuse charities and enterprises divert (not necessarily reuse) 90 000 tonnes of bulky waste and have helped 750 000 low income households to acquire appliances and furniture (FRN undated).
- 170 community composting sites (existing in 2007) composted 12 500 tonnes of organic waste (Open University 2009 [WR0211]).

Third sector involvement in waste activities is characterized by a large number of small charities and a handful of large social enterprises, plus nationally co-ordinated charity shops. Social objectives are often (but not always) the prime motivation for the organization, with waste activities being the means of achieving those objectives. An organization's orientation – whether it sees itself as a 'waste business' or not – shapes its capabilities and role as a waste operator/contractor (Hines *et al*. 2008 [WR0502]). The dominance of third sector organizations is a special feature of reuse activity in the UK and different models may be observed in other countries (Arold and Koring 2008).

Examples exist in Europe where there is a more developed second hand retail sector and/or greater integration of reuse organizations with the local authority bulky waste infrastructure. A notable example of the latter is the Belgian region of Flanders (Arold and Koring 2008, Vandenbussche undated).

Barriers and success factors

Barriers cited in the literature are summarized in Table 4. The success factors for these kinds of organizations are a mirror of the barriers and include the following particular examples.

- *Funding and business development support* – many of the barriers to capacity, effectiveness and growth are being addressed in the Defra/WRAP supported REAlliance programme, a community interest company led by a consortium of four third sector organizations that is providing support to third sector reuse organizations (Defra 2008a).
- *Co-ordination with local authority activities* – most often where activity is formalized in service level agreements. Some authors cite this as a key barrier where it is not seen (e.g. Curran & Williams 2007); or show a correlation between levels of reuse activities and authorities which have service agreements with reuse organizations (LCRN undated). The Flanders example shows how a package of policy provisions (including reuse targets, special exemptions, allowances, employment subsidy and tax treatment of reuse) can support the development of an integrated reuse sector (Vandenbussche undated).

Table 4: Barriers to the growth and development of third sector organizations and reuse infrastructure (example for the UK) (Brook Lyndhurst, SMP and RRF 2009).

Operational	Consumer
• Funding – tendency of some to rely on grants • Capacity, lack of enterprise culture, business skills, and governance • Decline in quality of material donated for reuse – result of 'fast fashion' and 'flat-pack furniture' • Logistics – high cost of property; large storage requirements • The 'rules' for bulky waste collection services may mean items are easily damaged – e.g. leaving items exposed to rain/vandals at kerbside; type of vehicle used to collect	• Lack of visibility/knowledge of reuse options – donation or purchase • Most bulky waste taken to HWRCs – reuse organizations prefer collections to maintain quality • Stigma around second-hand purchase, especially if linked to charity • Perception of bulky waste collection service – sometimes seen as inconvenient or expensive
Policy/regulatory	**Relationship with local authority bulky waste**
• Delays and changes in the implementation of the WEEE directive (though forthcoming revisions are expected to have a positive impact) • Perverse incentives created by relative prices of waste treatment options – reuse 'chronically undervalued' (LCRN, undated) • Planning regulations and waste management site licensing (for community composting) • Conditions and thresholds for exemption from the Animal By Products Regulations (ABPR) (community composting)	• Lack of strategic planning for reuse in bulky waste services • Lack of co-ordination between LAs and third sector (except where service level agreements are in place) • Lack of co-ordination *within* LAs between social services (potential clients) and waste services (suppliers) • No consistent practice with respect to payment of reuse credits to third parties • Shift towards integrated waste management contracts – possibility that small organizations are ineligible/unable to tender

Potential contribution of reuse and the third sector to waste prevention

Authors are generally optimistic about opportunities and growth for reuse activities, both generally and involving third sector organizations. Revisions to the WEEE directive are expected to increase reuse activity: Furniture Recycle Network (FRN) have suggested it might increase appliance reuse from 500 000 items a year to 1 million (FRN, undated). Stakeholders consulted during the review also suggested that the new national indicators for local authorities (NI, undated) (with the inclusion of reuse) may encourage authorities to pursue reuse as a means of achieving landfill diversion.

Community and social benefits

Strengths of third sector reuse/recycling organizations identified in the WREP studies include the following activities.

- Innovation and creativity, including trial of concepts before mainstream markets develop.
- Serving social or market niches that would otherwise not be covered by mainstream services.
- Leverage of additional resources (e.g. through volunteering).
- Strong ties with the local community, which may enhance education and communication activity.
- Job creation for low skill workers or the long term unemployed.
- Supply of appliances and furniture to low income households (the FRN and LCRN both suggest that demand currently exceeds supply).

One study set out to calculate the social return on investment of community waste organizations but with limited success (Resources for Change *et al*. 2008 [WR0506]).

Carbon reduction benefits

Reuse of bulky waste can lead to a carbon dioxide saving of 4.2 tonnes per tonne of furniture or appliances reused, and 19 tonnes per tonne of reused textiles, based on avoided emissions from new products (LCRN undated). The 21 500 tonnes of organic material composted at community compost sites in 2007 approximated to 1850 tonnes CO_2-equivalent emissions saved (Open University 2009 [WR0211] using Defra guidelines).

Tonnage diversion

Reuse of bulky waste (including WEEE) and textiles currently amounts to around 500 000 tonnes year^{-1} in England. Authors agree that there is significant potential to capture many more items for reuse (and recycling), and so contribute to diversion from landfill.

- Only 15% of bulky waste is reused, and a further 25% recycled, leaving more than 1 million tonnes going to landfill or for incineration (Curran & Williams 2007).
- The UK generates 1.5 to 2 million tonnes of clothing waste a year, of which only 16% is recovered for reuse or recycling (Defra 2008c).

At national level, authors suggest that reuse of between *a quarter and a third of bulky waste* would be feasible if best practice approaches are adopted, including better integration of third sector and local authority infrastructure (Curran & Williams 2007, Curran *et al*. 2007, Eunomia *et al*. 2007 [WR0103]). This would be equivalent to around double the present tonnage. In locations where reuse has been estimated at local level (in London), authorities are currently achieving 0.1 to 3.7 kg household^{-1} year^{-1} reuse on average (LCRN undated). In the Belgian region of Flanders, OVAM (2007) reported that the 33 accredited reuse centres in Flanders operate 99

outlets and in 2005 sold more than 17 400 tonnes of goods, equivalent to 2.88 kg inhabitant^{-1}. OVAM (2009) reported that 7.19 kg inhabitant^{-1} were collected for reuse in 100 accredited centres in 2007.

Similar projections are not available for *textiles*, although Defra's sustainable clothing action plan is investigating how greater recycling and reuse can be achieved (Defra 2007c).

No reliable evidence was identified on tonnes reused through commercial and private second hand channels, or through Freecycle, although indicative estimates calculated from data in various sources suggest anywhere between 8 and 25 kg per Freecycle member per year.

Retail solutions – refillables and self-dispensing systems

The review was concerned with packaging options that require active involvement of households/ consumers in making alternative choices. Other retail packaging solutions are largely passive as far as the household is concerned (e.g. light-weighting (WRAP 2009b) or mandatory deposit return schemes (ERM 2008 [WR1203]) and were excluded from the review. Working with the retailer Boots, a WREP study explored 15 possible options for a lower weight refill to use with an original primary cosmetics pack when it is empty (Lofthouse *et al*. 20, [WR0113]). Other evidence came from the WRAP retail innovation programme which included two studies on international experience of refills and their applicability to the UK (James Ross *et al*. 2008a, Lee *et al*. 2008) and one study on shop-based self-dispensing systems (James Ross *et al*. 2008b).

Current situation

The share of refillables in packaging has been in long-term decline, replaced by single-use (also known as single-trip or one-way) options. For example, the UK market share of refillable milk bottles has declined from 94 to 10% (during 1974–2006), for beer containers from 33 to 0.3% (1961–2006) and for soft drinks from 46 to 10% (1980–1989) (Lee *et al*. 2008). Refillables are available in the UK but demand has not taken off among consumers or retailers (Lofthouse *et al*. 2007 [WR0113], Lee *et al*. 2008).

Both refillables and self-dispensing systems (SDS) are more established in some other countries including the US and the Asia Pacific region, where different consumer cultures (less frequent shopping, more bulk buying) and awareness of environmental benefits play a part (James Ross *et al*. 2008a). Self dispensing is found mainly in food stores specializing in fresh/organic/health food products.

Barriers and success factors

Authors generally agree on the main barriers to greater take-up of refills (summarized in Table 5). A central conundrum is that consumers expect refills to be cheaper than original products; yet being cheaper can also convey a sense that the product is lower quality. Perception also plays an important role with retailers and producers, in particular a perception that retail volumes will be too low to generate acceptable profits. Notably, consumers like the fact that refills confer environmental benefits, but this is not found to be a primary motivation for purchase.

The following factors have been found to encourage consumer interest in refills.

