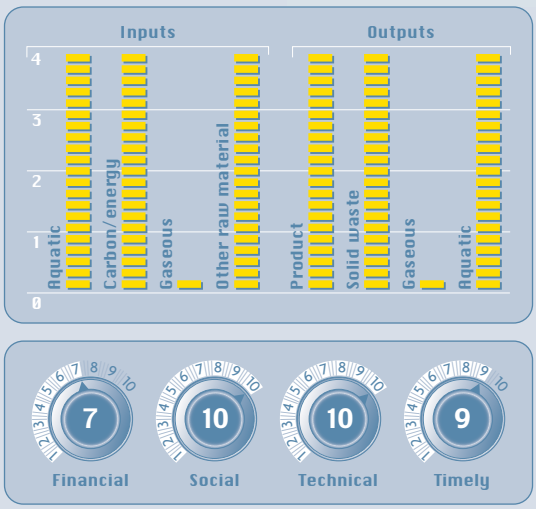


Agriculture: Agricultural waste mass balance – Opportunities for recycling and producing energy from waste technologies



Report type
Sector

Publication date
2002

Environmental body
C-Tech Environmental Group

Partners
Biffa Waste Services, Energy Services UK

Turnover
In 2000, the net value added by agriculture in the UK was £4.28 billion, (1% of the total UK value-added figure)

Contact Details
C-Tech Innovation Ltd
Capenhurst Technology Park
Chester
CH1 6ES, UK

Tel: +44 (0)1513472900 Fax: +44 (0)1513472901
Website: www.capenhurst.com
Registered in England number 4050834

www.massbalance.org

The Biffaward Mass Balance programme supported related projects entitled:

Towards sustainable agricultural waste management

ISBN: 1 857 05721 X, published by Environment Agency (2001).

The Environmental Body was Westcountry Rivers Trust.

Farms and universities

The Environmental Body was Forum For The Future.





Description

This report assesses all waste arisings in the UK agricultural sector, and contains critical evaluations of energy-efficient processing techniques and technologies for recycling and energy-from-waste applications. The report describes how proper use of agricultural waste will reduce pollution and fossil fuels use, and could provide new jobs in the rapidly changing rural economy. Key objectives of the report were to:

- Identify and quantify the major wastes arising by region and type of business
- Identify and quantify the major energy sinks
- Analyse energy efficiency

Structure

- The inputs
- Major waste arisings
- Focus on enterprise energy
- Techniques for waste recycling
- Energy recovery
- Policies and legislation
- Mass balances
- Waste treatment strategies

Mass flows

More than 80Mt pa organic farm wastes.

Key notes

Many recycling and energy recovery techniques have been developed that are applicable to the different forms of farm waste.

A centralised Anaerobic Digestion (AD) plant could take waste from a number of surrounding farms within a radius of typically 10–30km. A centralised plant capable of generating 1MW of electricity would require a digester of 10,000m^3 and is likely to cost £3–6 million.

UK agriculture is a major producer of waste. Recent figures show that, overall, about 40% of industrial and commercial waste is recovered (35% being recycled).

There are more than 200,000 registered UK farm holdings. Agriculture is a significant user of energy. The total energy use for agriculture is of the order of 10TWh/yr. In contrast, by using appropriate recycling technologies, many waste streams can yield significant quantities of energy. If all of the livestock wastes produced in the UK were to be treated using AD techniques, the energy produced would exceed the annual consumption of the entire agricultural industry.

Animal digestive processes and manures release about 40% of the UK's emissions of methane. Animal manures and urine are responsible for about 80% of the UK's ammonia emissions, which contribute to acidification and eutrophication.

In the UK, about 40% of the total phosphorus input to agricultural land is from livestock manures.

Gaps

The mass balances included in this report are basic, as they consider single products and/or farm categories. In reality, the nature of agriculture makes a true mass balance much more complex.

Concerns

Waste from agriculture accounts for 20% of the total waste arisings in the UK. Other issues, such as the disposal of plastics and chemicals (especially sheep dip), are also high on the environmental agenda.

Pollution by heavy metals, organic chemicals and pathogens from manure and sewage sludge is of concern.

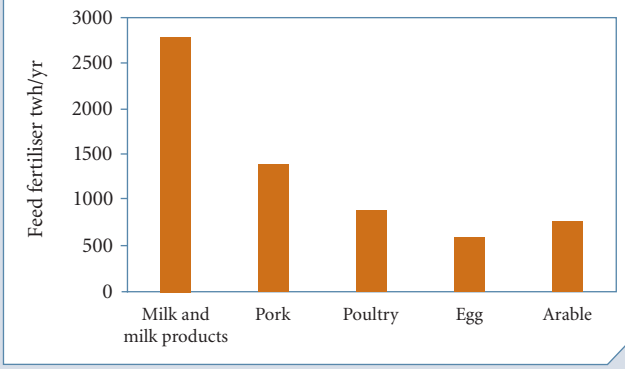
Widespread implementation of AD schemes, centralised or on-farm, is constrained by poor financial returns.

Conclusion

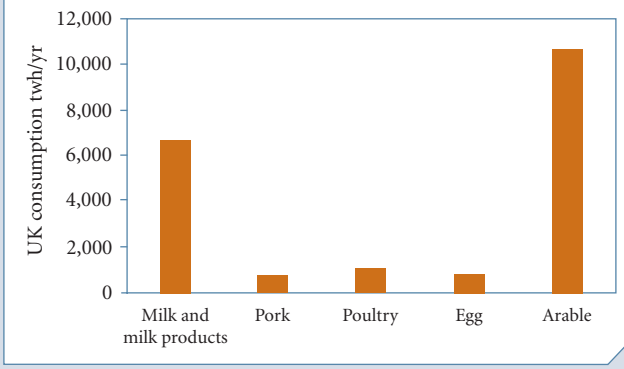
Almost everything used and produced can be recycled in one form or another. Some techniques show great promise, for example, anaerobic digestion (AD), but a concerted strategy is required for their introduction.

To be commercially viable, some farm wastes (eg. plastic films) need to be recycled at central reprocessing facilities, which may be dedicated to handling farm waste, or include farm waste with other industrial and municipal waste streams. Energy can be recovered directly through burning of agricultural waste products, or indirectly through the collection of by-products. The most appropriate technologies for on-farm operation are land-spreading, composting, straw burning and anaerobic digestion. The most appropriate technologies for centralised operation are poultry litter, straw burning, AD, composting and plastic recycling.

Annual UK inputs by food type



UK consumption by food type



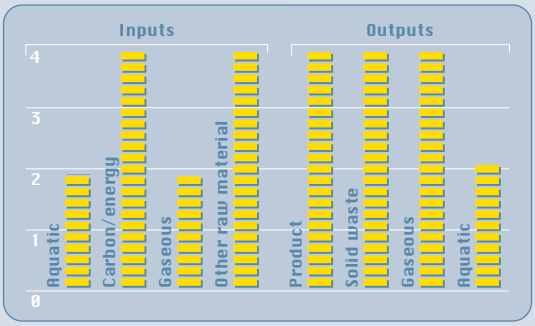
Animal digestive processes and manures release about

40% of the UK's methane





Automotive: Sustainable resource use in the motor industry – a mass balance approach





Report type
Sector

Publication date
2004

Environmental body
Viridis

Partners
Federation Internationale de l'Automobile (FIA)

Turnover
The vehicle and component manufacturing industry has a turnover of around £45 billion pa

Contact details
TRL Limited
Old Wokingham Road
Crowthorne
Berkshire
RG45 6AU, UK

Tel: +44 (0)1344 773131 Fax: +44 (0)1344 770356
Email: enquiries@trl.co.uk
Website: www.trl.co.uk

www.massbalance.org

Description

This document sets out the key findings, conclusions and recommendations of the Biffaward motor industry mass balance study. The report outlines the total material resource flows relating to the entire UK motor industry, from manufacture through vehicle use, to the final disposal of end-of-life vehicles (ELVs). The report identifies the waste and emissions associated with the industry within the UK. This is the first time that such a comprehensive study to document resource flows in the industry has been attempted.

Structure

- Key findings on resource use, wastes and emissions motor industry: infrastructure and legislation
- Resource use (products)
- Energy use
- Emissions to air
- Wastes
- Trends and influences on the motor industry

Mass flows

The addition to the vehicle stock of the motor industry in 2000 was 0.69Mt.

Key notes

Recent advances in 'integrated product policy' and 'producer responsibility' legislation are expected to accelerate progress towards establishing an organisation with the ability to provide strategic direction in future, which will necessarily include a wide diversity of stakeholders.

The UK as a whole (not just the automotive sector) produced around 571Mt of gaseous emissions in 2000, of which more than 559Mt comprised CO_2. Converting the relevant gases to tonnes of CO_2 and SO_2 equivalents, this equates to over 707Mt of greenhouse gases and 3.5Mt of acid rain precursors.

Gaps

The impact of manufacturing vehicles outside the UK for use within the UK has not been quantified.

Conclusion

To achieve the production of vehicles and components required in 2000, 4Mt of primary products were required, plus 3.08Mt of imported components, 0.15Mt of ELV components sold for reuse and 0.72Mt of fluids. This gives a total of 7.23Mt of products used in the production of new vehicles and components, of which 4.90Mt were incorporated into the production of new components and vehicles in the UK (of which 2.64Mt was exported).

In aggregate, the motor industry produced 7.21Mt of waste in 2000, including waste from production, maintenance activities, use and end-of-life vehicle arisings. This is equivalent to each person in the UK annually producing 0.12t of waste. This can be thought of as adding an extra 20% to the waste produced by each person over and above the total produced as household waste in the UK.

Emissions to the air from the motor industry in 2000 totalled 122.21Mt. 119.69Mt was from vehicle use alone, which is responsible for 23% of the total UK output of the air emissions. If the vehicle use emissions are expressed in terms of global warming potential, this is equivalent to 120Mt of CO_2, which represents 17% of the total for the UK in 2000.

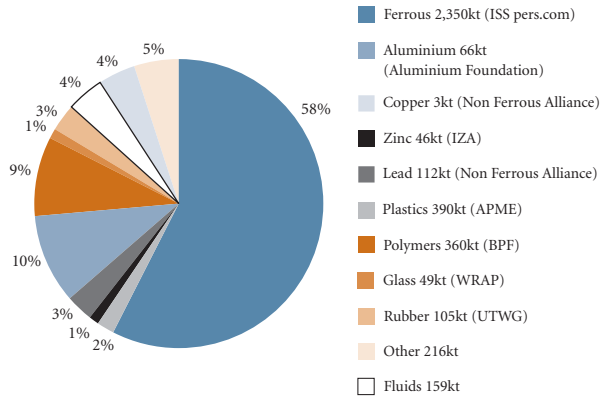
Recommendations

A number of sustainability issues have been identified in this report which cannot be addressed by industry actors alone and which will require support from additional stakeholders in order to achieve further progress.

