

Modelling the impact of lifestyle changes on household waste arisings

Defra Waste Research Evidence Programme Project (WR0107)
Annex 3: Interim Report
December 2005



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The views expressed reflect the research findings and the author's interpretation.
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Important Research Update (September 2009)

The innovative input-output model (forecasting tool) that was constructed as a part of this research, was developed using the most up-to-date data on waste arisings available in 2005, at the project start, i.e. up to and including data for 2003/04. Following completion of the initial research and model development in July 2006, new data on waste arisings became available, which highlighted a divergence between the model predictions and reported data from 2002-2006.

Additional research indicated that it would be necessary to include a range of as-yet-not-understood factors within the model in order to develop more accurate predictions. Defra have commissioned further research to try to understand other factors that may have influenced changes in waste growth patterns. The Information Note published with this report gives more detail on this research and the background.

The divergence observed between the model forecasts and recent waste growth currently limits the application of the model for policy purposes, and means that caution should be used with respect to interpreting the figures contained in this report and the associated research documents (e.g. quantification of future waste tonnages). However, this project still allows exploration of future trends in waste composition, if not total quantity.

Project purpose and objectives

- Our objective is to construct a model for predicting future household waste arisings, including compositional make-up, that:
 - is robust, rigorous and respected by potential users and beneficiaries
 - integrates economic, legislative, technological and wider social and lifestyle factors in a credible and useful way
 - is capable of adjustment and iterative development in order to provide assessments of the likely outcomes of different social and economic trends and waste management policies in the future
- The model will assist Defra by providing better tools for forecasting outcomes and planning waste management policy

The purpose of this Interim Report

- To report on the development of the forecasting model
- To provide an overview of the work to determine the impact of key future trends on consumer expenditure and consumption
- To provide a refined workplan for undertaking the necessary consultation prior to making adjustments to the model

Contents

1. Model construction
2. Impact of key future trends
3. Consultation and validation
4. Project timetable

1. Model construction

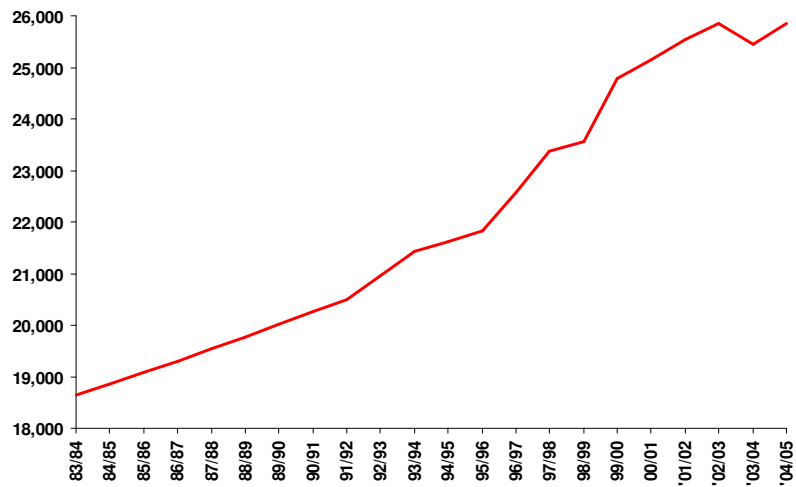
Data on the generation of household waste (1)

- There is limited consistent historical data on household waste
- The most reliable data is from Defra/Cipfa, which provides information over the last 20 years
- This data shows household waste to have grown by 1.6%pa over the twenty year period 1984 – 2004 - well below the 3% plus figures quoted in paper's such as the Strategy Unit's 'Waste Not Want Not'

Data on the generation of household waste (2)

- According to the Defra data growth over the years 1996 – 2000 was 3.2% pa. This, however, appears to be an unusual period
- Growth in waste appears to be well below the 2.6%pa growth in GDP
- Similar findings are evident across other countries :
 - EU25 growth averaged 2.3%pa, while municipal waste growth averaged 2%pa
 - In the US waste has grown at 0.4% pa, compared to GDP growth of 4.1%pa
 - In Japan waste has grown at 0.3% pa, compared to GDP growth of 1.3%pa