- *Weight*: they are lighter and so more transportable for people without cars.
- *Space:* they take up less room at home (a reason why a bulk buying culture in the US favours refills).
- *Brand loyalty*: consumers are already engaged with a brand; the refill is an extension of the offer.
- *Quality*: if the overall consumer offer of original-plus-refill conveys a sense of a quality or a premium product to the consumer.
- *Price*: if refillables are cheaper (as long as the product still conveys a sense of quality).
- *Waste reduction*: this is very much a secondary motivation after price and perception of quality.

Table 5: Barriers to the take-up of refills and self dispensing (example for the UK) (Brook Lyndhurst, SMP and RRF 2009).

Consumer	Retailer
• Expectation that the refill will be (much) cheaper • Lack of significant discount (real or perceived) between original and refill pack • Perception that refills may be lower quality • Making the pack too small makes consumers think they are getting less value, even if quantity is the same as the original • Lack of awareness/worries about availability • Lack of understanding about how refills work • Needing to be organized • Fear about 'lock-in' to particular product • Concerns about hygiene in open access SDS • Lack of branding on self-dispensed goods	• Shelf-space requirement of stocking original and refill versions of product – UK has greater product proliferation than, e.g., the USA • Stock management • Perception of low market volume and impact on profits • Mess and wastage from spillage (SDS) • Possibility of needing staff to support customers in using SDS
	Producer
	• Worries about cost of either refitting production lines to make refills, or sourcing additional suppliers • Risks to brand image/perception of quality (especially in relation to scuffing of reused glass; control where refill requires dilution) • Potential loss of product identity and consumer 'lock-in' if container design becomes generic • Perception of low market volume and impact on profits

The overall consensus in the literature is that refills need to be presented as a premium product at the same price, or at a lower price, so that consumers believe they are benefitting from switching.

Counter to some of the perceptions identified, the WRAP feasibility studies (James Ross *et al*. 2008a) found that both refills and SDS can generate cost savings for retailers as well as for consumers. Across WRAP's international case studies, consumer cost savings were 26% on average (James Ross *et al*. 2008a). SDS were also observed to encourage consumers to buy smaller portions, which could offer potential for reducing food waste.

Potential contribution of refills and self-dispensing to waste prevention

There is a significant problem in estimating the potential contribution of refills and self-dispensing systems to waste prevention at a national level, because impacts and benefits cannot be generalized across products (James Ross *et al*. 2008a, Lee *et al*. 2008). The case for refillable containers needs to be assessed on a product-by-product basis because the life-cycle benefits are so variable (Lee *et al*. 2008). In particular, less packaging in refills needs to be set against factors such as relative recyclability of primary pack and refills, logistics impacts, and whether the consumer sustains a shift to refills.

Indicative estimates are given in the various studies for individual products or models. In the Defra WREP study (Lofthouse *et al*. 2007 [WR0113]), for each individual product sold (rather than total tonnage for that product) a weight reduction of 60–90% was estimated on the basis of usage over a 6-month period. When recycling benefits are added, weight reduction would be 77–81%. Taking into account assumed sales volumes as well as product weights, the WRAP refills study reported the following indicative impacts on total tonnages of different refill options (using the UK as an example).

Glass instant coffee jars supported by soft pack refills:
77 000 tonnes year^{-1}
Soap pack pump dispensers supported by lidded packs:
4000–7000 tonnes year^{-1}
(the higher figure being if the refill is a bulk container providing several refills)
A trigger household cleaner dispenser supported by a capped bottle:
7500 tonnes year^{-1}
A soap dispenser supported by pouch refills:
5000 tonnes year^{-1}
Deodorant stick dispenser supported by shrink wrap refills:
10 000–11 000 tonnes year^{-1}

The indicative savings for SDS were rather less. Illustrative examples included a 70 tonne reduction from cornflakes, 26 tonnes from coffee (assuming it replaces jars), and 86 tonnes for detergent cartons.

Product service systems

This part of the review focused on one very specific WREP study by Cranfield University (undertaken in conjunction with house builder Taylor Woodrow) of a particular application of the concept of product service systems (PSS) (Cook & Gottberg 2009 [WR0106], Gottberg *et al*. 2010). The general idea of PSS is that consumers purchase a service (e.g. laundry) so reducing their need to own physical products (in this case a washing machine), thus over time reducing the quantity of WEEE.

In the concepts tested, the PSS (which may also include e.g. house cleaning, garden maintenance or home improvement) would be delivered through either a regular subscription or an ad hoc call out. The service would be administered by the housing developer through a call centre for consumers and service contracts with suppliers. The concepts were tested with consumers and staff from the developer in separate workshops, while potential waste and other environmental benefits were estimated quantitatively for different scenarios.

The research found that consumers were generally interested in the idea of PSS but were reluctant to consume it as a substitute for owning products; they tended instead to prefer PSS as a complement to 'self service'– that is, being able to do the task themselves when they wanted to, meaning that they would need to own the relevant appliance *as well as* using the PSS. The main condition influencing whether or not consumers liked the idea of PSS was a standard economic trade off between time and money. Those on higher incomes but time constrained were more likely to favour PSS than those on low incomes or retired.

The results suggest that product service systems may reduce the amount of WEEE from households on new developments by 13 tonnes over 10 years on a 200 household eco-development, most of which (8.8 tonnes) comes from washing machines through avoided ownership or smaller appliances (key assumptions are: 100% adoption of PSS; 80% ownership of smaller washing machines and vacuum cleaners; 25% ownership of drills and lawnmowers). Critical to the impact calculations are assumptions about substitution of large appliances by smaller ones which households then keep for longer than usual (15 years as opposed to 7). The assumption here is that consumers hold onto appliances until the end of their operational life, rather than replace them because of aesthetics, fashion or upgrading to the latest technology.

Cooper (2005) shows that the latter reasons are, in fact, key drivers of short product lifespan. There are also significant consumer barriers to keeping appliances in working order, including moderate to low interest in repairs (Cooper 2005) and a systematic tendency to over-estimate the cost of repairs (Huysentruyt & Read 2008).

The Cranfield study's authors also warn that actual consumer behaviour is a substantial unknown, since the models were tested as hypothetical 'what ifs'. They recommend that piloting and monitoring of PSS on new developments is required to substantiate their findings, for example on new

social housing schemes or in Eco Towns (Cook & Gottberg 2009 [WR0106]).

Product lifespan was not covered in detail in this evidence review, as it was outside of the main scope. However, it is likely to be of fundamental importance to waste prevention in future. For example, AEA *et al*. (2007 [WR0107]), ran a modelling scenario which showed that doubling product lifespan could have a significant impact on the arisings of waste household goods.

Policy measures – encouraging

A key aim of waste policy in England, as in other countries, is to decouple waste growth from economic growth. Devising measures that lead to decoupling requires an understanding of the factors that affect waste growth: this includes lifestyles, individual behaviour and consumer expenditure trends, as well as the relationship between waste generation and waste collection arrangements.

WREP has undertaken studies into all of these drivers through approaches such as econometric modelling (AEA et al. 2007 [WR0107]), building lifestyle scenarios (Brook Lyndhurst 2007 [WR0104]) and quantitative analysis of waste growth at the local level (Resource Futures 2009 [WR0121]). The precise outcomes of lifestyle and behaviour factors depend on the mix of assumptions made: in some scenarios (e.g. extending the lifespan of products) a waste reduction effect is found; other scenarios show continuing waste growth. These modelling approaches are discussed further in a parallel report in this special issue of the journal (Fell *et al*. 2010). The modelling studies point to the need to find points of influence with the consumer and in supply chains (see the evidence reviewed in previous sections) and through waste policy and implementation.

This section provides a summary of the international literature on policy measures to encourage waste prevention. The review covered policies which would need to be co-ordinated at national level, and policies where local authorities would need to take a lead in implementation. The selection of policy measures included in the review was shaped by what was found in the evidence base.

One of the WREP studies by Eunomia *et al*. (2007 [WR0103]) undertook a large-scale strategic review of the international use of policy options for waste prevention. The options included in the present review were shaped by that study, as well as the scoping exercise, the international review and suggestions from the project steering group. The evidence review focused particularly on policy measures that would impact directly on households or household waste prevention. Broader policy measures (such as the landfill tax escalator, business or schools waste) were excluded.

Table 6 summarizes the range of policy options identified in the literature, indicating their rationale, current status in England, and issues flagged in the evidence in relation to maximizing the benefit of each measure. The potential impact of each measure (as reported in the literature) is also shown in the table and discussed in the conclusions below: full details of these estimates are provided in the detailed module of the original review (Brook Lyndhurst, SMP and RRF (2009) – Level 2 module 5). These impact data come with a strong 'health warning', as they are derived from widely differing methodologies (including empirical research, case studies and modelling). Using them presents a number of other challenges to policy makers: they have a very wide range, from 'unknown' through a few thousand tonnes to more than 3 million tonnes per year; they relate to different waste prevention behaviours which, as discussed earlier, are very diverse; and impacts would appear to be in part a function of wider social, institutional and political conditions.

