WR1204
Household Waste Prevention Evidence Review:
L3 m5-1 (T) – Future waste growth, modelling & de-coupling

A report for Defra's
Waste and Resources Evidence Programme

October 2009

This research was commissioned and funded by Defra. The views expressed reflect the research findings and the authors' interpretation. The inclusion of or reference to any particular policy in this report should not be taken to imply that it has, or will be, endorsed by Defra

Resource Recovery Forum
The Social Marketing Practice™
BROOKLYNDHURST

Table of Contents

L3 m5-1 (T)
Future waste growth, modelling & de-coupling

This paper provides an overview of research which:

- examines long term trends in waste growth
- identifies structural drivers in the economy and society
- has undertaken technical modelling to try to explain and predict trends in the amount of household waste and the key drivers responsible

The evidence reviewed and topline findings are presented first, followed by further information on key findings and what the evidence says about the opportunities and barriers for making progress on waste prevention.

The evidence reviewed in this paper provides important background context to waste policy and the options for engaging households in waste prevention behaviour. Related report modules are:

L1 Executive report	L2 m2 Policy context L2 m5 Policy measures L2 m3 Consumers – engaging	L3 m5/2 (D) International Review

(D) denotes a briefing paper providing more background detail; (T) indicates a short focused topic briefing

1.1 Evidence reviewed

Evidence reviewed for the purposes of this paper falls under three headings:

- **decoupling** – decoupling refers, broadly, to the process of separating economic growth from associated negative environmental impacts and is a common notion mentioned in, or underpinning, much of the theoretical, practical and policy material covered in the review. The specific focus in the review was upon academic papers that had attempted to assess the extent to which decoupling had taken place and/or been successful.

- **modelling** – the term 'model' is used in three separate (though sometimes overlapping) ways in the waste prevention literature:

  - firstly, it is used to describe a typology (e.g. of social enterprises)

  - secondly, it is used to explain a behavioural system (e.g. which people perform certain waste prevention behaviours, and why)

  - thirdly, it refers to a mechanism for producing projections or forecasts (e.g. what will be the composition of waste in the future)

  The focus in this review has been upon the latter two of these. In general, there appear to have been relatively few attempts to construct formal models: the review has therefore focused predominantly upon selected studies commissioned under WREP (Tucker & Douglas, 2007, WR0112; AEA et al, 2006, WR0107). These earlier WREP studies are being followed up by further research to

understand the way in which collection arrangements affect waste arisings[1]. (These arrangements were suspected in the earlier work of being a significant influence on waste growth trends, but better data was required to enhance the power of modelling approaches.)

- **futures** – the possible future growth of waste is tackled in one of three ways in the literature:

  - *speculative* – numerous papers offer suggestions for the possible implications of the subject reviewed for the future of waste growth; these tend, however, to make propositions in isolation of wider factors

  - *quantitative* – a very small number of efforts have been made formally to project or forecast future waste arisings using quantitative techniques

  - *qualitative* – similarly, a small number of attempts have been made to produce qualitative scenarios

  The focus in this review has been upon the latter two; and, as before, the concentration has been upon the work commissioned under WREP (AEA et al, 2006, WR0107 and Brook Lyndhurst, 2007, WR0104).

1.2 Topline summary of findings

- **De-coupling** – is a broad concept, useful as a backdrop to the broad thrust of waste prevention, but with limited value in terms of developing specific interventions.

- **Modelling** – the complexities of human behaviour, and the intricacies of waste, mean that robust and reliable models of the kind that could be used formally to test policy interventions do not yet exist. Considerable further work, at both a conceptual level and in terms of assembling the necessary data sets, will be required over the coming years.

- **Forecasting** – conceptual and data problems mean that sophisticated forecasting models do not yet exist; while scenario-based approaches rely for their effectiveness on a degree of engagement with prospective users that appears so far to have been absent.

