Application of Life Cycle Assessment to Investigate Options for Disposal and Processing of End of Life Vehicles in 2015

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Statement of Use
A comparison of the environmental inputs and outputs, and associated environmental impacts of End of Life Vehicle (ELV) processing in 2015, according to recycling and recovery targets set out in the European Commission proposal 11034/971 (1997), the 1995 ACORD Implementation Plan and achieved using 1997 practices in the United Kingdom.

Key words
Life Cycle Assessment, LCA, End of Life Vehicles, ELV, Life Cycle Inventory, Recycling, Waste Disposal.

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EXECUTIVE SUMMARY

Introduction

In March 1997, the Environment Agency of England and Wales and the Department of Trade and Industry commissioned Ecobalance UK to use a life cycle approach to assess options for processing and disposal of end of life vehicles (ELVs). The options that were considered were:

- Practices that were current at the time the study was undertaken in 1997, applied to 2015;
- Reuse, recycling and recovery targets for 2015 (82% reuse and recycling, 18% to incineration with energy recovery, of which 5% is disposed as ash residuals) set out in a plan produced in 1995 by a UK industry group called ACORD (the Automotive Consortium on Recycling and Disposal). This plan provided much of the basis for the 1997 ACORD voluntary agreement;
- The reuse, recycling and recovery targets for 2015 (85% reuse and recycling, 10% energy recovery and 5% landfill) as set out in the draft EC ELV Directive 11034/971, produced in 1997.

At the time the study commenced, an earlier draft of the EC ELV Directive was also modelled that set a reuse and recycling target of 90%, energy recovery target of 5% with the remainder of material going to landfill.

Since this work was completed, the finalised EC ELV Directive has been published in the Official Journal on 21 October 2000 as *Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on End of Life Vehicles.* Please note that this finalised version of the ELV Directive differs in some respects from the version that forms the basis for this work (albeit the reuse, recycling and recovery targets contained in this version are unchanged from those in the 1997 draft version 11034/971).

The work reported here represents findings based on data and assumptions that were available and reasonable at the time the study was carried out. No attempt has been made to update assumptions and data values, or revise modelled scenarios, in the light of more recent data and knowledge gained in the intervening time, since this is outside the scope of this work. Any conclusions are made on the basis of these scenarios, data and assumptions.

Once vehicles become ‘end of life’ they (generally) undergo the following ‘disposal’ route:

- If the vehicle can still be driven, then it is usually driven to a vehicle dismantler who will pay for the vehicle. Alternatively the vehicle may be towed, either privately or by the dismantler.
- Materials and parts e.g. tyres, batteries are removed provided it is financially worthwhile to do so. Parts may be cleaned for resale and materials are separately collected.

- Materials collected by the dismantler are periodically collected and transported to an appropriate facility for further processing and treatment, e.g. smelter, where secondary material is produced for sale.
- The dismantled ELV may be crushed using a number of methods, these being shearing, baling or flattening. Such activities may occur at the dismantler or at a dedicated site (a scrapyard or feeder site).
- Ultimately, the ELV ends up at a shredder, a mechanical device which breaks the vehicle into small pieces that are subsequently divided and sorted into ferrous metal, a heavy fraction (non ferrous metal (NFM) fraction) and light fraction (fluff).
- The ferrous fraction is relatively pure, having been removed from other material using magnetic separation after shredding. It is transported for further processing in an electric arc furnace, either in the United Kingdom or overseas, where it is made into a secondary material for resale.
- The NFM fraction consists of aluminium, lead, copper, zinc, etc as well as glass, rubber and some plastics. It is transported to a heavy media separation plant (HMSP) for further processing. This plant separates out non ferrous metals from other material (plastics, etc) on the basis of differences in density. All separated metals are then transported for further processing overseas.
- After separation of the NFM fraction, the remaining material is known as 'fluff' and typically consists of dirt, rubber, light plastics and fabrics. Currently, the fluff fraction is transported to landfill although in the future, it is envisaged that the fluff fraction may undergo some form of further processing to recover, for example, plastics for recycling or energy recovery in a cement kiln, municipal solid waste (MSW) incinerator or blast furnace.

The life cycle approach used in this study is a pragmatic application of life cycle assessment (LCA) that employs a *gate to grave* system boundary and uses the system boundary expansion methodology to ensure functional equivalence between options, i.e. the comparison between options is made on a 'level playing field'. The reference flow for the study, which forms the basis for comparison between the different options, is one generic ELV.

The composition of the generic ELV was obtained using data supplied by major vehicle manufacturers making cars representing 40% of the UK car parc in 1996, based on registration statistics for that year. The resulting generic vehicle had a showroom weight of 1043.1 kg.

An extensive data collection exercise was carried out for this investigation involving operators across the ELV processing and disposal chain. All data were assessed for data quality and the methodology used was consistent with international standards for the application of LCA at the time of the study.

Life cycle inventories have been produced for each of the assessed options in this study and a life cycle impact assessment has been carried out. This calculates the potential impact of emissions arising from the inventory (or resources consumed) for specific key issues. The issues that were of key interest and have therefore been assessed in this study are:

- Global warming (direct, over 100 years);
- Air acidification;
- Stratospheric ozone depletion;
- Non renewable resource depletion;
- Eutrophication of water.

Results were also assessed for toxicological impacts using methodologies that employ value judgements including:

- Swiss critical volume method;
- Swiss ecopoints method;
- Environmental priority strategies method (EPS).

Life cycle impact assessment findings

The main findings of the study were as follows:

The stricter recycling and recovery targets in the draft EC ELV Directive 11034/971 and 1995 ACORD plan have the potential to reduce environmental impacts associated with ELV processing and disposal in comparison with 1997 practices, albeit marginally in some cases.

The draft EC ELV Directive 11034/971 potentially provides marginal improvements of 6% or less on the 1995 ACORD plan for certain impacts (global warming and air acidification), but provides no further improvement for non renewable resource depletion and eutrophication of water.

The greatest benefit (defined as the largest reduction in impact potential) arising from adoption of the draft EC ELV Directive 11034/971 or 1995 ACORD plan comes from avoidance of depletion of non renewable resources (up to 60%) and a reduction in the potential for air acidification (up to 23%).

The smallest improvement (defined as the least reduction in impact potential) when comparing the draft EC ELV Directive 11034/971 with other options relates to global warming for which only marginal reductions in impact potential have been calculated of 6%.

All options have a negligible impact on stratospheric ozone depletion of less than 0.1 g eq CFC 11, which is likely to continue to decrease given ongoing efforts to remove ozone depleting substances as part of measures agreed in the Montreal Protocol.

A limited number of specific flows have been found to dominate each of the impact potentials calculated for this assessment. These are as follows:

- The global warming impact potential is dominated by emissions of carbon dioxide from fossil fuels. The emissions of carbon dioxide associated with the processing and disposal of one ELV would require about 0.04 hectares of temperate forest to compensate. Methane emissions, which also make a contribution, are equivalent to emissions from 6 to 10 cows (depending on the option).
- Sulphur oxides and nitrogen oxides associated with combustion processes dominate the air acidification impact potential. Sulphur oxides emissions associated with processing and disposal of one ELV are equivalent to the emissions from a petrol driven car travelling between 6840 miles (for the draft EC ELV Directive 11034/971 option) and 9790 miles (for 1997 practices). Nitrogen oxides emissions from the same car are equivalent to a journey of 3560 miles in the case of 1997 practices up to 3900 miles for the 1995 ACORD plan.
- Potential impacts from resource extraction and use are mainly caused by natural gas and oil. Natural gas use equates to average daily natural gas use by 23 –35 people in the UK. Oil consumption is equivalent to the oil consumed to make petrol that will transport a car between 450 – 680 miles.
- The eutrophication of water potential impact is largely due to release of phosphates and COD (caused by release of organic compounds that are biologically or chemically oxidised in the aquatic environment). The phosphate emissions associated with processing and disposal of an ELV would need to be diluted with between 14 400 – 16 180 litres of water in order to attain the UK average phosphate concentration of 0.59 mg/litre for watercourses. The COD results would need to be diluted with between 337 – 360 litres of water, in order to ensure the typical COD consent figure of 750 mg/litre for effluent entering a sewer.
- The potential impact on stratospheric ozone depletion is due almost entirely to release of halon 1301, which is conventionally used as a fire retardant.

Other assessment methods that use value based judgements to assess toxicological effects have been used in this study. As these values are based on Swiss or Swedish conditions, their applicability to the UK should be borne in mind. Nevertheless, the assessments show that the draft EC ELV Directive 11034/971 and 1995 ACORD plan produce environmental benefits in 2015 of at least 20% when compared to 1997 practices. The exception to this relates to water releases for which only a marginal improvement of 5% was obtained.

In terms of potentially harmful emissions to air, the draft EC ELV Directive 11034/971 shows only a marginal improvement on the 1995 ACORD plan of 6%. Both produce a benefit over 1997 practices of 20%, due mainly to a cut in the emission of sulphur oxides.

Using an Ecopoints methodology, neither the draft EC ELV Directive 11034/971 or the 1995 ACORD plan are different although both show improvements of 32% on 1997 practices due, primarily, to the diversion of waste away from landfill.

The EPS methodology does show advantages for the draft EC ELV Directive 11034/971 over the 1995 ACORD plan of 14% and both show benefits over current practices due to the avoided need to mine for lead ore.

The small differences in results arising from comparison of the draft EC ELV Directive 11034/971 and the 1995 ACORD plan are not surprising when considered in the context of their respective recycling and recovery targets. The draft Directive allows for 85% reuse and recycling compared to 82% for the 1995 ACORD plan, a difference of just 3% (or 32 kg of material). Additionally the draft Directive allows for 10% energy recovery with an additional 5% of material going to landfill. This compares to 18% energy recovery in the 1995 ACORD plan, of which 5% is inerts that pass through the combustion process and are landfilled as ash (meaning that energy is potentially obtained from 13% of material passing through the combustion process). In essence, the study results compare recycling of this 32 kg of material (in the draft EC ELV Directive 11034/971 option), as opposed to combustion for energy (in the 1995 ACORD option) or landfilling (through 1997 practices).

Within the ELV processing and disposal chain, ferrous transport and processing has been found to be the dominant stage with respect to its potential impact on global warming, air acidification, non renewable resource depletion and eutrophication of water. Given that ferrous metal comprises nearly 70% of the generic ELV used in the study, this result is by virtue of the mass of material that needs to be processed.

Certain activities consistently show low potential for impacting on the environment (of those impact assessment methodologies considered in this study). This includes transportation to, and the activities of, the dismantler. The dismantler can provide a useful first stage of processing, by removing parts that may be reused, depolluting the ELV and source separating other key materials (such as tyres and engine blocks). In terms of the impacts assessed in this study, this activity comes at a negligible environmental cost, although other issues that are not part of this study may be of more importance, such as potential for local contamination of soil, etc.

In order to meet the recycling targets of the draft EC ELV Directive 11034/971 further removal and processing of material is necessary. Since ferrous and non ferrous metals are already recovered to a high degree, most of the material that will need to be recovered to meet the conditions of the draft directive is likely to be plastics, glass and rubber. Further processing of fluff arising from the shredder (and therefore energy consumption) is likely to be necessary. However, it would appear from this study, that such energy is worth expending from an environmental standpoint, if it offsets the need to extract and process ore to produce virgin materials and products, with the associated energy demands.

Similarly, use of some of this extra material as a source of fuel energy (and/or electricity) as in the case of the 1995 ACORD plan, appears to have environmental advantages, although depending on the impact potential chosen, such advantages may be marginal.

The higher recycling and recovery targets that are contained in the draft EC ELV Directive 11034/971 and 1995 ACORD plan, generally lower the impact potential associated with processing and disposal of ELVs (for impact methods calculated in this study) due to the more efficient use of resources and energy.

Comparison of ELV processing and disposal in 1997 with 'zero recycling'

The results above show that adopting further measures for reuse, recycling and recovery can provide environmental advantages for the assessed impact potentials. Furthermore, it is the activities of ferrous recycling that contribute most to the assessed environmental impact potentials of the ELV processing and disposal chain. However, it is important to set this result in context and one way this has been achieved in this study is to compare 1997 practices in the ELV processing and disposal chain with no recycling of the ELV.

This analysis has clearly shown that processing an ELV using practices in 1997, including activities of the industries that process recovered material from the ELV, are environmentally preferable for all assessed environmental impact potentials, when compared to a scenario with no recycling. The magnitude of benefit varies but reaches at least 30% for savings in global warming, air acidification and eutrophication of water impact potentials. Savings attained through recycling using 1997 practices were between 13% and 16% for stratospheric ozone depletion and non renewable resource depletion impact potentials.

Sensitivity analysis results

A strength of undertaking a life cycle approach is the ability to quantify uncertainty and examine the potential impact on results of alternative future scenarios. Five sensitivity analyses were performed for this study and the following results were obtained.

- Global warming, air acidification, non renewable resource depletion and eutrophication of water impact assessment potentials are not sensitive to a ±20% variation in the net heat value of the fluff arising from the shredder.
- The impact potential of the draft EC ELV Directive 11034/971 which contains greater recycling targets than the other two options displays the greatest sensitivity to an increase in energy required for a plant that would help generate the extra material. The impact assessment potential showing the greatest sensitivity is air acidification with a 6% increase for a doubling in energy requirements. Eutrophication of water shows no sensitivity to a variation in the energy requirements of such a plant.
- If the dismantler is required to collect more ELVs and travel further to provide such a service, the impact potentials that are most affected are air acidification and non renewable resource depletion. Eutrophication of water shows the least sensitivity for all options.
- If more parts can be removed from the ELV at the dismantler for reuse, the impact potential that benefits the most is eutrophication of water, due to a reduction in processing operations to transport and convert scrap material into useful secondary material.

- A change in the UK fuel mix that generates electricity for the national grid by 2015 produces a mixed result. Whereas the global warming impact potentials shows almost no variation, the non renewable resource depletion impact potential shows a greater effect for all options, compared to an improvement in terms of air acidification and eutrophication of water. These results are primarily due to a shift away from coal towards natural gas, but with the proportion of electricity coming from fossil fuels increasing in total.
- Global warming, air acidification and non renewable resource depletion impact potentials appear to be most sensitive to the net heat value of the fluff and the amount of parts that are removed at the dismantler.
- The eutrophication of water impact potential appears to be most sensitive to the amount of reuse of parts derived from the dismantler.

Comparison of findings for the UK with Germany and France

An assessment was undertaken to ascertain whether the findings for the UK would differ or remain broadly the same for other European countries, taken as Germany and France in this case. This was achieved by substituting the UK fuel mix that produces national grid electricity with that of Germany and then France. No other parameters were changed, i.e. practices in the UK were assumed to be the same in these other European countries (which in reality, may not necessarily be the case). For some unit processes, electricity use is aggregated meaning that the findings are likely to be under-reported. The main findings are as follows:

- Calculated global warming, air acidification, non renewable resource depletion and eutrophication of water impact potentials are similar to each other and results generated for the United Kingdom, i.e. between –5% and +1% of the UK results.
- All of the impacts for the German fuel mix are within 3% of those for the UK. Where impacts are greater or lesser than for the UK fuel mix, the discrepancy is in the same direction for all three scenarios.
- Germany's reliance on fossil fuels amounts to 65% compared to the UK total of 70%. The UK uses more coal, oil and natural gas compared to the greater use of lignite in Germany. This difference in emphasis on fossil fuel use appears to have a minimal influence on the impact of atmospheric emissions associated with global warming and air acidification. The emissions of carbon dioxide, sulphur oxides and nitrogen oxides would appear to be similar.
- There are greater differences between the impact of the scenarios based on a French fuel mix and those for the UK, although these impacts are all still within 5% of that for the UK fuel mix. French electricity is generated primarily from nuclear and hydroelectric plant. Consequently emissions of carbon dioxide, sulphur oxides, nitrogen oxides and particulates, all of which contribute to the air-oriented impact assessment methodologies are lower than for the UK scenarios. The reduced consumption of coal, oil and natural gas also leads to a lower impact on the depletion of non renewable resources.

Comparison with the 1996 draft of the EC ELV Directive

The three options that form the basis for this study have been compared to an earlier draft of the ELV Directive (from 1996) which contained reuse and recycling targets of 90%, with an additional 5% energy recovery and 5% landfill. The findings of the study are heavily dependent on assumptions relating to the availability of material for recycling, and are as follows:

- The higher reuse and recycling targets of the 1996 version of the draft EC ELV Directive produce material environmental benefits of at least 12% for all assessed impact potentials, except for stratospheric ozone depletion.
- The smallest margin of improvement between the 1996 draft EC ELV Directive and the 1997 draft EC ELV Directive 11034/971 is for the global warming impact potential (12%) and the air acidification impact potential (19%). These improvements are based on the ability to reuse and recycle 90% of the mass of an ELV, compared to 85% for the 1997 version of the Directive.
- The largest environmental benefit of those assessed in this study (in terms of decrease in environmental impact compared to the draft EC ELV Directive 11034/971) is derived for the non renewable resource depletion and eutrophication of water impact potentials, each decreasing by 38% and 47% respectively. These benefits are related to greater reuse and material recovery, thereby reducing the need to extract virgin materials from the earth, and emitting potentially eutrophicating substances during processing and manufacturing operations.

Comparison of end of life with the remainder of the vehicle life cycle

This section provides another basis for context based on the importance of end of life from an environmental standpoint, in comparison to manufacture and use of a car. The analysis included a comparison of literature sources as well as a comparison on the basis of data generated for this project. The main findings are as follows:

- Schweimer & Schuckert (1996) concluded that the end of life phase of a car consumed approximately 1% of the total energy requirements of the vehicle throughout its life cycle (which includes manufacture, use and end of life). The same paper also quotes a figure of 0.2% for total primary energy.
- Schweimer and Schuckert (1996) also reported that over 80% of carbon dioxide emissions are associated with the use phase of the vehicle. The paper goes on to state that the use phase, production of the vehicle and fuel processing account for the majority of emissions of nitrogen oxides.
- Kobayashi (1997) concluded that only 0.1% of the energy consumption of the full vehicle life cycle was attributable to the end of life phase. This same study also reports 0.04% of the lifetime carbon dioxide emissions to be linked to the ELV. It also finds the use phase accounts for over 80% of lifetime carbon dioxide emissions.
- The environmental impact of the ELV has been found to be between approximately 1 and 4 orders of magnitude less than that of the remainder of the vehicle life cycle. This is broadly consistent with the results of other papers, such as Schuckert *et al.* (1997).

Eutrophication, global warming and non renewable resource depletion are the impact potentials for which the end of life phase is the most significant in comparison with the remainder of the life cycle (manufacture and use). Of these, end of life contributes only 2% and 1% respectively to the potential impacts of the full vehicle life cycle for global warming and non renewable resource depletion.

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- The Automotive Consortium on Recycling and Disposal (ACORD);
- Motor Vehicle Dismantlers' Association of Great Britain (MVDA);
- British Metals Recycling Association (formerly the British Metals Federation (BMF));
- The Society of Motor Manufacturers and Traders Limited (SMMT);
- The Consortium for Automotive Recycling (CARE);
- British Plastics Federation (BPF);
- British Rubber Manufacturing Association (BRMA);
- British Secondary Metals Association;
- The Lead Development Association; and
- ETSU.

We would also like to thank the many companies and organisations that have helped in this study but who have asked not to be named for reasons of confidentiality.