Household Waste in England (000 tonnes) Data from Defra/CIPFA

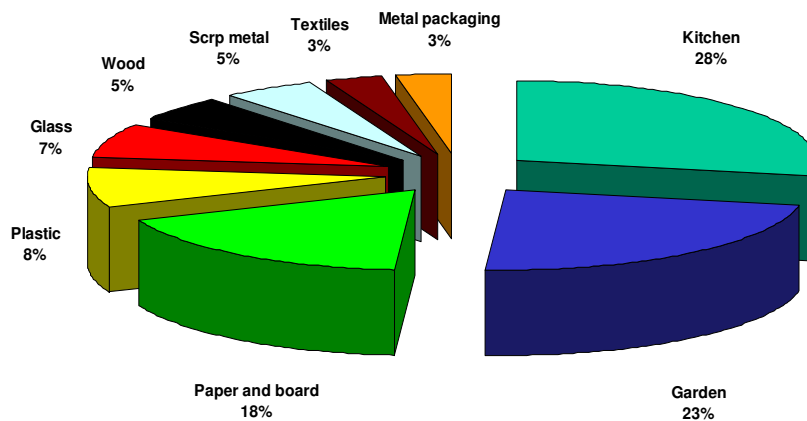


Source publication: Municipal Waste Management Survey

The composition of waste

- There is little data on the composition of waste
- Calculations of composition of waste stream are fraught with difficulties
- A reasonably comprehensive and detailed snapshot of household waste composition was carried out by Julian Parfitt in around 2001

Composition of household waste – early 2000s



Source : J Parfitt

Input output modelling as an approach

- Given that most household waste is generated by consumers' expenditure then we are able to use historical data on consumers' expenditure to construct a model of household waste
- We can then use detailed consumer's expenditure forecasts to generate forecasts of waste
- To do this we have used consumer's expenditure data back to the mid 1980s to track spending in constant price terms – close to a 'physical' measure of purchases – and mapped this on to waste production
- For each element of consumers' expenditure that creates waste we need to calculate
 - The weight of product
 - how much waste created, broken down between 'product waste' and 'packaging waste'
 - how these have changed over time

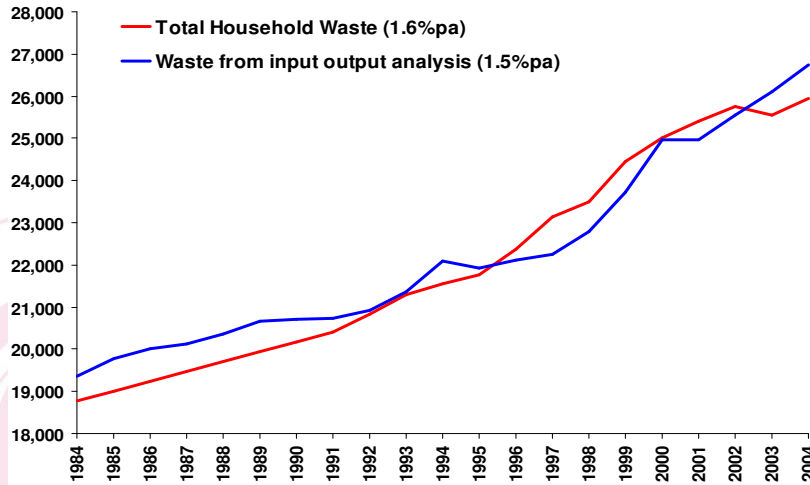
There are over 100 separate consumer spending categories, which include

Bread and cereals
Meat
Vegetables
Beer
Tobacco
Water supply
Garments
Shoes and other footwear
Dental services
Household textiles
Repair of household appliances
Pharmaceutical products
Audio visual and recording equipment
Newspapers
Restaurants, cafes etc
Life insurance