- **Usefulness** – nevertheless, the models and forecasts funded by WREP provide a powerful set of tools for aiding strategic thinking and the prioritisation of waste prevention areas. As a result of this work, the following were identified as the principal proposed foci for effort:

  - Food
  - Bulky non-electrical household goods
  - Green (organic) waste

- **Opportunities** – the key opportunities would appear to be to make long-run data development commitments at national level; and to develop user-friendly guides and/or facilitated programmes to enable both national and local policy makers to make best use of models, forecasts and scenarios.

[1] Resource Futures for Defra WREP (forthcoming), *Understanding Waste Growth at Local Level* WR0121. See also Resource Futures (forthcoming), *Municipal Waste Composition: A Review of Municipal Waste Component Analyses*.WR0119.

1.3 Key findings

The notion of 'de-coupling' is a central policy paradigm in global environmental strategy (OECD Environmental Strategy for the First Decade of the Twenty First Century, cited in The OECD Environment Programme, undated); and at European level in terms of sustainable consumption and production, and waste (European Parliament and the Council of the European Union, 2008).

De-coupling is interpreted in slightly different ways in different quarters, but is essentially concerned with breaking an historic link between economic growth (referring to wealth, or output) and the negative environmental consequences of that growth (see e.g. Ehrlich & Holdren, 1971 and Jackson, 2008).

De-coupling is contested in two respects. Firstly, there is a dispute about whether de-coupling is an appropriate concept, with mainstream policy and economics positing that continued (and continuous) high rates of economic growth can be achieved in a manner that is consistent with low environmental impact (see, for example, Committee on Climate Change, 2008, or BERR, 2009); whilst other voices (such as Daly, 1999, Hamilton, 2002, and the UK's Sustainable Development Commission, 2009) question whether economic growth as currently construed is in any way compatible with conserving finite natural resources on the scale that now appears to be required.

The second level of dispute concerns whether de-coupling can in fact be done (irrespective of whether it is the 'right' thing to do). In this case, there is more room for formal evidence to be deployed. On the basis of the evidence reviewed for this paper, the signs are not encouraging: across a series of papers reviewed (EEA, 2002, Mazzanti & Zoboli, 2008, Mazzanti, 2008, Giljum et al, 2005, case studies in Finland and the Netherlands set out in International Review L3 m5/2 (D)) de-coupling appears either to have been extremely weak, non-existent, short-lived or highly ambiguous (i.e. many other explanatory variables could explain apparent disconnects between indicators of economic growth and indicators of waste arisings).

It is also noteworthy that the reasons why decoupling did not occur (or occurred only on a limited basis) are not clear. A mix of economic, behavioural and/or service provision issues are implicated in the various papers – but, as in much of the work reviewed for this paper, the relative contribution of each was not distinguishable.

The complexities implied by this last remark have significantly affected the various modelling exercises reviewed (i.e. Barr et al, 2005, Barr, 2007, Tucker & Douglas, 2007, WR0112, AEA et al, 2006, WR0107 and Brook Lyndhurst, 2007, WR0104).

Tucker & Douglas, 2007, for example, build a model based on survey findings to explain self-reported waste prevention behaviour. They establish that the both the complexity of the relationships between variables (which include attitudinal factors (e.g. values, beliefs and norms), contextual factors (non-internal factors and constraints), personal capabilities (e.g. behaviour-specific knowledge and skills), and habits and routines) and the paucity of data referring to those variables means that "it is unlikely that we will ever identify all the factors affecting household waste prevention behaviours (and their variability) sufficiently enough to provide any definitive, deterministic explanation (or model)".

Similarly Barr, 2007, explores and models a wide range of attitudinal, behavioural and contextual factors on the basis of survey results, and whilst not going as far as Tucker & Douglas, 2007, nevertheless concludes that the relationship between input variables and predicted outcomes varies widely, in particular with respect to different waste prevention behaviours.