ABBREVIATIONS/GLOSSARY

Term	**Definition**
ABS	Acrylonitrile Butadiene Styrene
ACORD	Automotive Consortium on Recycling and Disposal
Air acidification	LCIA characterisation method developed by CML that quantifies the potential conversion of specific emissions into acid compounds through reactions with atmospheric elements (CML; 1992). It is expressed in terms of an acidification potential associated with an equivalent mass of hydrogen ions (H+).
Allocation	Partitioning of the input or output flows of a unit process to the product system under study.
APME	Association of Plastics Manufacturers in Europe.
BMF	British Metals Federation (former name for the British Metals Recycling Association).
BPF	British Plastics Federation
BRMA	British Rubber Manufacturing Association
BUWAL	Swiss Federal Office of the Environment, Forests and Landscape.
CARE	Consortium for Automotive Recycling
CFC	Chlorofluorocarbon
CML	Centre of Environmental Sciences, University of Leiden, Holland.
COD	Chemical Oxygen Demand
Coproduct	Any two or more products from the same unit process.
Critical review	Procedure whereby the goal and scope, results and interpretations of an LCA are independently reviewed to ensure compliance with ISO standards.
Cut off criteria	Preset significance level defined during the scoping of an LCA (typically on the basis of mass, energy, economic value and/or environmental relevance), below which data values need not be taken back to cradle as they are immaterial to study results.
DEAM	Data for Environmental Analysis and Management
DEFRA	Department for Environment, Food and Rural Affairs
DETR	Department of the Environment, Transport and the Regions (former name of what now comprises the Department of Transport, Local Government and the Regions (DTLR) and the Department for Environment, Food and Rural Affairs (DEFRA)).
DTI	Department of Trade and Industry
DTLR	Department of Transport, Local Government and the Regions
ELU	Environmental load unit – unit used in the EPS method.
ELV	End of life vehicle
EPS	Environmental Priority Strategies Impact Assessment Method
ETH	Eidgenossische Technische Hochschule, the Swiss Federal Institute of Technology, based in Zurich.

Feedstock energy	Inherent energy contained within a material or product that is realised on combustion.
Functional unit	Quantified performance of a product system for use as a reference unit in an LCA study.
Global warming	LCIA characterisation method using indices developed by the IPCC that quantifies the potential for warming of the atmosphere as a result of specific emissions. It is expressed in terms of a global warming potential associated with an equivalent mass of carbon dioxide.
Greenhouse effect	See global warming.
GWP	Global warming potential
HMSP	Heavy media separation plant
Indicators of performance	Method by which results are expressed in terms of a more visually realisable form, to aid understanding of the magnitude of the results.
IPCC	Intergovernmental Panel on Climate Change.
ISO	International Organisation for Standardisation.
JAMA	Japanese Automobile Manufacturers Association
LCA	Life cycle assessment.
LCI	Life cycle inventory (analysis).
LCIA	Life cycle impact assessment.
Life cycle assessment	Compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle.
Life cycle impact assessment	Phase of LCA aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts of a product system.
Life cycle inventory analysis	Phase of LCA involving the compilation and quantification of inputs and outputs for a given product system throughout its life cycle.
MAFF	Ministry for Agriculture, Fisheries and Food (now part of DEFRA).
MSW	Municipal solid waste
Mtoe	Million tonne oil equivalents.
MVDA	Motor Vehicle Dismantlers' Association of Great Britain
NFM	Non ferrous metal
ODP	Ozone depletion potential
PA	Polyamide, e.g. PA66
PB	Polybutadiene
PC	Polycarbonate
PE	Polyethylene
(PE)	Primary energy in the form of fuel energy released on combustion or electricity. Fuel energy is derived from combustion of fossil fuels and electricity is derived from the UK national grid (and its associated fuel mix), including distribution losses.
PET	Polyethylene terephthalate
(PM)	Primary material produced as a result of extraction of virgin resources and subsequent processing.

PP	Polypropylene
(PP)	Primary products manufactured from primary materials that are produced as a result of extraction of virgin resources and subsequent processing.
Product system	Collection of materially and energetically connected unit processes, which performs one or more defined functions.
PS	Polystyrene
PSC	Polar stratospheric cloud
PUR	Polyurethane
PVC	Polyvinyl chloride
(SE)	Secondary energy, in the form of fuel energy released on combustion or electricity. Fuel energy is derived from combustion of 'waste' materials and products derived from the ELV that have a net heat value. Using this fuel energy to drive a turbine produces electricity, which can be put on the national grid.
Sensitivity analysis	Systematic procedure for estimating the effects on the outcome of a study of the chosen methods and data.
SETAC	Society for Environmental Toxicology and Chemistry
Showroom weight	Vehicle weight including all normal fluids, except fuel.
(SM)	Secondary material, derived from material and parts removed from the ELV and subsequently transported to a processing facility for conversion into material which is useful for the same or a different function (as that for which it was originally used).
SMMT	The Society of Motor Manufacturers and Traders Limited
(SP)	Secondary product, representing a product that is removed from the ELV and after cleaning, testing etc, is available for reuse in the function for which it was originally used.
Stratospheric ozone depletion	LCIA characterisation method using indices developed by the WMO that quantifies the potential depletion of stratospheric ozone as a result of specific emissions (WMO; 1991). It is expressed in terms of an ozone depletion potential associated with an equivalent mass of CFC 11.
System boundary	Interface between a product system and the environment or other product systems.
System boundary expansion method	Methodology by which allocation is avoided by expanding a product system to include additional functions related to the coproducts.
TEAM™	Tools for Environmental Analysis and Management
Total primary energy	The sum of renewable and non renewable energy, and the sum of fuel and feedstock energy. Provides a summary of the total energy in a system.
Unit process	Smallest portion of a product system for which data are collected when performing a life cycle assessment.
WMO	World Meteorological Organisation.

1 INTRODUCTION

1.1 Terms of reference

Ecobalance UK, a member of the Ecobilan Group, was commissioned in March 1997 by the Environment Agency of England and Wales (hereafter referred to as the ‘Environment Agency’) and Department of Trade and Industry (DTI) to undertake a study using a life cycle approach to evaluate different options for disposal and processing of end of life vehicles (ELVs).

This study, which began in March 1997, was carried out entirely by Ecobalance UK. In May 2000, Ecobalance UK (and the rest of the Ecobilan Group) was acquired by PricewaterhouseCoopers and now resides within Global Environmental Services, which forms part of Assurance and Business Advisory Services (within PricewaterhouseCoopers).

Since completion of the study, a redrafted version of the proposed ELV Directive was published on 21 October 2000 in the Official Journal as *Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end of life vehicles*. Its primary aim is to reduce annual production of 8-9 million tonnes of waste from ELVs in the European Community, in line with the Commissions waste strategy (which has previously been applied to packaging and is likely to be applied to batteries and waste electrical and electronic equipment in forthcoming Directives).

It is important to note that the scenarios reported in this document, and the data and assumptions used to represent those scenarios, relate to that which was available and reasonable at the time the study was carried out. No attempt has been made to update assumptions and data values, or revise modelled scenarios, in the light of more recent data and knowledge gained in the intervening time, since this is outside the scope of this work. Any conclusions are made on the basis of these scenarios, data and assumptions.

1.2 Objectives

The objectives of this study as defined by the Environment Agency and DTI in their original Invitation to Tender were as follows:

- To compile detailed life cycle inventories of the environmental inputs (e.g. natural gas and oil extracted) and outputs (e.g. atmospheric and waterborne emissions, production of wastes) resulting from processes associated with disposal and subsequent processing of ELVs, and ensuring that these inventories were accurate at the time of the study.

- To provide an audit trail for all data in the inventories such that their derivation was clear and replicable and to indicate the uncertainties associated with data by the use of ranges, including estimates, and more complete statistics where these were available.

- To develop an assessment, using recognised methodologies, of the overall environmental impact for management of a typical ELV in the UK, from the inventories collected, for each of the following scenarios in order to identify which represents the best environmental option for management of ELVs:

    - Practices that were current in 1997 when 75% by weight of ELVs were reused or recycled with the remaining 25% being landfilled).
    - The Automotive Consortium on Recycling and Disposal (ACORD) voluntary targets for 2015 (82% reused or recycled; 18% incineration with energy recovery including 5% going to landfill), as set out in its Implementation Plan (ACORD; 1995). This plan provided much of the basis for the 1997 ACORD voluntary agreement.
    - The mandatory targets for 2015 as set out in the draft EC Directive 11034/971 (85% reused or recycled, 10% incineration with energy recovery), with the remainder going to landfill (EC; 1997).

- To provide an assessment of whether the best environmental option identified for the UK would also be the best environmental option for other EC countries, particularly France and Germany.

- To provide a detailed and reasoned assessment, using existing life cycle studies and other data, including those of motor vehicle manufacturers in the UK and/or Europe, of the relative significance of the impacts associated with an ELV *vis a vis* the remainder of the vehicle's life cycle.

The study was conducted in accordance with the ISO 14040 standards on LCA as drafted at the time of the study.

This technical report is divided into the following sections:

- Methodology, including goal and scope.
- Presentation of life cycle inventories.
- Life cycle impact assessment.
- Comparison of practices in 1997 with 'zero recycling'.
- Sensitivity analysis of the results.
- Comparison of the UK result with other European countries (France and Germany).
- Comparison with the 1996 draft of the EC ELV Directive (see below).
- Comparison of end of life with the remainder of the vehicle life cycle.

It should be noted that the original scope of work required an assessment of an earlier draft of the ELV Directive (EC; 1996) which was subsequently superseded during the course of the study by a revision published in October 1997 (EC, 1997). As a result, the scope of work was amended to include the latter revision of the Directive as well as the original. The 1996 version of the Directive set mandatory targets for 2015, which included 90% reuse or recycling, 5% incineration with energy recovery, with the remainder of material going to landfill. The results of this version of the Directive (which are now of more historical significance), in comparison with the other options listed above, are provided in Chapter 8 for interest.

1.3 Description of the ELV 'processing and disposal' route

Once vehicles become 'end of life' they (generally) undergo the following 'disposal' route, which is summarised in Figure 1.1:

Step 1: If the vehicle can still be driven, then it is usually driven to a vehicle dismantler who will pay for the vehicle. Alternatively the vehicle may be towed, either privately or by the dismantler.

Step 2: Materials and parts e.g. tyres, batteries are removed provided it is financially worthwhile to do so. Parts may be cleaned for resale and materials are separately collected. Some ELVs may be processed by 'itinerant collectors' who take high value materials before passing the vehicle on.

Step 3: Materials collected by the dismantler are periodically collected and transported to an appropriate facility for further processing and treatment, e.g. smelter, where secondary material is produced for sale.

Step 4: The dismantled ELV may be crushed (where it makes economic sense to bulk up the load for transport to a shredder) using a number of methods, these being shearing, baling or flattening (either with a mechanical flattener or the jib of a crane). Such activities may occur at the dismantler or at a dedicated site (a scrapyard or feeder site).

Step 5: Ultimately, the ELV ends up at a shredder, a mechanical device which breaks the vehicle into small pieces that are subsequently divided and sorted into ferrous metal, a heavy fraction (non ferrous metal (NFM) fraction) and light fraction (fluff).

Step 6: The ferrous fraction is relatively pure, having been removed from other material using magnetic separation after shredding. Total impurities are between 0.5-1.0%, consisting primarily of some fines, rust and non ferrous metals (principally copper). The ferrous fraction is transported for further processing in an electric arc furnace, either in the United Kingdom or overseas, where it is made into a secondary material for resale.

Step 7: The NFM fraction consists of aluminium, lead, copper, zinc, etc as well as other materials, such as glass, rubber and some plastics[2]. It is transported to a heavy media separation plant (HMSP) for further processing. This plant uses a series of flotation tanks in which the density of the water is adjusted using ferro-silicon and magnetite to separate out non ferrous metals from other material (plastics, etc) on the basis of differences in density. Separated aluminium is usually dried to stop it oxidising in air. All separated metals are then transported for further processing overseas.

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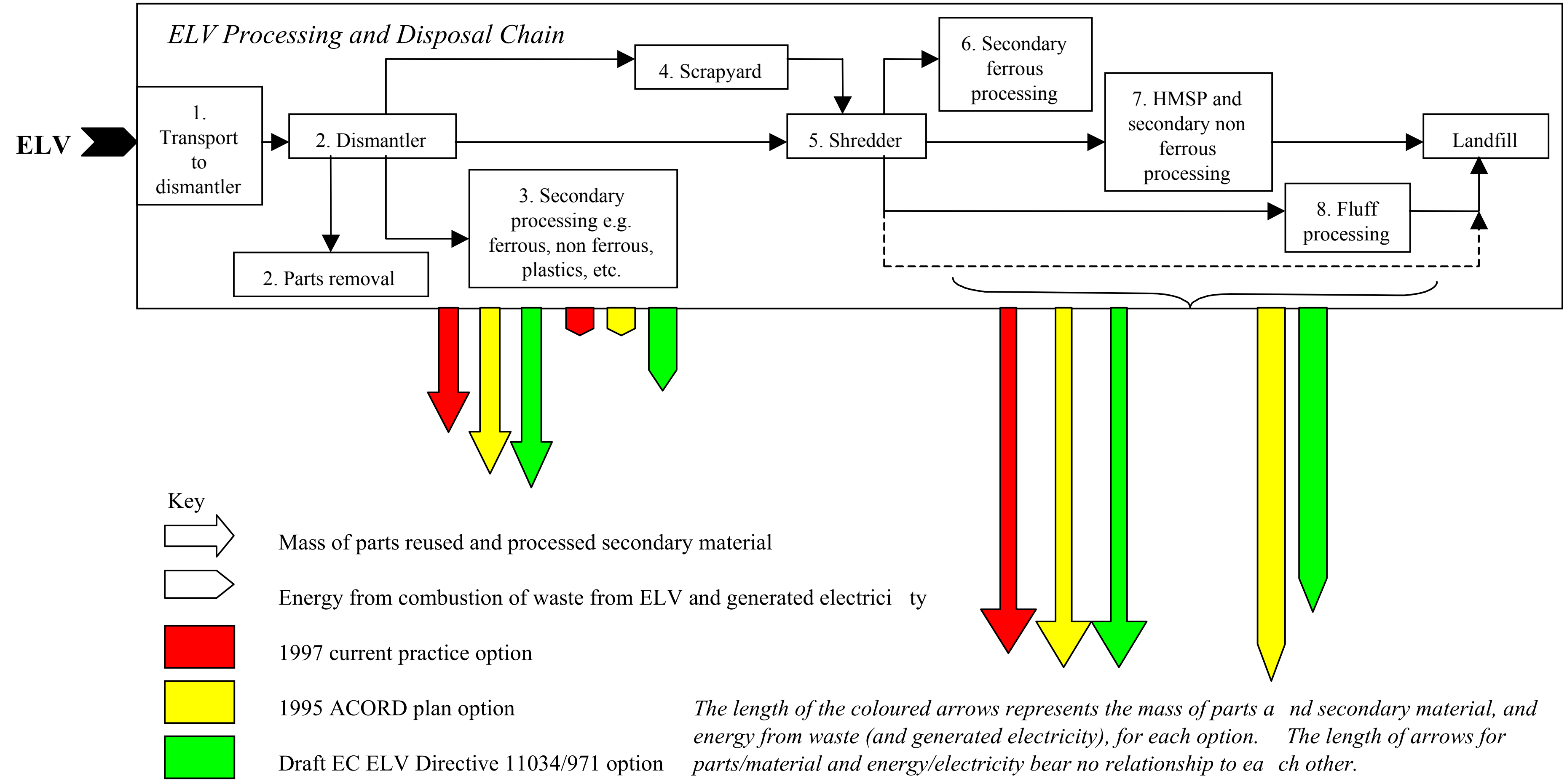
[2] Composition of the NFM fraction is variable depending on the composition of the infeed material and the chosen operating settings of the shredder. An operator who also has a heavy media separation plant (HMSP) is more likely to produce a lower grade NFM fraction, knowing that it will be processed at the HMSP. Metal content can vary by 50%.

Step 8: After separation of the NFM fraction, the remaining material is known as ‘fluff’ and typically consists of dirt, rubber, light plastics and fabrics. Currently, the fluff fraction is transported to landfill although in the future, it is envisaged that the fluff fraction may undergo some form of further processing to recover, for example, plastics for recycling or energy recovery in a cement kiln, municipal solid waste (MSW) incinerator or blast furnace.

Figure 1.1 Summary of ELV Processing Chain



The length of the coloured arrows represents the mass of parts and secondary material, and energy from waste (and generated electricity), for each option. The length of arrows for parts/material and energy/electricity bear no relationship to each other.

2 METHODOLOGY

2.1 Introduction to Life Cycle Assessment (LCA)

LCA is an environmental systems analysis and accounting tool for quantifying the inputs and outputs of an option, whether a product, a process or an activity, and relating these to environmental impacts. LCA is a systematic approach, where the system of interest comprises the operations that collectively produce the product or constitute the activity under examination. The system being assessed is linked to other industrial systems supplying and transporting inputs and carrying away and disposing of outputs - all of which are taken into account.

An LCA offers a clear and comprehensive picture of the flows of energy and materials through a system and gives a holistic and objective basis for comparisons. Results are presented in terms of the system function so that the value of that function can be balanced against the environmental effects with which it is associated.

The results of an LCA quantify the potential environmental impacts of a product system over the life cycle, to help identify opportunities for improvement and to indicate environmentally preferable options where a comparison is made. The results may also contribute to the design process by targeting more significant environmental impacts and the phase of the life cycle to which they relate.

The *cradle to grave* nature of LCA (that is from the extraction of raw materials from the environment to their eventual assimilation back into the environment) avoids the restricted perspective of environmental management tools that focus only on a site or specific environmental concern. This prevents problem shifting, where an apparent solution merely transposes an environmental input or output (and associated potential environmental impact) to another part of the life cycle.

However, in certain cases such as waste management studies, a *cradle to grave* approach need not necessarily be adopted since different options for recycling, recovery and disposal of a product will be the same up to the point where the product is designated as a waste. Such a pragmatic approach is an application of the life cycle technique and forms the basis of the study reported in this document.

LCA is based on the systematic identification and quantification of an inventory of environmental inputs and outputs for the whole life cycle, whereas an application of the technique quantifies those parts of the life cycle that are likely to vary when considering alternative options. The impact of these flows can then be assessed and interpreted.

The LCA concept dates from the late 1960s, and early studies concentrated simply on the use of energy and materials in the manufacture of products. More recently the focus of researchers has broadened to cover a range of sectors and to include a wide variety of environmental concerns including global warming and acidification. The emphasis on the use of LCA in making improvements in product manufacture is changing too, and the approach is becoming widely used by both industry and government as a means of comparing the environmental advantages and disadvantages of design options, alternative strategies and of informing and justifying policy development.

LCA (or an application of LCA) is generally regarded as consisting of four distinct activities, defined as:

- Goal and scope definition, which defines the purpose and scope of the study and sets out a framework within which it will be carried out, including boundary conditions and underlying assumptions.
- Life cycle inventory analysis (LCI), which quantifies environmental inputs and outputs throughout the life cycle (or more specifically parts of interest) of the product, process or activity.
- Life cycle impact assessment (LCIA), which assesses the effects of the inputs and outputs identified in the inventory can be divided into:

    - Classification: Grouping of specific environmental inputs and outputs into impact categories;
    - Characterisation: Quantifying the significance of each of the inputs and outputs in an impact category;
    - Normalisation: Calculating the magnitude of impact categories relative to reference information.
    - Grouping: Using value choices to assign impact categories into one or more sets, possibly involving sorting and/or ranking.
    - Weighting: Using value choices to convert indicator results of different impact categories based on numerical factors.

- Life cycle interpretation, in which the findings of either the inventory analysis or impact assessment, or both, are combined consistent with the defined goal and scope in order to reach conclusions and recommendations.

The International Organisation for Standardisation (ISO) has standardised the LCA approach in the ISO 14000 series of standards on environmental management (ISO 14040) (ISO 1997d, 1998, 2000a, b). At the time that this study was carried out, ISO14040 on *Principles and Framework* was a final draft international standard (ISO; 1997a), ISO 14041 on *Goal and Scope Definition and Inventory Analysis* was a draft international standard (ISO, 1997b) and ISO 14042 on *Impact Assessment* was only a committee draft (ISO; 1997c). The work reported here was carried out in accordance with these standards as presented at the time of the study.

2.2 Goal and scope definition

The goals of this investigation are provided in detail in Chapter 1. In summary, this study uses a life cycle approach to compare three alternative scenarios for the recycling, recovery and disposal of ELVs in 2015, based on;

- Industry practices in 1997.
- An implementation plan for the UK produced by the Automotive Consortium on Recycling and Disposal (ACORD) in 1995 (ACORD; 1995).
- The EC ELV Directive 11034/971 as drafted in 1997 on disposal of ELVs (EC; 1997).