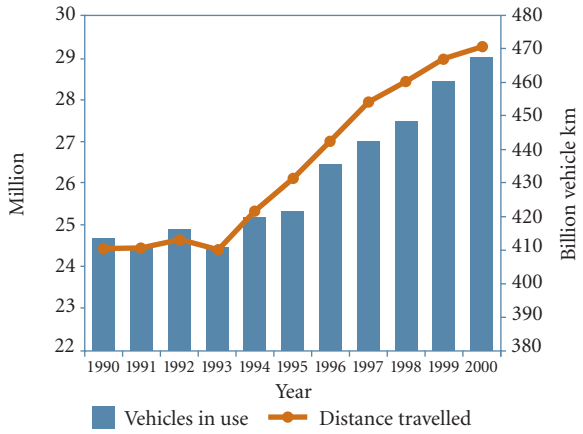
Recommendations to improve the resource productivity of the motor industry:

- Better monitoring and reporting of resource flows, to enable reporting on changes in resource use
- Creating new relationships between industry stakeholders to create progress towards achieving better resource productivity
- Invest in and share the results of research to define 'Design for Environment' principles for the motor industry, with the objective of increasing resource productivity and reducing reliance on non-renewable or hazardous materials
- Implementing practical measures aimed at stimulating action across the whole industry to minimise resource use, avoid waste production and maximising resource recovery
- Implementing practical measures to ensure that adverse environmental impacts associated with vehicle use are reduced

Primary products used in the UK Motor Industry in 2000



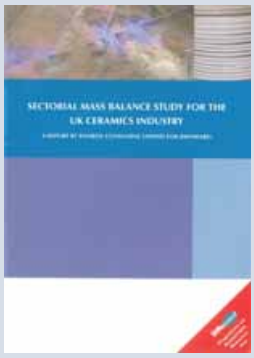
Growth in vehicles in use and distance travelled (UK)



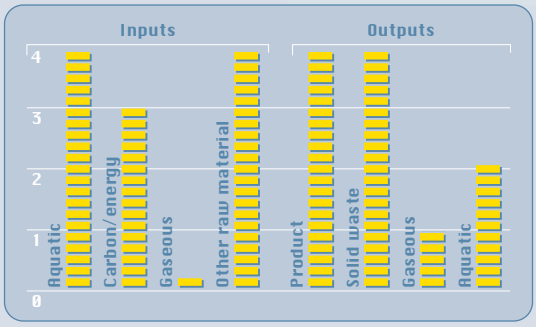
The annual economic losses associated with UK road transport have been measured as:

- Congestion £18 billion
- Accidents £17 billion
- Air pollution £3 billion
- Noise pollution £1 billion





Ceramics: Sectoral mass balance study for the UK ceramics industry





Report type
Sector

Publication date
2006

Environmental body
South West England Environmental Trust

Partners
CERAM, Enviros

Turnover
The European ceramics industry records total sales of around €25.6 billion pa

Contact details
Enviros Consulting Ltd
Telegraphic House
Waterfront Quay
Salford Quays
M50 3XW, UK

Tel: +44 (0)1618743652 Fax: +44 (0)1618480181
Email: keith.webster@enviros.com
Website: www.enviros.com

www.massbalance.org

Description

This report presents a mass balance of the UK ceramics industry, including the quantification of raw materials usage in the industry as a whole, and for its principal sub-sectors; the identification of the relationships between resource inputs, product outputs, losses, emissions and waste streams; the identification of the extent to which the industry's waste streams are currently reliant on landfill and the type of material so disposed.

The study has been structured to analyse the industry by the following sub-sectors:

- Table and ornamental ware
- Sanitary ware
- Refractory and industrial ceramics
- Tiles and flags
- Heavy clay products

Structure

- Profile of the ceramics industry
- Mass balance model of the ceramics industry
- Mass balance data
- Key performance indicators as measures of resource efficiency

Mass flows

The sector consumes 19.8Mt pa materials (raw materials and packaging 55%, water 45%).

Key notes

In addition to mapping material flows, other key aims of this study are to provide insight into more sustainable resource use and to identify potential areas for improvement. A means to initiate this is the development of Key Performance Indicators (KPIs) that the UK ceramics industry can use to benchmark future improvements in resource efficiency:

- Overall raw material efficiency
- Dry material resource efficiency
- Water efficiency
- Energy consumption
- Waste

The industry generates 273,000t waste pa.

The heavy clay industries are ideal for using waste streams generated by other industries as they are large consumers of raw materials and energy. The products are usually strongly coloured and so production can make use of materials unacceptable to other industries.

Other examples of the use of waste include:

- Incorporation of non-sewage water treatment sludge in the clay, resulting in energy saving
- Use of significant quantities of pulverised fuel ash, millscale, blast furnace slag and wood waste in the clay
- Additions of various coal processing wastes

The total amount of water consumed by the industry (7.7 million m^3) is approximately 41% of the total material input of the industry – raw materials, packaging and water, demonstrating the importance of this medium to the industry. It has been estimated that a further 1 million m^3 is embedded in the raw materials.

Gaps

The difference between outputs and inputs is 16% for the sector as a whole, due to:

- Accuracy of figures for the water content of raw materials which have been provided as 'wet weights', and which needs to be excluded to arrive at the 'dry weight'. In most instances, estimates only could be given
- Level of accuracy of the conversion of the number of product pieces to tonnages, for the table and ornamental ware and sanitary ware sub-sectors in particular
- For a large number of the sites supporting the study there were no data reported on air emissions, volume of effluent discharged or Total Suspended Solids (TSS) in the effluent

Concerns

The dry mass balance gives a measure of the confidence which can be given to the data provided. The difference between outputs and inputs is 16% for the sector as a whole. This difference can be accounted for by a number of factors, including:

- Accuracy of figures for the water content of raw materials which have been provided as 'wet weights', and which needs to be excluded to arrive at the 'dry weight'. In most instances, estimates only could be given
- The level of accuracy of the conversion of the number of product pieces to tonnages
- Stock differences over the study data gathering period have not been taken into account
- For many of the sites there were no data reported on air emissions
- For some sites, no data were available on volume of effluent discharged or Total Suspended Solids (TSS)

Conclusion

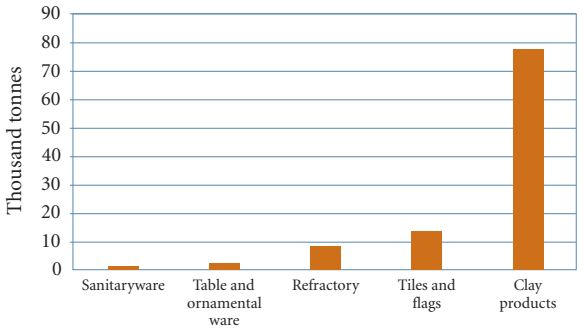
Water is a key raw material consumed by the industry. It is recognised by certain sub-sectors (table and ornamental ware) that water efficiency could be improved, initially through better monitoring.

The industry has a low waste to product ratio, estimated at 2% waste/product. However this value is significantly skewed by the mass flows within the highly resource efficient heavy clay sub-sector.

Approximately 80% of the waste generated by the industry goes to landfill. However, this waste stream is totally inert and consequently is often used in road surfacing.

Energy is a significant resource consumed by the industry.

Annual raw materials usage by sub-sector



Disposable Routes

Route	Mass (tonnes)	Mass (% of total)
Recycled	45,977	16.9
Incinerated	280	0.1
Reprocessed on-site	747	0.3
Reprocessed off-site	2,760	1.0
Landfill	222,786	81.7
Total	**272,524**	**100**

A quarter of the

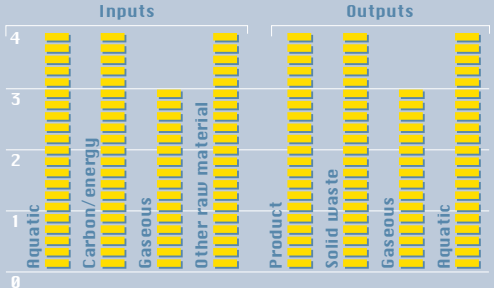
EU production

is exported to third world countries





Chemicals: Sectorial mass balance study for the UK chemicals industry





Report type
Sector

Publication date
2002

Environmental body
South West England Environmental Trust

Partners
Chemical Industries Association (CIA), Enviros

Turnover
Gross output is £49 billion
(10% of UK manufacturing)

Contact details
Enviros Consulting Ltd
Telegraphic House
Waterfront Quay
Salford Quays
M50 3XW, UK

Tel: +44 (0)161 8743 652 Fax: +44 (0)161 8480 181
Email: keith.webster@enviros.com
Website: www.enviros.com

www.massbalance.org

Description

The project aimed to:

- Gain an understanding of the flow and quantity of materials and resources through a specific UK chemicals manufacturing sector
- Provide insight into more sustainable resource use and waste management practices within the industry
- Understand and identify potential areas for improvement
- Quantity of raw materials usage in the industry as a whole, and for its principal sub-sectors
- Identify the extent of landfill dependency
- Quantify the tonnages of recycled material being used within the industry and opportunities where these can be substituted for virgin materials
- Prioritise areas for further action

Structure

- Profile of the UK chemical industry
- Mass balance model of the UK chemical industry
- Mass balance outputs

Mass flows

The global production of chemicals reached 400Mt in 2002.

Key notes

The global production of chemicals has increased from 1Mt in 1930 to 400Mt in 2002. In 1998 the European Union Chemical Industry was estimated to represent 31% of the global market in value terms and was the world's largest chemical industry, generating a trade surplus of €41 billion. The chemical industry is Europe's third largest manufacturing industry, employing 1.7 million people directly and with up to 3 million jobs dependent on it.

Key legislative drivers:

- Social, economic and market – globalisation
- Technological – process efficiency
- Environmental, health and safety – responsible care, environmental management, landfill directive, landfill tax, Integrated Pollution Prevention Control (IPPC) and Climate Change Levy

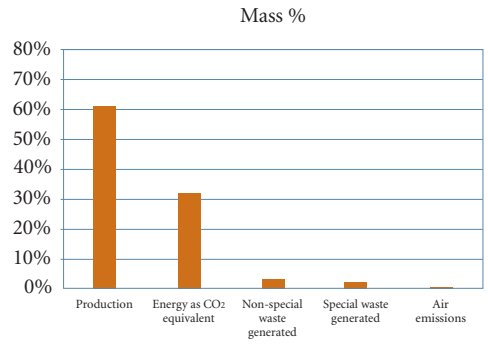
Around 90% of materials input is water. Perhaps surprisingly, energy represents a third of mass flow, whilst waste represents only 3%.

Key performance indicators (natural data set against which a profit or company can benchmark its performance) are:

- Overall raw material efficiency – 88.8% overall (ranging from 32.4% for pigments and dyes to 99.7% for industrial gases)
- Dry material resource efficiency – 88.4% overall
- Total waste and air emissions – 3.8% and 7.8%, respectively (mass/wet products)

About 448,000t of all the waste arising is disposed of via landfill, representing approximately 47% of the total. The remainder is treated, recycled or incinerated.

Production and resource consumption



Gaps

There is little measurement of water usage and output, with the exception of effluent discharges due to regulation. It has been impossible to present in detail the quantities of water output via cooling processes (cooling towers or once through water cooling) or steam loss, however this water has a low environmental impact. Some sites have significant rainwater intakes, however there is little analysis or measurement of how this water leaves the sites.

It was difficult to balance energy inputs and outputs as only high value energy outputs are measured (eg. steam) and low energy outputs have little to no value and have therefore have not traditionally been measured.

Conclusion

This highly regulated industry has already made significant efforts in recent years to optimise energy consumption, raw material usage and to minimise waste; the industry converts more than 80% of its raw material consumption into saleable product; the limiting factor to continued waste minimisation within the industry is the nature of the chemistry involved; water is the most significant raw material to the industry, used both as a raw material and a transport medium for material and energy.

The industry could consider establishing a water minimisation programme, along the lines of the voluntary energy efficiency programme, to improve its consumption of water and discharge of contaminated water. The industry could consider including some of the key performance indicators from this report in its annual reporting programmes, to enable the monitoring of resource flows to continue. There could be value in further investigation of whether process integration and/or networking could use some waste energy currently disposed of by the industry.

The study data outputs suggest that overall raw material efficiency (ie. that converted to useful product) is approximately 80%. Material losses to air and land seem to be approximately equal. The mass of materials lost to effluent is small. Losses to air are dominated by process CO_2 and water of reaction.

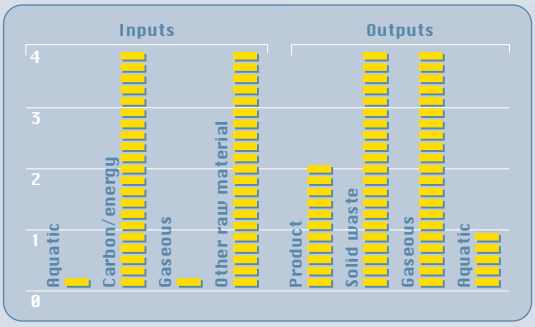
Global production of chemicals

increased from 1Mt in 1930 to 400Mt today





Construction: The construction industry mass balance – Resource use, wastes and emissions





Report type
Sector

Publication date
Revised 2003

Consultant
Viridis

Partners
Highways Agency, Laing Technology Group Ltd, WS Atkins Consultants Ltd, TRL, Ciria

Contact details
TRL Limited
Old Wokingham Road
Crowthorne
Berkshire
RG45 6AU, UK

Tel: +44 (0)1344 773131 Fax: +44 (0)1344 770356
Email: enquiries@trl.co.uk www.trl.co.uk

www.massbalance.org

The Biffaward Mass Balance programme supported related projects entitled:

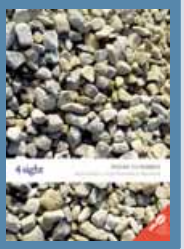
Beddington zero (fossil) energy development: construction materials report – toolkit for carbon neutral developments – part 1

The Environmental Body was BioRegional Development Group (see page 101 for full profile).

