Client Report :

Updating the BRE Environmental Profiles Methodology: The result for Bricks

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Executive Summary

This report forms the output of the Environmental Profiling work done for the Brick Development Association (BDA). The report provides a description of the update of the Environmental Profiling methodology, provides the Environmental Profiles for average bricks and provides an analysis of the environmental performance of the product together with a comparison of the data set submitted in 1997. Both datasets are calculated according to the new 2007 methodology.

Table 1 below shows the summary Ecopoint scores for average bricks on a per tonne basis.

Table 1. Product Specification Ecopoint per tonne scores for Average Bricks.

Product Specification	1997 data calculated to 2007 Methodology Ecopoints	2005 data calculated to 2007 Methodology Ecopoints
Average Bricks (Cradle to Gate)	1.71	1.07
Transport to Site	N/A	0.08
End of Life Disposal Construction/Refurbishment/Demolition		0.21/0.21/0.21

There has been an overall reduction in the environmental impact for the average brick, measured in Ecopoints generated with the 2007 methodology.

In particular, there has been an overall reduction in the impacts associated with minerals resource depletion and climate change. This is attributed to the slight decrease in the quantity of minerals per tonne used for the product and an increase in the use of alternative / waste materials. In terms of energy consumption, there has been an overall decrease in the use of natural gas and electricity, which is attributed to the reduction in climate change impact.

This data is provided to BDA to enable them to approve the use of their data in the forthcoming Green Guide to Specification and the UK Database of Environmental Profiles.

Contents

Introduction

This report provides a comparison of the Environmental Profiles of average bricks produced using the previous edition of the BRE Environmental Profiles methodology (hereafter referred to as 'old' data) and those produced for the 2007 edition ('new' data).

The aim of this report is to provide sufficient information to enable those involved with the production of this data to understand how their old generic data-sets compare to their new generic data-sets. Based on the data provided in this report, BRE hope that the new Environmental Profile(s) will be approved by the suppliers of this data for use within the next version of the Green Guide to Specification.

To enable a comparison to be made between the old and new data, the old generic data-sets are updated with the new inventory models (for e.g. electricity) and both data sets are analysed to the new methodology. This means that any differences between the two data sets are due to changes in the inputs and outputs of the generic model

The report is divided into four sections:

S**ection 1: The Updated Methodology** - this section of the report provides a review of the background to the new methodology. It explains who was involved in preparing the new methodology, a description of the key sections that have changed and a reminder of the documentation that already exists and has been approved during the update process.

Section 2: Creating the Generic Environmental Profile – a description of the sources of the data used in creating the new Environmental Profiles.

Section 3: **The Environmental Profiles –** this section of the report highlights the main differences between the old and new data provided and provides a brief commentary on the results.

Annexes - this section contains the full list of inventory data assumptions and both old and new per tonne Environmental Profiles.

Section 1 – The Updated Methodology

This section of the report provides a review of the background to the new methodology.

Preparing the Methodology

The Life Cycle Assessment methodology used for Environmental Profiles has been peer reviewed and complies with ISO FDIS 21930, the forthcoming standard for analysing the environmental impacts of construction products. The peer review process was conducted by a team of experts in LCA and building materials, headed by Wayne Trusty, Director of the Athena Institute in Canada.

BRE devised the original methodology in partnership with Government and 24 Trade Associations from the Construction Products sector to provide a single, consistent approach for applying LCA to all types of construction products. The recent update was undertaken under the auspices of the BRE Certification's Sustainability Board and through extensive stakeholder consultation. Within the Construction Products Association, a Construction Products Association Manufacturers Advisory Group (CPA-MAG) was established with the specific remit to contribute to the development of the methodology and the revision of the Green Guide to Specification.

The group comprised of representatives from each of the major sectors. Ieuan Compton of Kingspan insulation was the Chair and the Secretariat was undertaken by Jane Thornback, Environmental Policy Advisor, Construction Products Association. (Table 2).

Table 2 Original membership of the Construction Products Association Manufacturers Advisory Group

1. Miles Watkins, Aggregate Industries 2. Ian Stares, Baxi Potterton 3. Tom de Saulles, British Cement Association 4. John Nelson, BPB 5. Mercia Glick, British Plastics Federation 6. Christopher Stride, BPF EPS Construction Group 7. Martin Clarke, British Precast Concrete Federation 8. John Garbutt, BRUFMA 9. John Hedgecock, British Woodworking Federation 10. Andrew Gill, Celotex 11. David Westburgh, Corus Construction 12. Nick Avery, Corus R&DT 13. Justin Ratcliffe, Council for Aluminium in Building 14. Denis Higgins, CSMA 15. Sophie Read, Egger (UK) Ltd 16. Peter Trew/Mark Harris, EPIC 17. Carol Houghton, Eurisol 18. Adrian Bold, Knauf	19. Paul Franklin, Flat Roofing Alliance 20. Peter Stuttard, Glass & Glazing Federation 21. Peter Hazael, H+H Celcon 22. Ray Doughty, Hepworth Building Products 23. Martin Althorpe, H W Plastics / BPF – Windows 24. Ieuan Compton – Chairman Kingspan Insulation 25. Rebecca White, Marley Building Materials 26. Stuart Bell, Marshalls 27. Pete Thomas Tarkett, Marley Floors 28. John Hannah, Quarry Products Association 29. Nick Ralph, Rockwool 30. Andrew Schofield, Roof Block 31. Mark Harris, Sarnafil 32. Gunther Hentschel, Timber Trade Federation 33. David Duke-Evans, Wood Panel Industries Federation 34. Rita Singh, Construction Products Association 35. Kristian Steele, BRE 36. Paul Thistlethwaite, BRE

BRE consulted with the CPA-MAG on a range of project related items. Detailed Briefing Notes were issued by BRE to inform industry of BRE's intended approach and expected conclusions. This process enabled the industry to consider potential implications and provide the basis for their input to the project.