2.2.1 Functional unit and reference flow

The functional unit for the study is as follows:

> *The total quantity of ELVs (based on mass) for disposal in the UK over one year.*

In order to record data in a more manageable way and ease presentation in the inventory tables (Appendix A), we use a *reference flow* equivalent to one 'generic' ELV.

Using data on UK vehicle registrations for 1996 (SMMT; 1996), fifteen vehicle manufacturers whose combined sales comprised over 80% of the UK car parc were approached for composition data on their more successful models (according to number of registrations in 1996). Returns received from vehicle manufacturers totalled 49% of the UK car parc, of which data relating to 40% of the UK car parc were deemed to be of sufficient quality for inclusion in the study (using criteria discussed later in this section). Composition and weight data came in a variety of forms. Some manufacturers provided a weighted average for a particular model of car taking into account the various derivatives and associated level of trim, whereas others provided data on a 'typical' derivative of a particular model. Both forms of data were used to describe the generic ELV. Where the weight of the vehicle was provided with a full fuel tank, the weight and composition was recalculated to obtain the showroom weight using a fuel density of 0.88 kg/litre. Composition data were normalised using the registration statistics for individual models (SMMT; 1996) and aggregated.

The weight of the generic ELV used in this study is 1043.1 kg, with a composition provided in Appendix B.

This generic ELV provides the reference flow used to produce the inventories in Appendix A. When considering the 'whole' system (described by the functional unit), it is important to be able to 'back calculate' from the reference flow to the functional unit in order to obtain a perspective of total environmental inputs and outputs arising due to disposal of ELVs in the UK. This can be achieved by multiplying an inventory input or output by the number of vehicles disposed each year in the UK, which is approximately 1.4 million (Poll, 1996), *viz*;

Inventory value x 1 400 000 = Inventory value
(reference flow) (functional unit)

2.2.2 Approach to the study

Conventionally, LCA adopts a *cradle to grave* approach. However, in this study, the three options are the same up to the end of the use phase of the car, i.e. in respect of the environmental inputs and outputs and associated impacts for extraction of raw materials, energy use, transport, production of components, production of the car, use of the car, maintenance, etc. Thus each system would be treated identically not only from a methodological standpoint but also with respect to the data themselves. Consequently we adopt a *gate to grave* approach, the *gate* being the point at which a car becomes an ELV. We define this as the following:

- Where a car has to be picked up by a dismantler, the car becomes an ELV from the point where it has broken down.
- Where a car is driven to a dismantler (or towed by another private vehicle), the car becomes an ELV upon delivery to the dismantler.

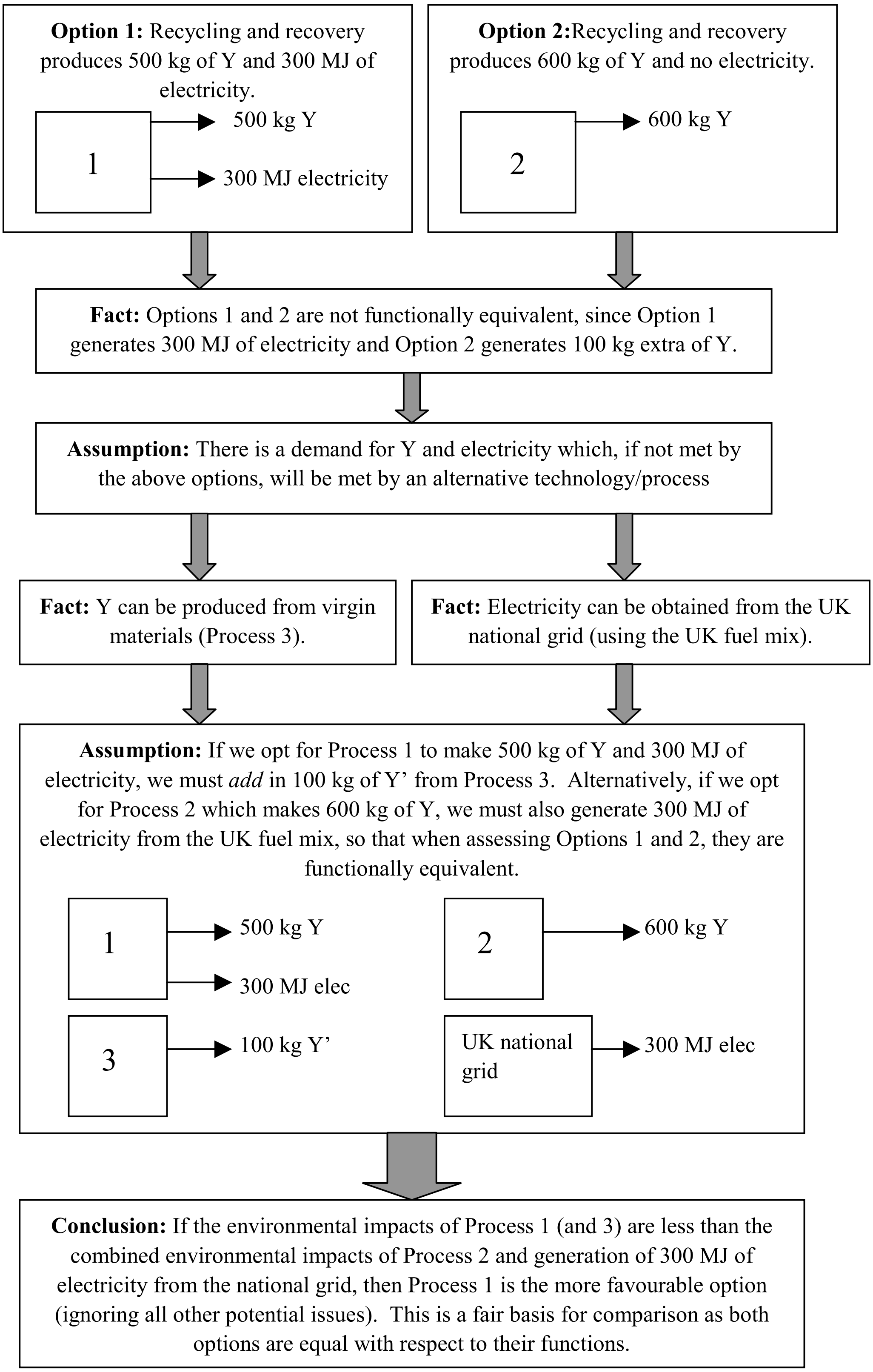
In practice, most ELVs are delivered to the dismantler. The deliverer has an economic incentive to do so because the dismantler is more likely to give a better price for a delivered car than one he has to collect.

The system boundary expansion method

The purpose of this study is to facilitate direct comparison between alternative options for recycling, recovery and disposal of ELVs, from an environmental perspective. Consequently the functional unit for the scenarios is the same, so as to compare like with like. In practice, this also requires that the product or service delivered by each system is the same. Disposal and subsequent processing of ELVs can be considered as a service. However, the disposal of ELVs yields products in the form of secondary materials and products and energy (by burning 'waste' materials as fuel and generating electricity for distribution to the UK national grid). In order to make a fair comparison, the amount of material, product and energy produced by each option must also be the same.

We ensure that materials, products and energy produced by the three options are equal by adopting an *additive* systems approach (the 'system boundary expansion method'). The basic principle of the approach is that where there is a shortfall of secondary material, product or energy in an option, this must be supplemented by alternative material, product or energy delivering the same function such that total material, product and energy produced by each option is equal. Figure 2.1 provides a worked example for options 1 and 2. This method is applied to each of the secondary materials, products and energy in Table 2.1, and is balanced by a corresponding primary material, product and energy.

Figure 2.1 Illustration of the System Boundary Expansion Method



Option 1: Recycling and recovery produces 500 kg of Y and 300 MJ of electricity.

Option 2: Recycling and recovery produces 600 kg of Y and no electricity.

Fact: Options 1 and 2 are not functionally equivalent, since Option 1 generates 300 MJ of electricity and Option 2 generates 100 kg extra of Y.

Assumption: There is a demand for Y and electricity which, if not met by the above options, will be met by an alternative technology/process

Fact: Y can be produced from virgin materials (Process 3).

Fact: Electricity can be obtained from the UK national grid (using the UK fuel mix).

Assumption: If we opt for Process 1 to make 500 kg of Y and 300 MJ of electricity, we must *add* in 100 kg of Y' from Process 3. Alternatively, if we opt for Process 2 which makes 600 kg of Y, we must also generate 300 MJ of electricity from the UK fuel mix, so that when assessing Options 1 and 2, they are functionally equivalent.

Conclusion: If the environmental impacts of Process 1 (and 3) are less than the combined environmental impacts of Process 2 and generation of 300 MJ of electricity from the national grid, then Process 1 is the more favourable option (ignoring all other potential issues). This is a fair basis for comparison as both options are equal with respect to their functions.

Table 2.1 Materials, Products and Energy provided by Reuse, Recycling and Recovery of ELVs[3]

Service	Secondary (from ELV)	Primary
Material	(SM) Ferrous (steel plate)	(PM) Ferrous (steel plate)
	(SM) Aluminium (sheet)	(PM) Aluminium (sheet)
	(SM) Copper	(PM) Copper
	(SM) Lead	(PM) Lead
	(SM) Zinc	(PM) Zinc
	(SM) Other Metals	(PM) Other Metals
	(SM) ABS	(PM) ABS
	(SM) PP	(PM) PP
	(SM) PE	(PM) PE
	(SM) PA66	(PM) PA66
	(SM) PVC	(PM) PVC
	(SM) PUR	(PM) PUR
	(SM) Other Plastics	(PM) Other Plastics
	(SM) Rubber	(PM) Rubber
	(SM) Glass	(PM) Glass
Product	(SP) Ferrous Product (cast)	(PP) Ferrous Product (cast)
	(SP) Aluminium Product (cast)	(PP) Aluminium Product (cast)
	(SP) Copper Product (wire)	(PP) Copper Product (wire)
	(SP) Lead Product	(PP) Lead Product
	(SP) Zinc Product (wire)	(PP) Zinc Product (wire)
	(SP) Other Metals Product	(PP) Other Metals Product
	(SP) ABS Product	(PP) ABS Product
	(SP) PP Product	(PP) PP Product
	(SP) PE Product	(PP) PE Product
	(SP) PA66 Product	(PP) PA66 Product
	(SP) PVC Product	(PP) PVC Product
	(SP) PUR Product	(PP) PUR Product
	(SP) Other Plastics Product	(PP) Other Plastics Product
	(SP) Rubber Product (tyre)	(PP) Rubber Product (tyre)
	(SP) Glass Product	(PP) Glass Product
	(SP) Other Materials Product	(PP) Other Materials Product
	(SP) Lubricant	(PP) Lubricant
	(SP) Coolant	(PP) Coolant
	(SP) Fluids (unspecified)	(PP) Fluids (unspecified)
Fuel Energy	(SE) Waste (fuel energy)	(PE) Fossil Fuels (fuel energy)
Electricity	(SE) Electricity	(PE) Electricity

In Table 2.1, where more specific information is assumed or known about the material or product, it is given in parenthesis, e.g. rubber product (tyre) as opposed to rubber, for example.

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[3] Please refer to the Glossary for an explanation of (SM), (SP), (SE), (PM), (PP) and (PE).

2.2.3 Components considered within the system boundaries

In life cycle terms, a system represents a process or group of processes that meet a particular function or functions, e.g. transport, production of ferrous metal. Sub-systems and unit processes within the system reflect the material and energy links necessary to account for the system function.

Each option (practices in 1997, the 1995 ACORD plan and the draft EC ELV Directive 11034/971) is represented as a system which interfaces with the environment. Each consists of three main elements, these being:

- The disposal of the ELV, which may generate secondary material and products as well as recovered energy (or electricity) derived from combustion of 'waste' (with energy recovery) from the ELV.
- Primary production of materials and products, reflecting the additive systems described above.
- Production of energy as fuel energy from conventional fossil fuel sources and electricity from the UK national grid, reflecting the additive systems described above.

A separate system is used to represent each of the primary materials and products considered in the study, as well as production of energy from fossil fuels and electricity from the UK national grid (Table 2.1). The functions of these systems are highlighted below, with more description provided in Appendix C and underlying assumptions in Appendix D. Figure 2.2 illustrates the contribution of these primary systems, based on Figure 1.1.

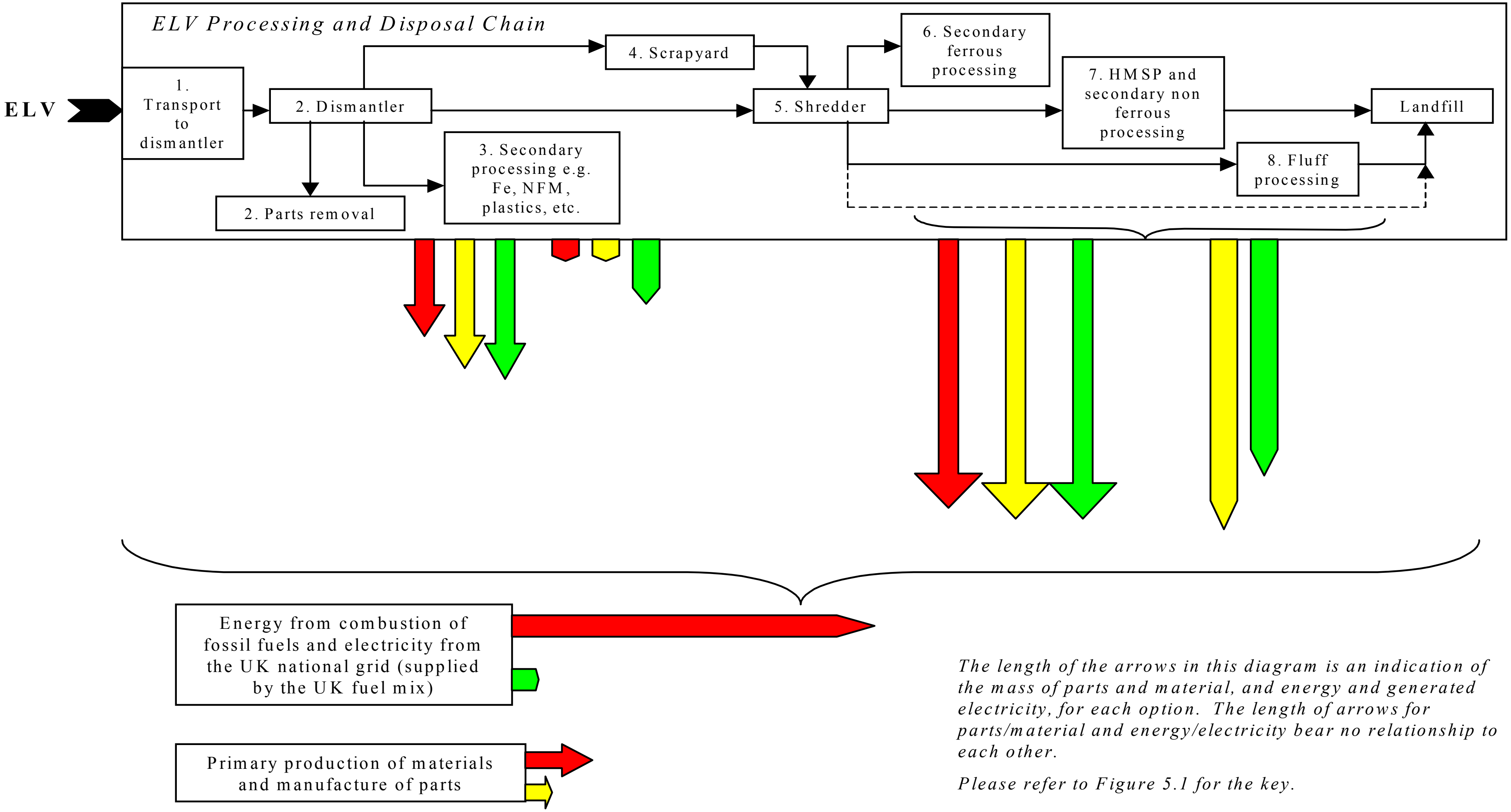
Primary materials and products:

- Extraction and processing of raw materials to produce primary materials or with further processing and fashioning, primary products, including energy use. It is assumed that electricity consumed is generated by a European average fuel mix, as the vehicles considered in this study are assembled using parts manufactured all over Europe.

Fossil fuel derived energy/electricity:

- Precombustion (extraction and processing) and combustion of fossil fuels (coal and gas), including transport and energy use.
- Production of electricity for the UK national grid using a mix of fuels representative for 1996.

Figure 2.2 Illustration of the Contribution of Primary Material and Parts, and Fossil Fuel Energy and Electricity generated for the National Grid from the UK Fuel Mix, for each Assessed Option, based on their Respective Reuse, Recycling and Recovery Targets.



The length of the arrows in this diagram is an indication of the mass of parts and material, and energy and generated electricity, for each option. The length of arrows for parts/material and energy/electricity bear no relationship to each other.

Please refer to Figure 5.1 for the key.

End of life vehicle recycling, recovery and disposal:

- Transport to the vehicle dismantlers (when not delivered by driving or towing with a private vehicle);
- ELV dismantling incorporating provision of secondary material and products;
- Transport of the dismantled ELV to a shredder (in both a crushed[4] (via a scrapyard) or uncrushed) form.
- Shredding of the ELV into a ferrous fraction, NFM fraction and fluff fraction, including provision of secondary material, transport, energy use.
- Transport of the NFM fraction to a Heavy Media Separation Plant (HMSP) and separation into secondary material and NFM waste.
- As appropriate (depending on the option), transport of fluff and NFM waste to landfill, and/or combustion facilities.
- Waste in landfill.
- Combustion of waste in a blast furnace, cement kiln (including further processing of waste) and MSW incinerator.
- Transport of combustion waste to landfill and behaviour in landfill.

This system considers the different ways in which ELVs are processed and acts as the 'driver' for each option, determining the mass of secondary materials and products made available, as well as energy and generated electricity derived from the ELV. This sets the input required from the primary systems for each option.

2.2.4 Data

Data for the study have been provided from sources representing many different industries that have an impact on, or are affected by, the disposal of ELVs. Data were collected in a number of ways, listed below:

- Individual proprietary data were obtained through use of questionnaires.
- Other proprietary data were gathered during a series of site visits.
- Aggregated data were obtained from the Ecobilan Group's DEAM (Data for Environmental and Analysis and Management) database.

Collected proprietary data were assessed for quality on a qualitative basis (ISO; 1997a, 1997b) for the following characteristics.

Coverage

This relates to coverage by time, according to geography and to technology. The most recent data made available were used in this study. Generally these were annual data for 1995-96. Some of the data relating to industries in the ELV processing chain came from the appropriate trade bodies, using statistics from members distributed around the UK. Other data came from specific sites. In this case, an effort was made to visit a range of sites representing different working practices and technology. Any data not available, or rejected on the basis that they did not satisfy data quality requirements, were substituted with aggregated data from the Ecobilan Group DEAM database.

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[4] The ELV may be mechanically or jib flattened, baled or sheared.

Precision, completeness and representivity
Figures for data variability were difficult to obtain. Cars have a variable composition depending, for example, on the level of trim associated with a particular derivative. This was handled using averaged figures by derivative (where made available) or a 'representative' derivative of the model.

An analysis of averaged figures (by derivative) compared to the 'representative' derivative data (for the same car), showed that the addition of options and trim resulted in the average ELV weighing 5% more than the manufacturer's representative derivative. Given the contribution of each type of data to the generic ELV, a net error in the ELV weight (and mass of materials and products) of less than 2% was calculated.

An analysis was also undertaken assuming that 20% of ELVs contain a diesel engine. Cars containing a diesel engine are heavier than their petrol engine counterparts, due to the engine being 'ferrous rich' as opposed to 'aluminium rich'. Variation in the ELV weight was found to be less than 1% due to this parameter.

Variability in other data, such as the activities of vehicle dismantlers, were difficult to assess because of a lack of reliable data. Working practices and technology within the industry, which is spread over many locations, are diverse, depending on economics, market, customers and geographical location.

Individual proprietary data were checked for mass balance, and where significant discrepancies were located, further questions were asked of the supplier of the data and amendments made on the basis of responses given. Independent sources of data for a particular process were compared to each other and the Ecobilan Group DEAM database.