4sight: Rocks to rubble building a sustainable region

The Environmental Body was National Centre for Business and Sustainability





Description

This report presents a comprehensive overview of resource flows through the industry. It then considers future trends and influences, and makes recommendations as to how resource productivity can be improved.

Structure

- Key findings on resource use, wastes and emissions
- Definition of the 'construction industry'
- Primary material resource use
- Secondary, recycled and reclaimed products
- Energy use in the construction industry wastes
- Emissions to air from the construction
- Trends and influences and their impacts on the construction industry
- Definition of the construction industry
- Precursor and successor material and product tables

Mass flows

In adding 275Mt to its stock, there was a total requirement for over 420Mt of material resources, of which only 360Mt were incorporated into construction products – the remainder becoming waste (mostly quarrying waste).

Of the resources used over 350Mt were primary materials, 43Mt were recycled materials, 22Mt were secondary materials (eg. industrial by-products) and 3Mt were reclaimed for reuse.

Key notes

Emissions to the air by the construction industry in 1998 totalled just over 30Mt, of which over 97% was carbon dioxide (CO_2). The total waste generated by the construction industry in 1998 was 151.0Mt. This figure comprises waste generated from material and product manufacture and waste from construction and demolition activity (C&DW). These wastes can be broken down as follows:

- Quarry wastes 58.7Mt
- Waste from material and product manufacture 2.0Mt
- Construction and demolition waste 90.3Mt

Gaps

There is a lack of strategic understanding of the impact of the construction industry on natural resources and the environment. It was not possible to quantify either water resources used or aqueous wastes generated by the construction industry.

There is one area of significant resource use which it was not possible to quantify; materials which are reused on the site where they arise without processing. They include soils which may be excavated and replaced elsewhere as part of 'cut and fill' works and construction and demolition wastes such as brick hardcore used as fill. These materials are not subject to waste management regulation and the processes by which they are used are not subject to process authorisations.

Concerns

The absence of a body which is able to provide strategic direction specifically for the construction industry by encouraging policy coherence and setting priorities for addressing resource inputs, non-primary materials markets, wastes and emissions, is a fundamental obstacle to achieving significant progress.

The prospects for effective waste management and minimisation are reduced by low availability of space and local communities can suffer from noise and traffic pollution from materials (including waste) transport.

The remediation of contaminated land will continue to produce a high proportion of contaminated waste material through traditional 'dig and dump' approaches.

Conclusion

The study showed that aggregates, concrete, clay and stone products account for the great majority of construction resource inputs. At present some 20Mt of certain construction and demolition wastes and soils are deposited at sites exempt from the provisions of the waste management licensing regime.

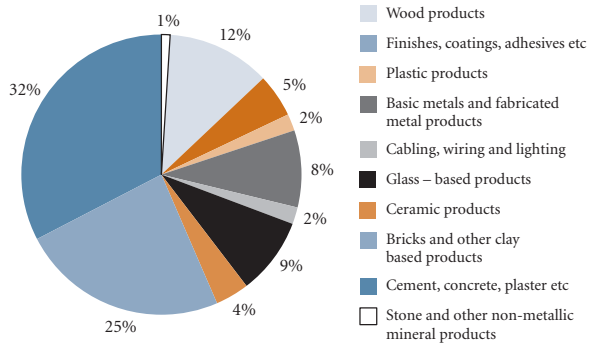
Four primary recommendations are made that it is considered will improve resource productivity in the construction industry. These are to implement:

- Comprehensive, consistent and permanent resource flow monitoring and reporting procedures
- Resource management planning initiatives aimed at minimising resource use and maximising resource recovery
- Practical measures to reduce the demand for resources
- Measures to maximise the recovery of potentially recoverable material resources

The existing housing stock of 21 million homes will require maintenance and significant upgrading. Spending in this area will continue to be a major proportion of UK construction spend.

Forecast demand for 3.8 million new homes.

Wastes from construction materials and products industry, kt (excluding quarry wastes)



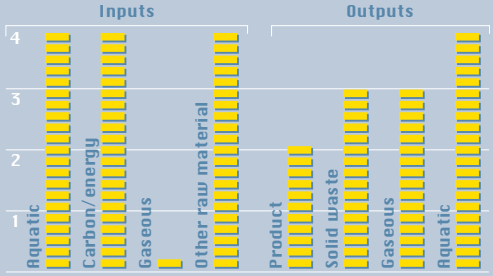
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Education: Resource management in the education sector





Report type
Sector

Publication date
2005

Environmental body
Waste Watch

Partners
The Rufford Foundation

Contact details
Waste Watch
56–64 Leonard Street
London
EC2A 4JX, UK

Tel: +44 (0)20 7549 0300 Fax: +44 (0)20 7549 0301
Email: info@wastewatch.org.uk
Websites: www.wastewatch.org.uk, www.wasteonline.org.uk

Waste Watch Wasteline
Tel: +44 (0)870 243 0136

www.massbalance.org

The Biffaward Mass Balance programme supported a related project entitled:

Farms and universities

The Environmental Body was Forum For The Future.



Description

This report identifies key aspects of resource usage in the sector whilst highlighting examples of best practice and innovation alongside practical advice and recommendations.

Structure

- Overview of the UK education sector
- Study results
- Analysis and discussion
- Putting the report in context
- Recommendations and case studies

Mass flows

Average inputs (per student per year): water 9.85m^3; energy 1800kWh; paper 12kg; desks 1.6kg, chairs 2.1kg; computers and printers and toner 1.3kg.

Key notes

- 83% of all establishments that took part in the survey were involved in national or local environmental initiatives
- Staff time, awareness and funding were cited as being key barriers to improved environmental performance
- The most commonly cited barrier to buying recycled products across the whole sector was cost
- On average, 21kg of waste is generated each year by every student in primary and secondary schools, if extrapolated to include the Further and Higher Education (FHE) sector this works out at 615,117t of waste produced by the whole sector every year

- Over half of the weight of waste analysed in detail from all establishments was made up of recyclable paper and cardboard
- Rural schools produce less waste per student than urban schools

UK schools account for 25% of public sector energy costs and they spend nearly £400 million per year on energy. The 25% most inefficient schools use more than three times as much energy per pupil than the most efficient 25% and the average school could save up to £17.85 per pupil per year by implementing energy efficiency measures. This would result in a 23% reduction in carbon dioxide emissions in the school sector.

Gaps

Mass flows for the entire sector are not provided. The surveyed sample was small (less than 100 out of 30,000 establishments).

Concerns

This study concludes that although good progress has evidently been made, there is still considerable potential for further environmental improvement in education, especially considering the size and scale of the sector in the UK.

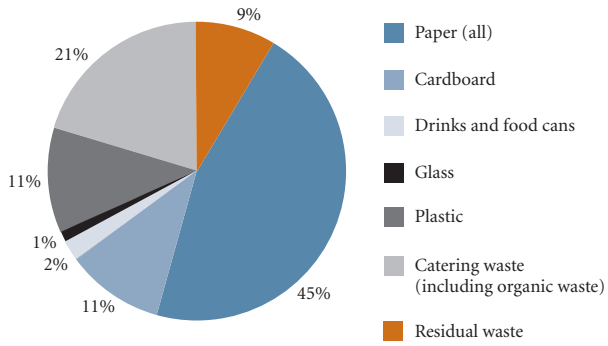
Conclusion

The sector's main environmental impacts arise through organisational policies and operational activities in terms of the purchase, use and disposal of resources.

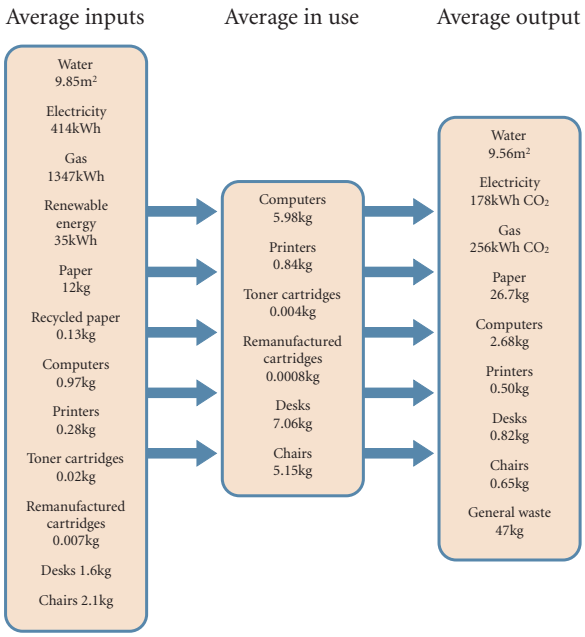
Of the main operational activities, the impact and cost of energy and water consumption has been documented widely; for example, energy and water benchmarks for government maintained schools in England have been made available annually by the DfES for the past five years.

Such practices have meant that the sector has reliable, practical information to refer to when implementing practices to improve energy efficiency and minimise water usage. The study found that resource use and waste production in the sector is very significant; for example, based on figures extrapolated from the study's findings the education sector's energy use produces approximately 5.45Mt of carbon dioxide (CO_2) per year and the sector creates 0.6Mt pa waste.

Waste in an average school



Average annual resource use per student



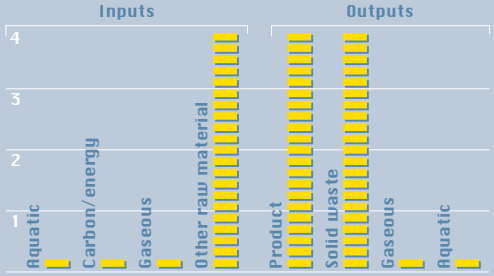
Schools can save £17.85 per pupil pa

using energy efficiency measures





Electricity: Mass balance study into electricity generation including a critical review of new and emerging technologies





Report type
Sector

Publication date
2004

Environmental body
C-Tech Environmental Group

Partners
EA Technology Limited

Turnover
Turnover from the sale of electricity in 2000 was £15.6 billion

Contact details
C-Tech Innovation Ltd
Capenhurst Technology Park
Chester
CH1 6ES, UK

Tel: +44 (0)1513472900 Fax: +44 (0)1513472901
Website: www.capenhurst.com

www.massbalance.org

The Biffaward Mass Balance programme supported a related project entitled:

UK status report on waste from electrical and electronic equipment

The Environmental Body was Industry Council for Electronic Equipment Recycling (ICER).



Description

The report sets out the total material resource requirement of the electricity generation industry and identifies the wastes and emissions associated with the industry. Information is presented as total mass (volume) and also as mass (volume)/kWh. The main recommendations are on the mass balance. Information is also provided on the generation of electricity, the different methods, their associated emissions and wastes, and wherever possible a comparison is made between the UK and international situations. Regulatory influences are also examined, as is the market for renewable energy sources.

Structure

- The electricity generation mass balance
- About the electricity industry
- The international electricity market
- The UK electricity market
- The use of coal to generate electricity
- The use of oil to generate electricity
- The use of gas to generate electricity
- The use of nuclear power to generate electricity
- The use of air and water to generate electricity
- Emissions
- The electricity generation mass balance
- The use of emerging technologies for renewable energy
- The role of effective energy efficiency
- Current legislation

Mass flows

Inputs for UK electricity generation: coal 47Mt; oil 1.2Mt; gas 23Mt; air 1x1012m^3; oxygen 1.1x10^{10}Mt; carbon 50Mt; O_2 63Mt.

Key notes

Electricity consumption has increased steadily rising from 11% of the total final energy consumption in 1970 to 18% in 2000.

The electricity sector contributed 1.3% to the Gross Domestic Product in 2000, and is very capital intensive with total capital assets of approximately £35 billion.