Separate consultative Briefing Notes were produced for the following topics:

1. Scope of Green Guide Review & Role of CPA-MAG and Project Steering Group
2. Green Guide: Format and content
3. Environmental Profiles: LCA methodology
    a. Characterisation
    b. Normalisation
    c. Weighting
4. Specifications
5. Energy model
6. Whole life performance
7. End-of-life and waste models
8. Existing LCA Data and update requirements

Briefing Notes were disseminated to the following stakeholders:

• CPA-MAG, along with Construction Products Association members

• Trade Associations which are not affiliated to the Construction Products Association

• Industry participants in the BRE Environmental Profiles Certification Scheme.

The Briefing notes were re-issued and modified where appropriate following the consultation process. The original Briefing Notes and subsequently agreed texts are available at http://www.bre.co.uk/greenguide

The new methodology document will be published later in 2007.

The New Methodology.

Significant changes have been made to the methodology for the 2007 update:

Impacts included in a Profile: The 13 parameters of an Environmental Profile have changed: Nuclear Waste has been added. Transport has been removed and the toxicity impact categories have been revised.

Characterisation Factors: The University of Leiden has issued revised Characterisation factors and these have been adopted. This means that the method for comparing the environmental impact of inputs and outputs has changed and that the impacts ascribed to the use of some resources and emissions have changed. Some will be higher, others are now lower, some impacts remain the same and some are no longer relevant. Briefing Note 3a provides full details.

Normalisation Factors: Previously, impacts from construction products were compared to the impact of one UK citizen. In the 2007 methodology the impacts are compared to those of one European citizen.

Weightings: A new weighting study was conducted using the opinions of environmental experts and this resulted in the production of a new set of weightings for the 13 environmental impacts presented in an Environmental Profile. Climate change remained the most important impact but the relative positions of other impacts has altered. New weightings and the background to their development have been described in BRE Information Paper IP4/07, Environmental weightings - their use in the environmental assessment of construction products.

Energy Model: New energy models are in place using data from ecoinvent (www.ecoinvent.com), which offer a comprehensive picture of the impacts associated with energy generation.

Whole life performance: new replacement rates have been applied.

End-of-life and waste models: the latest data has been applied to create new models for the proportions of material sent to different routes: landfill, incineration, reuse or recycling.

LCA Data: new inventory data for construction products has been gathered from UK Trade Associations and upstream data from ecoinvent has been adopted. This means, for example, the impact of using Hydrochloric Acid may now be different because we have identified a better set of data about its' manufacture.

Section 2: Creating the Generic Environmental Profile

The Briefing Notes provide details of the basic approach used in the creation of an Environmental Profile. This section of the report explains the models and data used in the creation of the Generic Environmental Profile for average brick.

The data has been prepared based on the data provided by the BDA. Data were supplied to the trade Association by the manufacturers listed below:

- Wienerberger Ltd, Stubbers Green
- Wienerberger Ltd, Windmill Lane
- Ibstock Brick Ltd, Dorket Head Factory
- Ibstock Brick Ltd, Parkhouse Factory
- Ibstock Brick Ltd, Laybrook Factory
- The York Handmade Brick Co Ltd, Forest Lane
- Freshfield Lane Brickworks Ltd, Freshfueld Lane
- Baggeridge Brick, Hartlebury 1
- Baggeridge Brick, Hartlebury 2
- Hanson Building Products, Clockhouse Brickworks
- Hanson Building Products, Howley Park Works
- Hanson Building Products, Heath Road

A full copy of the data assumptions made in preparing the LCA have been listed by BRE and is provided in Annex 1.

For completeness, two further assumptions are recorded here: transport for factory to site and the end of life model.

Transport from Factory to Site

Manufacturers are asked to provide data on the typical methods of transport of the product to the site. This includes distance travelled, vehicle type and average load and return load if any. In the absence of this

information, then BRE use default data provided by the Department for Transport from the continuing Survey of Roads Goods Transport[1].

To create this Environmental Profile, BRE used transport data provided by the BDA members. The Ecopoint score associated with the transport from factory to site model is 0.08 Ecopoints:

Waste Disposal/End of Life Model

A disposal route model has been produced by BRE's Centre for Resource Efficiency consisting of the percentage of material sent to each disposal route (landfill, incineration, recycling and reuse). Where relevant, they are also specific to construction waste, refurbishment waste and demolition waste. These models are used to calculate the relevant impacts of the disposal route using data from the ecoinvent database. Tailored models are created where evidence is available for particular disposal practices.

The model for the creation of the Generic Environmental Profile is presented here.

Construction Waste

% to Landfill	10%
% to Incineration	0%
% to re-use or recycling	90%
Ecopoints	0.21

Refurbishment Waste

% to Landfill (inert/non-hazardous/hazardous)	10%
% to Incineration (hazardous/non-hazardous)	0%
% to re-use or recycling	90%
Ecopoints	0.21

[1] typical load and haul data for 2005 calculated for common commodities used in construction and product manufacture from an extract from the Continuing Survey of Road Goods Transport provided to BRE by the Department for Transport in a personal communication (21.11.2006).

Demolition Waste

% to Landfill	10%
% to Incineration	0%
% to re-use or recycling	90%
Ecopoints	0.21

It should be noted that the cradle to gate Ecopoint scores provided within this report do not include the Ecopoints associated with the transport of materials from factory to site, or end of life impacts.

Section 3: The Environmental Profiles

To present the comparison data in this report, BRE analysed the process occurring in the factory and the impacts of extracting, manufacturing and transporting the raw materials (the 'cradle to gate' phase) to explore the relative impacts of different products and the process to manufacture 1 tonne of the product.

This was performed for both old and new data sets.