Consistency and reproducibility
The methodology used in the study was applied consistently throughout and is therefore reproducible.

2.2.5 Allocation procedures

Where it has been necessary to apportion inputs or outputs to more than one destination or source this has been made on the basis of mass.

2.2.6 Impact assessment

Discussion relating to impact assessment can be found in Chapter 4.

3 PRESENTATION OF LIFE CYCLE INVENTORIES

Life cycle inventories are presented in Appendix A. All results are expressed in terms of one ELV (the reference flow for the study).

Table A1 provides a comparison of the overall results for each option (1997 practices, the 1995 ACORD plan and draft EC ELV Directive 11034/971.

Tables A2 to A4 break down the total figures in Table A1 into contributions from the ELV processing and disposal chain, and contributing primary systems for each of the options.

Tables A5 to A7 break down the ELV processing and disposal chain for each option into contributing stages in the processing of the ELV.

The inventories are analysed using impact assessment and other assessment techniques in Chapter 4. Indicators of performance are also calculated as an aid to help interpretation of the magnitude of the figures.

Chapter 5 puts the results of the study in Chapter 4 in context by comparing current practice with a 'zero recycling' scenario (in which all ELVs are landfilled).

Chapter 6 provides the results of sensitivity analyses undertaken for parameters of interest within the life cycle system for ELVs.

Chapter 7 compares the impact assessment results for the UK, with equivalent results which might be expected given the different fuel mixes of other European countries. A comparison with Germany and France is provided.

Chapter 8 compares the results in Chapter 4 with the 1996 draft of the ELV Directive and Chapter 9 discusses the end of life of a vehicle in context with the production and use phases of its life cycle.

4 LIFE CYCLE IMPACT ASSESSMENT

4.1 Introduction

Life cycle impact assessment (LCIA) is a methodology for the calculation of measures of *potential* impact on the environment. This is achieved by assigning relevant flows from the inventory to an impact category (classification) and applying a weighting factor to each flow (characterisation) to provide a measure of equivalence. The impact assessment methodologies that have been assessed in this study are as follows:

- Global warming (direct, over 100 years).
- Air acidification.
- Stratospheric ozone depletion.
- Non renewable resource depletion.
- Eutrophication of water.

These are CML/SETAC problem oriented impact assessment approaches (so called because each focuses on a particular environmental issue), which are favoured by ISO (ISO; 1997c) and details of which are provided in Appendix E.

An impact *potential* represents the likely environmental impact as a result of the presence of contributory flows and their likely influence on an impact of interest. In the case of global warming and stratospheric ozone depletion, the difference between the potential and actual impacts is likely to be smaller, since emission of greenhouse or ozone depleting gases is not as affected by local or regional conditions. However, non renewable resource depletion and eutrophication impact potentials may differ from actual impacts to a larger degree because of regional or local conditions. For example, emission of potentially eutrophicating flows may occur in more than one river in different geographical locations, so that the calculated total eutrophication potential is dispersed and may not be such an issue in any one locality.

Flows displayed in each graph in this section do not necessarily comprise the only flows that contribute to a particular impact potential. However, those that are not shown produced results that were too small to appear on the graphs (less than 1%) and have therefore been omitted for clarity. In certain cases, the combined effect of the small contributions of these flows may be enough to show a slight difference in Figures 4.1a to 4.1h and the tabulated results in Tables 4.1 and 4.3.

Materiality of results, i.e. at what point differences between options become significant, is difficult to assess given the number of variables in this project. We use a difference of 5-6% as being immaterial and within the limits of data accuracy used in the study.

As an aid to reporting and in order to help understand the magnitude of the results, indicators of performance have been calculated for the main contributory flows for each impact assessment methodology above (except stratospheric ozone depletion). The assumptions that have been used to produce these indicators of performance are provided in Appendix F.

It should be remembered when reading this section that LCIA only provides a measure of potential environmental impact and does not predict exceedence of thresholds, safety margins or risks.

In addition, three other assessment methods used in parts of Europe have also been undertaken.

These methods require the assignment of relative values or weights to different impacts and their integration across impact categories in an effort to assimilate data and assist decision makers. These techniques, for which further details are provided in Appendix E, have only been applied to the inventory in Table A1 and consist of the:

- Swiss critical volume method.
- Swiss ecopoints method.
- Environmental priority strategies method (EPS).

4.2 Comparison of overall results for 1997 current practice, the 1995 ACORD plan and the draft EC ELV Directive 11034/971

4.2.1 Results of problem oriented impact assessment

Table 4.1 summarises the results of the impact assessment. Figures 4.1a to 4.1d present the life cycle impact assessment findings for global warming (direct over 100 years), air acidification, non renewable resource depletion and eutrophication of water. Results for stratospheric ozone depletion are negligible (less than 0.1 g eq. CFC 11) for all assessed options and are not presented graphically, although results are discussed below.

Table 4.1 Results of the Problem Oriented Impact Assessment for Assessed Options

Impact Category	Units	Current Practice (1997)	ACORD Plan (1995)	EC Proposal 11034/971
Greenhouse Effect (direct, 100 years)	tonnes eq. CO_2	1.20	1.22	1.15
Air Acidification	g eq H^+	205.7	176.4	166.8
Stratospheric Ozone Depletion	g eq CFC 11	0.07	0.06	0.06
Non Renewable Resource Depletion	kg/yr	3.43	2.18	2.15
Eutrophication of Water	g eq PO_4	38.8	33.9	33.6

Figure 4.1a Comparison of the Global Warming Impact Potential (Direct, over 100 years) arising from 1997 Current Practice, the 1995 ACORD Plan and the Draft EC ELV Directive 11034/971

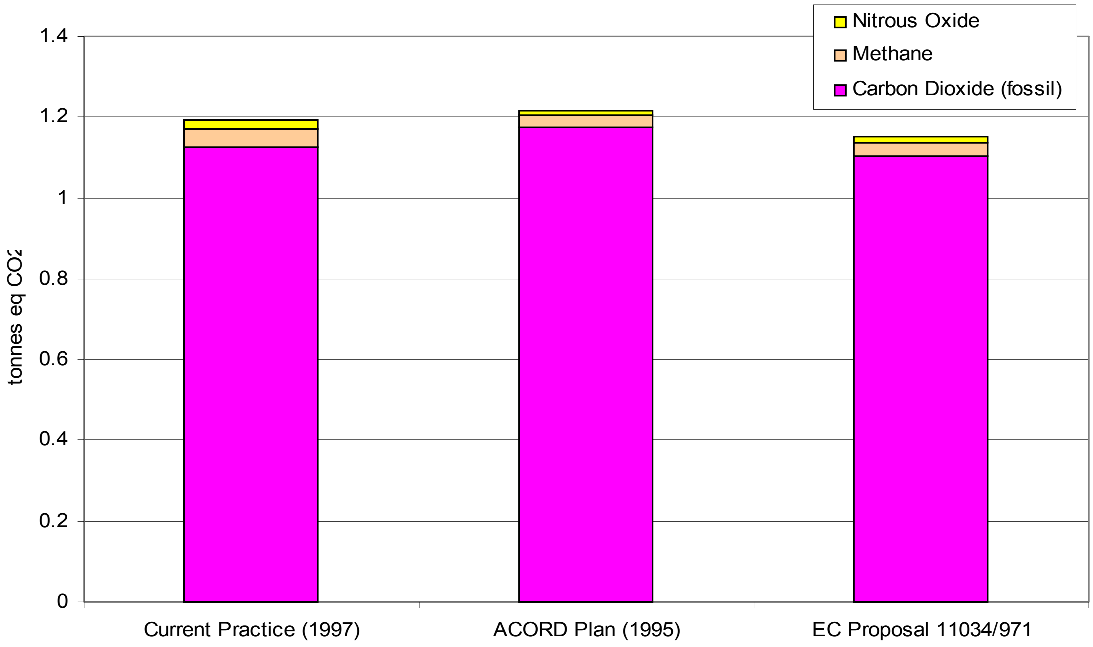


Figure 4.1b Comparison of the Air Acidification Impact Potential arising from 1997 Current Practice, the 1995 ACORD Plan and the Draft EC ELV Directive 11034/971

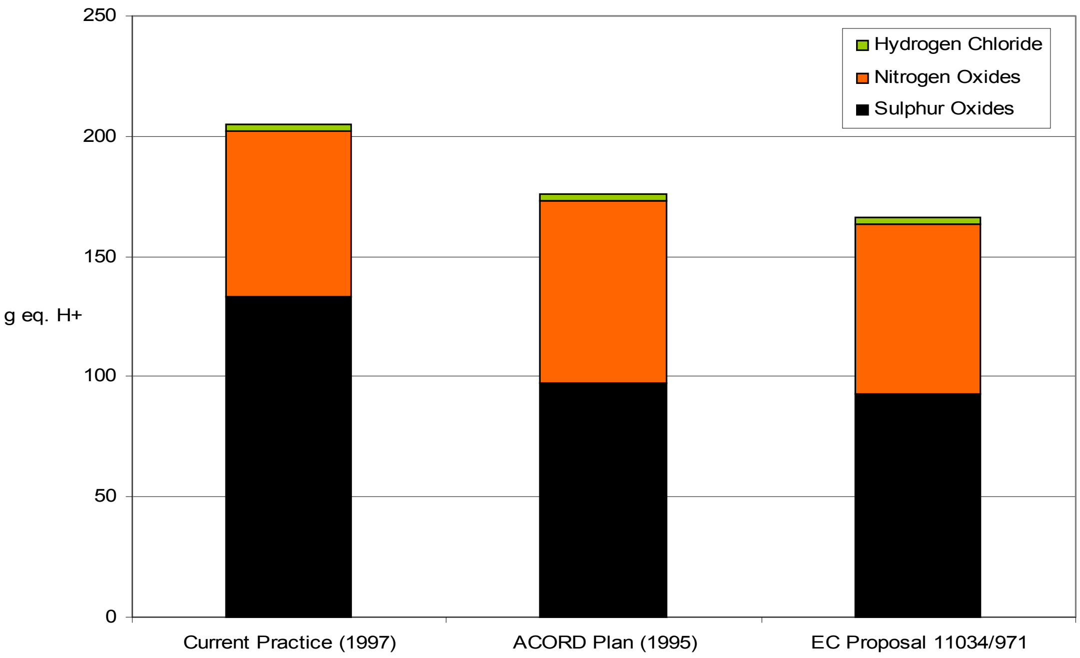


Figure 4.1c **Comparison of the Non Renewable Resource Depletion Impact Potential arising from 1997 Current Practice, the 1995 ACORD Plan and the Draft EC ELV Directive 11034/971**

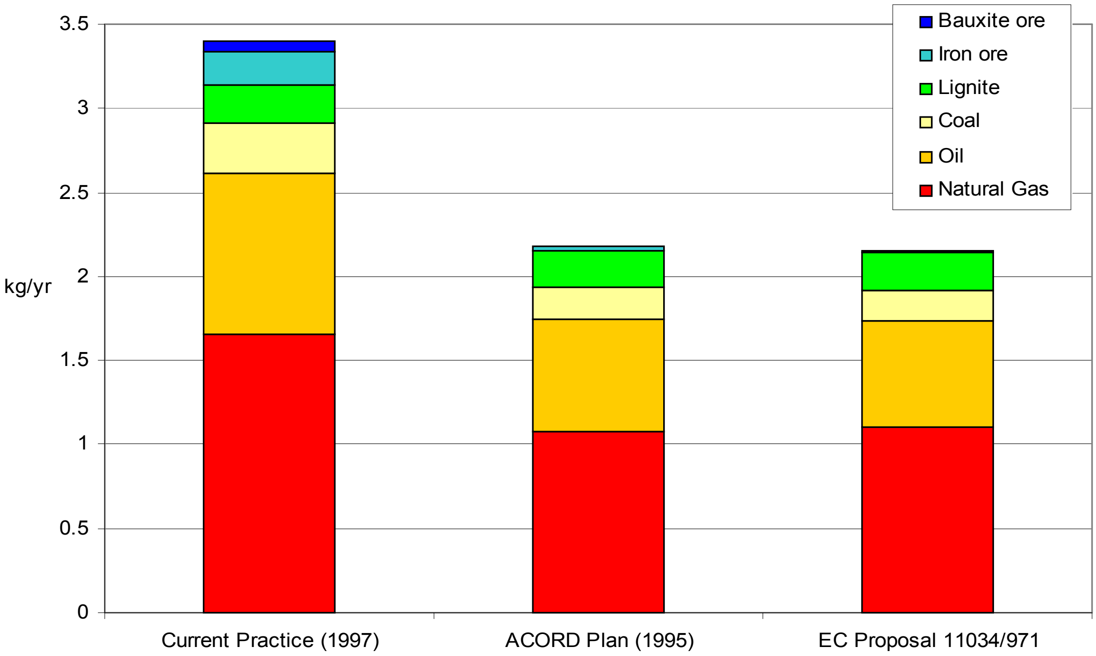
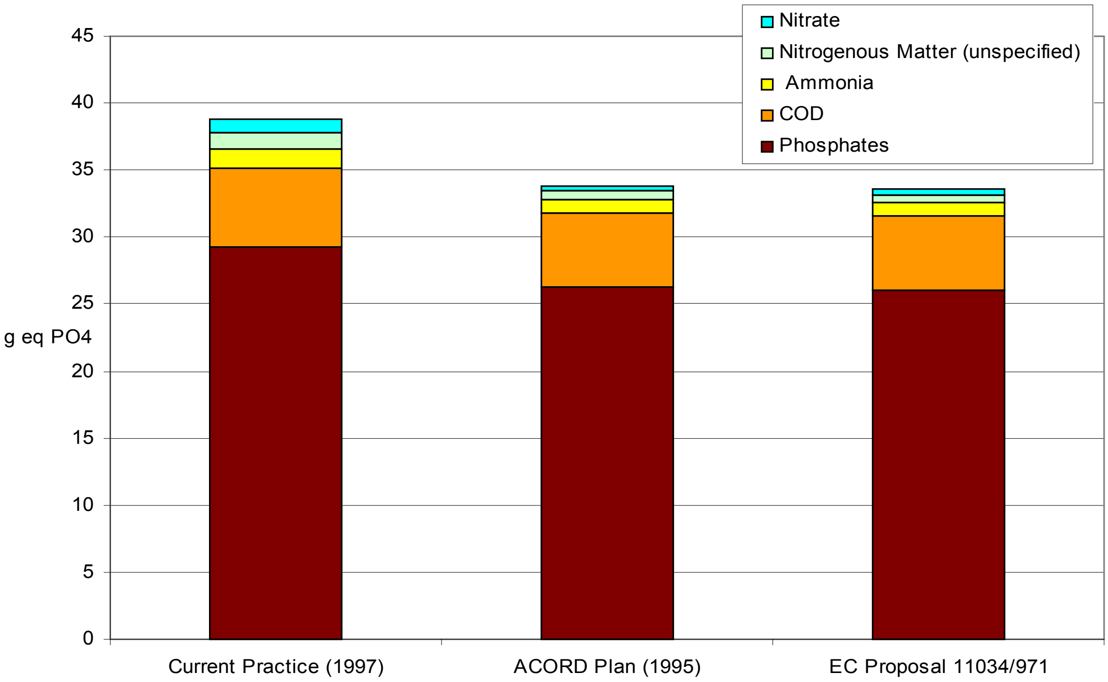


Figure 4.1d **Comparison of the Eutrophication of Water Impact Potential arising from 1997 Current Practice, the 1995 ACORD Plan and the Draft EC ELV Directive 11034/971**



The following observations can be drawn from Table 4.1 and Figures 4.1a to 4.1d:

The draft EC ELV Directive 11034/971 shows a marginal improvement (approximately 6%) on practices in 1997 and the 1995 ACORD plan in terms of potential impacts on global warming. The 1995 ACORD plan and 1997 practices are virtually the same in terms of their impacts on global warming, and indistinguishable given the limits of data quality.

Similarly, the draft Directive shows a marginal improvement of 6% for potential impact on air acidification, compared to the 1995 ACORD plan. Both the draft Directive and 1995 ACORD plan show improvements in the air acidification potential of around 23% when compared to 1997 practices.

Differences between the draft EC ELV Directive 11034/971 and the 1995 ACORD plan are negligible for the potential impact on non renewable resource depletion in the context of data quality. However, both show significant improvements of nearly 60% when compared to 1997 practices.

There is no discernible difference in the potential impact of the draft EC ELV Directive 11034/971 and the 1995 ACORD plan in terms of eutrophication of water. However both exhibit an improvement of 15% compared to the potential eutrophication impact of 1997 practices.

Specific flows dominate each of the assessed impact potentials, as graphically presented in Figures 4.1a to 4.1d. The contribution of each of these flows is presented in Table 4.2, which shows the following trends:

- The direct global warming impact potential (over 100 years) is dominated by emissions of fossil fuel derived carbon dioxide for all options;
- The air acidification impact potential is dominated by emissions of sulphur oxides and nitrogen oxides, which together comprise over 98% of potentially acidifying emissions for all three options;
- The small impact on stratospheric ozone depletion is mainly due to emission of halon 1301, which typically finds applications as a fire retardant. It should be noted that since there is an ongoing program to phase out ozone depleting substances under the provisions of the Montreal Protocol (and database information may not keep pace with such a phase out), the actual impact is likely to be less than this calculated figure;
- Extraction and use of hydrocarbon fuels (coal, oil, natural gas and lignite) accounts for over 91% of the non renewable resource depletion impact potential for the 1997 current practice option and over 98% for the other two options. The greater contribution of hydrocarbons for the 1995 ACORD plan and draft EC ELV Directive 11034/971 reflects the greater recycling and recovery targets in these options, meaning that less primary ores (iron, bauxite) need to be extracted compared to 1997 practices.
- The eutrophication of water impact potential arises primarily from release of phosphates and chemical oxygen demand due to release of organic materials, for all three options.

Table 4.2 Principal Flows contributing to Problem Oriented Impact Assessment Results (%).

Impact Category	Flow	Current Practice (1997)	ACORD Plan (1995)	EC Proposal 11034/971
Greenhouse Effect (direct, 100 years)	Carbon dioxide	93.8	96.6	95.9
	Methane	3.7	2.4	3.0
	Nitrous oxide	2.1	1.0	1.1
Air Acidification	Nitrogen oxides	33.6	43.0	42.3
	Sulphur oxides	64.7	55.3	55.8
Stratospheric Ozone Depletion	Halon 1301	100.0	100.0	100.0
Non Renewable Resource Depletion	Natural gas	48.2	49.5	51.2
	Oil	28.0	30.2	29.3
	Coal	8.6	8.7	8.6
	Lignite	6.6	10.3	10.5
	Iron ore	5.8	1.0	0.4
	Bauxite ore	2.0	0.2	
Eutrophication of Water	Phosphates	75.4	77.6	77.5
	COD	15.4	16.4	16.6
	Ammonia	3.7	2.9	2.8
	Nitrogenous matter	3.2	1.9	1.9
	Nitrates	2.4	1.2	1.2

4.2.2 Results of other assessment methodologies

Table 4.3 presents the results for the other assessment methodologies, which are graphically presented in Figures 4.1e to 4.1h below. These methods use value judgements to assess potential toxicological effects. Further details are provided in Appendix E.