It is very difficult to demonstrate a consistent, direct link between specific policy instruments and measurable waste prevention achievements. However, the international review (Strange 2009) suggests that a broad mix of policy measures can deliver waste prevention goals. The most frequently applied suite or 'package' of waste prevention policy measures appears to include most or all of the following activities.

- Producer responsibility.
- Variable rate charging (pay as you throw) systems (generally applied to householders' residual waste).
- Intense public awareness/communications campaigns.
- Public sector funding for pilot projects.
- Collaboration between public, private and third sectors.

Monitoring and evaluation

The evidence review identified monitoring and evaluation as the fourth, and overarching, element of an analytical framework for household waste prevention (Figure 4) which pinpoints the main avenues through which household waste generation can be influenced. Reliable and robust monitoring and evaluation of household waste prevention interventions is essential, to enable policy makers, local authorities and practitioners to:

- collect robust and high quality data;
- ensure robust decisions are made about where to prioritize resources; and
- ensure that waste prevention initiatives are being effective and delivering behaviour change.

Measuring waste prevention is challenging (Waste Watch 2006 [WR0105]): it is always difficult to measure what is not there. As detailed in a parallel paper in this special issue of the journal (Sharp *et al*. 2010b), the evidence reveals a range of approaches to monitoring and evaluation, including:

- self-weighing;
- pre- and post-intervention surveys, focusing on attitudes and behaviours and/or on participation rates;
- tracking waste arisings via collection data and/or compositional analysis; and
- estimation/modelling.

Table 6: Summary of evidence reviewed on policy measures for waste prevention (using England as an example to illustrate the potential impact) (Brook Lyndhurst, SMP and RRF 2009).

Policy options	Rationale	Current situation/status in England	Further issues	Potential impact
Household behaviour (through local waste services)				
Waste collection scheme design (e.g. alternate weekly collection (AWC), residual bin sizes, no side waste policy, etc.)	• *Restricting* capacity for residual waste while *maximizing* options for recycling encourages households to think about waste prevention as well as recycling	• National policy is to allow local authorities to choose system appropriate to their area WRAP guidance on AWC	• AWC known to be linked to reduced *total HH waste* but little evidence of relative contributions of source reduction and recycling • More evidence forthcoming in Defra waste growth and composition reviews (Resource Futures 2009, forthcoming)	4–13% reduction in total household waste from recycling and source reduction combined Equivalent to *~0.69 million tonnes*
Direct variable householder charging and financial incentives	• Costs borne by residents are proportionate to how much waste each produces (e.g. like utilities) • Charging by 'unit' of waste produced sends direct signal to household to recycle or prevent waste • Can reward high recyclers/low waste producing households International evidence shows both recycling and source reduction impact	• Provision made in Climate Change Act for five local authorities to pilot incentives schemes • No applications so far received by deadline	• Evidence suggests that a regular and convenient recycling service needs to be in place for charging to be effective as a residual waste reduction measure; and that complementary measures may be needed to avoid either simple diversion (e.g. to household waste recycling centres (HWRCs)) or fly tipping.	*1.0 million to 2.5 million tonnes* (reduction in LA collected waste based on scenarios – percentage reductions from 2006 Defra study applied to updated 2008 Defra waste statistics for baseline)
Producers and retailers				
Reducing quantities of junk mail[a]	• Producer responsibility agreements provide incentive for recycling and promotion of junk mail opt outs • Producers can be mandated to contribute to recycling collection costs (e.g. France) • Other measures (not in place in England currently) include stronger incentive or enforcement for junk mail opt outs– see col. 3.	• Voluntary agreement between government and Direct Mail Association • Targets for recycling of direct mail of 70% by 2013 • Prevention mechanism through Mailing Preference Service (MPS) • MPS opt out available for many years (15% of households registered with MPS) • Opt-in (or similar) provision under consideration	• Other options mentioned in the literature: • Increase postage charge on bulk mail • Tax or levy on junk mail • Legislative backing of 'no junk mail' stickers, allowing local authorities (LAs) to enforce them • Requiring all direct mail to have MPS details	*119 k to 223 k tonnes* direct mail could be avoided (scenarios based on package of 'other options')
Extended product warranties[a]	• Encourage longer product lifespan of products, reducing need to replace • Would be communicated to consumers through product labelling • Resulting change in consumer demand would influence production of more durable products	• Does not currently exist in Europe	• Would need to be implemented at EU level • Not suitable for products with high "in-use" environmental impacts (need to be guided by life cycle assessment (LCA) of product)	Unknown

Minimum standards for appliances[a]	• Waste/resource impacts included in eco-assessment for product labelling
	• Product labelling informs consumers' choices
	• Encourages producers to 'design out' waste
		• Various labels in use – including EU Eco-label – but currently not widely recognized or effective at communicating waste/resource impacts and benefits	• Best implemented at EU level
			• Could be built into the EU Eco-Label scheme
			• Stricter options would include:
			  • compulsory labelling for weight and durability
			  • mandatory minimum criteria
				Unknown

Table 6: Summary of evidence reviewed on policy measures for waste prevention (using England as an example to illustrate the potential impact) (Brook Lyndhurst, SMP and RRF 2009). *(Continued)*

Policy options	Rationale	Current situation/status in England	Further issues	Potential impact
Mandatory use of rechargeable batteries in new products[a]	• Reduce quantities of hazardous waste by increasing length of 'time in use' of batteries • Policy option would extend beyond households	• EU Batteries Directive comes into force in England in May 2009 • Introduces producer responsibility requirements • Focus on collection and recycling; no provision made for mandating rechargeable batteries	• Need a law requiring the use of rechargeables or law banning use of single-use batteries through EU Batteries Directive implementation • Raising targets for battery recycling could encourage prevention as well	Unknown – market for small household batteries currently *20 000 tonnes year^{-1}*
Other producer responsibility agreements[a]	• Producers bear costs of waste disposal of their products which (in theory) encourages waste prevention and recycling • Expected to influence product design	• Schemes in place at UK level for Packaging and WEEE • Proposed upward revisions to WEEE directive targets include specific reference to reuse of whole appliances for first time	• Little evidence of strong impact on prevention – compliance mechanisms tend to favour recycling • Collection costs currently greater than compliance costs, so LAs bear cost burden	Potentially significant but not known precisely Indicative potential of *250 000 tonnes* cited for packaging (based on assumption of 5% 'prevention effect')
Material or sector based voluntary agreements	• In addition to or complementary to producer responsibility	• Various in places in England • Direct mail (see above) • Courtauld Commitment – major retailers have voluntary target for absolute reduction in packaging waste by 2010; and to help cut household food waste by 155 000 tonnes in 2010 compared to a 2008 baseline • Carrier bags – voluntary agreement signed with retailers in 2008		Achievements: *80 000 tonnes year^{-1} packaging (2008)* = zero waste growth *137 000 tonnes year^{-1} food waste (2008)* *23 000 tonnes carrier bags since 2006*
Collaborative procurement (joint public sector procurement to eco-standards) [a]	• Encourages producers to offer most environmentally advantageous products • Potentially drives product innovation towards low waste products • Limited impact on household waste – spin-off to domestic products unknown	• Various initiatives in place in central and local government to 'green procurement' • Waste not necessarily priority – benefits need to be set in LCA context		Unknown Immediate impact on household waste probably small – but potentially significant impact on product design, including resource use in manufacture and products
Local authority waste management				
Home composting inclusion in LATS[a]	• Provides a financial incentive for LAs to promote home composting • Decline in residual waste arisings observed where HHs home compost • Modelling suggests significant cost savings possible for collection services • Current system may divert garden waste into household stream where it is collected free of charge	• Not currently included in landfill allowance trading scheme (LATS) calculations • Authors and stakeholders argue that this non-inclusion gives perverse incentive to LAs to maximize collection of biodegradable waste – rather than promote home composting	• Would require change in LATS calculation methods • Data issues – modelling work by WRAP under consideration by Defra • Spending on promotions and communication required to maximize impact	*1.4 million tones year^{-1}* (projection for 2020 assuming 50% household participation)

Table 6: Summary of evidence reviewed on policy measures for waste prevention (using England as an example to illustrate the potential impact) (Brook Lyndhurst, SMP and RRF 2009). *(Continued)*

Policy options	Rationale	Current situation/status in England	Further issues	Potential impact