Individual data sets were provided by the BDA members and BRE have combined these datasets to provide a single average brick Profile using a mass weighted average provided by the BDA as representative of the industry (see annex A). BRE have used this data as provided by the members and have not added any adjustment factors to the datasets.

Four charts are shown below. All of the breakdowns are provided on a per tonne basis. The charts are as follows:

- Figure 1: Ecopoint Comparison (Ecopoint per tonne)
- Figure 2a & 2b: Inputs into the process by proportion of mass (tonnes/tonne).
- Figure 3a & 3b: Inputs into the process by proportion of impact (Ecopoint/tonne).
- § Figure 4: Comparison of Ecopoint breakdown by issue (Ecopoint/tonne).

Preceding the graphical reports, a short paragraph summarises the findings.

The full Environmental Profiles for new and old data are presented in Appendices 2 and 3.

Figures 1 – 4 provide analysis of 1 tonne of average brick.

The findings show that the average brick has an improved environmental performance compared to the 1997 dataset (Figure 1). A number of issues have been reviewed to understand the reason for the improved performance of the average brick.

Firstly, the quantity of input materials used per tonne of product has been considered (Figures 2a &2b). This information shows that a larger quantity of materials are quarried on site for the 2005 datasets, and also an increased quantity of alternative / waste materials are being used, such as PFA / Town ash. This information is also presented within Table 3.

Looking in detail at the datasets, Figure 3a & 3b shows that the inputs accounting for the greatest proportion of impact are similar. For the 1997 dataset, this is associated with the use of clay / marl (quarried off-site) and fuel use. For the 2005 dataset, the minerals quarried on-site, i.e. clay / marl and fuel use also account for the largest impact.

For both the old and new datasets, the largest impacts on the environment from the production of average bricks is from minerals resource depletion and climate change (Figure 4). Both the minerals resource depletion and climate change have decreased for the 2005 dataset. Table 4 shows that there has been a

reduction in the quantity of minerals extracted compared to the 1997 dataset, while Table 2 also shows a reduction in the quantity of electricity and natural gas consumption.

Table 3. Inputs per tonne of average bricks

Input Material	Unit	1997 Dataset	2005 Dataset
Minerals (i.e. materials quarried on-site, clay, sand, aggregates, etc)	tonne / tonne	1.18	1.09
Other materials (i.e. Town Ash, Barium Slop, stains, etc)	tonne / tonne	0.0014	0.015
Packaging	tonne / tonne	0.003	0.002

Table 4: **Energy consumption for average bricks.**

Fuel	Unit	1997 Data	2005 Data
Electricity	MJ / tonne	193	160
Natural Gas	MJ/tonne	1997	1709

Ecopoint Scores

The table below provides the cradle to gate Ecopoint scores for a tonne of average brick.

Table 5: Product Specification Ecopoint scores for Average Brick

Product Specification	**1997 data calculated to 2007 Methodology Ecopoints (Cradle to Gate)**	**2005 calculated to 2007 Methodology Ecopoints (Cradle to Gate)**
Average Bricks	1.71	1.07

It should be noted that the cradle to gate Ecopoint scores provided within this report do not include the Ecopoints associated with the transport of materials from factory to site, or end of life impacts.