Figure 4.1e Comparison of Critical Volumes (Air) for 1997 Current Practice, the 1995 ACORD Plan and the Draft EC ELV Directive 11034/971

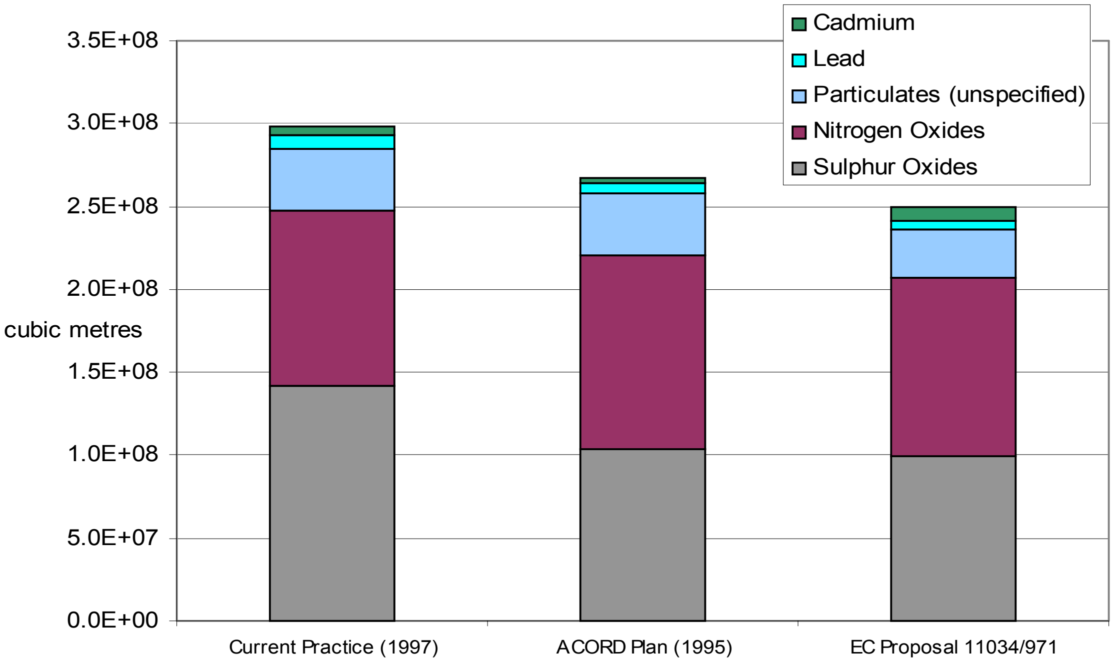


Figure 4.1f Comparison of Critical Volumes (Water) for 1997 Current Practice, the 1995 ACORD Plan and the Draft EC ELV Directive 11034/971

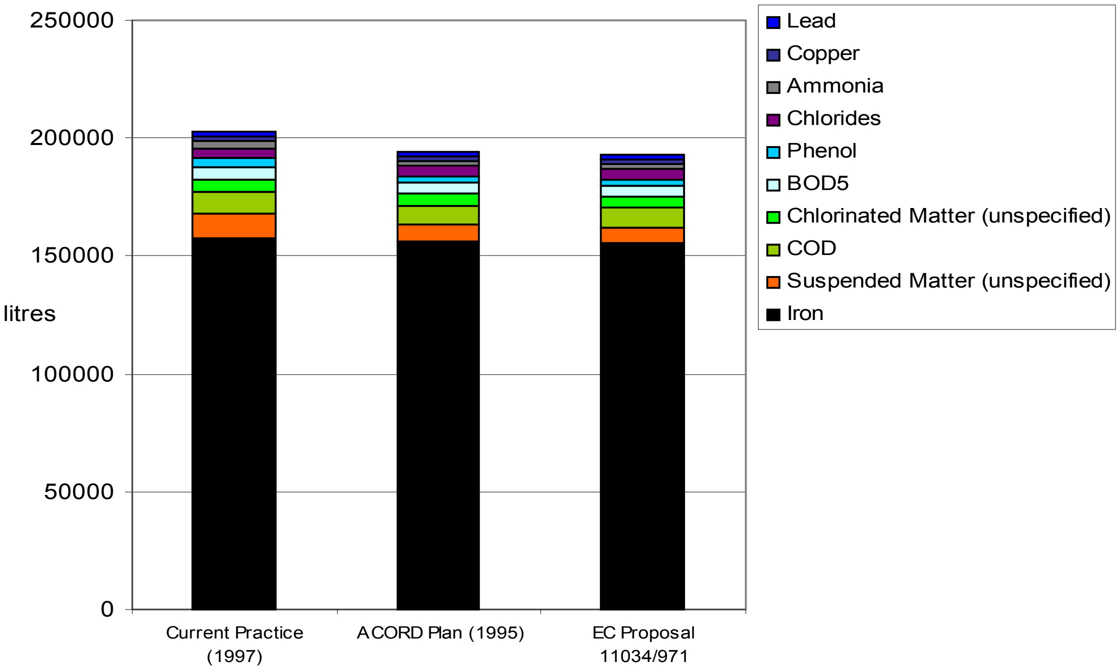


Figure 4.1g Comparison of Ecopoints (total) for 1997 Current Practice, the 1995 ACORD Plan and the Draft EC ELV Directive 11034/971[5]

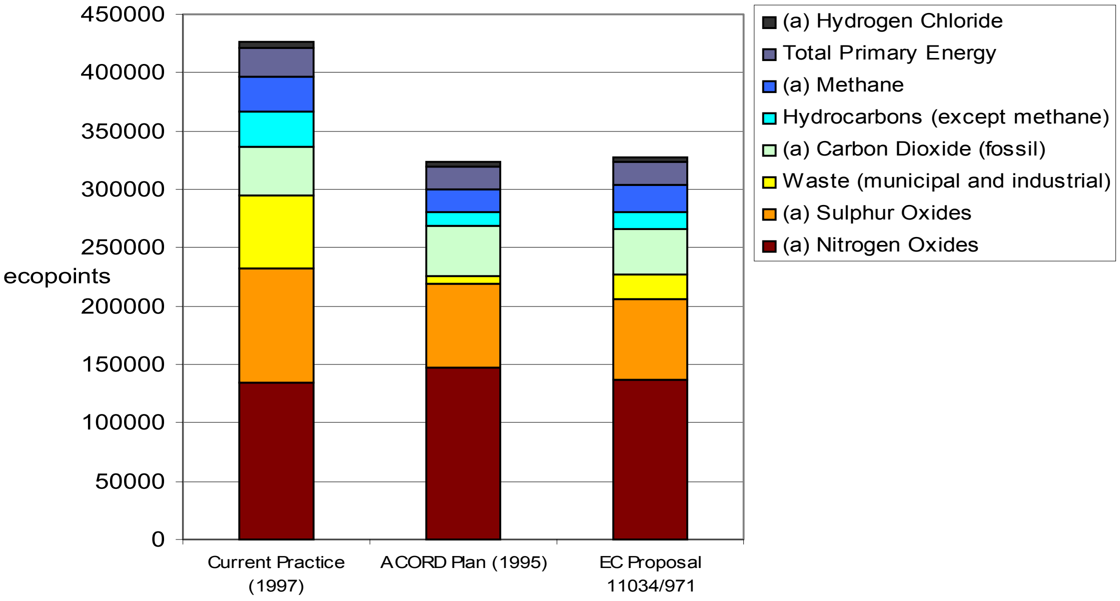
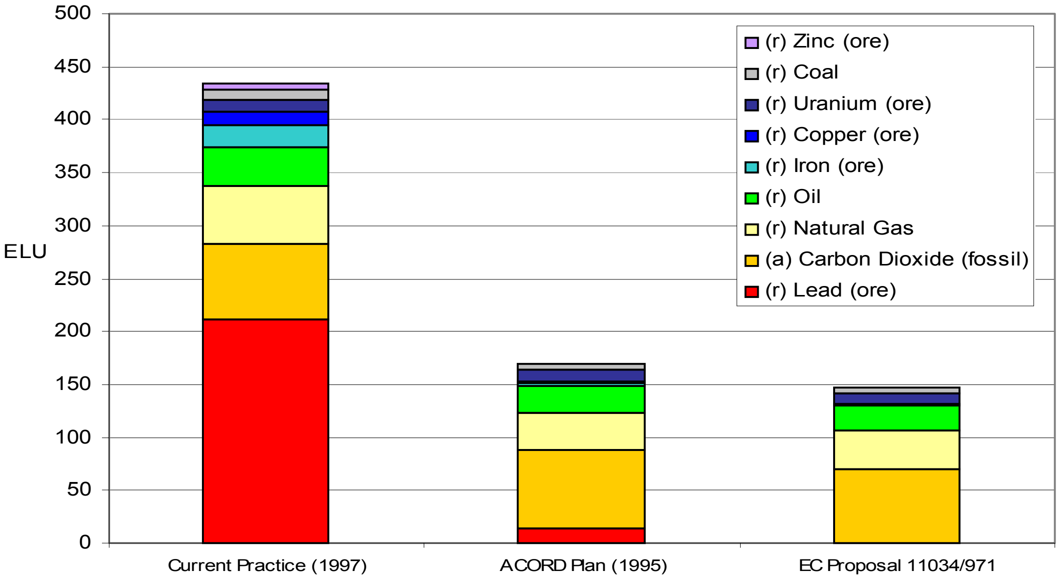


Figure 4.1h Comparison of EPS for 1997 Current Practice, the 1995 ACORD Plan and the Draft EC ELV Directive 11034/971[6]



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[5] Flows preceded by (a) in the legend represent emissions to air.

[6] Flows preceded by (r) in the legend represent extracted resources, whilst those preceded by (a) represent emissions to air.

Table 4.3 Results for the Other Assessment Methodologies for each of the Studied Options.

Impact Category	Units	Current Practice (1997)	ACORD Plan (1995)	EC Proposal 11034/971
Critical Volume (air)	m^3	300763073	268716954	251620019
Critical Volume (water)	litres	204785	195835	194198
Ecopoints (total)	ecopoints	431505	326244	329506
EPS	ELU	448	177	155

These assessment methods show the following trends:

The critical volume methodology for air shows that the draft EC ELV Directive 11034/971 has a marginally smaller impact in terms of toxicological effects than the 1995 ACORD plan of about 6%. Both show an improvement on the effects of 1997 practices of up to 20%. This is due to a greater emission of sulphur oxides in the 1997 Current Practice option in comparison with the other two options.

The 1995 ACORD plan and draft EC ELV Directive 11034/971 are virtually identical in terms of their respective toxicological impacts due to water releases. Both show a marginal improvement of about 5% on 1997 practices. The main contributor to this assessment method for all three options is the release of iron.

With respect to Ecopoints, both the 1995 ACORD plan and the draft EC ELV Directive 11034/971 are virtually identical, with a significant improvement of 32% on 1997 practices. This improvement arises primarily due to the diversion of waste away from landfill.

The draft EC ELV Directive 11034/971 produces a 14% smaller EPS score than the 1995 ACORD plan, and is nearly one third of the score obtained for 1997 practices. This is primarily due to avoiding the need to mine for lead ore.

4.3 Analysis of results in Chapter 4 by life cycle impact potential

In the sections below, each of the figures 4.1a to 4.1d is broken down in more detail for each of the assessed options, in order to gain an understanding of where the life cycle environmental impacts are arising.

4.3.1 Greenhouse effect (direct over 100 years)

Figures 4.2a to 4.2c illustrate the global warming impact potential results for each of the options, broken down by contributing sub systems. These comprise the ELV processing and disposal chain and contributing primary systems arising from the system boundary expansion methodology.

Figure 4.2a Global Warming (Direct, over 100 years) Impact Potential broken down by Contributing System for the 1997 Current Practice Option

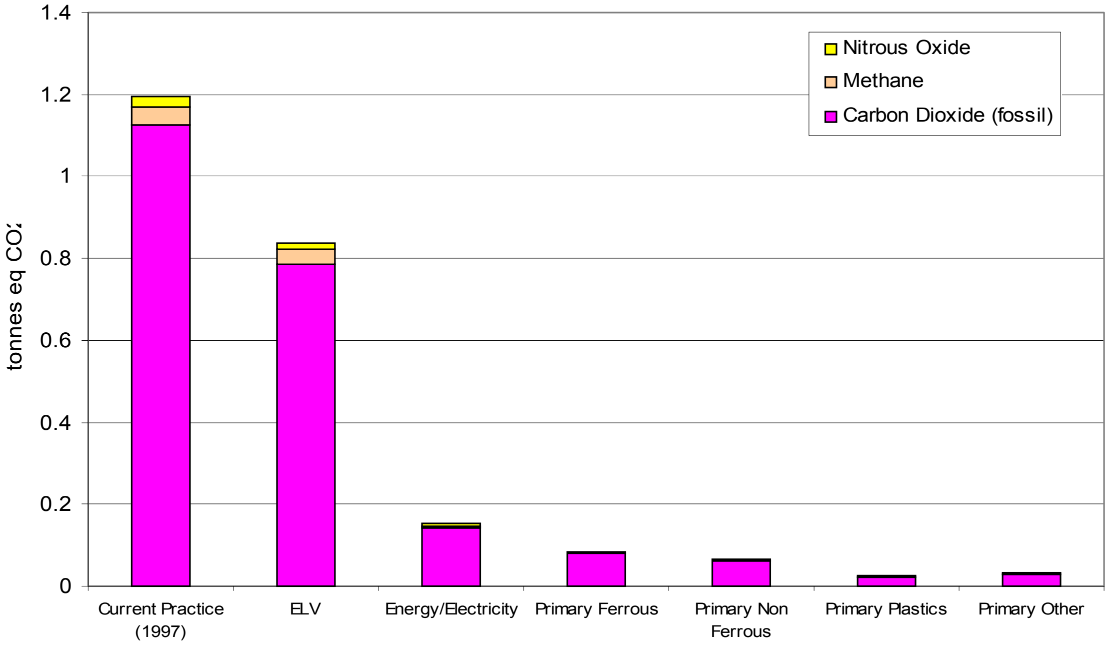


Figure 4.2b Global Warming (Direct, over 100 years) Impact Potential broken down by Contributing System for the 1995 ACORD Plan Option

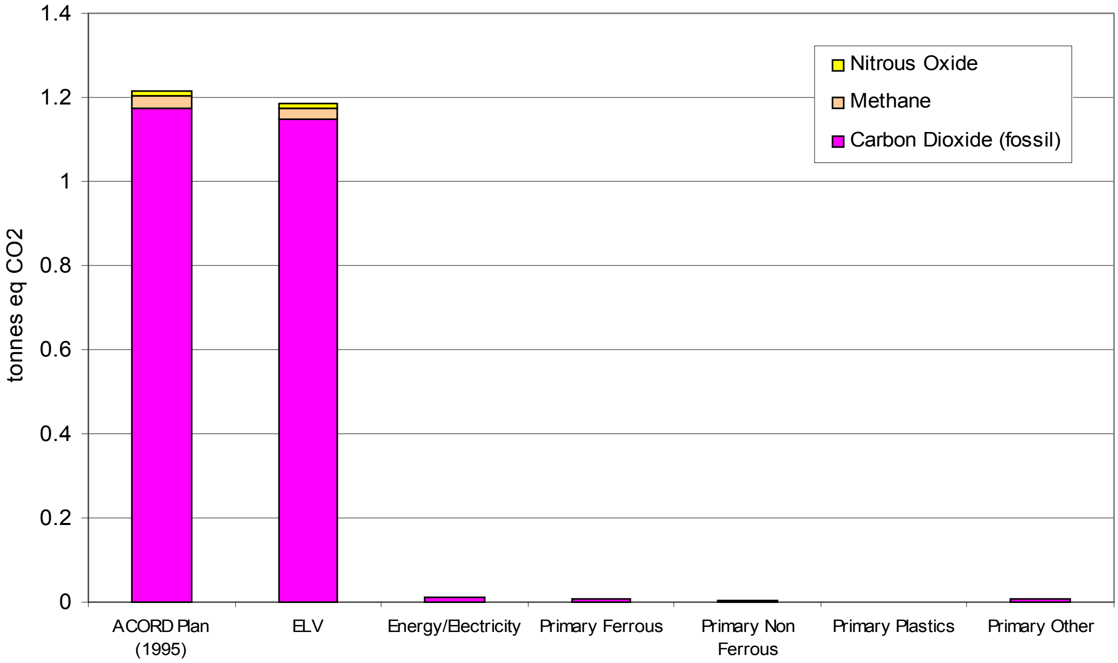
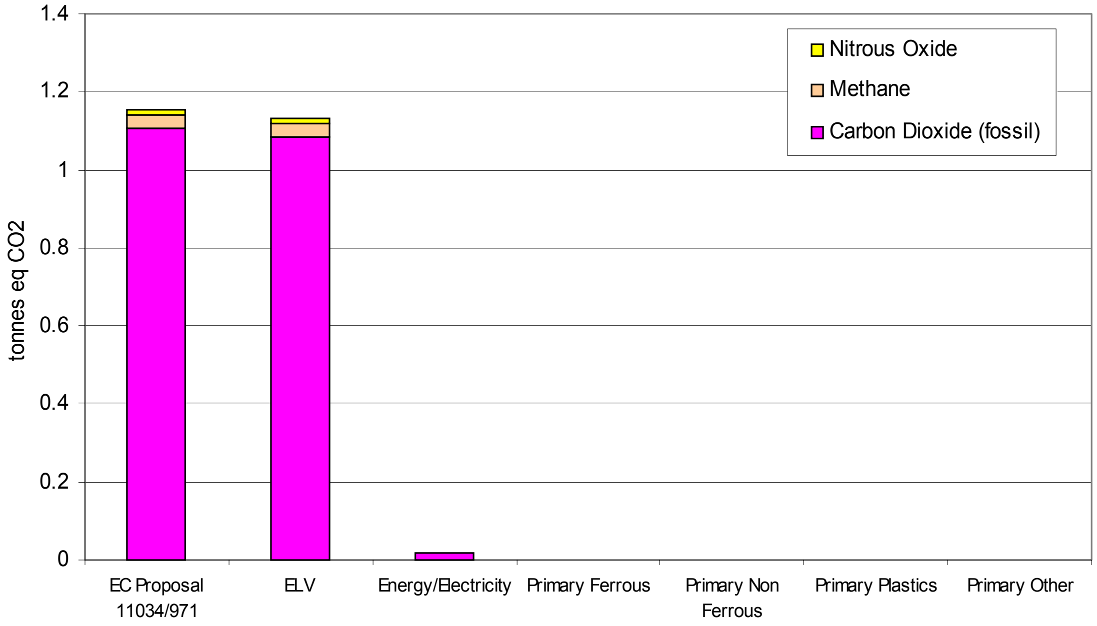


Figure 4.2c Global Warming (Direct, over 100 years) Impact Potential broken down by Contributing System for the Draft EC ELV Directive 11034/971



The figures above reveal some interesting trends, which are as follows:

The contribution of the ELV processing and disposal chain to the overall result increases with greater recycling (and recovery), i.e. the contribution of the other primary systems becomes less. Thus, in the case of the 1997 Current Practice option, the global warming impact associated with ELV processing and disposal comprises 70% of the impact potential compared to 98% for the draft EC ELV Directive 11034/971. This trend is a reflection of the recycling and recovery rates achieved for each option. When there is a lower rate of recycling and recovery (as in the case of the 1997 Current Practice option), the shortfall in provision of material and product from the ELV is supplemented with material and product from virgin sources reflected in the primary material systems.

Greater recycling targets in the draft EC ELV Directive 11034/971, in comparison with the 1995 ACORD plan, mean that we see a contribution from the primary ferrous, non ferrous and other systems. This is a reflection of the slightly higher reuse and recycling target in the draft EC ELV Directive 11034/971 of 85% compared to the 1995 ACORD plan target of 82%.

Both the 1995 ACORD plan and draft EC ELV Directive 11034/971 options show a contribution from combustion of fossil fuels or electricity from the national grid. This requires some further interpretation. The 1995 ACORD plan states that material (after 82% reuse and recycling) should be combusted for energy recovery (as fuel or electricity). In contrast, the draft EC ELV Directive 11034/971 allows for 10% of material to be combusted as a fuel (or for electricity generation) but with an additional 5% of material that can go to landfill. This segregation of material for energy recovery and landfilling in the draft Directive has been made on the basis of net heat value (in the life cycle model). Thus, material derived from the ELV with a higher net heat value is assumed to be available for combustion whereas inert material is assumed to be landfilled. As part of this process of segregation, we assumed that all tyres are removed from the ELV at the dismantlers regardless of whether they would be remoulded or not. Those that would not be suitable for remoulding or other applications, would be combusted at the Elm Energy facility in Wolverhampton to generate electricity for the national grid. In modelling the 1995 ACORD plan, we assumed that such tyres would remain on the ELV and help to increase the net heat value of the waste destined for combustion and energy recovery. In mass terms the amount of material for combustion in the draft Directive option is less than in the 1995 ACORD plan (104 kg compared to 188 kg). However, we assume that the net heat value of the waste arising from the draft Directive is higher than that obtained from the 1995 ACORD plan, because of the incentive to remove inerts arising from the permissible 5% limit on material to landfill. This means that more energy (and electricity) is obtainable per unit mass of waste from the draft Directive ELV in comparison with the 1995 ACORD ELV. Due to this interpretation, the draft EC ELV Directive 11034/971 option generates marginally more electricity from combustion of waste from the ELV (58 MJ electric) but produces less fuel energy (259 MJ). As a consequence, the draft Directive option features fossil fuel energy (due to the greater fuel energy generated from combustion of ELV derived waste in the 1995 ACORD plan option) and the ACORD plan option features generation of electricity using the UK fuel mix (due to greater electricity generation in the draft ELV Directive option).