Stimulating re-use of durable goods[a]	• Reuse extends product lifespan, reduces waste to landfill and has carbon saving benefits
	• Only ~15% of bulky waste currently reused
	• Most disposed through LA collection channels/ HWRCs
	• Reuse rate for bulky goods in LA channels (collection and HWRC) only ~2–3%
		• No national targets but reuse included in new national performance indicators for LAs
		• Higher targets and inclusion of reuse in WEEE Directive revisions expected to boost reuse sector
		• National guidance on optimizing bulky waste collections
		• REalliance programme supporting capacity development of third sector reuse organizations
			• Data coverage and quality of reuse sector is weak
			• Better integration and strategic planning of LA and third sector services needed
			• Options might include:
			  • service level agreements with third sector
			  • single customer contact point for collection service in each authority
			  • 'first call' of reuse organizations on bulky waste
			  • financial incentives for reuse organizations
			• No standard LA practice towards payment of reuse credits to third parties
				~500 000 tonnes of bulky and textile waste currently reused
				
				Optimized reuse rate ~30% of bulky waste arisings (double present level)
				
				Indicative scenarios of *215 000 tonnes* of furniture and *100 000 tonnes* WEEE (but limited to reuse organizations)
				
				30% reuse of *all* bulky waste would be equivalent to higher tonnage than scenario

Local authority targets for waste prevention[a] (potentially supported by levy for missed targets)	• Target for residual waste (reducing over time) encourages LAs to consider all means of reducing waste, including prevention	• Targets for residual waste in Waste Strategy 2007 (see section 1) • New national indicator for residual waste • No specific target for waste prevention (as distinct from residual waste)	• Levies for missing targets used in some countries to support progress to target • Levy may be used in conjunction with direct householder charging • Examples of specific targets in other countries (e.g. Flanders reuse target; Wallonia levy)	*3+ million tonnes* (scenario modelling based on Wallonia; depends on configuration of target and/or levy)
Implementation plans for WP[a]	• Dutch experience shows it can bring key stakeholders from whole product lifecycle together to draw up strategic plans ('covenants') for particular material streams and lead to reduction	• EU Waste Framework Directive requires waste prevention plan – may be opportunity to encourage LAs to draw up WP plans • Some activity in UK sustainable product roadmaps – though end of life less prominent than energy/materials in current roadmaps	• Requires well facilitated stakeholder processes	Unknown but potentially significant Impact on household waste less clear than on commercial waste
Restrictions on landfill	• Restrictions on particular materials increases treatment costs and encourages waste prevention	• Defra considering introduction of further landfill restrictions – research commissioned exploring key experience in other EU countries		Unknown but potentially significant

[a] Indicates measure was included in the Eunomia *et al*. study (2007 [WR0103])
Key sources are: Eunomia *et al*. (2007 [WR0103]). Also various WRAP reports, for example, WRAP (2007b) and press releases. Other references for policy measures are ACR+ (2008), Dunne *et al*. (2008), EPA (2008), Eunomia (2006), Gordon Mackie Associates Ltd (2007), OVAM (2004), OVAM (2008), Parfitt, (2006), Salhofer *et al*. (2008), Skumatz (2008), WIN (2009), Enviros (2004).

There appears to be an emerging consensus that no single approach is sufficient on its own, rather a 'hybrid' method using a suite of monitoring approaches – usually including surveys, waste tonnage data and monitoring of campaigns – is recommended.

The evidence suggests that there is no benefit in trying to further collate evidence from past waste prevention projects, other than to establish, in a few selected cases, if waste prevention behaviour has been sustained beyond cessation of the active campaign. A more promising way forward is to ensure that new intervention campaigns are properly evaluated and that the evidence is captured and collated into a common resource.

Table 7: Evidence gaps identified in the evidence review and stakeholder engagement (Brook Lyndhurst, SMP and RRF 2009).

Consumer	Retail and third sector
Which messages work • Impacts of campaigns/consumer intervention • Cost-benefits of dedicated waste prevention officers, and community outreach resource • Whether providing incentives adds value to interventions (e.g. subsidies, prizes etc.) • Spillover or rebound effects – is recycling a block? • Ethnographic observation of in-home behaviour to identify lifestyle levers	• Consumer engagement with bulky and WEEE reuse (potentially building on the approach in Defra's sustainable clothing study and product roadmaps) • Comprehensive data on the size and character of bulky waste and the reuse sector • Evidence on the impact of producer responsibility on waste prevention, as opposed to recycling • Evidence from retailers working with other stakeholders to prevent household waste
Policy measures	**Monitoring and evaluation**
• Impact data for high level measures – England and international • Methodologies for measuring these impacts (e.g. of extended warranties on product lifespan) • Comprehensive data on the prevention effect of different collection system arrangements, including AWC • Cost benefit assessment of prevention versus recycling	• Guidance on 'fit for purpose' techniques and how to operationalize them • Guidance on measurement issues – e.g. attribution/ displacement • Good practice on survey design • Quality of data analysis and reporting • Use of compositional data tied to attitude/ behaviour surveys • Standard conversion factors (except FRN standard weights for reuse, which are widely accepted) • Standard benchmarks for carbon impacts of different prevention activities

Evidence gaps and future research priorities

Gaps identified through the literature research and by stakeholders are consolidated in Table 7, organized around the four main themes identified in Figure 5.

Issues around data cut across all the themes covered in the review. There are two key problems with the evidence base on household waste prevention – both in England and across Europe.

- *Lack of data* – national statistics, or nationally endorsed sources of information, which would help local authorities (and others) identify priorities or understand consumer behaviour, includthe following items.
  - Extent of consumer behaviour for different activities (lack of consistent estimates was confirmed in this review).
  - Tracking or longitudinal data.
  - Size and character of waste prevention options – for example, the reuse and bulky waste; impacts of collections systems on arisings (both of these issues are currently being researched by WRAP and WREP respectively).
  - Benchmarks – for example, on carbon impacts of different waste prevention activities.
- *Poor quality data* – which can affect the impact of campaigns or interventions.
  - (Sometimes) there is unclear reporting of methods and data, assumptions or conversion factors used.
  - Impact data may be derived from small sample sizes.

Taking the gaps in Table 7 into account, two types of further evidence were identified as being required – technical research and good practice guidance. Although the possible options suggested in Table 8 are based on the example of England, many are relevant internationally, particularly where there is potential for improved or good practice to be shared between countries.

The challenge going forward will be to put in place processes that can achieve the following objectives.

- Capture the practice data in 'real time' (rather than retrospectively which has been the case up until now).
- Continue to use central resources to develop consumer insight on key activities that can then be disseminated to local authorities.
- Will develop a suite of best practice guidance on aspects of waste prevention.
- Be capable of tracking both consumer and tonnage trends as well as carbon impacts.

Conclusions

At the outset of this evidence review, a number of key questions were framed jointly with the Defra policy teams (see Figure 1). The conclusions are structured as responses to those questions.

What is the extent to which waste prevention behaviours are practised?

The evidence revealed many limitations in the data available to answer this question, with some notable exceptions. A significant cause of weakness in the evidence is that no two researchers ask households about the same portfolio of waste prevention behaviours. Unlike recycling, *waste prevention is not one behaviour but many*.

Beyond acceptance of top level definitions such as the OECD (2002) and the Waste Framework Directive (EU Directive 2008), there is no consensus definition in the literature of which specific behaviours make up 'waste prevention'.

Table 8: Options for addressing evidence gaps for household waste prevention (using England as an example) (Brook Lyndhurst, SMP and RRF, 2009).

Entry points	Possible research options	Possible guidance options
Monitoring and evaluation	(1) Feasibility of using compositional analysis in local campaign evaluation (2) Waste prevention behaviour tracking (Defra sustainable behaviours unit survey)	(1) M&E guidance (covered in the new WRAP guidance) (2) Standard survey question bank (3) Standard metrics for impact (e.g. Love Food hate Waste (LFHW), home composting)
Voluntary action by consumers	(1) Consumer research on attitudes/behaviours to different reuse actions (e.g. appliances as part of Defra road map work programme) (2) Modelling – adoption curves for behaviours and saturation limits (3) Centrally co-ordinated consumer research specific to individual behaviours, repeated over time, and disseminated to local authorities (4) Negative spillover from recycling and ways to overcome (small scale qualitative research) (5) Observational/ethnographic in-home study of waste prevention action to identify lifestyle behaviour change levers (6) Longitudinal follow-up of selected campaigns, with robust method, to quantify sustained behaviour change resulting from interventions (7) Cost–benefit of dedicated waste prevention officers and/or outreach	(1) Best practice guidance on campaign messages, including case studies that have worked (2) WRAP toolkit – plan for continuing dissemination and profile post launch, including training for local authority officers and others
Stakeholders	(1) Commitment to continual improvement of data on bulky waste and the reuse economy – WRAP/Defra liaison (2) Case study research of reuse partnerships with local authorities, how they work, model service contracts, impacts, benefits and ways of overcoming barriers (including overseas examples) (3) Case studies of retailer/stakeholder partnerships for reducing household waste, to support best practice guide	(1) Dissemination 'fact sheets' from WRAP retail innovation programme aimed at the public– to help LAs engage the public on waste prevention and counter personal responsibility barrier regarding packaging (2) Best practice guide for LAs on reuse partnerships based on research insights (3) Best practice guide to local authorities on working with retailers to prevent household waste
Policy measures	(1) Modelling – relative benefits of recycling and waste prevention, and priorities for waste/costs/carbon, to support local authorities in making the business case for waste prevention (2) Examination of case studies of 'early adopter' local authorities of strategic waste plans and prevention targets, identifying factors for success and risks. (3) Modelling and scenario testing extended product warranties; consumer attitudinal research on warranties in context of product lifespan	(1) Continuing update of Best Practice guidance to local authorities on how to develop strategic plans and targets for waste prevention (already part of training support to WRAP toolkit)
Cross cutting	(1) Role of financial incentives (*NB excluding direct charging*) in supporting waste prevention	

This may help to explain why statistical models struggle to explain the origins of waste prevention behaviour – they typically leave around 70% of it unexplained. It may be the case that there is too much 'noise' caused by different motivations for different kinds of prevention behaviours in the models, so that they lose explanatory power.