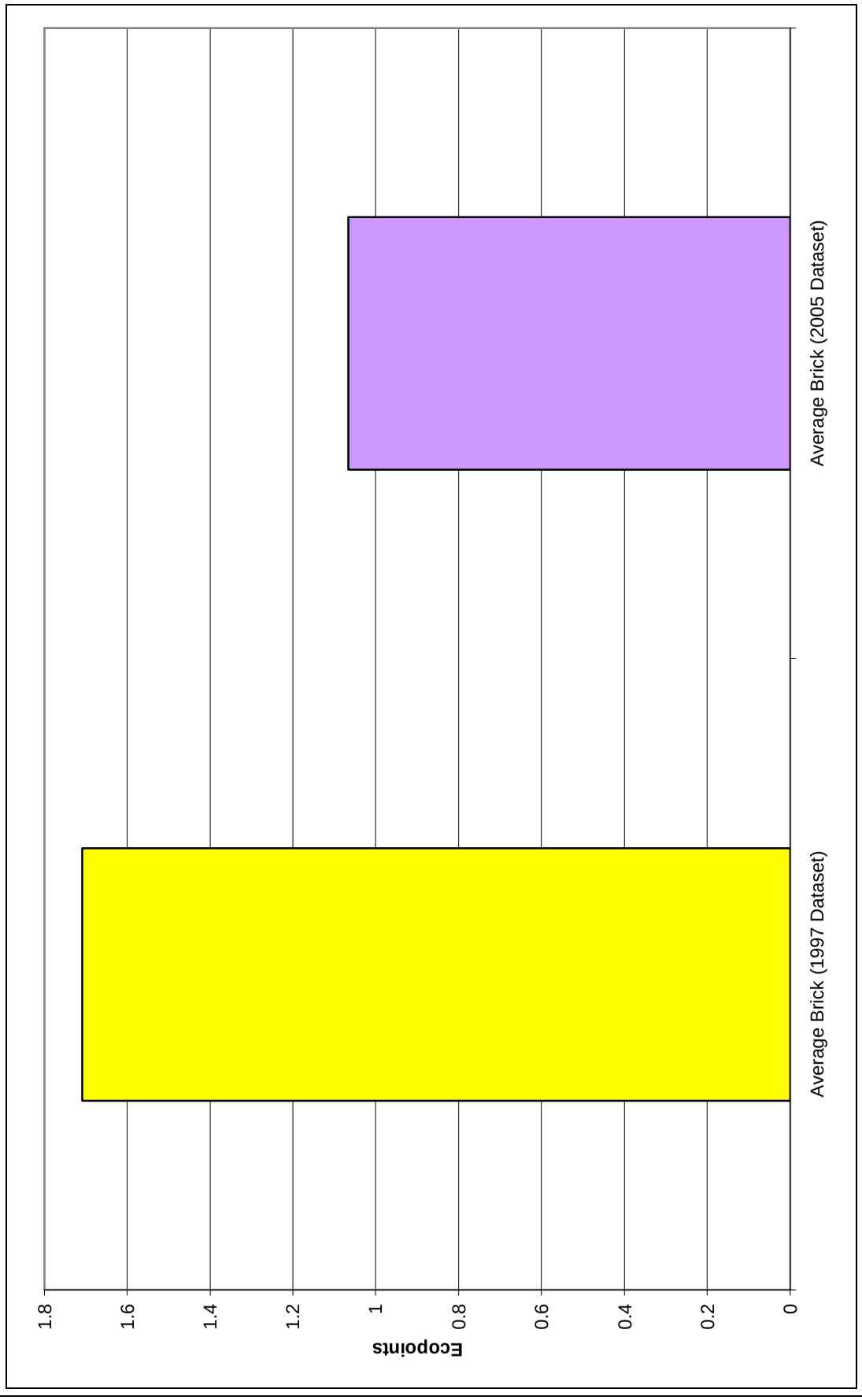

Figure 1: Ecopoint Comparison (Ecopoint per tonne)

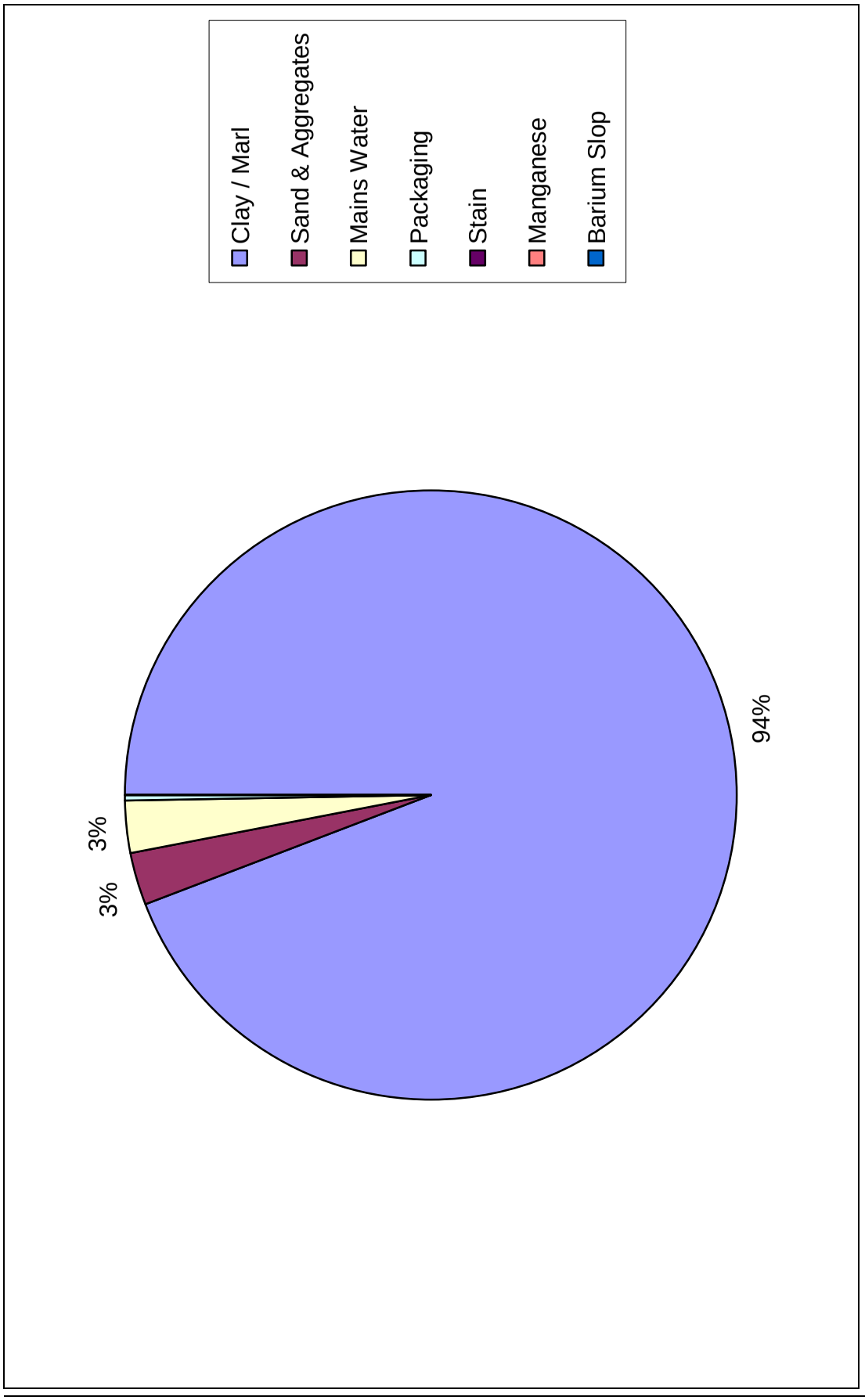

Figure 2a: 1997 Dataset - Inputs into the process by proportion of mass (tonnes/tonne).