All of the contributing systems in each of the options generate carbon dioxide from fossil fuels. Most methane emissions arise from the ELV processing and disposal chain for each of the options.

Expressed as indicators of performance, we obtain the following results:

Area of temperate forest required to take up an equivalent amount of carbon dioxide (CO_2) annually:
1997 Current Practice: Equivalent to 0.039 hectares of forest
ACORD Plan (1995): Equivalent to 0.040 hectares of forest
Draft EC ELV Directive 11034/971: Equivalent to 0.038 hectares of forest

Equivalent methane (CH_4) emissions arising from cattle daily:
1997 Current Practice: Equivalent to 10 cattle
ACORD Plan (1995): Equivalent to 6 cattle
Draft EC ELV Directive 11034/971: Equivalent to 8 cattle

Area of temperate forest required to take up carbon dioxide equivalent emissions (tonnes eq. CO_2) annually:
1997 Current Practice: Equivalent to 0.041 hectares of forest
ACORD Plan (1995): Equivalent to 0.042 hectares of forest
Draft EC ELV Directive 11034/971: Equivalent to 0.039 hectares of forest

Figures 4.2d to 4.2f below show the global warming impact potential associated with each of the components of the ELV processing and disposal chain for each option.

Figure 4.2d Global Warming (Direct, over 100 years) Impact Potential broken down by Contributing System in the ELV Processing and Disposal Chain of the 1997 Current Practice Option

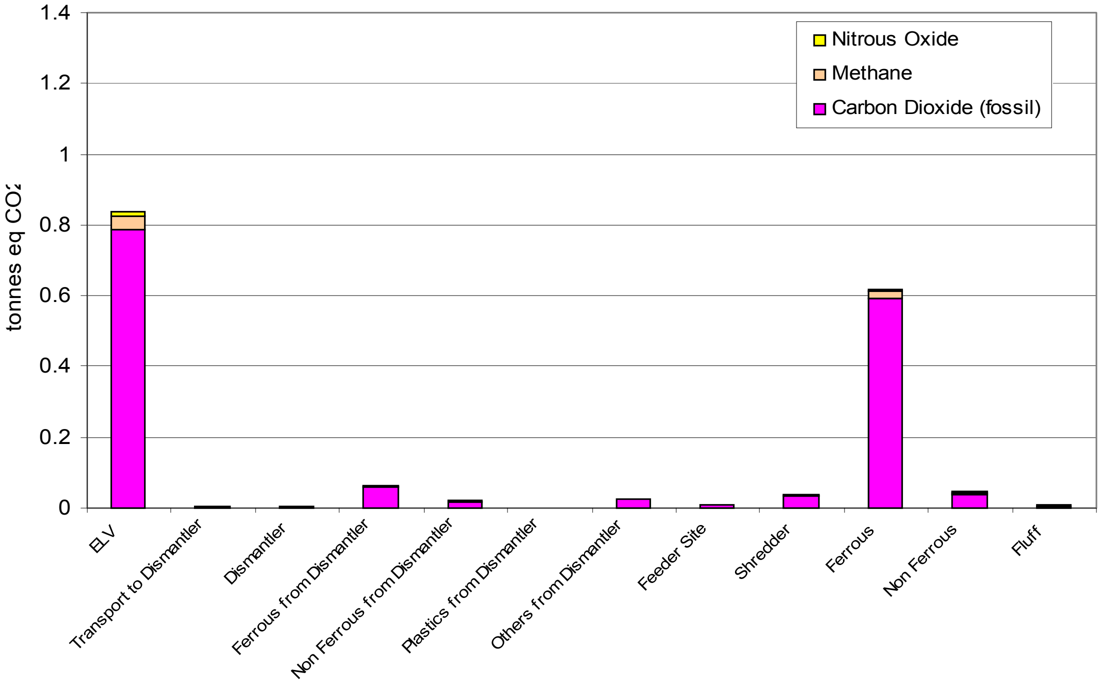


Figure 4.2e Global Warming (Direct, over 100 years) Impact Potential broken down by Contributing System in the ELV Processing and Disposal Chain of the 1995 ACORD Plan Option

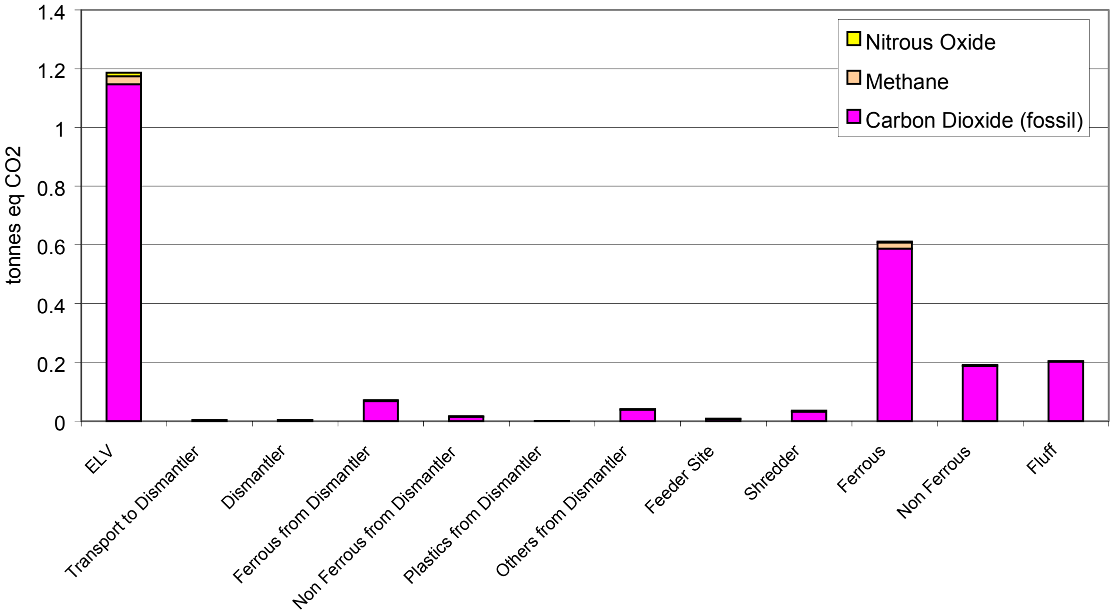
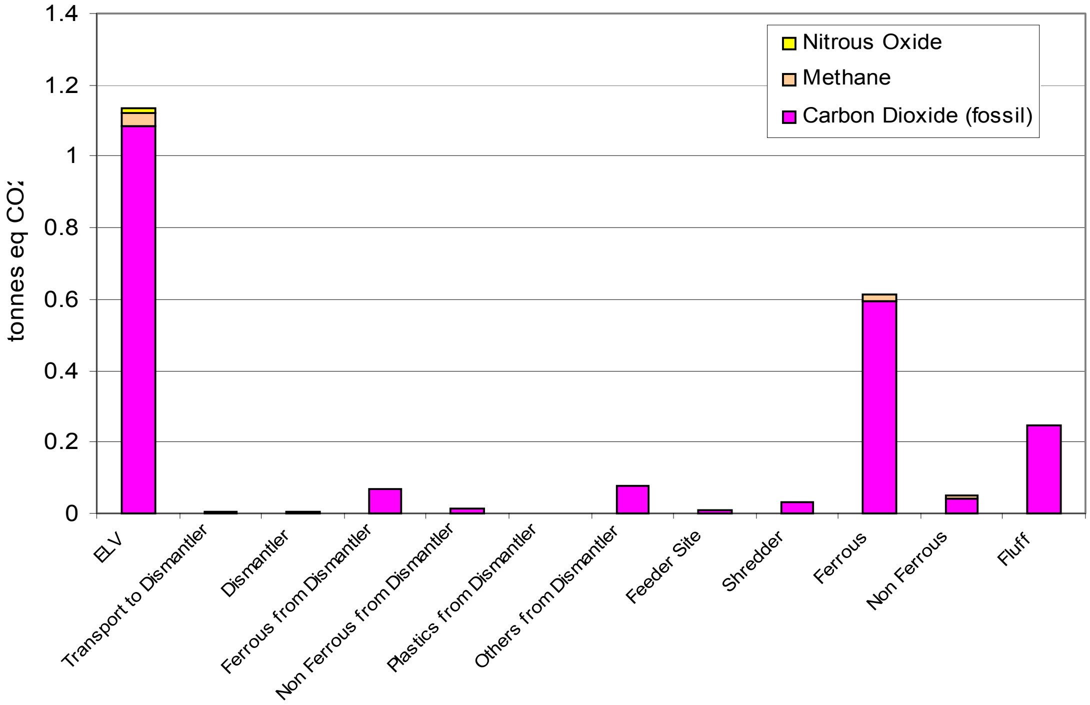


Figure 4.2f Global Warming (Direct, over 100 years) Impact Potential broken down by Contributing System in the ELV Processing and Disposal Chain of the Draft EC ELV Directive 11034/971 Option



Examination of these figures reveals the following trends:

All three options show that it is the transport and subsequent processing of secondary ferrous metal arising from the ELV that makes the greatest contribution to the global warming impact potential of ELV processing and disposal. This ferrous may arise at the dismantling or shredding stage and can total 57% (for the 1995 ACORD plan option) to 82% (for the 1997 practices option) of the calculated global warming impact potential of ELV processing and disposal. This result is unsurprising given that the majority of an ELV is typically ferrous metal (in mass terms).

The global warming impact potential of the non ferrous and fluff fractions arising from the shredder varies due to the amount of combustion (with energy recovery) that is considered in these systems. In the 1997 Current Practice option, there is no combustion of fluff or NFM waste, all of which is landfilled. Consequently the contribution of these systems is small (about 5%), and in the case of the NFM system, more related to subsequent NFM transport and processing. The 1995 ACORD plan suggests the combustion of all material (that cannot be reused or recycled) and as a result, we see a more significant contribution to the global warming impact of 33% from the non ferrous and fluff systems. The draft EC ELV Directive 11034/971 option does not feature such a significant contribution since it allows for 5% of material derived from the ELV to go to landfill.

For all options, certain life cycle stages in the ELV processing and disposal chain show consistently negligible global warming impact potentials (a combined contribution of 2% or less). These stages include transport to the dismantler, the dismantling operation itself, plastics processing arising from dismantling (since this is not a mainstream activity) and feeder sites, all of which are low energy users in comparison with other parts of the life cycle.

4.3.2 Air acidification

Figures 4.3a to 4.3c illustrate a breakdown of the air acidification impact potential for each of the options, in terms of the contribution of the ELV processing and disposal chain and other contributing primary systems.

Figure 4.3a Air Acidification Impact Potential broken down by Contributing System for the 1997 Current Practice Option

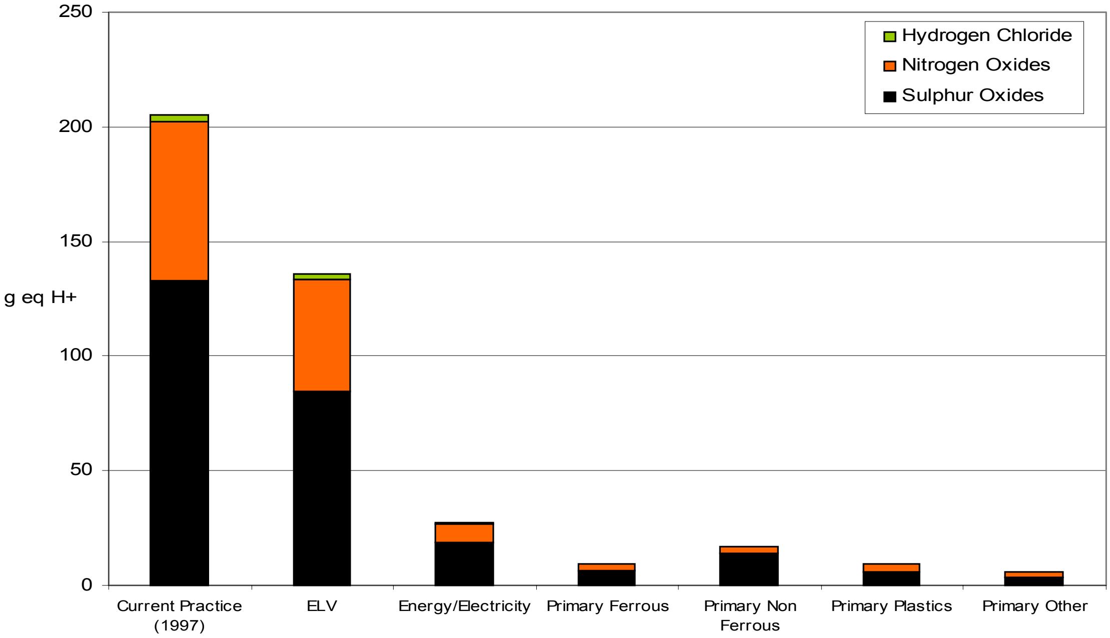


Figure 4.3b Air Acidification Impact Potential broken down by Contributing System for the 1995 ACORD Plan Option

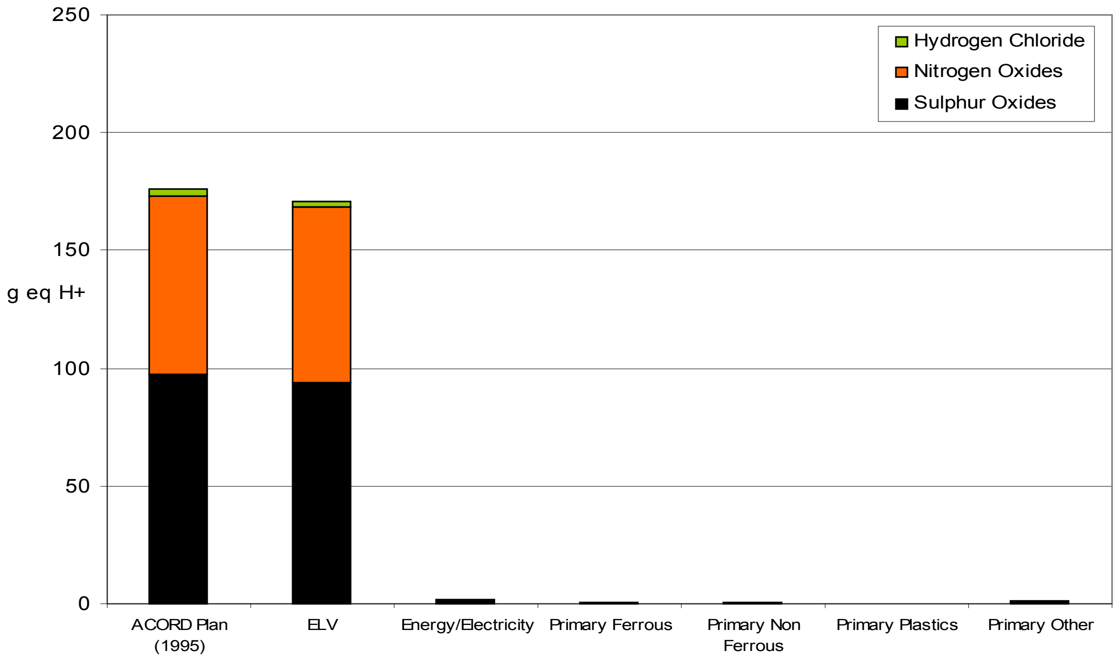
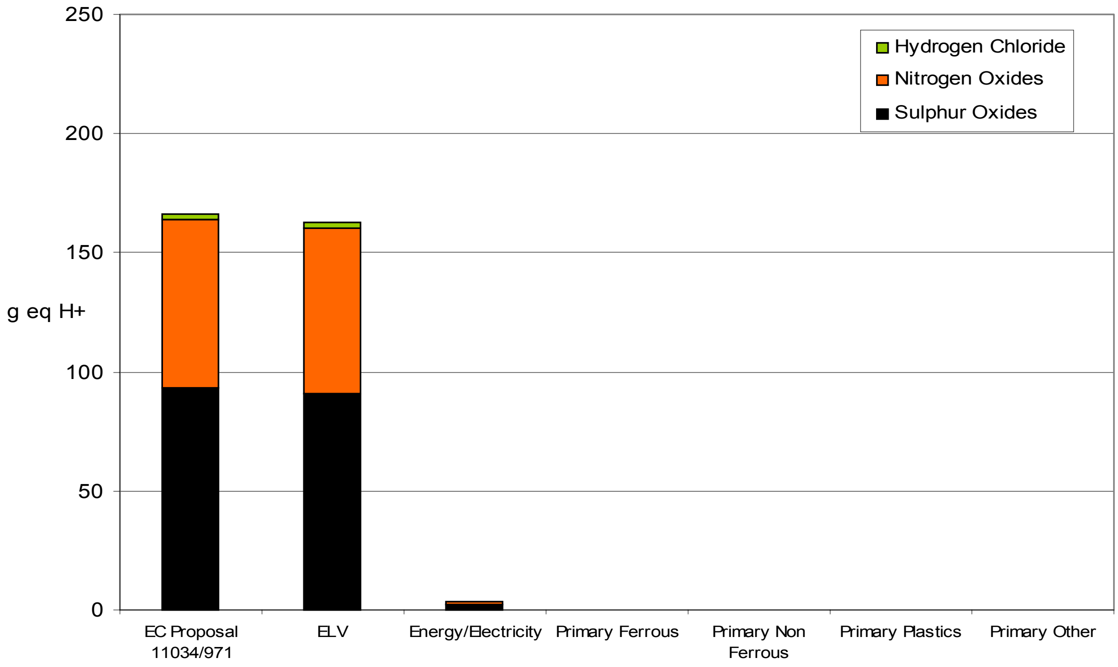


Figure 4.3c Air Acidification Impact Potential broken down by Contributing System for the Draft EC ELV Directive 11034/971 Option



Since the air acidification impact is largely due to combustion processes (whether from transportation or processing operations), the trends revealed in Figures 4.3a to 4.3c above bear close resemblance to those discussed in the section above on global warming, which also related primarily to combustion processes.

In this case, we see the dominance of the ELV processing and disposal chain (for the same reasons as already discussed above) and the contribution (or not) of the primary systems for each of the options, again as discussed in the global warming section above.

In all cases, each system produces sulphur oxides and nitrogen oxides that contribute to the total figure. Expressed as indicators of performance we obtain the following comparisons:

Nitrogen Oxides (NO_X) emissions expressed as the distance travelled by a petrol car, during which it will produce equivalent NO_x emissions:
1997 Current Practice: Equivalent to 3560 miles
ACORD Plan (1995): Equivalent to 3900 miles
Draft EC ELV Directive 11034/971: Equivalent to 3630 miles

Sulphur Oxides (SO_X) emissions expressed as the distance travelled by a petrol car, during which it will produce equivalent SO_x emissions:
1997 Current Practice: Equivalent to 9790 miles
ACORD Plan (1995): Equivalent to 7170 miles
Draft EC ELV Directive 11034/971: Equivalent to 6840 miles

Figures 4.3d to 4.3f below show the air acidification impact potential of the ELV processing and disposal chain broken down by contributing system.