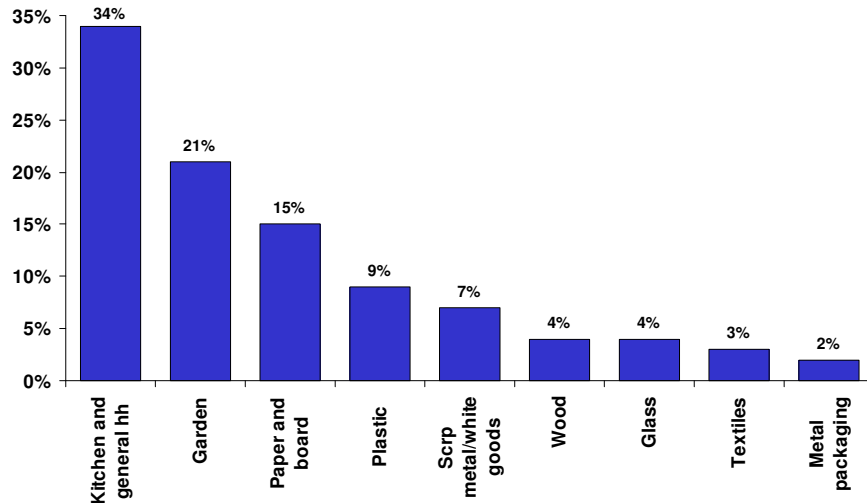
Of which only some generate waste

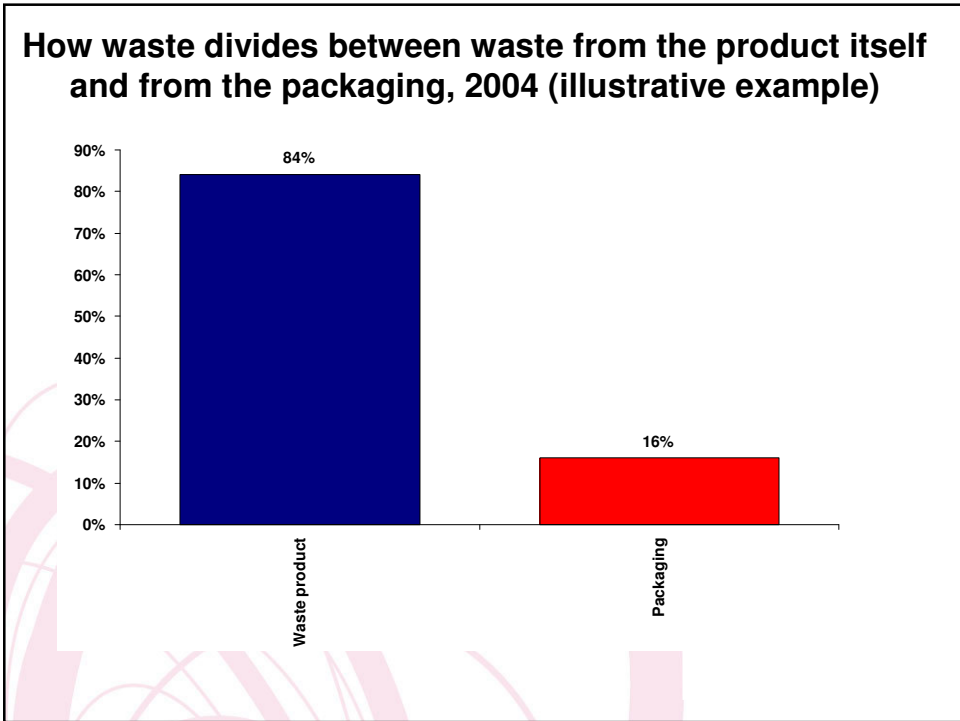
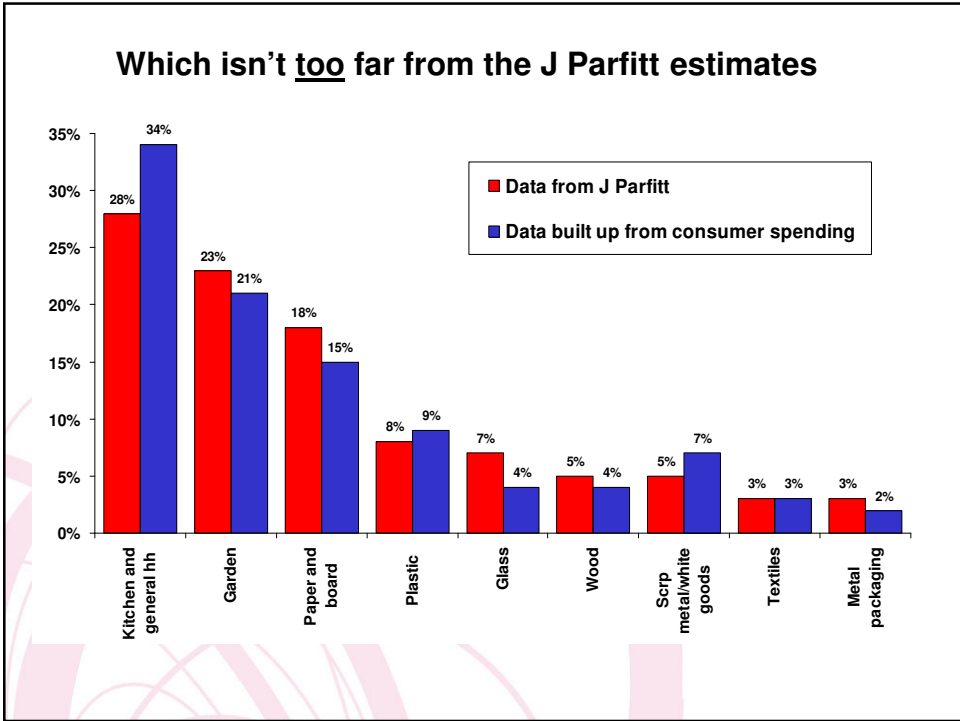
Bread and cereals	✓
Meat	✓
Vegetables	✓
Beer	✓
Tobacco	✓
Water supply	
Garments	✓
Shoes and other footwear	✓
Dental services	
Household textiles	✓
Repair of household appliances	
Pharmaceutical products	✓
Audio visual and recording equipment	✓
Newspapers	✓
Restaurants, cafes etc	
Life insurance	