In 1999, the United Kingdom accounted for 2.6% of total world energy consumption and was responsible for 2.5% of total world carbon emissions. Under the Kyoto Protocol, the United Kingdom has set a target of reducing greenhouse gas emissions by 12.5% on 1990 levels by 2008–2012, and to cut carbon emissions 20% by 2010.

Energy related carbon emissions in the UK have fallen from 167.4Mt of carbon in 1990 to 152.4Mt in 1999, a 9% reduction. The decline in carbon emissions has been due to a decrease in the share of coal (the most carbon intensive fossil fuel) in the total fuel mix.

Gaps

No consideration has been made for energy consumption or material losses in the transport of material to the power stations.

Concerns

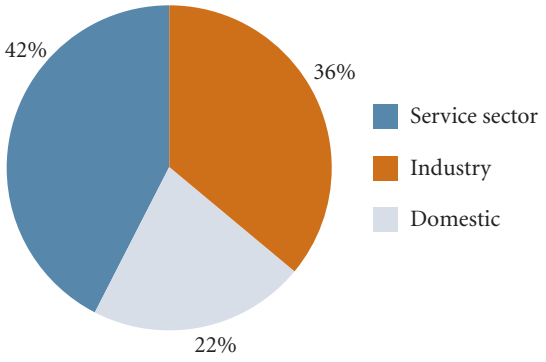
In the future there will be a much increased use of renewable electricity, in particular in order for the UK to honour its obligations under the Kyoto Protocol. Indeed in September 2003 the DTI announced that the UK will be building enough offshore wind farms to power one in six households by 2010. The cost of renewable power installations is relatively high and so Government support will need to grow. The increasing cost of gas is leading to an increase in the use of coal.

Conclusion

The adoption of the Combined Cycle Gas Turbines (CCGT) has had a huge impact on the environmental emissions due to its high efficiency, but it is very sensitive to gas prices. The impact of electricity generation on water and land is generally overlooked. The supply and use of energy will continue, and indeed increase in for example, developing countries, due to the human desire for heat, light and the ability to perform work.

In the UK in particular, the overall emissions associated with the power industry had been declining, due to the enhanced operating efficiency of the existing nuclear power stations, and the increasing use of gas to generate electricity via closed cycle gas turbine technology. However, as was pointed out in the body of the report, the increasing cost of gas is leading to an increase in the use of coal, albeit with improved environmental measures.

Percentage of energy consumed as electricity per sector



The UK generation mix

Type of generation	Capacity (MW)	Percentage
Coal	30272	38%
Gas	24989	31%
Oil	5816	7%
Nuclear	12242	15%
Hydro	4128	5%
Other	2306	3%
Total	79753	99%

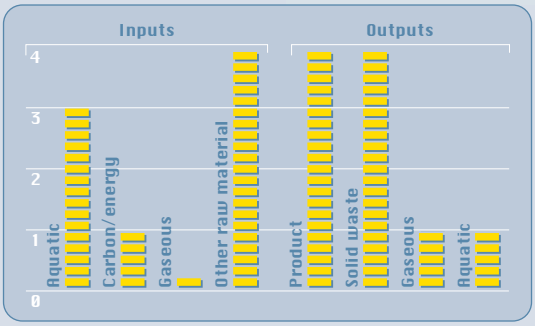
Generation from hydropower and other renewable energy sources is projected to grow by

56% over the next 24 years





Food and Drink: UK food and drink processing – mass balance





Report type
Sector

Publication date
2004

Environmental body
C-Tech Environmental Group

Partners
Mini-Waste Food Processing Faraday

Turnover
Food and drink processing contributes about £70 billion of sales (15% of manufacturing activity) and just under £19 billion of gross added value (2.6% of GDP) to the UK economy

Contact details
C-Tech Innovation Ltd
Capenhurst Technology Park
Chester
CH1 6ES, UK

Tel: +44 (0)1513472900 Fax:+44 (0)1513472901
Website: www.capenhurst.com

www.massbalance.org

Description

This report provides a comprehensive assessment of the major inputs, outputs and wastes arising from UK food and drink processing using the mass balance format. The report also considers the status of relevant UK and EU legislation, and current and future options for waste minimisation and energy and value recovery from the industry's wastes.

Structure

- Food processing: what and where?
- Policies and legislation
- Mass balances
- Options for food processing waste
- Advances in food processing technology

Mass flows

The industry consumes nearly 56Mt pa ingredients, producing almost 59Mt pa of products including the total mass of beverages. Total external wastes for the sector are estimated to be 5.8Mt pa (10% of the weight of useful products). About 1.9Mt pa of this is biodegradable.

Key notes

The food and drink processing sector is the major consumer of UK agricultural output, and sales of its products are an important contributor to the UK's GDP and trade balance. The sector also produces around a 10% of the country's industrial and commercial waste

The sector employs 455,000 people (1.7% of total employment, over 12% of manufacturing employment) in nearly 8,000 businesses.

UK farmers supply more than 2 million cattle, 10.5 million pigs and 14.5 million sheep annually for processing into meat and meat products.

In 2001, the UK fishing industry landed 738 thousand tonnes with a total value of £574 million. The UK fish processing industry employs 22,000 people in around 550 businesses.

Gaps

Although outside the scope for detailed study in this report, many fresh food producers have to deal with product returns from the retail sector. The end result is more mixed waste, in which the energy value of the food and the materials value of the packaging are both made more difficult to realise.

It was impossible to obtain satisfactory data relating to effluent discharge from the food processing industry.

Concerns

Waste is a challenge which the food and drink processing industry needs to address with urgency. The measures introduced to mitigate the effects of BSE have resulted in the closure of some significant reuse routes for animal by-products, and other materials such as uncooked dough and pastry wastes which are also no longer allowed to re-enter the food chain. In the interim, these materials are being forced, after undergoing thermal treatment, to the UK's primary waste management destination, landfill. However the long term theme of EU policy, enacted through UK legislation is to minimise landfill wherever possible.

The raw materials of the food industry contain a proportion of inherently non-consumable material. Peelings, offal, husks must be re-evaluated for potential new uses as old outlets become restricted.

Wastes from primary processing of livestock vary between 35–42% of the incoming animal weight

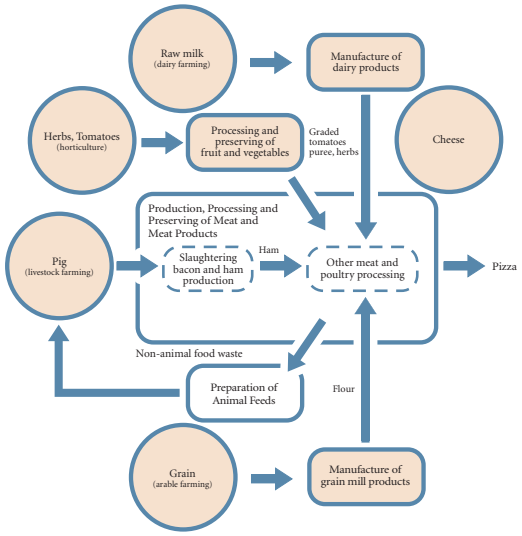
A further difficulty encountered is a fairly high degree of uncertainty over how specific wastes streams will be affected by legislative changes, and how legislative instruments will be enforced.

Conclusion

The UK's food and drinks output of 59Mt is produced with an accompanying 5.8Mt waste (about 10% of output). Energy is the most obvious form of recoverable value from food processing waste, though these are typically too moist to recover energy easily by thermal means. Anaerobic Digestion (AD) has great potential as a recovery route for energy from food wastes. Biodegradable food processing waste has much in common with sewage, agricultural organic waste, and commercial food waste.

Technology transferred from other industries can be adapted to handle food processing wastes. Combined Heat and Power (CHP) can help maximise the efficiency of energy recovery, Stakeholders must act concertedly to drive change in practice and promote waste minimisation.

Complexities of resource flows for food processing output



Waste management options for food processing waste

	Amount to Waste Management Route (ktonnes)							
Food processing class	Land disposal	Land recovery	Re-used	Recycled	Thermal	Transfer	Treatment	Total
15.1 Meat & meat products	283	285	205	146	17	65	234	1,235
15.3 Fruit & vegetables	184	70	152	494	0	1	22	922
15.4 Oil & fats	44	–	0	19	-	4	2	70
15.5 Dairy products	90	78	38	179	0	3	1	389
15.6 Grain mill products	46	106	77	34	0	0	0	263
15.7 Animal feeds	144	127	1	29	0	0	4	305
15.8 Other foods	747	68	893	627	42	28	137	2,542
15.9 Beverages	260	86	807	95	0	3	11	1,463
Total	1,799	819	2,274	1,722	59	104	412	7,189

UK farmers annually sell:

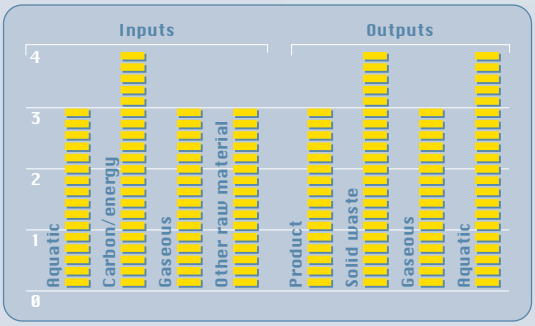
- 2 million cattle
- 10.5 million pigs
- 14.5 million sheep

for processing into meat and meat products





Foundries: The foundry mass balance project





Report type
Sector

Environmental body
Castings Technology International

Partners
DTI

Contact details
Castings Technology International
7 East Bank Road
Sheffield
S2 3PT, UK

Tel: +44 (0)114 2728647 Fax: +44 (0)114 2730852
Email: info@castingstechnology.com
Website: www.castingstechnology.com

www.massbalance.org

Description

This report outlines the mass balance of the foundry industry, a 1.3Mt pa industry, providing a diverse range of products in a vast number of metal alloys.

Structure

- History of environmental issues
- UK mass balance project
- The foundry sector
- Historical and current contexts
- Materials used by the foundry industry
- The mass balance model
- Data quality and assumptions
- Results
- Overall sector mass balance
- Mass balance by metal group
- Benchmarking
- Resource productivity
- Format for future data reporting

Mass flows

The industry produces 1.27Mt of cast products from a total of 4.5Mt of materials, although this figure includes water use of 1.8Mt.

Gaps

Returns for zinc and magnesium and other low volume materials also need to be brought into the balance for the castings sector.

Concerns

There has been a desire within the EU via the Integrated Product Policy to purchase more sustainable goods and services. However this has been hindered by a lack of tools with which to measure one route of supply against another. Such developments would allow the EU community to progress further down this route to achieve environmental aspirations.

Conclusion

From the sample taken, 51% of companies segregated all of their waste into constituent streams, 35% segregated some of their waste streams – mainly sand and 14% carried out no segregation at all. This shows a significant improvement over the last similar study for 1996, where only 34% of foundries carried out any type of segregation. This improvement in waste management is likely to have come about as a result of landfill taxation.

The industry uses a large proportion of sand for the production of moulds for castings. This sand is mixed with various binders and additives to assist the rigidity of the mould. When casting has taken place, these break down with the heat involved in casting and the waste sand is either disposed of, or reclaimed. Levels of reclamation vary from zero in small foundries to 95% for those who can justify the installation of plant.

82% of the total sand used within the industry is recycled, however the remaining sand is the main waste stream from the industry and accounts for 54% of all waste.

Filtration dust is the next largest category of waste after sand and general waste at over 87,000t (13.6% of all solid waste and 17% of segregated waste).

Key contents

For the foundry industry mass balance, detailed data was collected from 38 UK companies with a further 51 companies providing additional data. This represents around 18% of the industry by mass involved in the full survey.