It is particularly noteworthy that both the Barr, 2007, work and the Tucker & Douglas, 2007, work each find themselves able to explain around 30% of observed changes in waste prevention behaviour, leaving 70% of changes unexplained. A remarkably similar finding (i.e. 30:70) comes from the investigation of the Theory of Planned Behaviour by Tonglet et al, 2004 (whose observation that many waste prevention projects may have failed because they were insufficiently grounded in theory could easily be rebutted by the proposition that too many theories of behaviour change fail because they are insufficiently grounded in what actually happens).

The quantitative modelling approach from AEA et al, 2006, adopts a very different approach. It uses 'top down' data on the historic relationship between consumer spending (at a highly disaggregated level), the weight of materials purchased and the weight of total waste arisings by waste stream. On the basis of historic relationships, and forecasts of and assumptions about the future path of consumer spending, it is able to project waste arisings.

In and of itself, the model makes no presumptions about either behaviour change or other techniques by which waste prevention might be achieved; rather, it provides a tool for quantifying 'what if?' questions. This was how it was used by the scenario-based work from Brook Lyndhurst, 2007, which consisted principally of a qualitative exploration of the many factors that might influence UK lifestyles over the period to 2020 – the rationale being that lifestyle choices shape waste behaviour. The scenarios explore household formation rates, the numbers of single person households, the prevalence of eating out, the relative preferences of older and younger people, the rise and fall of gadgets and numerous other lifestyle issues.

The qualitative scenarios are given quantitative expression using the AEA et al, 2006, model, with each scenario expressed as a series of assumptions that affect the driver variables. Thus, for example, a scenario of lower economic growth brought about by the more widespread adoption of greener lifestyles would manifest itself in a different outcome from a scenario of lower growth brought about by – for example – a global economic downturn.

In all cases, the outputs from the models take the form of national figures for the thousands or millions of tonnes of waste arising per year per waste stream.

As with both Tucker & Douglas, 2007, and Barr, 2007, however, the forecasting approaches both suffer from a chronic and severe shortage of data, as well as conceptual problems. The AEA et al, 2006, model, for example, endeavours to mimic the kinds of econometric approaches used in economic forecasting – but in the field of economics, high quality data on numerous features of the economy have been available for several decades. In the case of waste, this is not the case. Econometric models are, in addition, typically 'dynamic' (i.e. variables interact with one another, and the equations that link variables can themselves be re-specified within the model) whereas the data limitations *qua* waste mean that the model is essentially linear.

This issue was highlighted most specifically when, during the testing of the model, new results from WasteDataFlow[2] began to suggest a divergence in the previously stable relationship between consumer spending and waste arisings. Analysis of the role of collection systems (Parfitt, 2007) and further exploration of the model by AEA merely confirmed the complexity of the relationships between the possible explanatory variables, and the basic shortage of data. A follow-up WREP project (WR0121) to explore this further through a series of local authority case studies was due to report after completion of the current review project[3].

[2] WasteDataFlow is the web based system for municipal waste data reporting by UK local authorities to government.
[3] Resource Futures for Defra WREP (forthcoming), *Understanding Waste Growth at Local Level* WR0121. Op. cit.

The qualitative approach can be interpreted as a partial solution to this problem, but throws up another:– namely, that the thinking required to navigate a qualitative scenario for the purposes of specifying a quantifiable assumption, or, more generally, for deploying insights for the purposes of developing plans and policies, can be considerable. It may be, for example, that only those teams responsible for developing scenarios (e.g. Brook Lyndhurst, 2007, Tucker & Douglas, 2007) are actually able to use them.

This leads to a further point, referring specifically to the current economic downturn. None of the papers formally reviewed here had taken account of the recession, and any remarks about the impact of the recession for waste prevention must perforce comprise conjecture. However, one of the scenarios in Brook Lyndhurst, 2007, did consider the waste implications of a prolonged period of much lower economic growth and suggested that, depending on the nature of the reasons for that lower growth, this could conceivably be associated with a cessation of the long run trend of waste growth. On the assumption that the current recession will bring about a reduction in the volume of goods purchased, it would be reasonable to suppose that the volume of waste will dip (with various lags and differential impacts for different waste streams), but whether this results in any fundamental change in the underlying pattern of waste behaviour would require further analysis.