An initial model shows waste predicted from input-output is generally in line with the official data



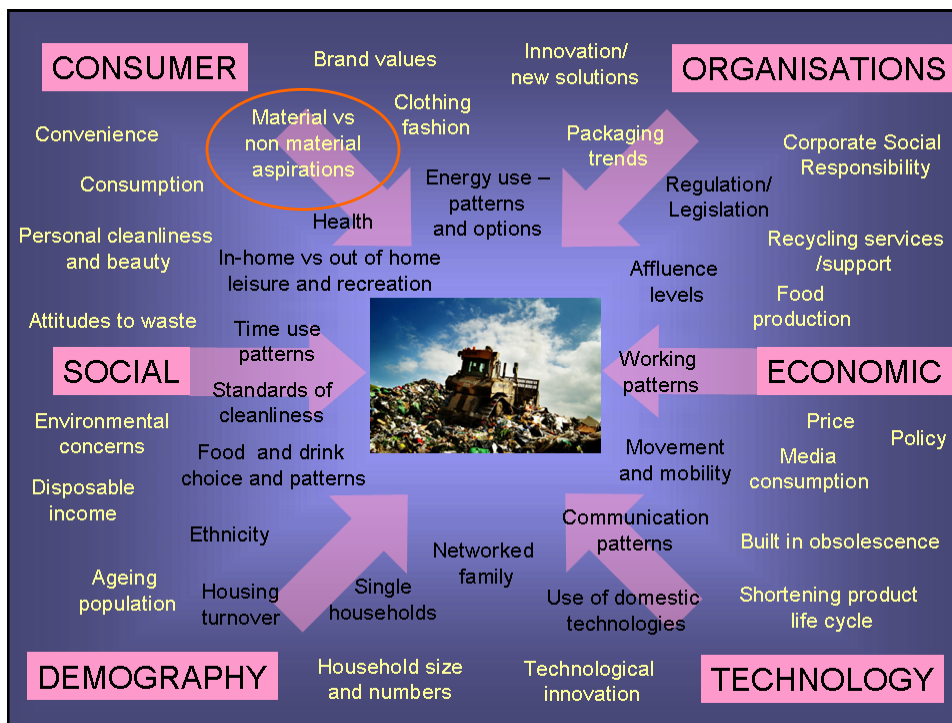
Easy to calculate the composition of the waste stream (illustrative example for 2004)





Forecasts

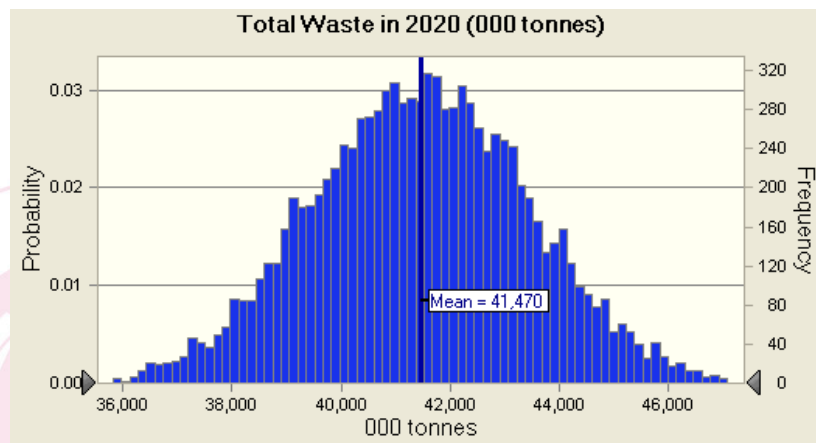
- Having built the model to ensure that we are able to track waste production for the 21 years to 2004/05 we are then in a position to produce forecasts. These forecasts will require an number of inputs to :
 1. Forecasts of consumer spending for each of the 50 or so separate consumer spending categories that generate waste (these will be based on detailed consumer spending forecasts that the future Foundation generates on a regular basis)
 2. For each category an indication of how the following will change from today:
 - weight of product
 - Proportion of product going into waste stream
 - Amount of packaging used per kg of product
 - Average length of time product kept before disposal into waste stream
- These forecasts will be dependent on a range of drivers