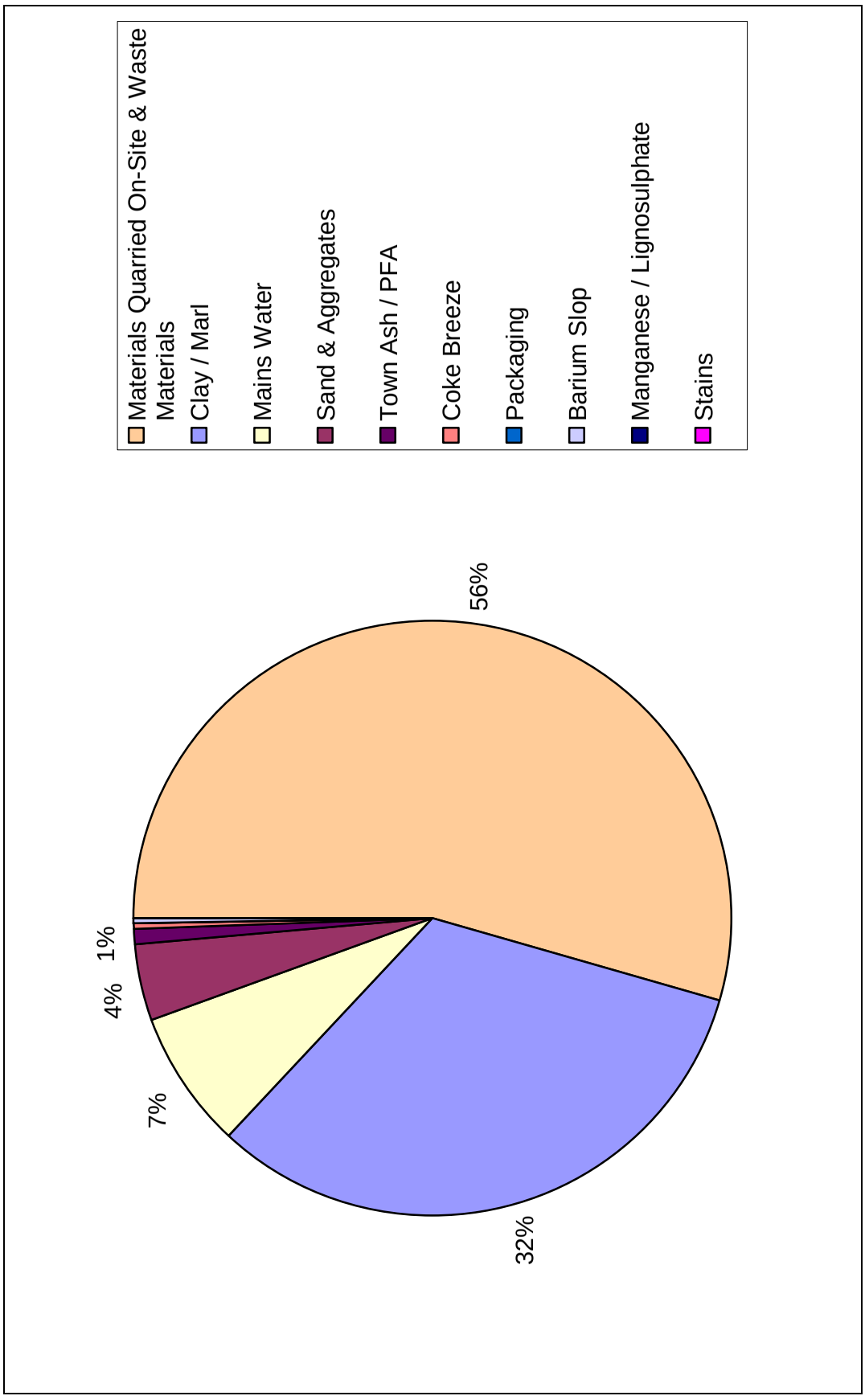

Figure 2b: 2005 Dataset - Inputs into the process by proportion of mass (tonnes/tonne).