Some authors manage to identify categories of prevention behaviours that seem to be broadly related, such as those which relate to minimizing purchase, as opposed to private reuse of products at home. Others argue that each individual behaviour needs to be understood separately. WRAP's work on home composting and on food waste, which show very different origins, underline the case for behaviours to be targeted with bespoke messages.

Although there is no consensus definition of a waste prevention behavioural portfolio, and estimates vary on the extent to which different behaviours are practised, studies generally agree that there is a broad hierarchy of action. Donation for reuse tends to be at the top (mainly clothes), running through private reuse behaviours, to avoidance or substitution of purchase at the bottom. Stakeholder views on the hierarchy of consumer practice differed and we speculated that their perception is skewed by their current interests and activities (e.g. in food waste). The danger of practitioners and policy makers relying on 'gut feel' and personal experience to understand consumers was highlighted by this mismatch of perception with the evidence.

What are the barriers and opportunities to encourage participation?

The most significant issue emerging from the evidence is lack of consumer understanding of both the idea of 'waste prevention' and of the actions that might be associated with it. There is, in particular, a general tendency to equate the idea of 'reduce waste' with 'recycling'. Some academic papers suggest that it is only the most environmentally motivated or committed recyclers that undertake prevention behaviour, and there are hints in the evidence that (kerbside) recycling may get in the way of developing prevention habits. Therefore it cannot be assumed that prevention is the next 'natural step' from recycling.

Lack of understanding is compounded by lack of visibility. Waste prevention is usually a very personal behaviour, done imperceptibly (e.g. when shopping) or out of the sight of others (at home), so that there is no descriptive social norm to support it – as there is now with widespread recycling. Equally there is no injunctive norm – the sense that something should be done – because many of the behaviours involve rethinking consumption. Prevailing consumer identity that is achieved through the acquisition of material possessions or affiliation with brands was identified as a significant barrier to consumer engagement.

Opportunities exist to raise the profile and visibility of prevention, not through general exhortations to "reduce waste", but by identifying specific activities, helping consumers to be good at them (e.g. through handy tips, doorstepping, community outreach) and educating about the need to do these things. Consumers may not immediately identify such activities as 'environmental' and other hooks may need to be found, at least in this early adoption phase. This kind of approach is exemplified in the WRAP-led Love Food Hate Waste campaign (LFHW 2009), as is the notion of an 'ethic of care' – for products, the environment or wider society – which was also flagged as a motivation in the literature (Watson 2008).

What are the options available to householders and what is their impact?

A variety of methods and tools was identified in the literature to engage households in waste prevention behaviour. None of them is radically different from the approaches used to increase recycling participation, for example doorstep campaigns or community outreach. Common themes included the need to provide specific tips on how to reduce or prevent waste; to encourage people to try new activities that break into routine or unconscious habits; and to make the results of taking action more visible (e.g. by encouraging people to monitor their own waste production).

It was possible to identify a small number of interventions where waste impacts had been measured, though significant data limitations were identified that make it difficult to produce a robust overall estimate of the impact of campaigns. Drawing on the data, our best judgement is that campaigns which target a mix of behaviours can achieve around 0.5 to 1 kg household^{-1} week^{-1} reduction**.** These can only be indicative estimates at this stage and much more substantial evidence is required (but see Sharp *et al*. 2010a for a more detailed discussion).

Of separate measures, the highest impacts are observed from home composting (where the data are the most reliable) and food waste.

What are the options for other stakeholders and what is their impact?

Under this heading, the review looked mainly at reuse in general and the role of the third sector within it specifically, as well as retail solutions which require active involvement of consumers – notably refills and self-dispensing product systems. Passive solutions, such as light-weighting of packaging materials and or mandatory deposit return schemes were excluded.

In total, current reuse in England amounts to around 500 000 tonnes year^{-1}, of which around half is textiles. Once again, the data are weak, needing to be pieced together from diverse sources. In addition, there is a commercial second-hand market of unknown size, which is important because its channels compete for supply with local authority and third sector options. Freecycle and similar schemes are a new trend which are growing fast but currently of unknown impact.

Higher reuse rates are achieved through third sector channels – around 65 to 80% depending on material, compared to 2 to 3% for bulky waste channelled through local authority collections and HWRCs. Third sector channels appear able to collect materials of a higher quality, thus enabling the high re-use rate, whereas local authority doorstep collections and household waste and recycling centres (HWRCs) are often collecting bulky waste of very low quality.

Authors agree that there is significant scope to increase the scale of reuse activity in the UK, although estimates of the tonnage potential vary – perhaps up to double the present level would be feasible. The evidence points to significant social benefits too from third sector operators, although researchers have found it very difficult to measure this benefit as a return to public investment.

Forthcoming revisions to the WEEE Directive (WEEE 2009) in Europe are expected to boost the reuse economy. There is a consensus in the literature and from stakeholders that in order to optimize the role of reuse in waste strategy, more needs to be done to create an integrated reuse system, which involves enhancing the following linkages and building good working relationships between the following groups of reuse stakeholders.

- *Between waste, social services and housing providers at the local level* – to join up supply and demand sides for reused furniture and appliances.
- *Between local authorities and the third sector* – through service agreements and consistent approaches to the payment of reuse credits.

- *Between the service infrastructure and consumers/households* – by supporting campaigns and services that increase the visibility of reuse options, and working to undermine the stigma associated with second hand goods.

There are useful international examples of a more retail-focused second-hand culture, and more integrated reuse networks between local authorities and the third sector. Flanders is an exemplar of a strategic level, integrated policy package for reuse, including per capita targets and favourable treatment on product taxes and employment subsidies (Arold & Koring 2008, Vandenbussche undated).

In relation to retail solutions, and specifically the refillable options focused on in this review, the principal barriers relate to consumer price sensitivity and no real price advantage. Consumers like the environmental benefits but these are not a primary motivation for purchase. Barriers for manufacturers and retailers relate to a perception of low profitability, stock management issues, and possible costs of refitting manufacturing lines. Taking England as an example, retailers are already supported to undertake R&D into refillables and other lower waste packaging through WRAP and its retail innovation programme (WRAP 2009b); and the Courtauld Commitment by major retailers to reduce waste provides an incentive to innovate (WRAP 2009a). The main opportunity here is to continue to build on such work.

Looking at retail solutions more broadly, influencing design standards was also hinted at in the literature as a major opportunity, as was a possibility to influence consumer behaviour through carbon or eco-labelling. This evidence review did not include mandatory options – such as deposit-return schemes – which are covered in other Defra research (ERM 2008 [WR1203]).

What is the impact of different policy options and measures on waste prevention?

The new Waste Framework Directive (EU Directive 2008) is likely to raise the political priority of waste prevention across Europe, both to reduce waste arisings *per se*, and to reduce the quantity of residual waste going to landfill (which is how the current English target for household waste prevention is framed (Defra 2007b)).

The various policy options investigated in the literature covered by this review vary considerably, both in terms of the scale of their potential impact and in the degree of confidence that can be ascribed to calculations of impact. Different behaviours, different methodologies and different institutional arrangements combine to make comparison between options exceptionally difficult.

Table 9 draws together all the quantitative information identified in the review on actual or potential impact of waste preventions options, and provides a worked example of what this could mean at a national level in England. It is important to bear in mind the many and various limitations with the data presented, even though it is derived from the most robust sources found. Most of the illustrative totals involve some significant assumptions (e.g. grossing up to national level from a single local campaign). *These figures should be seen as*

Table 9: Illustrative potentials of waste prevention options (using England as an example).