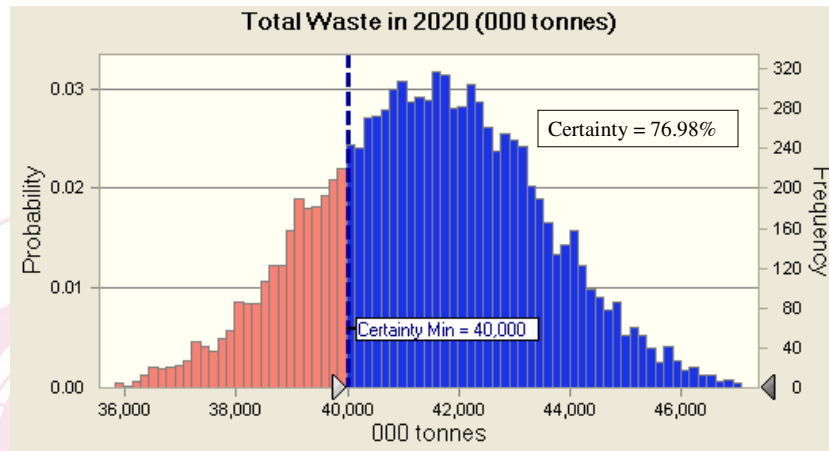
Key drivers identified

- 1 Increase in affluence
- 2 Culture of change
- 3 Single society
- 4 The experience economy
- 5 Shortening product life cycle
- 6 Teleworking, knowledge economy
- 7 Increased longevity
- 8 Baby boomers
- 9 The growth of online shopping, convenience
- 10 Regulation/legislation
- 11 Climate change
- 12 Ethical consumption

As each of the assumptions in the model might not be certain – having a range of possibilities – we might use a technique known as Monte Carlo simulations to give a range of possible outcomes for, say waste production in 2020



So, in this instance we could say we are 77% certain that waste will be at least 40,000 tonnes by 2020



Summary of input output approach

- Lack of data (particularly compositional information) means that we cannot model the data directly at a macro level
- We appear to have reasonable estimates of the overall growth in household waste in England over the past 20 years and we have a detailed snapshot of composition for 2000/01
- We can use this data to construct and parameterise a model of household waste over the past 20 years using consumer spending data (along with data on such things as the growth in volume of mail)
- The input into the model of a range of assumptions for the various inputs will provide forecasts
- These forecasts will be very 'rich'

Progress on construction of the model (1)

		PROGRESS
1	Mapping between overall published data and output from model built up from consumer spending data	Largely Done
2	Incorporation of elements not dependent on consumer spending – garden, direct mail, free newspapers	Largely Done
3	Construction of forecasting models for consumer spending	Done
4	Future Proofing to assess impact of non-economic factors – social change, policy, etc	Done

Progress on construction of the model (2)

		PROGRESS
5	Generation of forecasts for consumer spending	Started
6	Incorporation of output from Future Proofing process	Not done
7	Generation of base forecasts for waste	Not done
8	Design of waste forecasting model for use by end user	Started
9	Construction of waste forecasting model	Not done

2. Impact of key future trends

- We have now identified the most significant trends impacting on future consumption patterns and waste arising in households
- This involved an extensive futureproofing exercise conducted by the project team where 76 trends and drivers were assessed
- These have been applied to the individual spending categories which will be included in the model, again by the project team in a workshop (although the approach was used as a the basis of an exercise at the Stakeholder Workshop)

Selecting key trends for the input/output model

- Given the plethora of factors and trends that could be used to inform the model, the requirement has been to use an objective and rigorous approach to identifying those will have the greatest impact on the future levels of household waste
- In terms of the modelling process the 'ideal' number is around 12 drivers/trends for which we have a good idea about the likely future direction and impact
- The selection process has been based on an established methodology we call 'Futureproofing' – an approach that has been developed and applied successfully to a number of projects by the Future Foundation (for Elextrolux, PostComm, Hachette and P&O Cruises amongst others)