Figure 4.3d Air Acidification Impact Potential broken down by Contributing System in the ELV Processing and Disposal Chain of the 1997 Current Practice Option

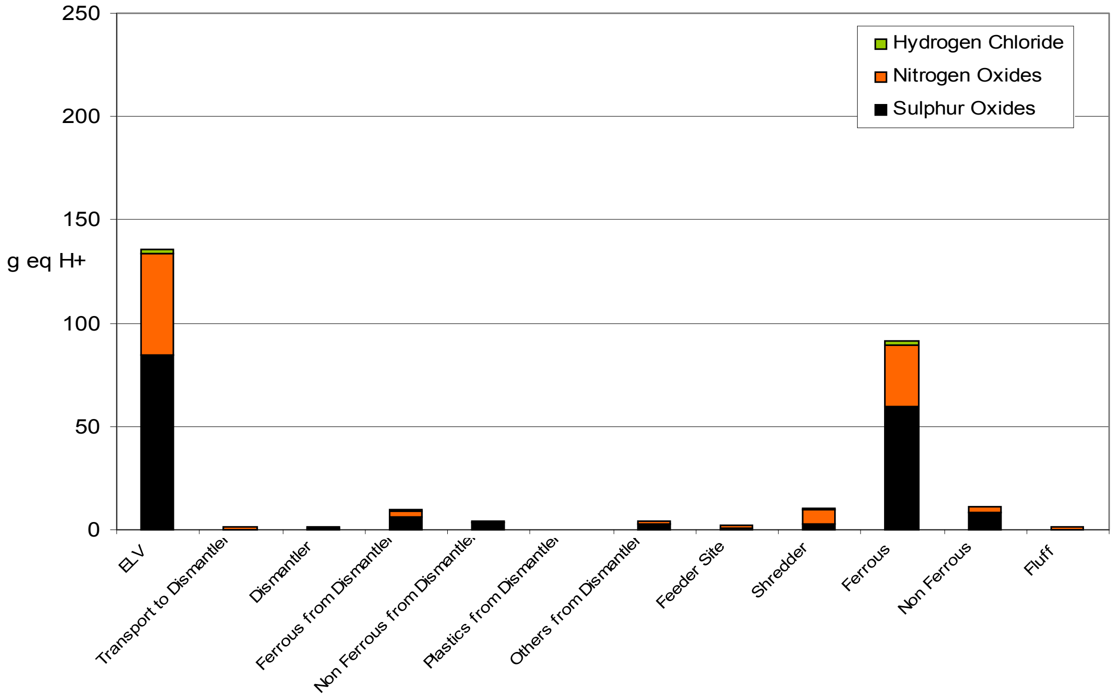


Figure 4.3e Air Acidification Impact Potential broken down by Contributing System in the ELV Processing and Disposal Chain of the 1995 ACORD Plan Option

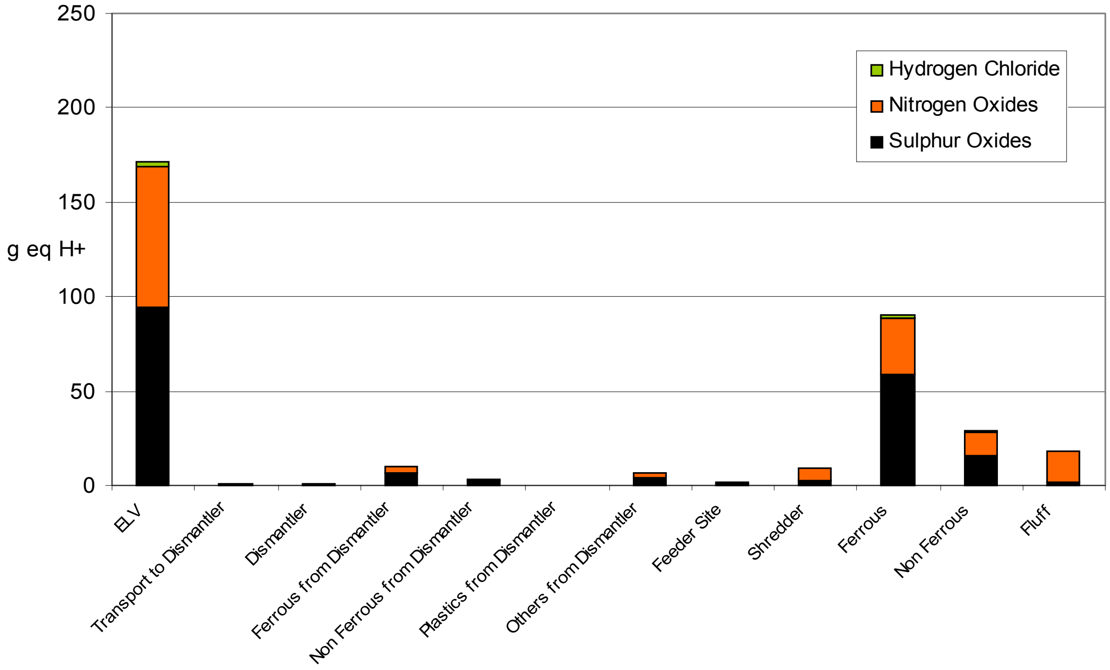
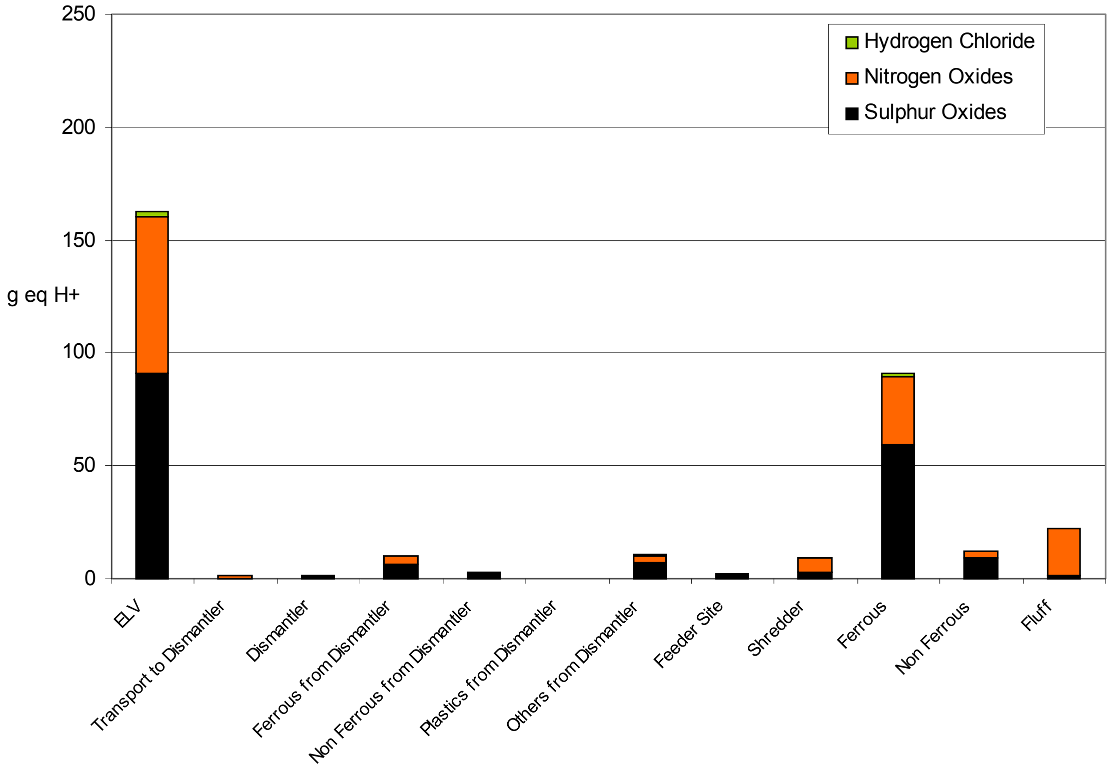


Figure 4.3f Air Acidification Impact Potential broken down by Contributing System in the ELV Processing and Disposal Chain of the Draft EC ELV Directive 11034/971 Option



As with the global warming results reported above, the air acidification impact potential results for the ELV processing and disposal chain show that it is the transportation and processing of secondary ferrous metal that makes the greatest contribution to acidification (from 59% for the 1995 ACORD plan to 74% for 1997 practices). This result arises due to the prevalence of ferrous metal in an ELV (on the basis of mass).

Similarly, combustion of fluff and NFM waste in the 1995 ACORD plan option produces the largest contribution of 27% from these stages of the life cycle compared to only 9% for the 1997 practices option (in which no fluff or NFM waste is combusted, but instead sent straight to landfill). High emissions of nitrogen oxides relative to sulphur oxides in the fluff fraction of the 1995 ACORD plan and draft EC ELV Directive 11034/971 occur as a direct result of the combustion of the fluff. The higher sulphur oxides emissions (relative to nitrogen oxides) observed for the ferrous stage in all three options is due partly to the combustion processes in the electric arc furnace and partly to transportation to overseas processing facilities by ship (using heavy fuel oil).

Transport to dismantlers, the dismantling activity, processing of plastics removed at a dismantlers (which is not a mainstream activity) and crushing ELVs at feeder sites have a negligible combined potential impact on air acidification, principally because they are small energy users in comparison with other parts of the life cycle (less than 3%)

4.3.3 Stratospheric ozone depletion

The small result calculated for the potential impact on stratospheric ozone depletion is due to emission of the fire retardant halon 1301. The model shows that trace emissions of halon 1301 occur in most life cycle stages. However, as mentioned in Chapter 4, this result should be treated with caution due to ongoing activities that are reducing reliance on ozone depleting substances as a condition of the Montreal Protocol process. Due to the rapid transformations that are taking place, it is likely that LCA databases may not keep pace with developments and may, as a consequence, overstate the likely impact potential on stratospheric ozone depletion.

4.3.4 Non renewable resource depletion

Figures 4.4a to 4.4c provide a breakdown of the non renewable resource depletion impact potential for each of the options, in terms of the contribution of the ELV processing and disposal chain and other contributing primary systems. It is important to note that this methodology considers depletion on a global scale, and does not take into account local or regional depletion issues, that may be of more or less significance.

Figure 4.4a Non Renewable Resource Depletion Impact Potential broken down by Contributing System for the 1997 Current Practice Option

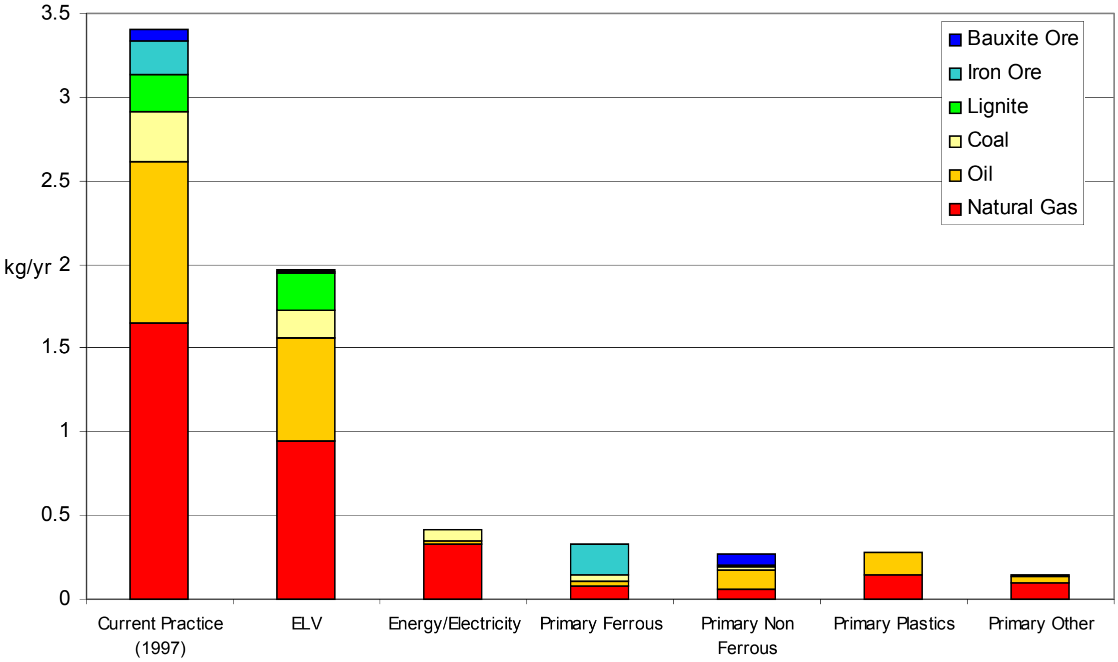


Figure 4.4b Non Renewable Resource Depletion Impact Potential broken down by Contributing System for the 1995 ACORD Plan Option

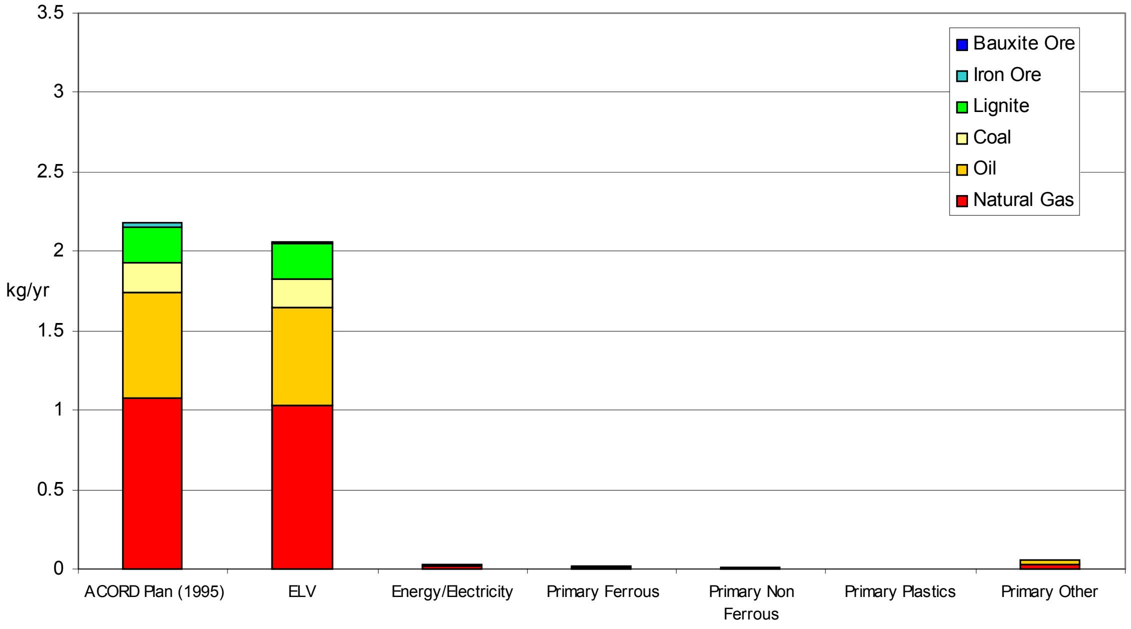
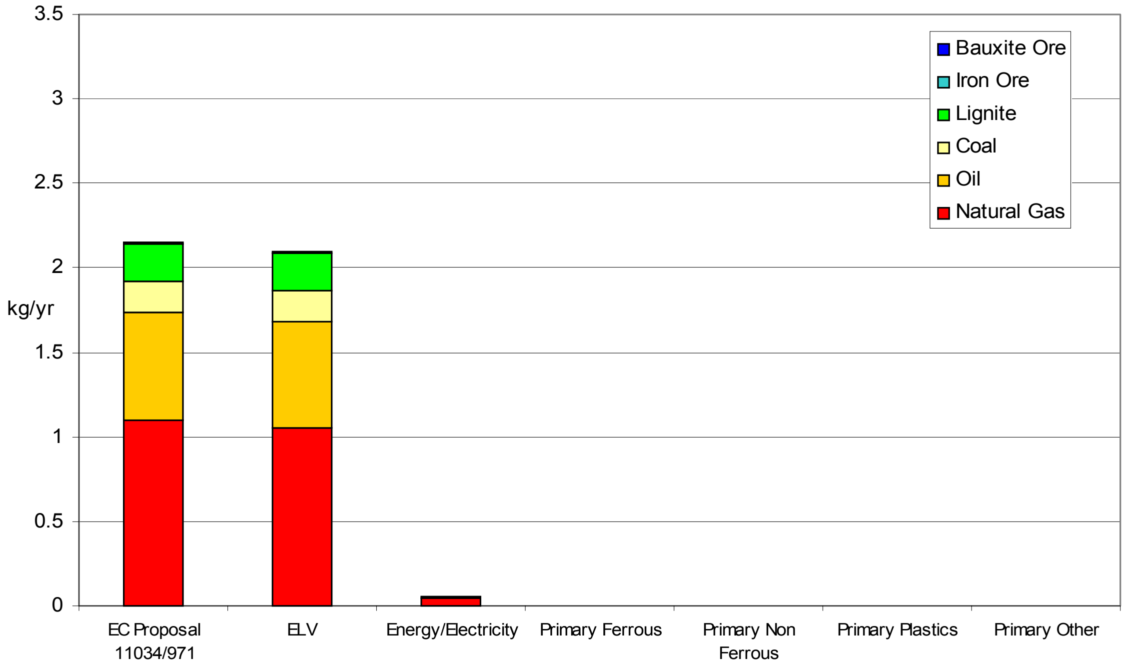


Figure 4.4c Non Renewable Resource Depletion Impact Potential broken down by Contributing System for the Draft EC ELV Directive 11034/971 Option



Figures 4.4a to 4.4c show the following trends:

For all options, depletion of fossil fuels constitutes the major impact potential, in comparison with other non renewable resources. These may be used for generating energy or as a feedstock (as in the case of oil to make plastics).

Lower recycling and recovery rates for 1997 practices, means more primary production of materials and products is necessary. Consequently, the ELV processing and disposal chain makes less of a contribution to the total non renewable resource depletion impact potential in comparison to the other two options (57% as opposed to 94% or more).

As observed for the global warming and air acidification impact assessment potentials, the 1995 ACORD plan features impacts arising from production of primary material and products (and generation of electricity on the national grid) because it achieves slightly lower recycling rates compared to the draft EC ELV Directive 11034/971. The draft Directive incurs further non renewable resource depletion impact potential from production of fuel energy from fossil fuels, as it does not attain the level of energy recovery achieved by the 1995 ACORD plan.

Natural gas and oil make the largest contribution to the observed result (at least 76%), due primarily to the smaller known reserves in comparison with coal.

Expressing natural gas and oil depletion in terms of indicators of performance, we obtain the following results:

Oil consumption expressed as equivalent oil consumption through use of petrol in a car travelling a distance:

1997 Current Practice:	Equivalent to 680 miles
ACORD Plan (1995):	Equivalent to 470 miles
Draft EC ELV Directive 11034/971:	Equivalent to 450 miles

Natural gas consumption expressed as the number of people in the UK consuming natural gas on a daily basis:

1997 Current Practice:	Equivalent to 35 persons
ACORD Plan (1995):	Equivalent to 23 persons
Draft EC ELV Directive 11034/971:	Equivalent to 23 persons

Figures 4.4d to 4.4f provide a breakdown of the ELV processing and disposal chain for each of the above options in terms of potential impact on non renewable resource depletion.