1.4 Opportunities for progressing waste prevention

Notwithstanding the various difficulties associated with the modelling and forecasting processes, it is possible to distinguish a short set of opportunities for progressing waste prevention that emerge from the literature reviewed for this paper:

- there is a view common to all papers that serious and sustained progress on waste prevention will require a mix of hard (i.e. fiscal, regulatory and service provision) and soft (i.e. behaviour change) measures.

- there are mixed views on the balance within this mix; though those suggesting more reliance on behaviour change measures (Tucker & Douglas, 2007, and Brook Lyndhurst, 2007) both acknowledge that, in Tucker & Douglas's words, "massive repeat intervention" will be required to bring about noteworthy changes in behaviours.

- at the household level, detailed propositions for opportunities emerging from, in particular, the Tucker & Douglas, 2007, and Barr, 2007, work are captured in other report modules (all of the nine L3 m3 papers, on various aspects).

- at the macro level, the AEA et al, 2006, and Brook Lyndhurst, 2007, analyses are clear that the opportunities for significant reduction in tonnages focus on three waste streams – food, bulky (principally furniture and other non-electrical household items) and green waste.

- the implication, linking to the view from the conceptual modelling that "waste prevention" should not be thought of as a single category of behaviour, is that the best opportunities at a strategic level imply a tactical focus on those three streams.

- each stream has fundamentally different drivers (household items are much more clearly a function of economic prosperity than green waste, for example) implying quite different approaches for each stream.

Finally, and on a slightly different note, it is perhaps worth acknowledging that the full value of the various studies reviewed for this paper may reside less in the eventual outputs from the work and rather more in the process by which they were created. Best practice guides to scenario-planning (see, for example, Defra, 2009) suggest that this is the case; and this could imply that the key opportunity for progressing waste prevention lies in enabling waste strategists at national and local level actually to participate in modelling and forecasting exercises rather than merely receiving reports.

1.5 Barriers to progressing waste prevention

The principal barrier emerging from this element of the review is that, as set out above, a chronic shortage of data allied to weaknesses in the conceptual understanding of human behaviour limit the ability to construct formal models or produce robust forecasts.

Barriers at the household level - that is, those that are predominantly behavioural (e.g. the impact of habits, the difficulty posed by some repeat behaviours and so forth) and those associated with service provision - are covered elsewhere in other report modules (all nine L3 m3 papers but especially L3 m3/2 (D)).

Barriers at the macro-level – broadly referred to by Barr, 2007, and Tucker & Douglas, 2007, as "context" – are explored in more depth by AEA et al, 2006, and Brook Lyndhurst, 2007, and fall under three headings:

- **environmental** – insofar as they are beyond our control (in the shorter term at least) environmental factors can act as limiting factors on waste prevention. Climate change, in particular, is expected to have impacts on all aspects of social and economic life and, though this may be a small issue in the grander scheme of things, will, for example, impact on the nature, scale and timing of green waste.

- **economic** – the basic premises of consumerism – to buy more food, to buy more clothes, to replace household items long before they have ceased to be of use – conflict with many of the precepts of waste prevention.

- **politics** – many waste generation/prevention behaviours are grounded in long-standing, deeply personal beliefs and values, territory that is exceptionally difficult for politics, and the scale of political risk is a key barrier to adopting measures that may have the best prospects for preventing waste (Brook Lyndhurst, 2007).

1.6 Researchers' recommendations and further questions

Emerging from the studies reviewed for this paper come four main recommendations:

- more and better **data** is needed, at all levels, from household behaviours through to economy-wide linkages between waste arisings and other variables.

- more and better **models** need to be developed and tested, to reduce the scale of 'unexplained' variance.