Recycled internally within the foundry:

- 3.9Mt (51%) of materials from a total of 7.6Mt used
- 84% of sand
- 35% of all metallic materials used
- Virtually 100% of waste metals
- 6 times the solid waste output from the industry is recycled internally

Energy Consumption

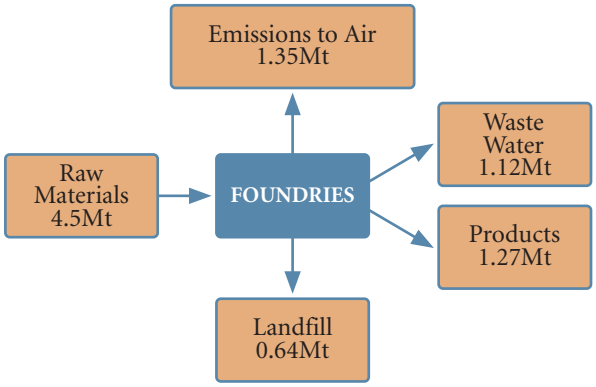
- 1.27Mt of products
- 0.64Mt of waste to landfill
- 1.35Mt of emissions to atmosphere

The energy consumption of the cast metals industry for the year 2000 was estimated to be:

Gas	1,353,000MWh
Electricity	1,692,000MWh
Gas	418,000MWh
Gas	23,000MWh
Total	**3,486,000MWh**

For each tonne of casting produced, the energy consumption was around 2.74MWh

Material flows through foundries (2000, Mt)

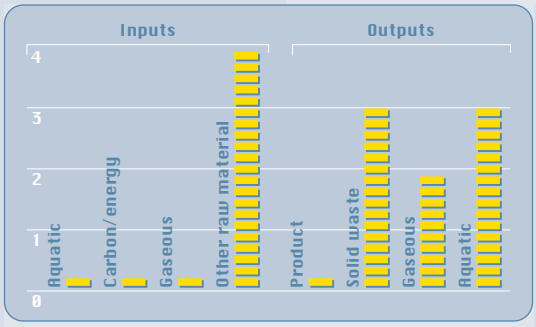


For every tonne of product cast, there is more than one tonne of emissions to air.





Furniture: Benchmarking solvent use in the UK furniture manufacturing sector





Report type
Sector

Publication date
2004

Environmental body
British Furniture Manufacturers

Partners
Bevan Funnell Ltd, Granyte Surface Coatings plc, Viatec, Wm Bartlett and Sons Ltd, Wood Bros (Furniture) Ltd

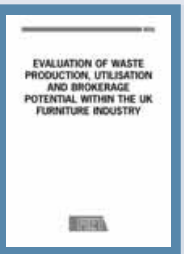
Turnover
The sector has an estimated £7 billion turnover

Contact details
BFM Ltd
30 Harcourt Street
London
W1H 2AA, UK

Tel: +44 (0)207 724 0851 Fax: +44 (0)207 706 1924
www.bfm.org.uk

www.massbalance.org

The Biffaward Mass Balance programme supported the following related projects:



Evaluation of waste production, utilisation and brokerage potential within the UK furniture industry.
The Environmental Body was the Furniture Industry Environment Trust (FIET).

Packaging optimisation in the furniture sector.
The Environmental Body was the Furniture Industry Environment Trust (FIET).

Benchmarking wood waste combustion in the UK furniture manufacturing sector.
The Environmental Body was the British Furniture Manufacturers Limited.

Description

The main aims of this project were to:

- Generate information on the relative performance of different wood coating sub-sectors
- Quantify solvent emissions
- Quantify levels of solvent waste generation by sub-sector and analyse the disposal and recovery routes
- Develop solvent usage waste benchmarks
- Produce guidance on the best operating practices and encourage their uptake
- Contribute to the review of PG6/33(97) – the wood coating process guidance note

This report shows the degree of progress, associated costs and the impact in terms of solvent reduction. It also provides benchmarks with which companies can compare their own performance.

Structure

- Introduction
- Controls on solvent use
- Characteristics of wood coating operations
- Solvent use in the furniture sector
- Benchmarks of solvent use
- Conclusions

Mass flows

Audited companies consigned 136,400 litres of solvent waste off-site each year – 98.5t of solvent. A further 36,600 litres of thinners (26.4t solvent) were recycled on site. The sector emitted 10,500t solvent in 2000. A further 983t solvent were sent off-site for reuse and recovery.

Extrapolated to the entire sector, the solvent inputs are as follows:

- Solvent consumption is typically stain (14%), sealer (27%), lacquer (32%), cleaning thinners (13%), thinning thinners (6%) and other uses (7%)
- Sectoral solvent emissions were probably around 10,500t in the year 2000

Key notes

None of the large reproduction manufacturers had been able to achieve compliance, having generally reached a plateau of between two and five times the mass balance allowance. With regard to the 41 companies participating, a good degree of solvent reduction had been achieved. Their consumption fell by 41% (605t pa) between 1998 and 2000.

Gaps

The furniture industry is diverse in nature. Any analysis of solvent use based on sector-wide averages will be largely meaningless. Therefore, this project centred upon three specific areas of wood coating:

- Reproduction manufacturers
- Solid timber manufacturers
- Board material manufacturers

It is recognised that there are failings in such a classification. Some manufacturers were involved in solid timber and board material manufacturing. Such operations were classed according to the major coating use. Ideally, many more sub-divisions might be incorporated.

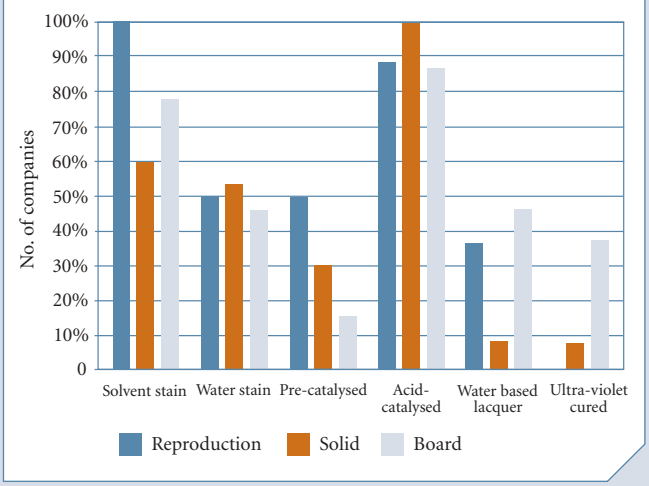
Concerns

Virtually all coatings were supplied in 25 litre tins. These were not designed for reuse and they were considered problematic by all furniture manufacturers. With furniture sites typically being charged £2 per tin, research into reusable containers could significantly improve the environmental and economic performance of both coating users and suppliers.

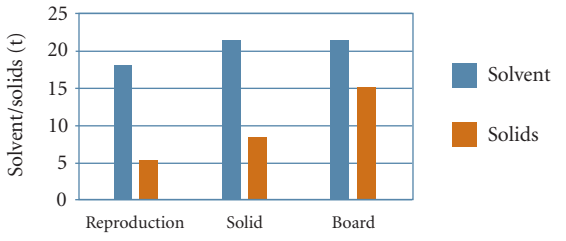
Conclusion

This study suggests that the sector purchases around 11,500t of solvent p.a. with 1,000t of this being sent off-site as solvent waste for recovery. With regard to the 41 companies which participated in this study, a good degree of solvent reduction had been achieved. Their consumption fell by 41% or 605t pa between 1998 and 2000. Significant expenditure was required to achieve this progress – totalling £7.63 million over five years. However, much of this sum was recouped by the £7.30 million savings that accrued over the five year period. This picture changes when the facts are considered on a sub-sectoral basis.
The reproduction manufacturers have been able to make the least progress and they have incurred a significant cost in the process. Between 1998 and 2000, the average solvent to solids ratio improved from 3.58 to 3.03:1 and these manufacturers incurred an average cost of £231,000 from 1995 to 2000.
The board sub-sector has progressed its solvent to solids ratio from 3.20 to 1.68:1 between 1998 and 2000, whilst making an average saving of £87,000 between 1995 and 2000. This had enabled 50% of large sites to achieve compliance.

Coating types

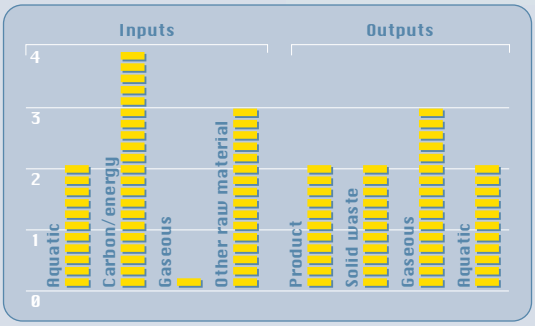


Average use of solvent and solids





Government: Adding value to public services – Analysis of public sector resource use





Report type
Sector

Publication date
2003

Environmental body
Waste Watch

Partners
Hampshire County Council London Borough of Camden Wolverhampton MBC

Contact details
Waste Watch
56–64 Leonard Street
London
EC2A 4J, UK

Tel: +44 (0)20 7549 0300 fax: +44 (0)20 7549 0301
Email: info@wastewatch.org.uk
Website: www.wastewatch.org.uk

www.massbalance.org

Description

This study provides an initial analysis of the flow of resources in administrative functions of public sector organisations. The following areas are considered: water, waste, energy, travel and office products.

Structure

- Results
- Resource flow analysis

Mass flows

12–15% of all goods and services purchased.

Key notes

Activities to improve performance across the 19 Government departments include:

- Harmonising data collection, monitoring and reporting
- Establishing environmental management systems across the entire estate
- Developing targets for key environmental impacts
- Publishing departmental plans for delivering targets and reporting on progress
- Establishing lines of responsibility for achieving targets
- Extending the framework to cover social impacts

The public sector emitted 1.71Mt CO_2 in the reporting period, 1.2% of the total UK emissions of CO_2 from energy and travel.

Gaps

Data returns were most complete for water, electricity, gas and non-fleet vehicle mileage. Significant data gaps were found for mileage, other than for non-fleet vehicles, and for the procurement and disposal of office products.

Concerns

Public sector emitted 1.71Mt of CO_2 in the reporting period, which accounts for 1.2% of the total UK emissions of CO_2 from energy and travel.

Approximately 47,000t pa paper are recycled by the public sector.

It was not always clear from the findings whether the higher performing organisations provided examples of good practice, or whether external factors, such as the inherited property portfolio, were significantly affecting performance. High-level commitment is essential for securing the necessary staff, financial and technical resources, and for developing a culture which encourages staff to change behaviour. A lack of genuine commitment was illustrated by the general absence of recycling infrastructure within many local authority organisations.

Conclusion

Decentralisation of procurement has increased the challenge of data collection and information sharing within organisations, and has diffused the buying power of individual organisations. All organisations would benefit from closer scrutiny of resource use, monitoring data to ensure that anomalies or flaws in data collection systems are identified.

For certain resources, for example, staff mileage for travel other than by non-fleet vehicles and the procurement and disposal of office products, data availability was particularly poor.

Improved data collection tools for non-vehicular mileage will facilitate the development of travel plans promoting the use of more sustainable forms of transport.

Increasingly, the public sector outsources many ancillary functions, including waste management and building maintenance. It was noted that contractors were not always able to provide sufficient resource use data to satisfy reporting requests. Procurement data should not be limited to the number of items purchased or level of resources used.

External reporting, including third party verification of the reports, can be a powerful tool for increasing an organisation's capacity for resource use data management and is a strong motivation for improved performance.