Actual achieved (latest year): million tonnes year^{-1}			
Love Food Hate Waste 2008 (a)	0.14	Courtauld – packaging 2008 (a)	0.08
Bulky and textiles reuse 2007 (e) (NB estimates suggest percentage of bulky reused could ~ double in future)	0.50	Carrier bags avoidance 2008 (a)	0.02
Projection: million tonnes year^{-1}			
Home composting by 2020 (p) (included in LATS)	1.40	General household campaigns (ip)	0.56 to 1.12
Love Food Hate Waste (p) (Courtauld by 2010)	0.16	Love Food Hate Waste (p) (total household food waste inc. above)	0.25
Junk mail – low (p)	0.12	Junk mail – high (p)	0.22
Reuse – furniture (p)	0.22	Reuse – WEEE (figure is for weight of metal diverted) (p)	0.10
Refill – e.g. glass coffee jars (p)	0.08	Refill – e.g. deodorant stick (p)	0.01
Deepen producer responsibility (p)	0.25	Mandatory rechargeable batteries (p) (if all single use substituted)	0.02
		Self-dispensing – e.g. cornflakes (p)	70 tonnes
Alternate weekly collection (AWC) – 4% to residual HH waste (ip)	0.69	Local authority waste prevention targets and residual levy (p)	3.00 (min)
Charging – 4% to total HH waste (ip)	1.01	Charging – 10% to total HH waste (ip)	2.52

(a), actual achieved: (e), estimate of current performance; (p), future projection derived directly from the literature reviewed; (ip), indicative projection which scales up best practice estimates from the literature to the whole of England.
See Brook Lyndhurst, SMP and RRF (2009) and refer to the detailed Level 2 module 5 for sources and basis of assumptions.

best estimates which illustrate relative orders of magnitude, rather than definitive statements of potential. Note also that each measure is assessed in isolation: no attempt is made to measure any results that might arise from combinations of measures; note, too, that the impact of some initiatives is a function of the level of resources devoted to them.

The figures seem to suggest that the largest voluntary gains could come from home composting and local cross-cutting waste prevention campaigns (though there is likely to be double-counting here, as local campaigns normally include home composting promotion). The other significant options are all top-down policy measures, though as explained earlier it is not possible even to make rough estimates of some of the more interesting options – such as extended product warranties – with current data.

In addition to pure tonnage gains, some authors suggest there are potential quick wins in options such as junk mail and carrier bag reduction (supported by voluntary agreements) that are popular with the public and relatively straightforward to implement. Since their waste prevention impacts may not be that large (e.g. with carrier bags) it will be important to leverage any 'foot in the door' effects of initiatives on these aspects in order to educate on the bigger impact activities. This will be especially so in local campaigns.

Overall recommendation

The review suggests that the most effective and most frequently applied household waste prevention policy measures include prevention targets, producer responsibility, householder charging, public sector funding for pilot projects, and collaboration between public, private and third sector organizations, supported by long term and intense public intervention and communications campaigns.

Internationally, these individual policy instruments are often combined in packages of measures (Strange 2009). The need for a 'package' approach, or a 'basket of measures', is linked to and reinforced by the fact that waste prevention is not one behaviour, but many. Tackling these complex and disaggregated behaviours will require similarly subtle and variegated policy. There is no simple, 'one size fits all' solution.

Acknowledgements

The evidence review on which this paper is based was funded by the Waste and Resources Evidence Programme (WREP) of the UK Department for Environment, Food and Rural Affairs (Defra). Defra is committed to developing policy from an evidence-based platform; and this project was commissioned to provide such an evidence base for household waste prevention. The review is not a statement of policy; and the inclusion of or reference to any given policy should not be taken to imply that it has, or will be, endorsed by Defra as an option for England. The views expressed in this paper are those of the authors, and do not necessarily reflect those of Defra.

The authors would like to express their thanks to the Defra Steering Group, in particular Rachel Gray of WRAP and Andrea Collier of Defra; to the expert panel, to those who participated in the stakeholder workshops and the electronic survey, and to those who gave telephone interviews. Specific mention should also be made of the unstinting, dedicated support given by Ellie Kivinen and Rachel Drayson of Brook Lyndhurst; and of David Fell of Brook Lyndhurst who helped draw the project to a close.

References

Note: *Many of the references are to research projects commissioned by Defra's Waste and Resources Evidence Programme (WREP) or other Defra science programmes. Full copies of the published reports for such projects (marked in this reference list with an asterisk*) are available via the Defra Research and Development web portal, http://randd.defra.gov.uk/ – click on 'search' and enter the reference number (e.g. WR1204, EV02004) as the keyword.*

ACR+ (2006) *Waste Prevention in Regional Waste Management Plans – Technical Report*. (Hannequart JP. (ed.)) http://www.acrplus.org/index.asp?page=280 (accessed 31 July, 2009).

ACR+ (2008) *Analysis of Municipal Waste Management Practices in Europe – an Image of Some of the Best Performing Cities and Regions*. Association of Cities and Regions for Recycling and Sustainable Resource Management (ACR+), Brussels. http://members.acrplus.org/upload/documents/document221.pdf (accessed 30 July 2009).

ACS (undated) (Association of Charity Shops). *An Analysis into Public Perception and Current Reuse Behaviour Conducted in the East of England.* http://www.charityshops.org.uk/C2R/Choose2ReuseReportFull.pdf (accessed 28 July 2009).

AEA Energy and Environment, The Future Foundation and The Social Marketing Practice (2007, updated 2009). *WR0107: Modelling the Impact of Lifestyle Changes on Household Waste Arisings*. A project for Defra's Waste and Resources Evidence Programme (WREP)*.

Andrew Irving Associates (2005) *Carrier Bag Usage and Attitudes – Benchmark and Target Market Study*. Prepared for Corporate Culture PLC on behalf of WRAP. http://www.wrap.org.uk/downloads/CarrierBagUsageFull.df65fbcc.1909.pdf (accessed 28 July 2009).

Arold, H. & Koring, C. (2008) *New Vocational Ways and Qualifications for Professionalisation in the Second-Hand Sector. European report: An Investigation and Analysis of the Second-Hand Sector in Europe*. http://www.qualiprosh.eu/download/European_Sector_Analysis_Report_english.pdf (accessed 28 July 2009).

Barr, S., Gilg, A. & Ford, N. (2005) Defining the multi-dimensional aspects of household waste management: A study of reported behaviour in Devon. Resources, Conservation and Recycling, 45, 172–192.

Barr, S. (2007) Factors influencing environmental attitudes and behaviors. A UK case study of household waste management. *Environment and Behavior*, **39**(4), 435–473.

Blakey, N.C., Wilson, D.C. & Smith, N. A. (2007) Developing the evidence base to support policy: a planned approach to waste and resources research in the UK. *Proceedings of the Institution of Civil Engineers: Waste and Resource Management*, **160**(WR3), 113–123.

Brook Lyndhurst and Waste Watch (2006) *WR0504: Establishing the Behaviour Change Evidence Base to inform Community Based Waste Prevention and Recycling.* A project for Defra's WREP*.

Brook Lyndhurst (2007) *WR0104 Lifestyle Scenarios: the Futures for Waste Composition*. A project for Defra's WREP*.

Brook Lyndhurst, SMP (The Social Marketing Practice), and RRF (Resource Recovery Forum) (2009) *WR1204: Household Waste Prevention Evidence Review*. A project for Defra's WREP*.

Brook Lyndhurst, Waste Watch and RRF (2010) *WR0209: Enhancing Participation in Kitchen Waste Collection Schemes*. A project for Defra's WREP*, forthcoming.

Changeworks and SisTech (2008). *The Waste Wise Armadale Project. Final Report*. http://www.changeworks.org.uk/uploads/WWA%20Final%20Report.pdf (accessed 28 July 2009).

Charityshops (2009) http://www.charityshops.org.uk/ (accessed 28 July 2009).

Cook, M. & Gottberg, A. (2009) *WR0106: Achieving Household Waste Prevention through Product Service Systems*. Centre for Natural Resource Management, Cranfield University, Final report and technical reports. A project for Defra's WREP*.

Cooper, T. (2005) Slower consumption reflections on product life spans and the "throwaway society". *Journal of Industrial Ecology*, **9**(1–2), 51–57.

Cox, J., Wilkins, C., Ledsom, A., Drayson, R. & Kivinen, E (2009) *EV02004. Environmental Action Fund (EAF): A Review of Sustainable Consumption and Production Projects (SCP2.2)*. A report to the Department for Environment, Food and Rural Affairs. Defra, London.

Curran, A. & Williams, I.D. (2007) Maximising the recovery of household bulky waste in England. In Proceedings Sardinia 2007, Eleventh International Waste Management and Landfill Symposium, S. Margherita di Pula, Cagliari, Italy; 1–5 October 2007. CISA, Environmental Sanitary Engineering Centre, Italy.

Curran, A., Williams, I.D. & Heaven, S. (2007) Management of household bulky waste in England. *Resources, Conservation and Recycling*, **51**, 78–92.

Darby, L. & Obara, L. (2004). Household recycling behaviour and attitudes towards the disposal of small electrical and electronic equipment. *Resources Conservation and Recycling*, **44**, 17–35.

Darnton, A. (2008) *Practical Guide: An Overview of Behaviour Change Models and their Uses*. For the Government Social Research Unit. http://www.gsr.gov.uk/downloads/resources/behaviour_change_review/practical_guide.pdf (accessed 28 July 2009).