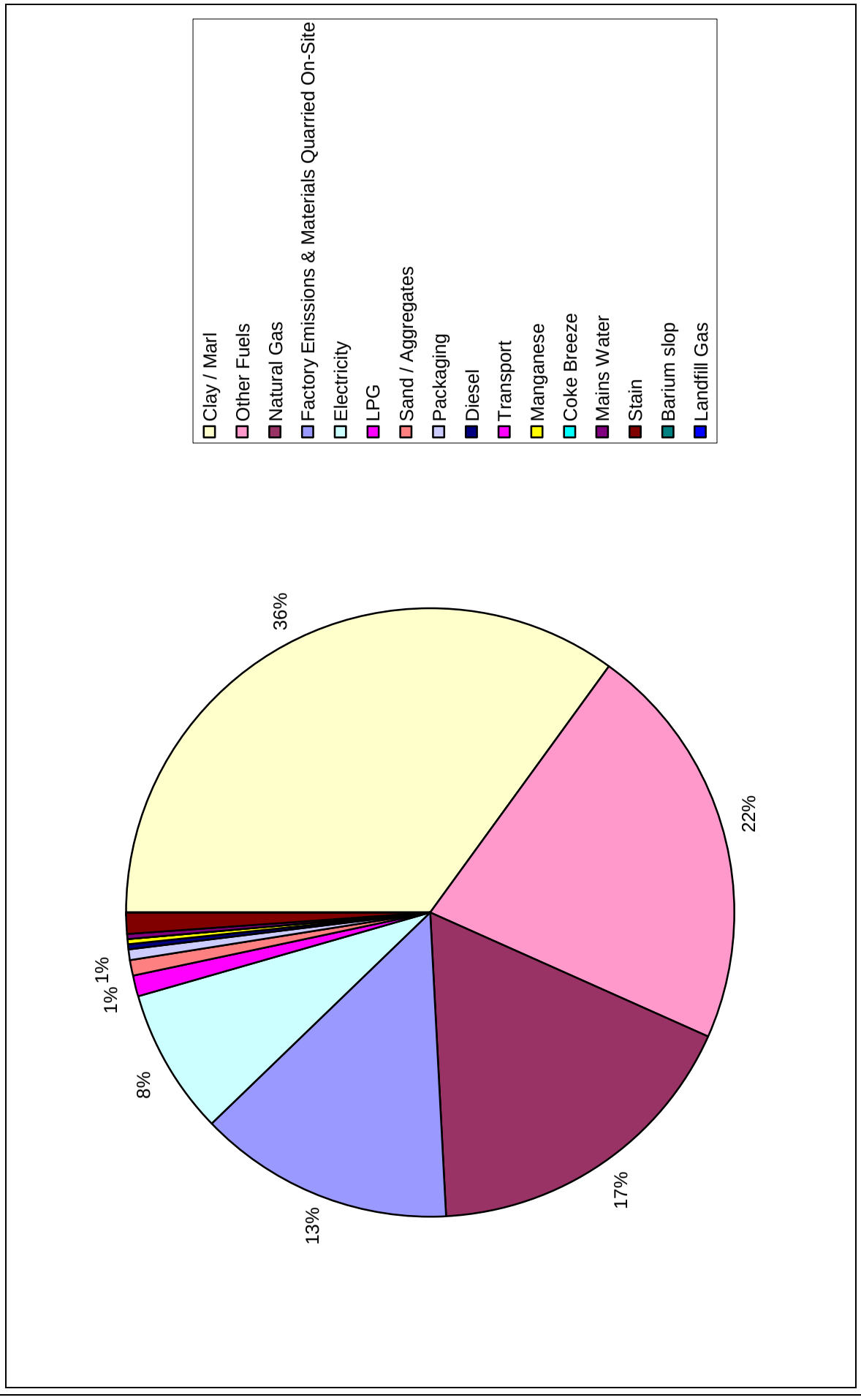

Figure 3a: 1997 Dataset - Inputs into the process by proportion of impact (Ecopoint/tonne).

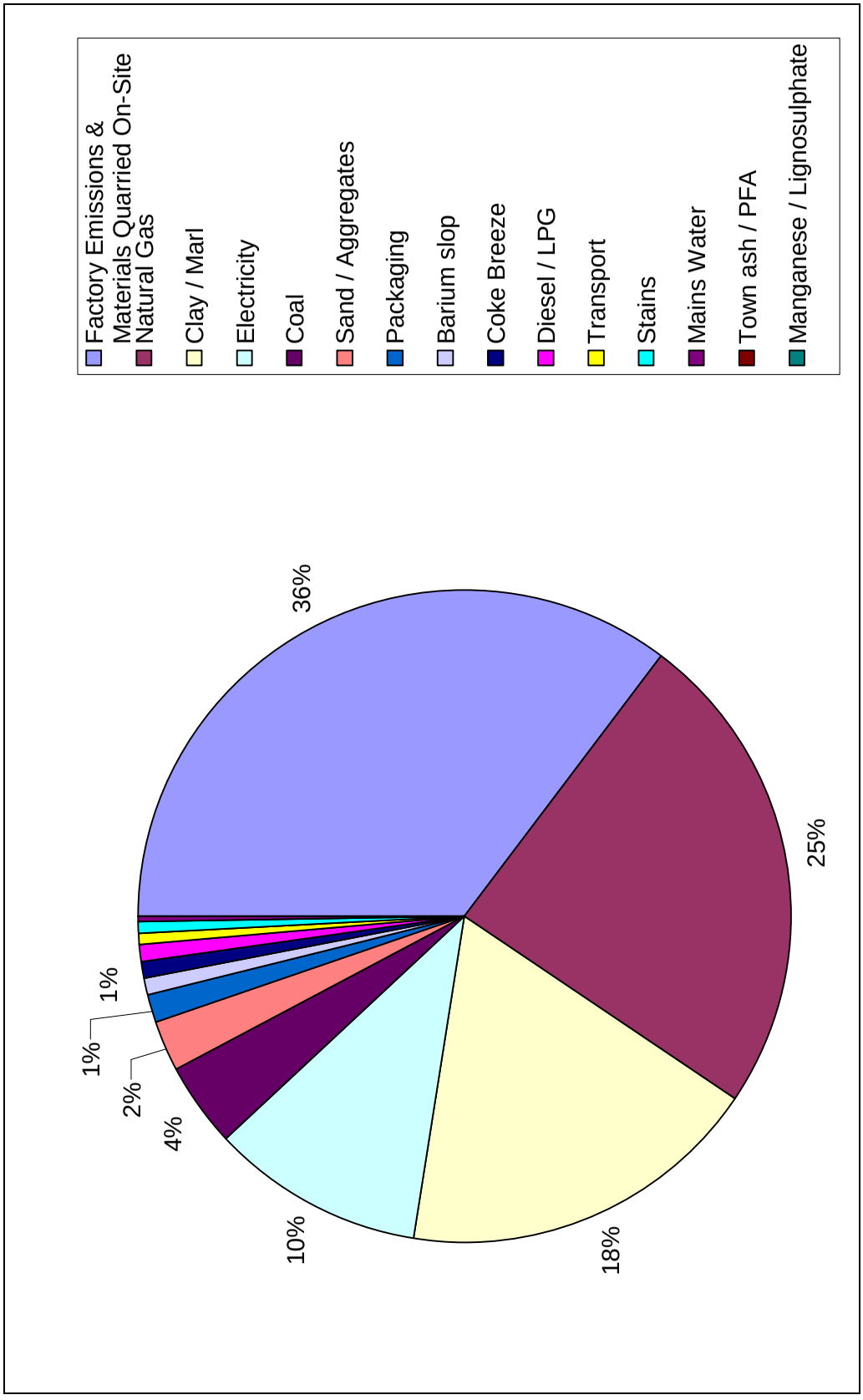

Figure 3b: 2005 Dataset - Inputs into the process by proportion of impact (Ecopoint/tonne).