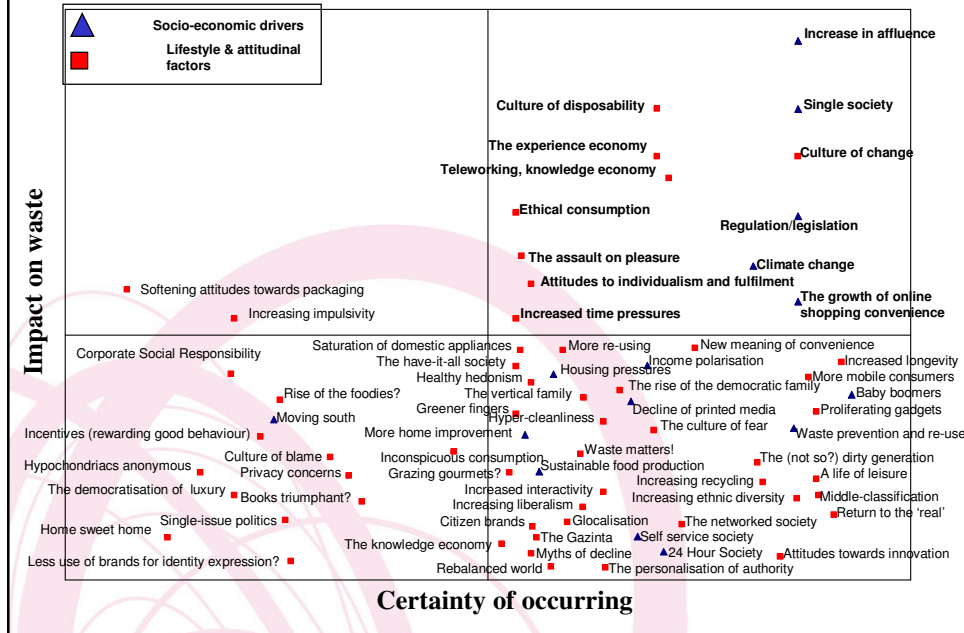
The futureproofing process

- We identified an extensive list of possible lifestyle and other trends affecting household waste production using our on line data and trends resource nVision
- The next stage involved a workshop at which we undertook an evaluation of all these trends on a specially constructed grid
- This involved assigning numerical values to each factor against degrees of *certainty* and degrees of *impact* on future household waste arisings
- This approach allowed us to make the most use of actual forecasted trends (where we have sufficient numerical data for a quantitative forecast) and apply expert judgement and knowledge to other trends where future outcomes can only be assessed more qualitatively
- From this process, we have identified the most significant trends for the on-going modelling process

The ranking system used

- Every nominated trend was ranked initially on scale of 0 – 3 in terms the degree of certainty of the trend occurring
- Then we assessed the impact on both consumption and waste creation of each trend on a scale from +3 (strongly positive) to –3 (strongly negative), in terms of how much they would change from the direction and strength of current trends (ie. more or less) - not their absolute effect
- These were then combined to produce an overall 'score' for each of the 76 trends assessed
- Using a weighting system to combine the impact on waste and certainty of occurring, this provided us with the list of the 12 key ranked trends

The results of the future proofing workshop



12 most significant key trends

- 1 Increase in affluence
- 2 Culture of change
- 3 Single society
- 4 The experience economy
- 5 Shortening product life cycle
- 6 Teleworking, knowledge economy
- 7 Increased longevity
- 8 Baby boomers
- 9 The growth of online shopping, convenience
- 10 Regulation/legislation
- 11 Climate change
- 12 Ethical consumption

Applying the trends to the product categories

- The next stage has been to assess the effect of these trends and drivers on every one of the product categories that will be included in the model
- We tested the approach at the stakeholder workshop and it clearly generated good levels of discussion as well as an appreciation of the complexity of the task
- The full analysis has been conducted in a day-long workshop involving the project team to ensure consistency of view across all categories
- The results have been recorded, with notes explaining key features of the decisions made
- Here we include some examples to give a sense of the variation by category

Categories most affected by trends

Category	Overall impact of trends
Information processing equipment	15.5
Materials	11.5
Audio visual and recording equipment	11.5
Major tools and equipment	10.5
Small electric household appliances	8.5
Other food	8.5
Glassware, tableware and household appliances	8.5
Carpets and other floor coverings	8.0
Household textiles	7.5
Furniture and furnishings	7.5
Electrical appliances for personal care	7.5
Books	7.5
Other personal effects	7.0
Telephone and telefax equipment	6.5

Second tier rankings

Bread and cereals	6.0
Shoes and other footwear	5.5
Pharmaceutical products	5.5
Non-durable household goods	5.5
Photographic etc equipment	5.0
Other articles of clothing and clothing accessories	5.0
Garments	5.0
Recording media	4.0
Musical instruments and major durables for indoor recreation	4.0
Fruit and vegetable juices and other soft drinks	4.0
Therapeutic appliances and equipment	3.5
Milk, cheese and eggs	3.5
Meat	3.5
Jewellery clocks and watches	3.5
Fish	3.5
Equipment for sport, camping and open-air recreation	3.5
Tobacco	2.5
Stationery and drawing materials	2.5
Other medical products	2.5