Darnton, A., Elster-Jones J., Lucas K. & Brooks M. (2006) *Promoting Pro-Environmental Behaviour: Existing Evidence to Inform Better Policy Making*. Summary Report for Defra. Defra, London, UK http://randd.defra.gov.uk/Document.aspx?Document=SD14002_3822_FRP.pdf (accessed 28 July 2009).

Defra (2004) *Waste and Resources R&D Strategy 2004/05 – 2006/07*. http://www.defra.gov.uk/environment/waste/wip/research/pdf/rdstrategy.pdf (accessed 28 July 2009).

Defra (2005) *UK Sustainable Development Strategy, Securing the Future*. http://www.defra.gov.uk/sustainable/government/publications/uk-strategy/ (accessed 28 July 2009).

Defra (2006) Our Approach to Evidence and Innovation. See current web-site entry at http://www.defra.gov.uk/science/how/documents/EvidenceAndInnovation.pdf (accessed 28 July 2009).

Defra (2007a) *Waste and Resources Evidence Strategy 2007–2011*. http://www.defra.gov.uk/environment/waste/wip/research/pdf/wres-2007-2011.pdf (accessed 28 July 2009).

Defra (2007b) *Waste Strategy for England 2007*, p. 11. http://www.defra.gov.uk/environment/waste/strategy/ (accessed 28 July 2009).

Defra (2007c) *Defra Sustainable Clothing Action Plan*. http://www.defra.gov.uk/environment/business/products/roadmaps/pdf/sustainable-clothing-action-plan.pdf (accessed 28 July 2009).

Defra (2008a) *Third Sector Strategy (REconomy capacity building initiative supported by Defra and WRAP).* http://www.defra.gov.uk/corporate/how-do-we-work/third-sector/strategy/documents/Defra-Third-Sector-Strategy-1108.pdf (accessed 28 July 2009).

Defra (2008b) *Survey of Public Attitudes and Behaviours Toward the Environment*. http://www.defra.gov.uk/environment/statistics/pubatt/download/pas2007report.pdf (accessed 28 July 2009).

Defra (2008c) *Defra Sustainable Clothing Roadmap*. http://www.defra.gov.uk/environment/business/products/roadmaps/clothing.htm (accessed 28 July 2009).

Defra (2009a) *Unlocking Habits to Enable Pro-environmental Behaviours – EV0502, AD Research and Analysis*. For Defra's Sustainable Consumption and Production Evidence Programme (SCPEP)*, forthcoming.

Defra (2009b) *Catalyst Behaviours – EV0508*, Brook Lyndhurst. For Defra's Sustainable Consumption and Production Evidence Programme (SCPEP)*, forthcoming (10 November 2009).

Defra (2009c). Municipal Waste Management Statistics for England 2008/09. Statistical Release 257/09 5th November 2009.) http://www.defra.gov.uk/evidence/statistics/environment/wastats/archive/mwb200809_statsrelease.pdf (accessed 10 November 2009).

Defra (undated a) *Evidence Based Policy Making*. http://www.defra.gov.uk/science/how/evidence.htm (accessed 28 July 2009).

Defra (undated b) Defra's programme of social research on pro-environmental behaviour can be found at http://www.defra.gov.uk/environment/business/scp/evidence/theme3/sustain-consump.htm (accessed 28 July 2009).

EU Directive (2008) Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives. *Official Journal of the European Union* 22.11.2008, L 312/3. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:312:0003:0030:en:PDF (accessed 28 July 2009).

Dorset County Council, AEA, The Social Marketing Practice, Mike Read Associates and The University of Northampton (2008) *WR0116: Household Waste Prevention Activity in Dorset. Summary Report, Technical Annexes*. A project for Defra's WREP*.

Dunne, L., Convery, F.J. & Gallagher, L. (2008) An investigation into waste charges in Ireland, with emphasis on public acceptability. *Waste Management*, **28**, 2826–2834.

Enviros (2004) *International Waste Prevention and Reduction Practice for Defra*. Source document located on archive at Scottish EPA website. http://www.sepa.org.uk/waste/moving_towards_zero_waste/waste_hierarchy/idoc.ashx?docid=5c50b3f9-acad-4ff1-b22b-bff5906d635f&version=-1 (accessed 28 July 2009).

EPA (Environment Protection Agency) (2008) *The National Waste Prevention Programme Fourth Annual Report 2007/2008*. US Environmental Protection Agency, Washington DC, USA

ERM (2008) *WR1203: Review of Packaging Deposits System for the UK*. A project for Defra's WREP*.

Eunomia, The Environment Council, Öko-Institut, TNO and Atlantic Consulting (2007) *WR0103: Household Waste Prevention Policy Side Research Programme*. A project for Defra's WREP*.

Eunomia (2006) *Modelling the Impact of Household Charging for Waste in England for Defra*. http://www.defra.gov.uk/environment/waste/strategy/incentives/pdf/wasteincentives-research-0507.pdf (accessed 28 July 2009).

Fell, D., Cox, J. & Wilson D.C. (2010) Future waste growth, modelling and decoupling. *Waste Management & Research*, **28**, 281–286.

FRN (undated) *Live Long and Prosper – The value of re-use in Britain. Presentation*. FRN, Bristol, UK

FRN (2009) Average weights. http://www.frn.org.uk/statistics.asp (accessed 28 July 2009).

Global Action Plan *et al*. (2008) Global Action Plan, (Nye, M. & Burgess, J.) (School of Environmental Sciences, University of East Anglia). *WR0114: Global Action Plan, Promoting Durable Change in Household Waste and Energy Use Behaviour*. A project for Defra's WREP*, forthcoming.

Global Action Plan (2009) *EcoTeams Evaluation Report for Defra Environmental Action Fund*. See Cox *et al*. (2009), op. cit.

Gordon Mackie Associates Ltd (2007) *Direct and Variable Charging for Household Residual Waste – Overview of Key Issues*. Prepared for the Chartered Institution of Wastes Management. http://www.ciwm.co.uk/mediastore/FILES/14030.pdf (accessed 28 July 2009).

Gottberg, A., Longhurst, P.J. & Cook, M.B. (2010) Exploring the potential of Product Service Systems to achieve household waste prevention on new housing developments in the UK. *Waste Management & Research*, **28**, 228–235.

Gray, S. & Toleman, I. (2006) National home composting survey results, 1997–2005. Sustainable Waste & Resource Management Conference Proceedings, 19–21 September, Warwick University, UK., pp. 775–786.

Hampshire County Council and Brook Lyndhurst (2008) *WR0117: 'Small Changes Big Difference', Towards a Materials Resource Authority: Promoting Practical Waste Prevention and Exploring Options for Resource Management.* A project for Defra's WREP*, forthcoming.

Hines, F., Morley, A., Frater, L., Cartwright, S. & Chandrashekar, S. (2008) *WR0502: Social Enterprises and Sustainable Waste and Resource Management: Evaluating Impacts, Capacities and Opportunities*. A project for Defra's WREP*.

Huysentruyt, M. & Read, D. (2008) *How do People Value Extended Warranties? Evidence from Two Field Surveys*. http://www.dur.ac.uk/resources/dbs/faculty/working-papers/WP-113-Jun08.pdf (accessed 28 July 2009).

Ipsos MORI (2008a) *Consumer Behaviour Change Baseline Topline Results* (20th February 2008). For WRAP. Ipsos MORI, London UK

Ipsos MORI, (2008b) *Awareness of Mailing Preference Service DMA Topline Results*. Ipsos MORI, London UK

Jackson, T. (undated) Various research papers by Professor Tim Jackson can be found at http://portal.surrey.ac.uk/portal/page?_pageid=822,512810 &_dad=portal&_schema=PORTAL (accessed 28 July 2009).

James Ross Consulting Ltd and Butcher & Gundersen (2008a) *Potential Refill Solutions for the Food and Non-food Retail Sectors – Feasibility Study (for WRAP)* http://www.wrap.org.uk/downloads/Refills_06_food_and_non_food_Report.2ef4bd45.5518.pdf (accessed 28 July 2009).

James Ross Consulting Ltd, Marketry Ltd and The Brewery (2008b) *Self Dispensing Systems – Commercial Feasibility Study* (for WRAP) http://www.wrap.org.uk/downloads/self_dispensing_FINAL_20_Mar_07.2dbdeff9.3813.pdf (accessed 28 July 2009).

LCRN, (undated) *London Community Recycling Network for the Greater London Authority. Third Sector Reuse Capacity in London*. http://www.london.gov.uk/gla/publications/environment/reuse-fullreport.pdf (accessed 28 July 2009).

Lee, P., Vaughan, P., Bartlett, C., Bhamra, T., Lofthouse, V. & Trimingham, R. (2008) *Refillable Glass Beverage Container Systems in the UK* (for WRAP) http://www.wrap.org.uk/downloads/Refillable_glass_beverage_systems_-_FINAL.b6bbd6b9.6159.pdf (accessed 28 July 2009).