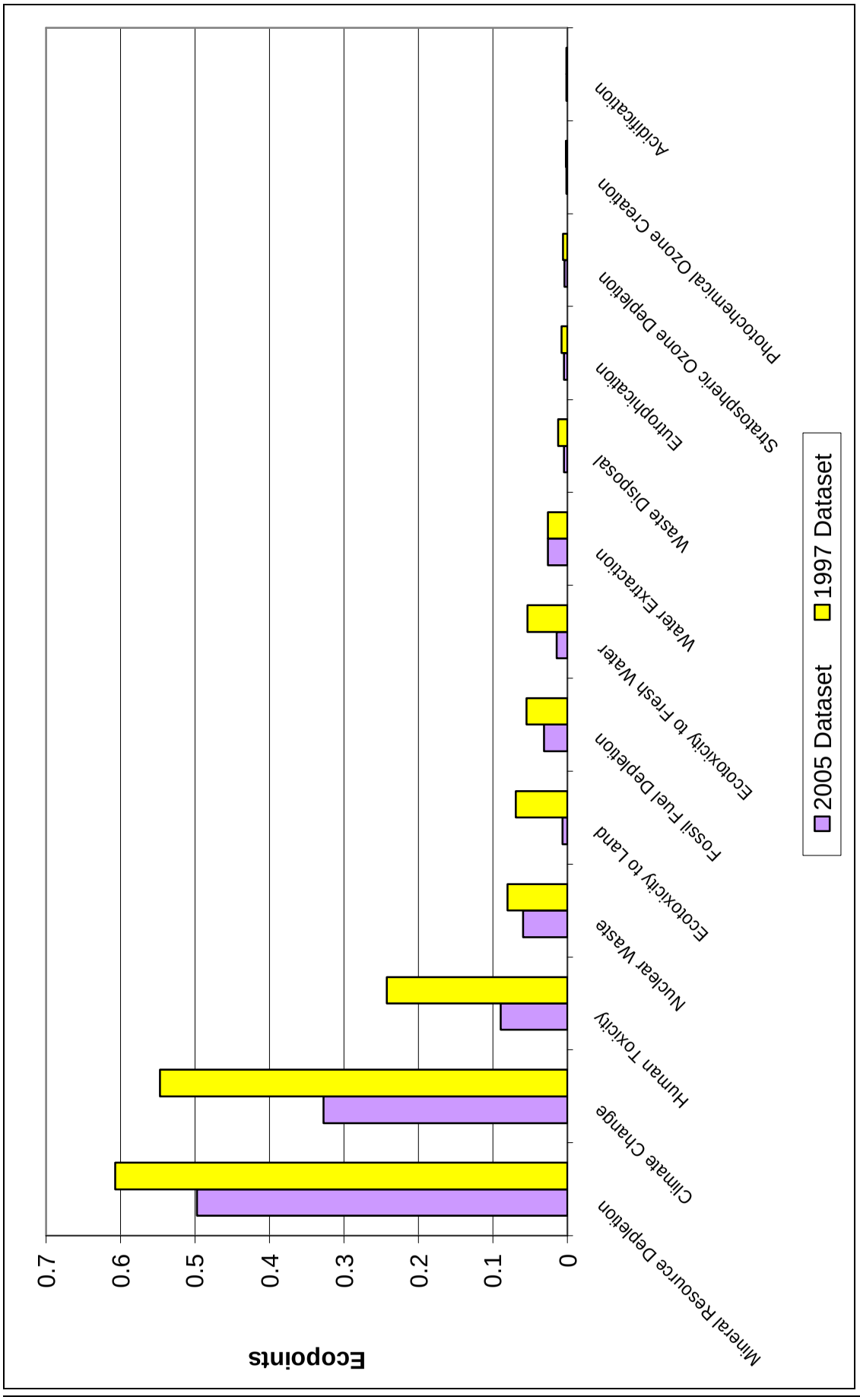

Figure 4: Comparison of Ecopoint breakdown by issue (Ecopoint/tonne).

Conclusion and Next Steps

This report compares the Environmental Profiles of old and new data sets prepared for the BDA. There has been an overall reduction in the environmental impact for the average brick, measured in Ecopoints generated with the 2007 methodology.

For the product, there has been an overall reduction in the impacts associated with minerals resource depletion and climate change. This is attributed to the slight decrease in the quantity of virgin minerals per tonne used for the product and an increase in the use of alternative / waste materials. In terms of energy consumption, there has been an overall decrease in the use of natural gas and electricity, which results in the reduction in climate change impact.

On the basis of the data presented in this report, BRE requests approval for the use of the new data for average brick in the UK Environmental Profiles Database and the forthcoming edition of the Green Guide to Specification.

Annex 1 : Data Assumptions for the creation of the Generic Environmental Profiles

<table>
<tr><th>Questionnaire Section</th><th>Data Figures</th><th>Data Assumptions / Conversion Figures / Sources</th><th>LCI Data Source</th></tr>
<tr><td>General</td><td colspan="3">The individual brick datasets have been combined to create an average brick Profile using the percentages below:

<table>
<tr><th>Brick Type</th><th>Kiln</th><th>Tonnes</th><th>Allocation</th></tr>
<tr><td>Wire cut ext</td><td>continuous</td><td>3,961,864</td><td>68.7%</td></tr>
<tr><td>Soft mud</td><td>continuous</td><td>1,336,815</td><td>23.2%</td></tr>
<tr><td>Wire cut ext</td><td>intermittent</td><td>123,596</td><td>2.1%</td></tr>
<tr><td>Soft mud</td><td>intermittent</td><td>256,411</td><td>4.4%</td></tr>
<tr><td>Handmade SM</td><td>intermittent</td><td>66,395</td><td>1.2%</td></tr>
<tr><td>Handmade ext</td><td>intermittent</td><td>24,312</td><td>0.4%</td></tr>
</table></td></tr>
<tr><td>LCI Models</td><td colspan="3">The following LCI models have been used within the creation of the brick Profile:

<u>Raw Materials</u>
• Sand / Aggregates: Manufacturer data supplied by the Quarry Products Association
• Clay: Clay, at mine/CH U
• Materials Quarried on Site: BRE Minerals Extraction
• Barium Slop: Barite, at plant/RER U
• Manganese / lignosulphate: Manganese, at regional storage/RER U
• Stain: Iron oxide pigment – manufacture data

<u>Utilities</u>
• Electricity, medium voltage, at grid/GB U
• Natural gas: Natural gas, burned in boiler modulating <100kW/RER U
• Mains Water: Tap water, at user/RER U
• Diesel: Diesel, burned in building machine/GLO U

<u>Packaging</u>
• Shrink wrap: Packaging film, LDPE, at plant/RER U
• Plastic banding: Polypropylene, granulate, at plant/RER U
• Wooden Pallets: BRE converted EUR-flat pallet/RER U</td></tr>
<tr><td></td><td colspan="3"></td></tr>
</table>

Annex 2 – Environmental Profile: Characterised and normalised data for 1 tonne of Average Brick: Old Data

Approved Environmental Profile

Characterised and Normalised Data for 1 tonne of:

Average Brick - 1997 Data

Quality of Data for Profiled Material (Data for other constituent materials are available from BRE)

Start Date	**01 January 1997**
End Date	**31 December 1997**
Source of Data	**BDA**
Geography	**UK**
Representativeness	**100% of Industry**
LCA Methodology	**BRE Environmental Profiles 2007**
Allocation	**100% to Product**
Date of Data Entry	**01 October 2007**
Boundary	**Cradle to Gate**
Comments	

Issue	Characterised Data	Unit
Global Warming (GWP100)	310	kg CO_2 eq. (100yr)
Water Extraction	0.84	m^3
Minerals Extraction	1.5	tonnes
Ozone Depletion	0.00013	kg CFC11 eq.
Human Toxicity	550	kg 1,4-DB eq.
Freshwater Aquatic Toxicity	8.2	kg 1,4-DB eq.
Nuclear Waste	0.00000023	m^3 high level waste
Terrestrial Ecotoxicity	1.1	kg 1,4-DB eq.
Waste Disposal	6.1	kg
Fossil Fuel Depletion	4600	MJ
Eutrophication	0.081	kg PO_4 eq.
Photochemical Oxidation	0.19	kg ethene eq.
Acid Deposition	1.6	kg SO_2 eq.

Issue	Normalised Data	Western European Citizen's Impacts
Global Warming (GWP100)	0.025	12300 kg CO_2 eq. (100yr)
Water Extraction	0.0022	378 m^3
Minerals Extraction	0.062	24.4 tonnes
Ozone Depletion	0.0006	0.217 kg CFC11 eq.
Human Toxicity	0.028	19700 kg 1,4-DB eq.
Freshwater Aquatic Toxicity	0.0062	1320 kg 1,4-DB eq.
Nuclear Waste	0.0098	2.37E-05 m^3 high level waste
Terrestrial Ecotoxicity	0.0086	123 kg 1,4-DB eq.
Waste Disposal	0.0016	3750 kg
Fossil Fuel Depletion	0.017	273 GJ
Eutrophication	0.0025	32.5 kg PO_4 eq.
Photochemical Oxidation	0.0089	21.5 kg ethene eq.
Acid Deposition	0.023	71.2 kg SO_2 eq.

BRE Ecopoints Score	**1.7**	Ecopoints

Annex 3 – Environmental Profile: Characterised and normalised data for 1 tonne of Average Brick: New Data

Approved Environmental Profile

Characterised and Normalised Data for 1 tonne of:

Average Brick - 2005 Data

Quality of Data for Profiled Material (Data for other constituent materials are available from BRE)

Start Date	**01 January 2005**
End Date	**31 December 2005**
Source of Data	**BDA**
Geography	**UK**
Representativeness	**100% of Industry**
LCA Methodology	**BRE Environmental Profiles 2007**
Allocation	**100% to Product**
Date of Data Entry	**01 October 2007**
Boundary	**Cradle to Gate**
Comments	

Issue	Characterised Data	Unit
Global Warming (GWP100)	190	kg CO_2 eq. (100yr)
Water Extraction	0.84	m^3
Minerals Extraction	1.2	tonnes
Ozone Depletion	0.000092	kg CFC11 eq.
Human Toxicity	200	kg 1,4-DB eq.
Freshwater Aquatic Toxicity	2.2	kg 1,4-DB eq.
Nuclear Waste	0.00000017	m^3 high level waste
Terrestrial Ecotoxicity	0.097	kg 1,4-DB eq.
Waste Disposal	2.2	kg
Fossil Fuel Depletion	2600	MJ
Eutrophication	0.047	kg PO_4 eq.
Photochemical Oxidation	0.11	kg ethene eq.
Acid Deposition	1.4	kg SO_2 eq.

Issue	Normalised Data	Western European Citizen's Impacts
Global Warming (GWP100)	0.015	12300 kg CO_2 eq. (100yr)
Water Extraction	0.0022	378 m^3
Minerals Extraction	0.051	24.4 tonnes
Ozone Depletion	0.00042	0.217 kg CFC11 eq.
Human Toxicity	0.01	19700 kg 1,4-DB eq.
Freshwater Aquatic Toxicity	0.0017	1320 kg 1,4-DB eq.
Nuclear Waste	0.0073	2.37E-05 m^3 high level waste
Terrestrial Ecotoxicity	0.00079	123 kg 1,4-DB eq.
Waste Disposal	0.00058	3750 kg
Fossil Fuel Depletion	0.0095	273 GJ
Eutrophication	0.0015	32.5 kg PO_4 eq.
Photochemical Oxidation	0.0051	21.5 kg ethene eq.
Acid Deposition	0.019	71.2 kg SO_2 eq.

BRE Ecopoints Score	**1.1**	Ecopoints