- the principal waste prevention **behaviours** should be treated as discrete phenomena, not lumped together, in both research, policy and implementation terms.

- **significant change** is going to require either the use of strong instruments (i.e. fiscal or regulatory techniques), or very large scale and sustained behaviour change campaigns, or luck (e.g. the apparent cessation of waste growth in England in the past three or four years persists indefinitely for reasons that remain elusive).

1.7 Practical issues and lessons

On the basis of the review, we draw the following practical lessons for policy makers and local authorities:

- Waste prevention should not be a generic programme, but should focus on individual waste streams and/or behaviours, each of which will require a bespoke approach.

- 'De-coupling' should be borne in mind, but only as a backdrop. The extent to which de-coupling is relevant will vary from stream to stream, behaviour to behaviour.

- Given current economic circumstances, it could be wise to explore the extent to which the pursuit of a 'low carbon economy' (BERR, 2009) and strategies for recovering from the recession could be allied to accelerating and embedding waste prevention ('lightweighting the economy').

- It will be important to build on the wider lessons from behaviour change (e.g. the power of community action, the need for repeated interventions etc) in formulating stream-specific waste prevention plans.

- The likely need for 'harder' measures should not be forgotten – it seems unlikely that behaviour change alone will be sufficient to deliver large-scale waste prevention in a cost-effective manner.

1.8 References

AEA Energy and Environment, The Future Foundation and The Social Marketing Practice (2006) Modelling the Impact of Lifestyle Changes on Household Waste Arisings. Summary report. WR0107.

Barr, S. (2007) Factors influencing environmental attitudes and behaviours. A U.K. case study of household waste management. Environment and Behavior 39(4): 435-473.

Barr, S., Gilg, A. and 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.

BERR (Department for Business, Enterprise & Regulatory Reform) (2009) Low Carbon Industrial Strategy: A Vision.

Brook Lyndhurst (2007) Lifestyle Scenarios: the Futures for Waste Composition. Summary report. WR0104.

Committee on Climate Change (2008) Building a Low Carbon Economy – the UK's Contribution to Tackling Climate Change.

Daly, H.E. (1999) Beyond Growth – Economics of Sustainable Development.

Defra (2009) About Horizon Scanning & Futures. http://horizonscanning.defra.gov.uk/default.aspx?menu=menu&module=About

EEA (2002) Waste and material flows.

Ehrlich, P.R. and Holdren, J.P. (1971) Impact of Population Growth. Science 171 (3977) pp. 1212-1217.

The European Parliament and the Council of the European Union (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

Giljum, S., Hak, T., Hinterberger, F. and Kovanda, J. (2005) Environmental governance in the European Union: strategies and instruments for absolute decoupling. International Journal of Sustainable Development 8(1) pp. 31-46.

Hamilton, C. (2004) Growth Fetish.

Jackson, T. (2008) Why politicians dare not limit economic growth. New Scientist 2678 pp. 42-43.

Mazzanti, M. and Zoboli, R. (2008) Waste generation, waste disposal and policy effectiveness: Evidence on decoupling from the European Union. Resources, Conservation and Recycling 52(10) pp. 1221-1234.

Mazzanti, M. (2008) Is waste generation de-linking from economic growth? Empirical evidence for Europe. Applied Economics Letters 15 (4) pp. 287-291.

The OECD Environment Programme (undated) Indicators to Measure Decoupling of Environmental Pressure from Economic Growth.

Parfitt, J. (2007) Infra-structure contribution to household waste increases 2000/1 2005/6. Presentation to Defra Waste Strategy team.

Tonglet, M., Phillips, P.S. and 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. and Douglas, P. (2007) Understanding Household Waste Prevention Behaviour. WR0112

UK SDC (2009) Redefining Prosperity.

Basis of this report

The material in this paper is derived from a large scale evidence review of household waste prevention conducted by Brook Lyndhurst, the Social Marketing Practice and the Resource Recovery Forum for Defra's Waste and Resources Evidence Programme.