Lofthouse, V., Bhamra, T. & Trimingham, R. (2007) *WR0113: Refillable Packaging Systems*. A project for Defra's WREP*.

London Development Agency (LDA) and Brook Lyndhurst, (2007) *WR0501: Replicating Success: Social Enterprises & the Waste Sector in London.* A project for Defra's WREP*.

LFHW (2009) *Love Food Hate Waste*. http://www.lovefoodhatewaste.com/ (accessed 28 July 2009).

NI (undated) *National Indicators for Local Authorities*. http://www.communities.gov.uk/publications/localgovernment/finalnationalindicators (accessed 28 July 2009).

NLWA (North London Waste Authority) (2009) *North London Watch Your Waste Week* 4th to 12th October 2008. http://nlwa.coopa.net/news/eco_models_launch_london%27s_first_ever_watch_your_waste_week (accessed 28 July 2009).

NRWF (National Resource & Waste Forum) (2004) *Waste Minimisation Toolkit*. http://www.nrwf.org.uk/Wasteprevention.htm (accessed 28 July 2009).

Obara, L. (2005) *The ESRC Centre For Business Relationships, Accountability, Sustainability and Society, Is Waste Minimisation a Challenge Too Far?: The Experience of Household Waste Management and Purchasing in the UK*. Working Paper Series No 29. http://www.brass.cf.ac.uk/uploads/wpwasteminchallengeLO1005.pdf (accessed 28 July 2009).

OECD (2002) *Working Group on Waste Prevention and Recycling: OECD Workshop on Waste Prevention – Toward Performance Indicators 8–10 October 2001*. http://www.oecd.org/document/21/0,3343,fr_2649_34395_37987605_1_1_1_1,00.html (accessed 28 July 2009).

Open University (2009) (Lead author Slater R.) *WR0211: Unlocking the Potential of Community Composting*. A Project for Defra's WREP*, forthcoming.

OVAM, (2004) (Openbare Vlaamse Afvalstoffenmaatschappij). *Indicators of Waste Prevention. Development of a Methodology for, and Testing of OECD- Indicators*. D/2004/5024/43. OVAM, Mechelen, Belgium.

OVAM, (2007) *Implementation Plan for Environmentally Responsible Household Waste Management*. OVAM, Mechelen, Belgium. http://www.ovam.be/jahia/Jahia/pid/977 (accessed 28 July 2009).

OVAM (2008) *Analysis of Innovative Environmental Policy Instruments – Towards the Realisation of Environmentally Responsible Production and Consumption*. OVAM, Mechelen, Belgium. http://www.ovam.be/jahia/Jahia/cache/offonce/pid/176?actionReq=actionPubDetail&fileItem=1553 (accessed 28 July 2009).

OVAM (2009) *Prevention and Management of Household Waste in Flanders*. PowerPoint presentation by OVAM's Lore Mariën on April 27, 2009.

Parfitt, J. (2006) Home composting versus 'collect and treat' options for biodegradable municipal wastes – towards a more level playing field? In *CIWM 2006 Conference Proceedings*, briefing session 1, paper 3. Chartered Institution of Wastes Management, Northampton, UK.

Phillips, P. (2009) *A Report to East Midlands Regional Assembly on the Role of Freecycle in Regional MSW Practice*. Unpublished.

Resources for Change, The New Economics Foundation, Resource Futures and Community Environment Associates (2008) *WR0506: The Benefits of Third Sector Involvement in Local Authority Waste Management*. A project for Defra's WREP*.

Resource Futures (2009) *WR0121: Understanding Waste Growth at Local Level*. A project for Defra's WREP*.

Resource Futures (forthcoming). *WR0119: Municipal Waste Composition: A Review of Municipal Waste Component Analyses.* A project for Defra's WREP*, forthcoming.

Salhofer, S., Obersteiner, G., Schneider, F. & Lebersorger, S. (2008) Potentials for the prevention of municipal solid waste. *Waste Management*, **28**, 245–259.

Salisbury, V. (2008) *Performance Evaluation of the Waste Challenge Team, Hereford and Worcester County Council* [unpublished].

Sharp, V. (2006) *WR0508: Behaviour Change – Scoping the Way Forward*. A project for Defra's WREP*.

Sharp, V., Giorgi, S. & Wilson, D.C. (2010a) Delivery and impact of household waste prevention intervention campaigns (at the local level). *Waste Management & Research*, **28**, 256–268.

Sharp, V., Giorgi, S. & Wilson, D.C. (2010b) Methods to monitor and evaluate household waste prevention. *Waste Management & Research*, **28**, 269–280.

Strange, K. (2009) *International Review of Household Waste Prevention Policies & Practices*. Module L3 m5/2(D), as part of WR1204, a project for Defra's WREP*.

Skumatz, L.A. (2008) Pay as you throw in the US: Implementation, impacts, and experience. *Waste Management*, **28**, 2778–2785.

Tonglet, M., Phillips, P.S. & Bates, M.P. (2004) Determining the drivers for householder pro environmental behaviour: waste minimisation compared to recycling. *Resources, Conservation and Recycling*, **42**, 27–48.

Tucker, P. & Douglas, P. (2007) *WR0112: Understanding Household Waste Prevention Behaviour*. A project for Defra's WREP*.

Vandenbussche, B. (undated) *Reuse in Flanders – Introduction in the Flemish Reuse Sector* [unpublished].

Wastenet (undated) *Waste and Resources Research Portal*. http://wastenet.defra.gov.uk/ (accessed 28 July 2009).

WARRR (undated). *Waste and Resources Research Repository*. http://warrr.org/ (accessed 28 July 2009).

Waste Watch (2006) *WR0105: Project REDUCE Monitoring & Evaluation – Developing Tools to Measure Waste Prevention. Summary Report and Project Evaluation Reports*. A project for Defra's WREP*.

Watson, M. (2008) *A Review of the Literature and Research on Public Attitudes, Perceptions and Behaviour Relating to Remanufactured, Repaired and Reused Products*. Report for the Centre for Remanufacturing and Reuse, University of Sheffield. http://www.shef.ac.uk/geography/staff/watson_matt/researchpublications.html (accessed 28 July 2009).

WEEE (2009) *EC Directive on Waste Electrical and Electronic Equipment (WEEE).* http://www.berr.gov.uk/whatwedo/sectors/sustainability/weee/page30269.html (accessed 28 July 2009).

Wickens, S. (2005) *Waste Free Households Project, Ross-shire Waste Action Network (RoWAN).* Final report. http://www.rowanweb.org.uk/UserFiles/File/final%20reports/Final%20Report%20-%20100%20WFH%20Project2005.pdf (accessed 28 July 2009).

Williams, N., Croker, M. & Barrett, D. (2005) Review of the voluntary and community waste sector in England. In: *House Policy Consultancy for ODPM, DfT & Defra*. Office of the Deputy Prime Minister, Department for Transport and Defra, London, UK

Wilson, D.C., Smith, N.A. & Blakey, N.C. (2007) Using research-based knowledge to underpin waste and resources policy. *Waste Management & Research*, **25**, 247–256.

WIN (undated) *Waste Improvement Network – Helping Councils do More with Less*. http://www.win.org.uk/ (accessed 28 July 2009).

WRAP (2006) *Improving the Performance of Waste Diversion Schemes, A Good Practice Guide to Monitoring and Evaluation*. http://www.wrap.org.uk/downloads/Annex_2.2442f793.2648.pdf (accessed 28 July 2009).

WRAP (2007a) *Understanding Food Waste – Research Summary*. http://www.wrap.org.uk/retail/case_studies_research/report_the_food_we.html (accessed 28 July 2009).

WRAP (2007b) (Gray, S. lead author) *Possible Method for Estimating the Landfill Diversion Attributable to Home Composting for use in LATS Calculations*. A discussion paper by WRAP. WRAP, Banbury, UK.

WRAP and the Women's Institute, (2008) *Love Food Champions*. http://www.wrap.org.uk/retail/case_studies_research/report_love_food.html (accessed 28 July 2009).

WRAP (2009a) *Courtauld Commitment*. http://www.wrap.org.uk/retail/courtauld_commitment/ (accessed 28 July 2009).

WRAP (2009b) *Retail Packaging Solutions*. http://www.wrap.org.uk/retail/index.html (accessed 28 July 2009).

WRAP (2009c) *Waste Prevention Toolkit*. http://www.wrap.org.uk/applications/waste_prevention_toolkit/restricted.rm (accessed 28 July 2009)

WRAP (2009d) based on revised estimates from WRAP which state that 150kg/hh/year can be attributable to home composting (forthcoming) WRAP, Banbury, UK.

WRAP (2009e) Food waste prevention – committed food waste recycler (CFWR). Personal communication with WRAP via e-mail 6 May 2009.