Third division

Fruit	2.5
Coffee, tea and cocoa	2.5
Bicycles	2.5
Beer	2.0
Wines, cider and perry	1.5
Vegetables	1.5
Oils and fats	1.5
Major appliances whether electrical or not	1.5
Sugar, confectionery and ice-cream	1.0
Spirits	1.0
Solid fuels	1.0
Small tools and equipment	1.0
Newspapers	1.0
Clothing materials	1.0
Spare parts and accessories for personal transport equipment	0.5
Pets and related products	0.5
Other appliances, articles and products for personal care	0.5
Garden, plants and flowers	0.5
Games, toys and hobbies	0.5
Liquid fuels	0.0

Expenditure category: Garments

Key trend	Product consumption levels +3 to -3	Impact on waste volumes +3 to -3
1. Increasing affluence	1	0
2. Culture of change	1	0
3. Single society	0	0
4. The experience economy	1	0
5. Shortening product life cycles	2	0
6. Teleworking, knowledge economy	-1	0
7. Increased longevity	-1	0
8. Baby boomers	1	0
9. The growth of online shopping, convenience	1	0
10. Regulation/legislation	0	0
11. Climate change	0	0
12. Ethical consumption	0	-1

Garments

- Increased disposability of clothing can be attributed to shortening product life-cycles, a culture of change and increased affluence
- We also think that the experience economy will encourage more clothes shopping, for specialised clothing for sport, as well as new clothing for travel and going out
- Teleworking will have us buying fewer clothes as we 'slob about' at home more, while ethical shopping may decrease product wastage in this category by encouraging giving to charity shops
- While the clothes that are sold on through this channel will still end up in the waste stream, many will not be fit for resale and disposed of in the commercial waste stream. While old people buy fewer clothes, we think that the ageing of the baby boomer generation may reverse this

Expenditure category: Pharmaceutical products

Key trend	Product consumption levels +3 to -3	Impact on waste volumes +3 to -3
1. Increasing affluence	1	0
2. Culture of change	0	0
3. Single society	0	0
4. The experience economy	0	0
5. Shortening product life cycles	0	0
6. Teleworking, knowledge economy	0	0
7. Increased longevity	2	0
8. Baby boomers	1.5	0
9. The growth of online shopping, convenience	0	0
10. Regulation/legislation	-0.5	-1
11. Climate change	0	0.5
12. Ethical consumption	0	0

Pharmaceutical products

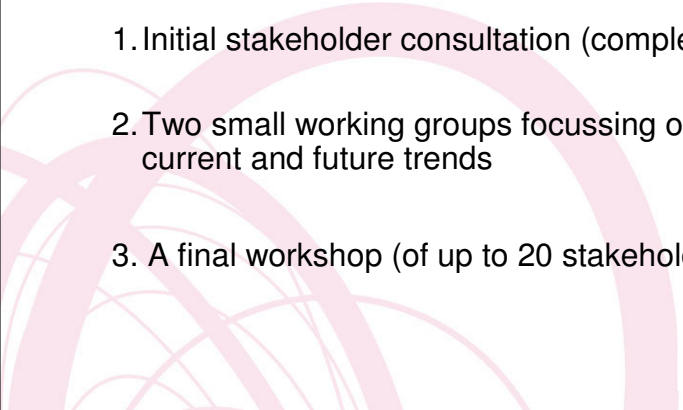
- Affluence has brought with it a willingness to buy medication to an unprecedented degree, and innovation in this field looks set to ensure further growth into the future
- An ageing population is sure to increase health problems, although the baby boomers are healthier than previous generations, which may mitigate this
- There is a small chance that governments may try to decrease the amount of pills people are taking, but it is more likely that regulation will concentrate on returning unused pills and so on, thus taking them out of the household waste stream

3. Consultation and validation



Project consultation

- Consultation has been built into the project design and process, as integral to the success of the project, comprising three main activities:

1. Initial stakeholder consultation (completed)
 2. Two small working groups focussing on past, current and future trends
 3. A final workshop (of up to 20 stakeholders)
- 

Report of the first stakeholder workshop

Here, we summarise the operation and outputs from a half day workshop, held on 13th October, 2005 at Regents College, NW1

Objectives of the workshop

- To explain the planned model design and construction to potential users and stakeholders attending the workshop
- Through this to involve a range of different and fresh perspectives to review and enhance the key decisions shaping the model design, construction and use
- To engage participants in the process of applying the key lifestyle and socio-economic drivers to specific product consumption categories

Attendees

Academia

Georgina Davis	University of Bristol
Angela Druckman	University of Surrey
Christine Thomas	Open University

Consultancies

Andy Maunder	AEA Technology
Peter McHenry	AEA Technology
Darren Perrin	Entec UK Ltd
Elaine Kerrell	SWAP