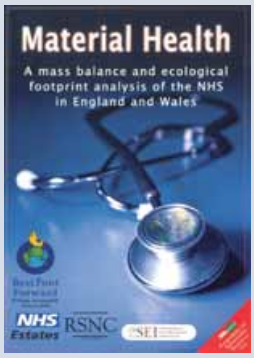
Recommendations

It is recommended that:

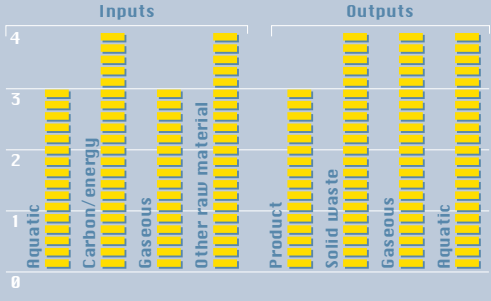
- A local authority initiative is developed, with assistance from central Government, and involving the Improvement and Development Agency (IDeA) and the Audit Commission
- Further research is undertaken to develop data collection systems that bridge the gap between decentralised procurement and the need for comprehensive data
- Good practice case studies undertaken to help identify priority activities to support the implementation of the Framework for Sustainable Development in Government (FSDiG) and the local authority initiative
- Travel plans incorporating clear targets for the reduction of vehicular mileage are developed and implemented
- The requirement to provide resource use data is an element of new or updated contractual arrangements
- Decision-making tools are developed to promote more sustainable procurement, including tools to assist in contract specifications and product selection
- A group of public sector 'pioneers' is established to assist in the identification of products and services that improve resource productivity

Estimated public sector resource use (output)

Resource	Type	Public sector output
Water	13.8 million m^3	
Energy	electricity	701,000 tonnes CO_2
	electricity	574,000 tonnes CO_2
	electricity	zero
	electricity	na
	solid fuel	40,000 tonnes CO_2
Travel	non-fleet vehicles	236,000 tonnes CO_2
	non-fleet vehicles	143,000 tonnes CO_2
	rail	10,000 tonnes CO_2
	air	4,600 tonnes CO_2
Total CO_2	energy and travel	1.71 tonnes kg CO_2
Office products	paper	9,370 million sheets
	fluorescent tubes	1.07 million units
	computers	178,000 units
	fax machines	770 units
	telephones	102,000 units
	toner cartridges	429,000 units
Waste	controlled	141,000 tonnes
	special	7 tonnes



Health: Material health – mass balance ecological footprint of the NHS





Report type
Sector

Publication date
ISBN: 0-9546042-1-0

Environmental body
RSWT

Partners
Best Foot Forward, Stockholm Environmental Institute, NHS Estates

Turnover
The NHS in England and Wales spent an estimated £11.6 billion on products (73% spent on medical and surgical supplies) in 2001

Contact details
Best Foot Forward Ltd
The Future Centre
115 Magdalen Road
Oxford
OX4 1RQ, UK

Tel: +44 (0)1865 250818 fax: +44 (0)18865 794586
Email: mail@bestfootforward.com
Website: www.bestfootforward.com

www.massbalance.org

Description

The report set out to determine the mass balance and ecological footprint of the NHS in England and Wales – it is an important step towards quantifying the environmental impact of the NHS. The results section includes: The mass balance analysis, vignettes and the ecological footprint analysis. The methodology section details the research techniques used to obtain and collate data, the assumptions and analyses made during calculations of the mass balance and ecological footprint. Discussion includes the principal sources of data, data quality and gaps in the availability and provision of data.

Structure

- Mass balance analysis
- Ecological footprint analysis
- Ecological sustainability
- Scenarios

Mass flows

In 2001 the NHS consumed 1.3Mt products and 53t food, generating 0.39Mt of waste. The NHS stock build up total was 1,004,162t in 2001.

Key notes

In 2001, the ecological footprint of the NHS in England and Wales was 4,964,825gha (global hectares) or 0.09gha per capita:

- Products and waste was 58% of the total ecological footprint (2,866,647gha) – 31% was furniture, office and computer equipment
- Patient, visitor and staff travel was 22% of the total ecological footprint (1,115,345gha)
- Direct energy was 17% of the total ecological footprint (865,661gha)
- Food was 2% of the total ecological footprint (97,217gha)
- 77% was animal-based food products
- Water and built land were both 0.2% of the total ecological footprint (8,485gha and 11,470gha respectively)

More than 601,000 pharmaceutical items were dispensed in the community as GP prescriptions, in England and Wales, in 2001. This equates to almost 900t, at an estimated cost of £6.2 billion

In 2001, the NHS in England and Wales consumed an estimated 53,256t of food, at an approximate cost of £250 million. Over two-thirds of all food procured by the NHS was through NHS Purchasing and Supply Agency (PASA) arranged contracts.

In 2003, the NHS in England and Wales generated an estimated 261,086t of domestic waste at an estimated disposal cost of £15 million. This represents 1% of all municipal waste generated in England and Wales.

Gaps

The mass of pharmaceuticals consumed by the NHS in England and Wales could not be calculated using ProdCom data. Most of the ProdCom data was suppressed or unavailable, probably due to confidentiality issues. Unfortunately, the composition of stock in the NHS in England and Wales is unavailable due to the lack of data and the inability to make any 'educated' assumptions on mass.

It had been hoped that this study would be able to quantify construction materials consumed by the NHS in England and Wales in 2001, and calculate the ecological footprint associated with this construction. It became evident, mainly due to a lack of appropriate data that this would be difficult to achieve within the time frame of the project.

Concerns

Only 1.8% (4,748t) of domestic waste generated by the NHS in England and Wales, in 2001, was recycled. Multi-service Trusts recycled the largest proportion of their domestic waste (3.5% of 22,191t). The lowest recycling rate was 0.5%, achieved by both medium community and children's Trusts.

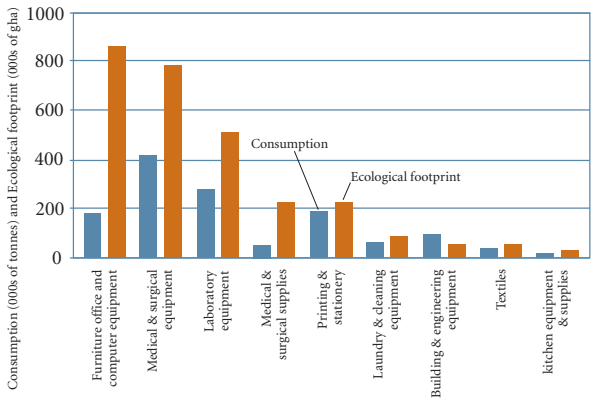
It is suggested that 61% of clinical waste is domestic, implying that 73,500t clinical waste generated by the NHS in England and Wales could be domestic waste. This means £14.5 million pa is wasted by inadequate waste segregation.

Conclusion

The NHS stock build up total was 1Mt in 2001, while resource consumption was 1.4Mt (excluding water and energy consumption). Therefore the NHS eco-efficiency was calculated at 72%. This means that for every tonne of material and product consumed by the NHS, 72% is retained while 28% is wasted. This compares positively to the UK's eco-efficiency of 52%.

The mass balance and ecological footprint analysis of the NHS should be seen as a baseline study intended to deliver a platform from which further research and data analysis can take place.

Ecological footprint versus mass consumed in 2001

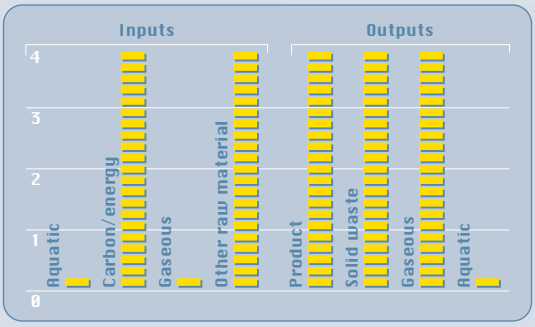


	Tonnes	% of total emissions
Total emissions	3,169,176	100%
Carbon Dioxide (CO_2)	3,169,176	99.6%
Methane (CH_4)	172	0.01%
Nitrous Oxide (N_2O)	54	0.002%
Nitrogen Oxide (NO_x)	4,103	0.13%
Carbon Monoxide (CO)	1,325	0.04%
Volatile Organic Compounds (VOC)	198	0.01%
Sulphur Dioxide (SO_2)	4,103	0.16%
Particles (PM_{10})	1,325	0.03%
Black Smoke (BSq)	198	0.01%

Sources: Derived from DTI, 2003a, Forum for the Future, 2003 and NAEI, 2003.



Magazines: Balanced reading – mass balance of the UK magazine publishing sector





Report type
Sector

Publication date
2004

Environmental body
The University of Leeds Environmental Trust

Partners
Polestar Group, Pira International

Turnover
The industry accounts for around 1% of UK GDP.

Contact details
Pira International
Randalls Road
Leatherhead
Surrey
KT22 7RU, UK

Tel: +44 (0)1372 802195, Fax: +44 (0)1372 802245
Email: info@pira.co.uk

www.massbalance.org

Description

The project aims to quantify all of the resources used, and wastes and emissions produced by the magazines supply chain during the year 2001.

Structure

- The life cycle of a magazine in the UK
- The mass balance model
- The wider context
- Pressures and future opportunities

Mass flows

In 2001, the magazines supply chain used 1Mt of materials in order to deliver 0.74Mt of product to the final consumer.

Around 2.68 billion magazines were published in the UK in 2001 (1.31 billion consumer magazines, 0.94 billion customer magazines, and 0.43 billion business magazines).

Key notes

Paper was the main raw material consumed, accounting for 87% of all raw material inputs. In 2001, 928kt of magazine grade papers were consumed in the UK to produce magazines. The vast majority of this paper is virgin material. Subsequently, paper is the main waste output from the supply chain. Around 797kt of waste paper were produced in 2001, of which 118kt arises as process waste at printers and 147kt arises as waste at wholesale depots from the sorting and processing of unsold product returned by retailers. All of the paper arising as process waste at printers and wholesale depots is recycled.

Gaps

The data collection process, and the application of assumptions and calculations to the data collected, introduces inevitable uncertainties. Therefore, the numbers presented should not be interpreted as absolutes, but instead be considered as being indicative of the probable scale of the material flows associated with the magazine publishing supply chain.

Paper, which represents the largest resource flow into the magazines supply chain, is the subject of another study of the Biffaward Mass Balance programme. Therefore data have not been collected and presented on the resources consumed by and emissions associated with the production of the paper used by the magazines supply chain.

Concerns

Up to 30% of magazines distributed through the news trade are returned by retailers to wholesalers as unsold under the sale or return system. The wholesalers process this material, and as a result 147kt of paper are sent to recycling mills in the UK and 25kt of mixed waste materials are sent to landfill.

Conclusion

The principal outcome of the study is a model of the flows of materials associated with the UK magazines' supply chain in the year 2001. Up to 30% of magazines distributed through the news trade are returned by retailers to wholesalers as unsold under the sale or return system. The wholesalers process this material, and as a result 147kt of paper are sent to recycling mills in the UK and 25kt of mixed waste materials are sent to landfill. Reducing the returns rate by 10% would reduce the total amount of product needed by the supply chain by 6%. Overall, 54kt less paper would be consumed by the supply chain; raw materials consumption and emissions from printing processes would be down by 6%; and 45kt less waste paper for recycling and 7.6kt less mixed waste for landfilling would be generated at wholesale depots.

Recommendations

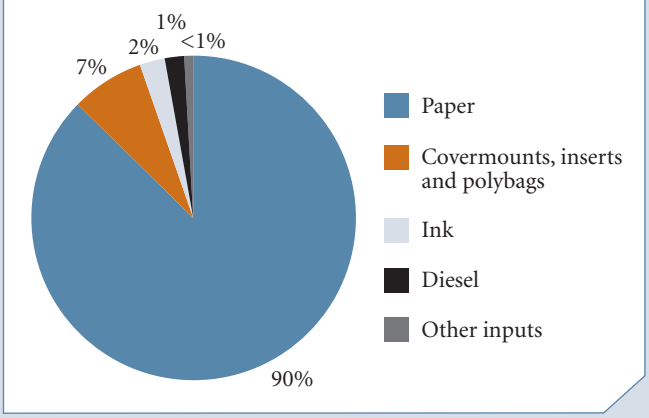
Publishers should be encouraged to be responsible in their use of covermounts. Wholesalers should continue to keep a watching brief on opportunities for recycling covermounts and polybag materials, but overall it is suggested that landfill remains the best waste management option for this waste stream. Any initiative that can contribute to reduced return rates should be seriously considered, wherever additional environmental impacts created or financial burdens added are not counterproductive.

Because of the high transport intensity of this sector, distributors and wholesalers should keep a watching brief on developments in Liquid Petroleum Gas (LPG) and other alternative fuels.The magazine supply chain should continue to support the principles of geographical wholesaler agreements and consolidated supply.

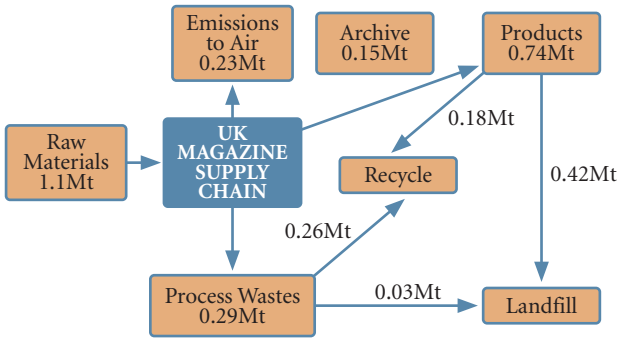
Opportunities to increase post-use magazine recycling should be pursued. These efforts should concentrate on educating existing recyclers that magazines can be recycled along with newspapers in existing schemes. It is not necessary for the UK magazine industry to attempt to change its paper usage from virgin to recycled materials.