Government Departments and Agencies

Mark Barthel	WRAP
Fran Lowe	Environment Agency
Julian Parfitt	WRAP

Independent Consultants

Chris Coggins	Wamtech
Chris Church	CEA
Veronica Sharp	The Social Marketing Practice
Maggie Thurgood	Consultant
David Wilson	Independent Consultant

Attendees (cont'd)

Industry

Jane Durney	BioRegional Development Group
Tom Watkin	Hyder Consulting plc

Local Authorities

Richard Bradbury	London Borough of Camden
Colin Bateman	London Borough of Merton
Frances Clephan	Hampshire County Council
Zoe Kimber	Hampshire County Council
Joanne Ward-Smith	Surrey County Council

Researchers and Market Analysts

David Fell	Brook Lyndhurst
David Elliott	MPG International
Sarah Knapp	MEL
Chris Farmelo	Future Foundation
Melanie Howard	Future Foundation
Sandy Patel	Brook Lyndhurst
Nikhil Shah	Future Foundation

Agenda for the seminar

- 9.30 Welcome & Introduction
- 9.45 Proposed model design
- 10.25 First exercise: applications for the model
- 11.00 The selected trends for the model
- 11.15 Syndicate group work: impact of trends on selected product categories
- 12.00 Feedback from the groups
- 12.20 Summary and close

Proposed applications of the model (delegate suggestions)

- Can be used to evaluate policy instruments more effectively
- Could it identify the need for treatment facilities in future (vs. landfill)?
- Could help to identify balance of saving/using products in the future
- Can encourage need for greater producer responsibility vs. end-of-pipe
- Will help to specify types of data needed in future to make models more robust
- It should help to prioritise waste minimisation strategies
- Provide a better analysis of materials mix (weight vs. material)
- It will give a better understanding of drivers → better policy development will follow

Questions that you would like to ask of the model (delegate input)

- Will it be able to identify potential reductions in e.g. food waste from other savings?
- Will new technologies that might have an impact be incorporated (e.g. nano-technology)?
- Can it identify potential material substitution and force this to change/happen through policy?
- Can it answer what-if questions?
- Are catastrophic events such as global warming incorporated?
- What further development will be required to make the model usable at the local level?
- How much residual waste treatment capacity would a LA need by 2020, assuming recycling initiatives succeed?

Brief for the syndicate work

- Each table was allocated 12 – 15 product categories from the ONS consumer trends data
- Taking the key trends identified by the Future Proofing analysis teams were asked to assess their impact on the consumption and packaging components of selected categories
- As before this used a scale of +3 to –3 dependent on their view of whether these trends will affect consumption and waste in each of the categories (compared to current trends)
- Feedback to plenary (how process worked and what they noticed)

Overview of seminar learning (1)

- Whilst most respondents were positive about the model design, some individuals initially expressed concern
- The biggest areas of concern related to issues around the ability to summarise and condense extensive learning in this highly complex and multifaceted field in order to create a workable model
- Many useful applications for the model were identified and proposed by participants in an exercise although specific questions about the application of the model to specific local areas were raised

Overview of seminar learning (2)

- However, once participants became engaged in reviewing the social trends analysis from the Future Proofing exercise, it was clear that this was generally seen as providing a valuable additional perspective to thinking about the future of waste arising
- The syndicate exercise really worked to involve participants in the process, and elicited worthwhile discussion and debate, although some groups were able to complete more categories than others
- Overall, we felt the objectives were achieved, and with most participants expressing interest in further involvement, we are creating a community of interest

Proposed objectives for two working group meetings and final workshop

- Two small working groups focussing on past, current and future trends to identify:
 - Green waste arisings (e.g. quantification of tonnages of green waste that is home composted, taken to CA sites or collected at the kerbside)
 - Packaging composition (e.g. changes in product types, materials, weights and volumes)(Each workshop comprising ~6 specialist individuals)
- A final workshop (of up to 20 stakeholders) to:
 - Validate the effectiveness of the model
 - Begin to identify the policy implications and formulate practical policy options from the emerging 20 year views

Proposed attendees

- Two Working Groups:
 - Green Waste Arisings
 - WRAP
 - Community Composting Association
 - Local Authorities, e.g. Dorset, Hampshire, Devon
 - Imperial College
 - Packaging Composition
 - INCPEN
 - Manufacturer
 - Retailer
- Final Workshop
 - Sub-set of first consultation

Additional consultation activities

- FF meeting with Henley Centre plus exchange of key drivers trends
- FF has provided Brook Lyndhurst with evidence base for all 76 trends used in Future Proofing
- Attendance of the project team at the Defra 'Future Scenarios' co-ordination workshop on 28th November 2005
- FF attended the ERM project workshop in Birmingham on 14th December 2005

4. Project timescales

Next stages of the project