Magazine publishers should consider sustainable forest products certification, with a view to switching to certified paper.

Primary resources consumed by the magazine supply chain



Material flows through magazines (2001, Mt)

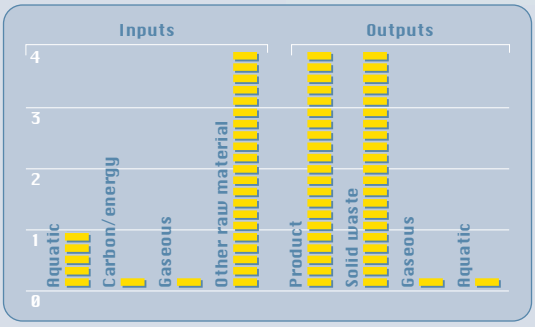


Around 573 million magazines are unsold each year





Newspapers: A mass balance of the UK newspaper industry





Report type
Sector

Publication date
2002

Environmental body
National Society for Clean Air and Environmental Protection (NSCA)

Partners
Bridgewater Paper Co. Limited, Stora Enso AB, Stora Enso Research, Sun Chemical Limited, University of Paisley

Contact details
Environmental Technology Group
University of Paisley
High Street
Paisley
PA1 2BE, UK

Tel: +44 (0)141 848 3205/3229
Fax: +44 (0)141 848 3229
Email: tuck-ch0@paisley.ac.uk
Website: www.newspaper.paisley.ac.uk

www.massbalance.org

Description

This report describes material flows of printed newspapers through the UK economy. The results were reconciled into a fully interlocking mass balance of UK newspapers and newsprint. The resultant mass balance is based around the UK newspaper recycling loop including all the sources and sinks. The overall newspaper mass balance has been developed as an interactive computer simulation model as well as the paper representation presented in this report. That simulation model enables:

- The progressive updating of the balance as new circumstances evolve
- The evaluation of the sensitivity of the balance to alternative professional assumptions
- The evaluation of 'what-if' scenarios for different possible futures. Possible future scenarios are modelled for the period 2004–2005

Structure

- Newspaper production
- Distribution and circulation
- Newspaper consumption
- Recovery and markets
- Component material flows
- An interlocking mass balance

Mass flows

2.2Mt newspapers are produced each year.

Key notes

In 2001–2002, around 0.77Mt (of the 2.2Mt newspapers in circulation) were recovered for recycling. This gives a national recycling rate of just under 35%. Around 0.73Mt of those recycled newspapers were recovered through local authority collections with only a relatively small minority being recovered from commercial and institutional waste streams.

Total recovery of pre-consumer and post-consumer newspaper wastes in the UK (2001/2) was 1.13Mt out of a total recovery of 1.76Mt of newspapers,

pamphlets and magazines. 64% of recovered newspapers were post-consumer in origin, the remainder being made up of 266,000t of over-issued newspapers and 0.13Mt of printers' wastes. Other paper grades account for 0.15Mt pa recovered newspapers.

Key issues facing the newspaper sector over the last decade have been:

- What target should be set for the recycled fibre content of newspapers (see eg. International Institute for Environment and Development, 1999)
- Whether it is environmentally preferable to incinerate rather than recycle old newspapers (see eg. British Newsprint Manufacturers Association, 1995)
- Stimulating new markets for reuse of old newspapers. Without those end markets extra recovery would be commercially meaningless

It is now becoming clear that:

- The current target of 70% recycled fibre content by the end of 2006 should be achievable and should raise no insoluble technical issues
- Incineration has a role to play in newspaper management
- Markets for recovered newspaper, other than reprocessing into new paper, are unlikely to account for anything more than a fraction of the recovered waste

Gaps

Data uncertainties, data gaps and data conflicts are significant to the overall balance. The most important of these unknowns are:

- How much newspaper is collected in commercial, industrial and institutional waste streams as opposed to household waste streams
- The true weight of newspapers in household residual waste

Very little detail is known about commercial wastes arising in the UK and more sectoral audits need to be undertaken in order to define those mass flows in greater depth. Securing greater recovery of newspapers from households and issues surrounding recovered paper also need to be addressed. Different professionals make different estimates of UK resource flows, and policy decisions can be taken based on those estimates.

Establishing a mass balance for UK newspapers is not straightforward. The balance suffers from a vagueness of definition and from changing definitions around the newspaper life cycle. Newspapers are printed on newsprint, or at least most of their contents are, though not all publications that are printed on newsprint are classified as newspapers. Some are classified as magazines. Other publications, notably some advertising sheets, are not audited as either being a newspaper or a magazine.

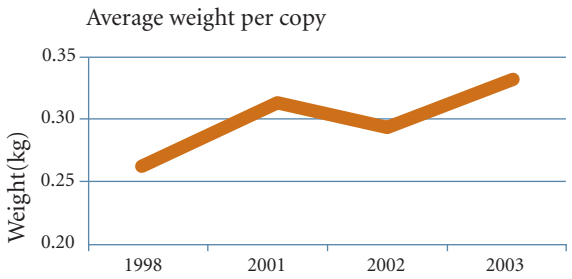
Concerns

If the market for home newsprint consumption, increases then home waste paper supply will increase too, thereby displacing import requirements.
The downside is that if the home newsprint market does increase then so will the tonnage of unrecovered newsprint. The tonnage of newspaper landfilled will therefore increase.

Conclusion

Overall, the results have provided a framework of the flows of newspapers and their embodied components through the UK economy.
That framework will evolve as new events and circumstances unfold, and as our knowledge and data sets improve. A computer simulation version of the balance provides a tool to follow and forecast the newspaper mass balance into the future, under different sets of assumptions and different evolving scenarios. This study highlights many of the problems of reconciling conflicting, uncertain and sparse evidence. The substitution of waste paper de-inking for thermomechanical pulp production in UK newsprint production should result in the UK producing an overall more marketable product. If those markets can be realised, newsprint production in the UK should return back close to capacity, recovering from the depressed markets seen in 2002.

Input-output statistics UK newsprint manufacture 2002



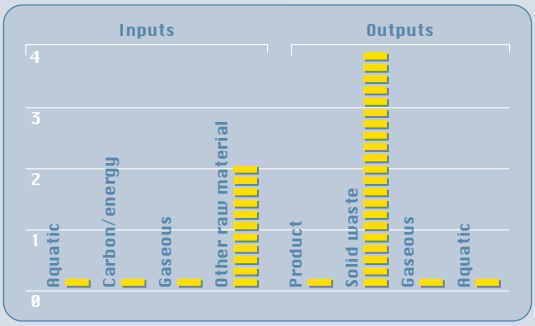
Based on 16 daily titles measured in the last 2 weeks of February each year (University of Paisley, unpublished)

	Tonnes per annum	Moisture content (%)	Tonnes per annum dry matter
Input			
Recovered paper*	1,150,000	0.97	1,052,250
(Recovered newsprint)	(805,000)	0.40	(736,575)
Output			
Solid rejects	8,341	72%	1,501
De-inking sludge	343,212	36%	219,656
Newsprint	1,059,500	8.5%	969,443

*Note: The input figures refer only to the recovered fibre flows and do not record any other material inputs. Source: UK newsprint mills & Confederation of Paper industries.



Offices: Rethinking waste management to reap rewards minimising waste for business benefit





Report type
Sector

Publication date
2004

Environmental body
Waste Watch

Partners
KPMG LLP Lloyds TSB Bank plc, Northern Rock, Prudential plc

Turnover
In 2001, the industry contributed £46.3 billion to UK GDP

Contact details
Waste Watch
56–64 Leonard Street
London
EC2A 4JX, UK

Tel: +44 (0)20 7549 0300 Fax: +44 (0)20 7549 0301
Email: info@wastewatch.org.uk
Website: www.wastewatch.org.uk

www.massbalance.org

Description

This report assesses the environmental impacts of the financial services sector and is of interest to a wide range of stakeholders including national governments, investors and employees.

Structure

- Methodology
- Overview of the financial services common findings of the study
- Site study results
- Product use analysis
- Legislation and change

Key notes

On average 496kg of waste is generated each year by every employee in the financial services industry that is equivalent to five reams of paper per employee each week. 69% of all waste generated is disposed of to landfill.

The average recycling rate is 24%. 60% of the waste generated by large and head offices is paper/card – all of which is recyclable.

Concerns

0.37Mt pa of waste are produced each year by the UK financial services industry, 69% of which (generated on participating sites is landfilled). Recycling rates across all sizes of office surveyed ranged from 0–69% and the average recycling rate at participating sites was 24%.

Barriers to recycling include:

- Space
- Infrastructure
- Weight and costs
- Finance
- Keeping staff informed

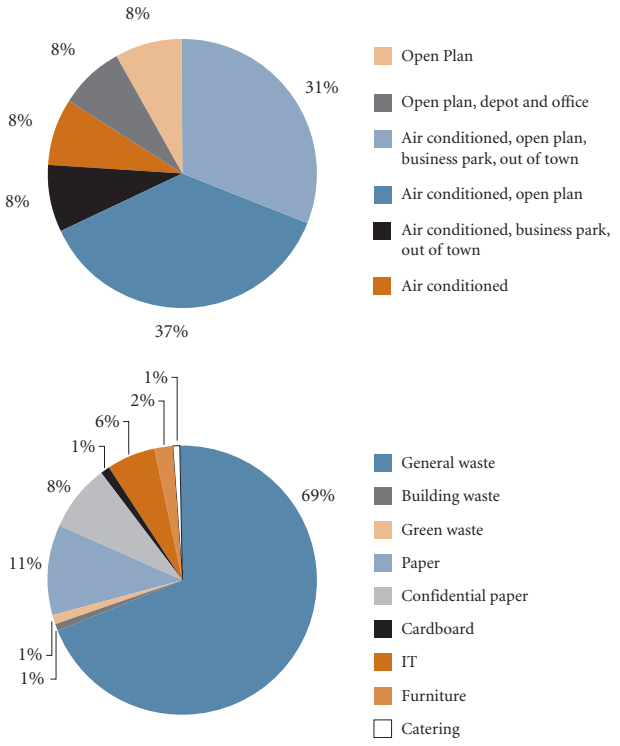
Conclusion

Through this study of representative sites from the insurance, banking, pension fund, tax and accounting sectors, an insight has been gained into patterns and trends in waste generation, management and recycling in general.

Going forward, the type and quantity of waste generated, and the disposal method will be affected by:

- Environmental legislation – a key theme is producer responsibility based on the polluter pays principle
- National waste strategies – the English strategy includes a target to reduce the landfilling of commercial and industrial waste to 85% of 1998 levels by 2005
- The adoption of new distribution channels, such as the internet
- Intense merger, acquisition and disposal activity
- Predicted future growth by non-financial sector parent companies
- Centralised procurement
- Work-life balance resulting in an increased range of services and activities on site

Proportionate share of office type



Recommendations

The number of staff on site determines the amount of waste generated – 'more staff means more waste'.

Increasing staff numbers and reducing floor space increases the amount of paper in the waste stream.

Building design, recycling collection infrastructure, budgets and communication are the main barriers which limit recycling.

Recycling schemes can provide an income and innovative schemes present good PR opportunities.

Extending paper recycling schemes beyond confidential paper is one of the key ways of increasing recycling rates since, taken as a whole, mixed paper, newspapers and magazines accounted for an average of 26% of the waste leaving large offices. White paper accounts for a further 20%.

Examples of good purchasing practice within head offices:

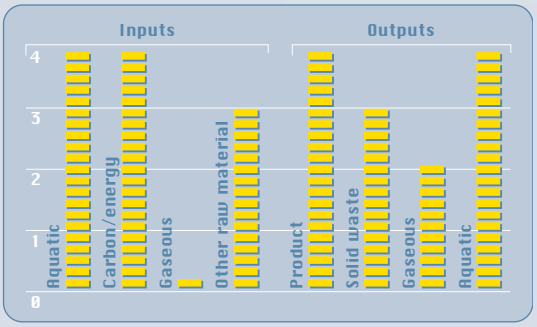
- Environmental criteria are included in purchasing decisions
- Cross-departmental purchasing group addresses the issue of green procurement to reduce impacts through purchasing
- Purchasing data are stored in a detailed manner and are readily available from departments
- Regular communications with suppliers
- Where available and cost effective, products with recycled content are bought as standard

On average 5 reams of paper per employee goes to landfill





Poultry: Resource flow analysis of the British poultry industry





Report type
Sector

Publication date
2006

Environmental body
RAC Environment Ltd

Partners
2 Sisters Food Group, Prosper de Mulder Lloyd Maunder, National Farmers, Union Manor Farm Ducklings, Kelly Turkeys, The Cobb Breeding Company, ABN, BOCM Pauls, Moy Park, British United Turkeys, British Poultry Council

Contact details
Peter Danks
RAC Environment Ltd
Races Farm
Aston Street
Aston Tirrold
Didcot
Oxon
OX11 9DJ, UK

Tel: +44 (0)1235 851515 Fax: +44 (0)1235 851511
Email: race@racesfarm.demon.co.uk

www.massbalance.org

Description

The report follows the developing UK Poultry meat industry from its early stages to the present day, looking at scale, structure and ownership of today's industry and the drivers affecting the sector. It covers the mass balance, quantifying resources and energy flows in the sector in 2002. This covers feed production, all aspects of farming, processing and rendering, together with the linking transport requirements.

The report concludes with a summary of environmental, economic and social issues affecting the sector and anticipates change in these drivers. The conclusions and recommendations look at ways in which the sector might improve its resource use and so increase competitiveness in the global marketplace. The information gathered for this report encompasses the three major aspects of mainstream poultry production (chickens, turkeys and ducks), from the production of feed through the breeding and growing of the stock, to the production of jointed meat products and pet food ingredients.

Structure

- The poultrymeat industry
- History
- The poultrymeat industry today
- Industry drivers
- Legislation affecting poultry enterprises
- The future of the UK poultrymeat industry
- The mass balance
- Industry sectors and the supply chain
- Mass balance outputs
- Ecological Footprint
- Benchmarking the sector
- Environmental issues – current and future
- Economic, market and social issues – current and future

Mass flows

Inputs to the broiler processing sector comprised 1.87Mt live birds, 14.8Mt water, 16.5m^3 chemical and 843GW energy. Key outputs comprised 1.2Mt carcasses, water 7.9Mt water, 25,100t dry waste, 0.14Mt meat wastes, 0.25Mt feathers, 0.33Mt blood and 0.48Mt animal by-products.

Key notes

UK productivity of poultry in 2002 comprised 808 million chickens, 23 million turkeys and 20 million ducks. In total, about ten companies in the UK are each capable of processing more than 20,000 birds a day.

The ecological footprint of energy use in the UK poultry industry is 0.25 ha per tonne of poultry meat produced, a total of 300,542g ha.

Within the UK, the broiler industry is important both socially and economically. Poultry meat accounts for 43% of UK meat consumption and the poultry industry consumes almost one-fifth of the UK's annual wheat harvest.

In the UK, the sector directly employs almost 60,000 people (full and part-time) and probably double that number in related ancillary and supply sectors. In 2002, the retail market value of poultry meat was £2.8 billion.

Concerns

None of the opportunities for improvement in environmental performance identified in the conclusions are likely to happen without the involvement of third parties. Processors of all sizes consider themselves to be in the business of poultry, not waste management or power generation. If changes are to be made, the most successful application is likely to be in new-build projects, not through the retrospective installation of technology in existing plants.

Conclusion

There is some potential for reduction in energy use during feed manufacture, and by production of a ration that would allow zero or minimal use of compounded feedstuffs on farms.

The scope for reduction of environmental impact in the rendering and pet food sectors is limited by the relative simplicity of the process, but opportunities are most likely to arise from energy recovery in rendering plants and the use of relatively low value, dry products for combustion in on-site Combined Heat and Power (CHP) plants, rather than such material being sent to landfill. Immediate savings could be realised through the use of low energy fluorescent light in housing.

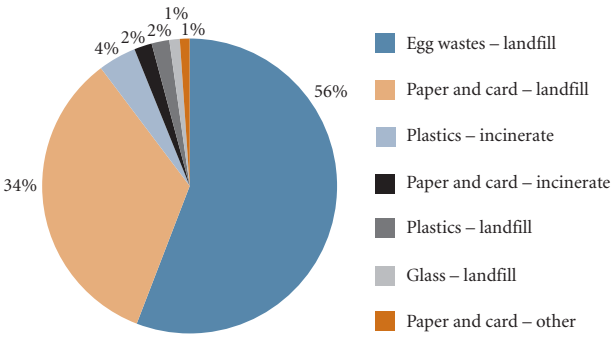
The use of better insulation in older building stock would help to reduce the current need for both heating and cooling at different stages of the production cycle on many UK poultry farms.

Technology to enable the better use of manure from all poultry units as a fertiliser would encourage closed-loop recycling of nitrogen into feedstuffs for use in the sector via agricultural land.

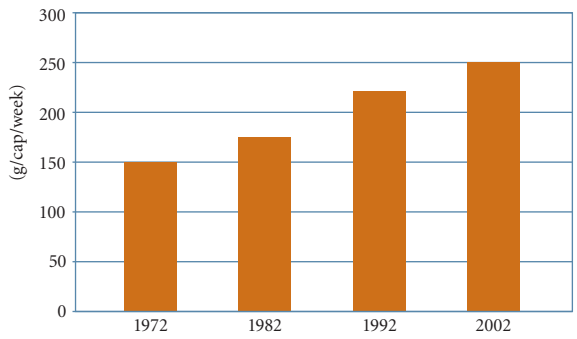
In summary, few improvements can be made in the environmental performance of the sector without significant capital investment. In the current world poultry market, it is unlikely that any such investment will be made in UK operations, in the absence of some form of encouragement.

The UK poultry sector will continue to have a major role as a supplier of high quality food to the nation, but it is very likely that companies will increasingly move live bird production and primary processing to sites overseas, particularly for production of commodity meat for the inclusion in pre-prepared foods, if the differential costs of infrastructure development remain so heavily weighted against the UK.

Breakdown of the waste types arising from the hatchery sector



Increase in chicken consumption in the last 30 years (g per person/per week)

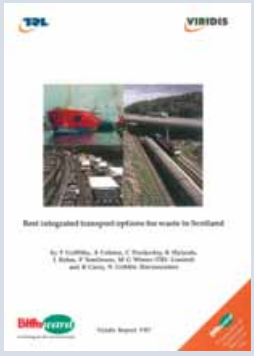


Poultry consume almost

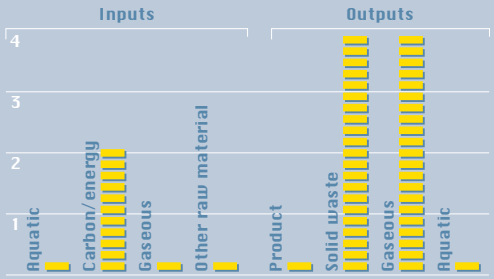
one fifth

of the entire UK wheat harvest





Transport in Scotland: Best integrated transport options for waste in Scotland





Report type
Sector

Publication date
2004

Environmental body
Viridis

Partners
Scottish Environmental Protection Agency (SEPA), TRR

Contact details
TRL Limited
Old Wokingham Road
Crowthorne
Berkshire
RG45 6AU, UK

Tel: +44 (0)1344 773131 Fax: +44 (0)1344 770356
Email: enquiries@trl.co.uk
Website: www.trl.co.uk

www.massbalance.org

Description

The main purpose of this study was to provide a better understanding of the movement of wastes and its effects in Scotland, and to provide guidance that enables the identification of locations for the development of waste management facilities. The ultimate aim of the study is to decrease the impacts from the transport of waste.

Structure

- Issues associated with waste transport
- Planning and policy framework for waste transport
- Characteristics of Scottish waste transport
- Waste transport modelling
- Future scenarios for modal shift of waste

Mass flows

In 2001, 8.91Mt waste was landfilled in Scotland from a population of 5.1 million.

Key notes

Moving from present infrastructure to supersites dramatically improves the economics of transport by modes other than road. When looking at the cumulative cycle of 2002–2020 there is potential for a shift of 25–40% of the total waste transported for rail, and 5–15% of waste transported by water.

Waterway transportation is the most efficient in terms of energy use, with rail averaging 42% more energy use per journey, and road transport averaging approximately 300% more energy use per journey.

Lorries account for 6% of all vehicle kilometres travelled in Scotland, but account for 18% of road deaths.

Gaps

For the model to produce robust results the quality of the waste input data must improve.

Data in Scotland on waste arisings, transport and costs are poor.

Quantification of the potential impacts on employment is beyond the scope of this study.

Concerns

There are no explicit mechanisms by which the transport implications of the waste strategies are captured and incorporated into the appraisal processes.

The impacts of the Landfill Directive with respect to the classification of landfill sites, means that in Scotland, there are no landfill sites earmarked to manage Special Waste as of July 2004. This is having a significant impact on the current behaviour and costs associated with the haulage of such waste.

Conclusion

The results from the cost models suggest that only marginal modal shift is feasible with existing waste infrastructure in Scotland. Between 2002 and 2020, the maximum percentage that can be transferred to rail from road is just 2.3%, while for waterways (canals and coastal shipping) this percentage is only 0.06%. The transfers to rail and water do not bring any benefit in terms of reducing emissions to air. Although the modal potential indicated as a proportion is small it should not be discounted. The savings over a base case of all road transport were in the range of £1–£4.7 million.

Planning policy is driving the following:

- Multi-modal transport solutions
- Modal shift away from road transport
- Achieving economies of scale
- Integrating land use and transport planning

Recommendations

The key transport policy aims in relation to waste transport are:

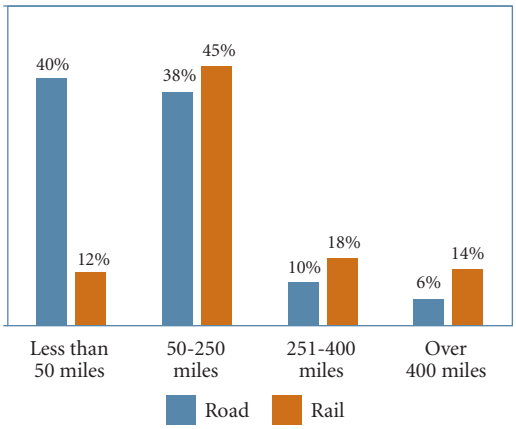
- Decrease environmental impact
- Decrease transport distances
- Investigate alternative transport modes to road
- Work with the location of facilities in terms of land use planning
- Deliver an integrated, multi-modal approach

Scottish Environment Protection Agency (SEPA) should carry out a dedicated national commercial and industrial waste arisings survey similar to those carried out in England, Wales and Northern Ireland.

A 'top-down' review of all wastes by stream, together with proposed sites for waste management should be carried out.

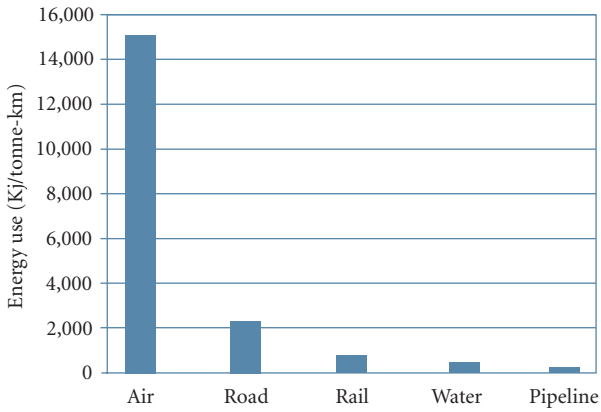
Guidance that exists for the appraisal of waste projects should be revised to explicitly consider the issues explored in this report.

Current transport usage distances for freight carried



Current transport usage distances over which freight is carried – average proportion of road/rail freight carried over specified distances (ORR, 2000)

Energy use for freight transport by mode



Energy use for freight transport by mode (Shipbuilders and Ship-repairers Association, 2000)

Costs of waste transport in Scotland vary from

£1–£1,000+ per tonne