Figure 4.4d Non Renewable Resource Depletion Impact Potential broken down by Contributing System in the ELV Processing and Disposal Chain for the 1997 Current Practice Option

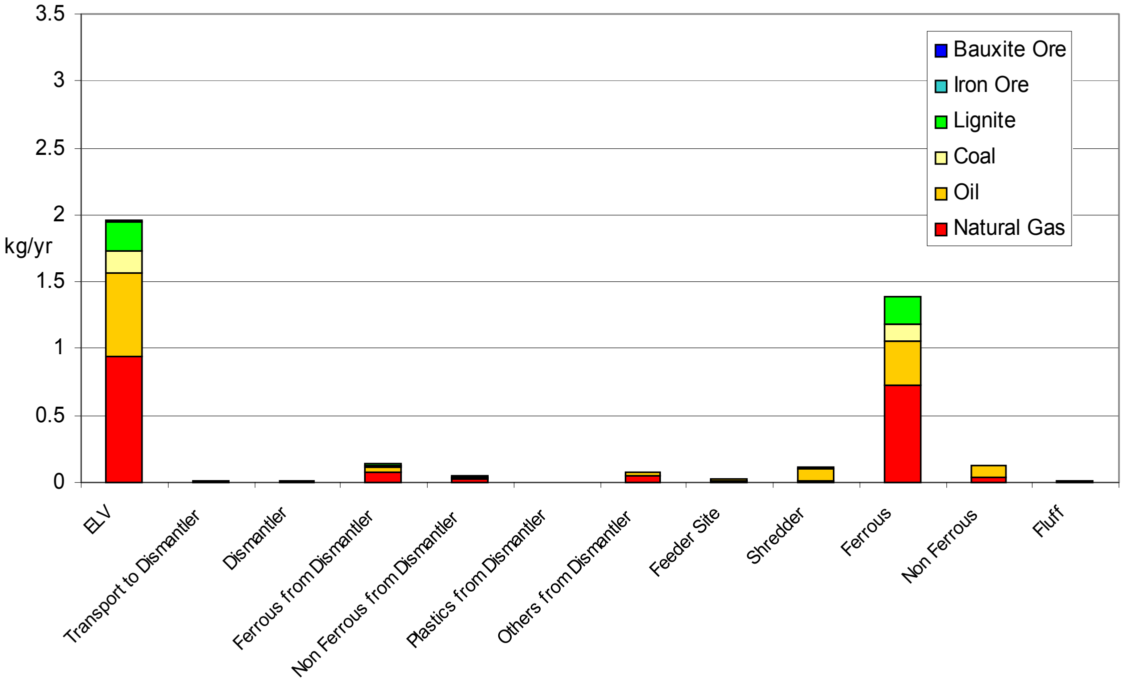


Figure 4.4e Non Renewable Resource Depletion Impact Potential broken down by Contributing System in the ELV Processing and Disposal Chain for the 1995 ACORD Plan Option

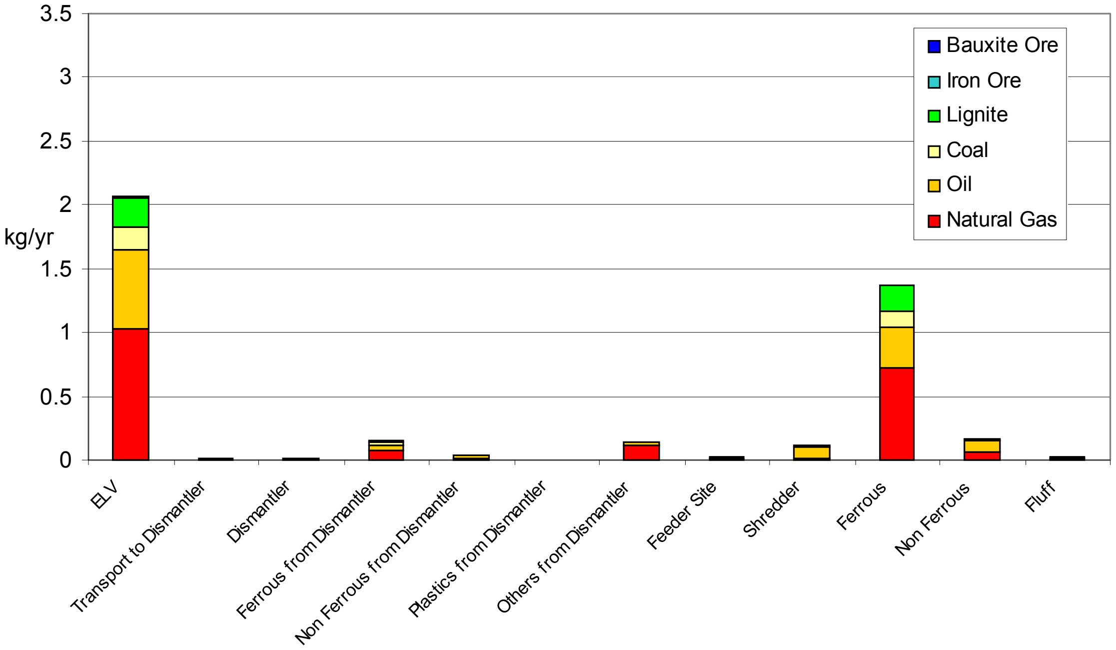
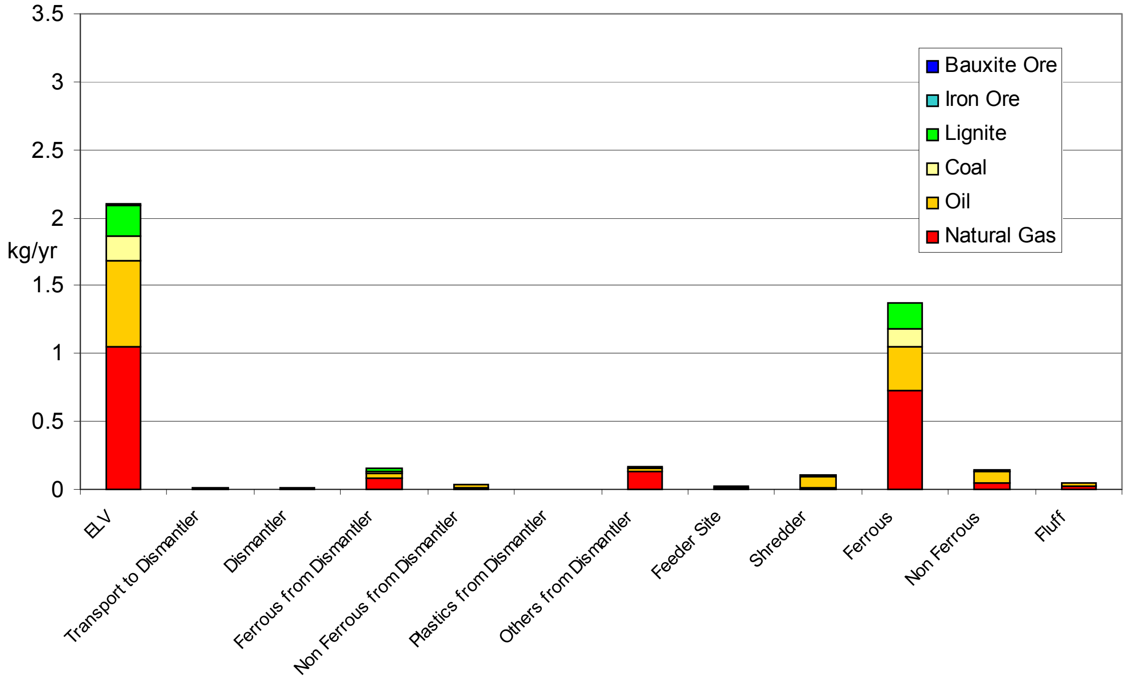


Figure 4.4f Non Renewable Resource Depletion Impact Potential broken down by Contributing System in the ELV Processing and Disposal Chain for the Draft EC ELV Directive 11034/971 Option



Figures 4.4d to 4.4f illustrate the following points:

As with previous results, it is the transport and processing of ferrous scrap that makes the largest contribution of 73 – 78% to the calculated result, due to the amount of ferrous in an ELV in comparison to other materials (on a mass basis).

The result for ferrous transport and processing shows depletion of lignite, a fossil fuel that is not commonly used in the UK. Since we assume that half of the ferrous for processing is exported, this lignite depletion relates to use as a source of fuel overseas.

The non renewable resource depletion impact potentials are generally a function of the amount of material that is being processed and the energy demands of the process or processes. Typically ferrous and non ferrous metals processing, and glass processing (contained in the Others from Dismantler column) are energy intensive and are the main reason why we see depletion of natural gas and oil in these columns. Similarly diesel combustion at the shredder is the reason we see oil depletion for this column.

The fluff fraction in the 1997 Current Practice option has less of a non renewable resource depletion impact potential than its counterparts in the other two options. This is because fluff in the 1997 Current Practice option goes to landfill (requiring some fuel for transport) whereas in the 1995 ACORD plan and draft EC ELV Directive 11034/971 options, it is processed further, requiring energy.

It is reasonable to assume that those life cycle stages that have a negligible potential impact on non renewable resource depletion are the processes that are less energy intensive and/or process a small amount of material from the ELV. These stages include transport to the dismantler, the dismantling activity itself, and transport and processing of plastics removed at the dismantler (which is not a mainstream activity), which collectively contribute about 1% of the calculated impact.

4.3.5 Eutrophication of water

Figures 4.5a to 4.5c provide a breakdown of the eutrophication of water impact potential for each of the options, in terms of the contribution of the ELV processing and disposal chain and other contributing primary systems. It is important to note that this methodology does not consider the geographical distribution of emissions of potentially eutrophicating substances, i.e. the impact of eutrophication will be very different if all discharges arise at a single outfall in one lake or slow moving river as opposed to dispersed emissions into several rivers in different countries. Since it is reasonable to assume that most industries would have discharge consents for their respective locations, the potential for eutrophication will depend very much on local conditions that are outside the scope of this study.

Nevertheless, it is of interest to learn which activities have the greatest potential to cause eutrophication in the context of this study.

Figure 4.5a Eutrophication of Water Impact Potential broken down by Contributing System for the 1997 Current Practice Option

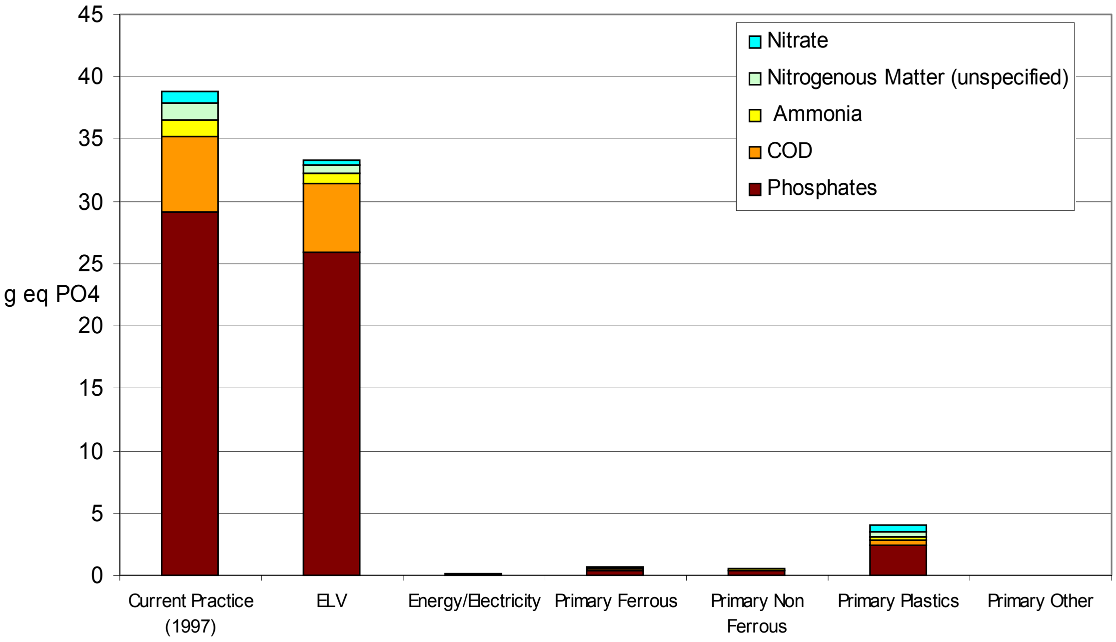


Figure 4.5b Eutrophication of Water Impact Potential broken down by Contributing System for the 1995 ACORD Plan Option

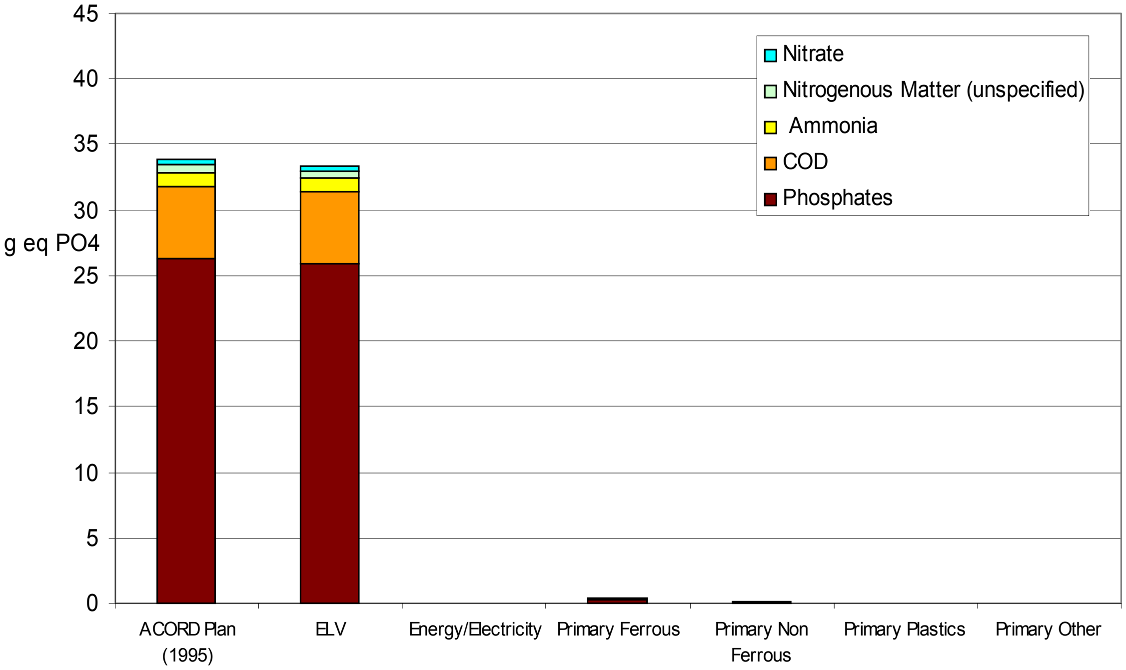
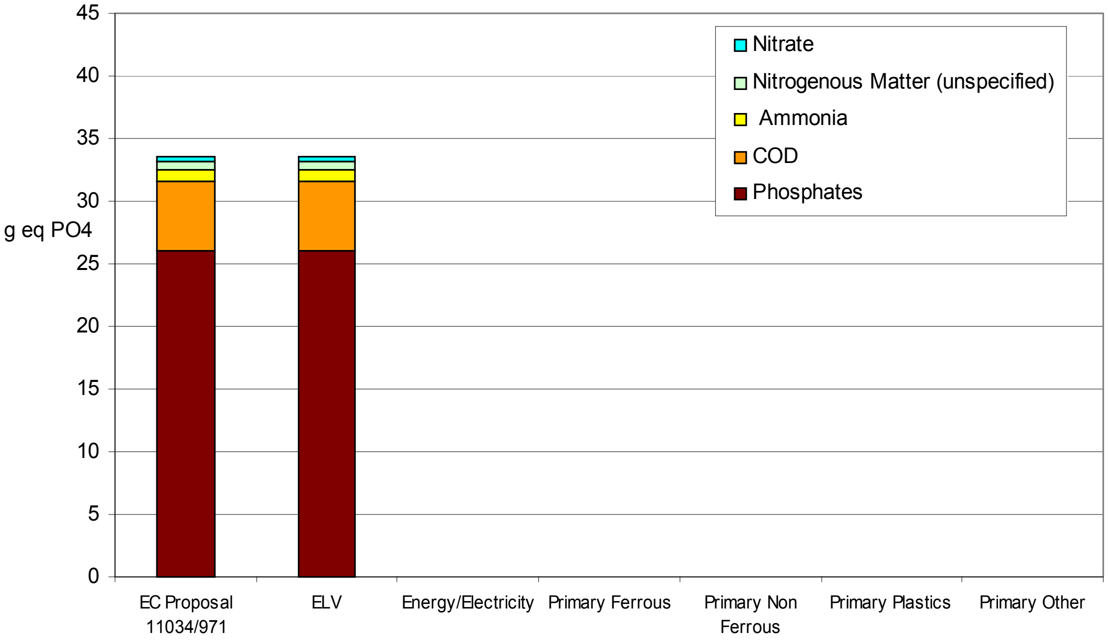


Figure 4.5c Eutrophication of Water Impact Potential broken down by Contributing System for the Draft EC ELV Directive 11034/971 Option



Figures 4.5a to 4.5c show the following results:

For all three options, it is emission of phosphates that is the largest contributor to the calculated result (75 – 77%). Emission of organic compounds that are oxidised chemically or biologically leads to the next most important contribution by COD, arising from the ELV processing and disposal chain.

The eutrophication impact potential of primary ferrous and non ferrous metals production appears to be small in comparison with the eutrophication impact potential of primary plastics production. For example, in the 1997 Current Practice option primary ferrous production totals 25 kg (with a contribution to the impact potential of less than 2%) compared to 12 kg for primary plastics production (and a contribution to the impact potential of over 11%).

Virtually 100% of the eutrophication of water impact assessment potential for the draft EC ELV Directive 11034/971 is due to emissions in the ELV processing and disposal chain.

Phosphate emissions and COD expressed as indicators of performance are as follows:

Chemical Oxygen Demand (COD) expressed in terms of equivalent water necessary to attain a typical COD consent figure of 750 mg/l COD for effluent entering a sewer:
1997 Current Practice: Equivalent to 360 litres
ACORD Plan (1995): Equivalent to 337 litres
Draft EC ELV Directive 11034/971: Equivalent to 337 litres

Phosphates expressed in terms of the necessary volume of water needed so that the UK average phosphates concentration of 0.59 mg/l is attained:
1997 Current Practice: Equivalent to 16 180 litres
ACORD Plan (1995): Equivalent to 14 550 litres
Draft EC ELV Directive 11034/971: Equivalent to 14 400 litres

Figures 4.5d to 4.5e break down the ELV processing and disposal chain into contributing life cycle stages so that we can see the main processes that have the potential to contribute to eutrophication of water.

Figure 4.5d Eutrophication of Water Impact Potential broken down by Contributing System in the ELV Processing and Disposal Chain for the 1997 Current Practice Option

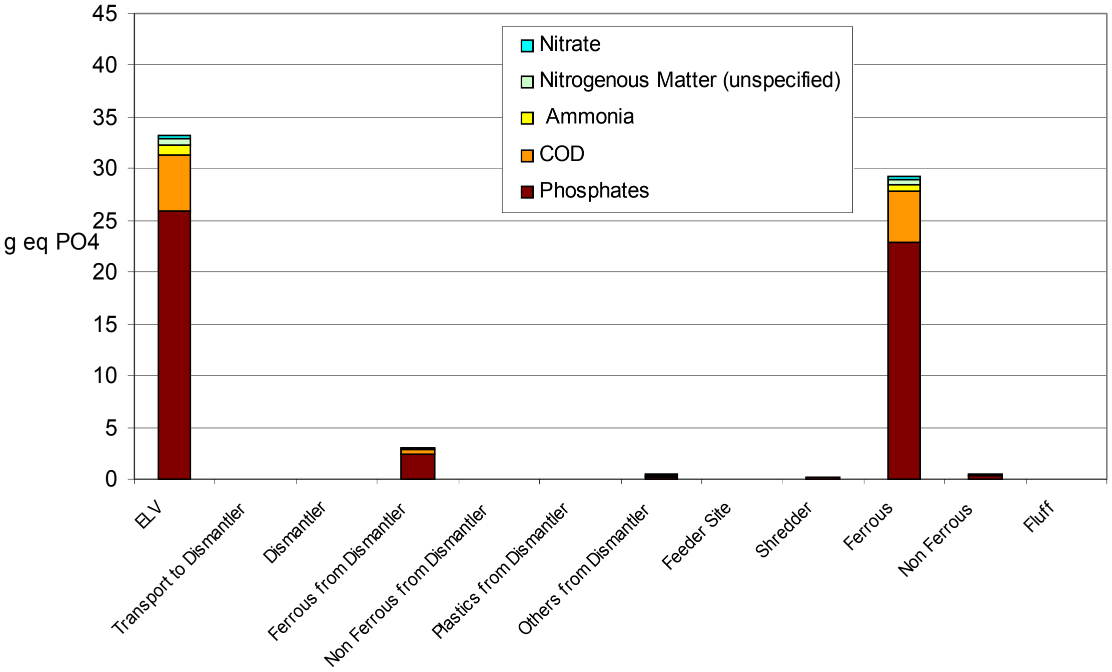


Figure 4.5e Eutrophication of Water Impact Potential broken down by Contributing System in the ELV Processing and Disposal Chain for the 1995 ACORD Plan Option

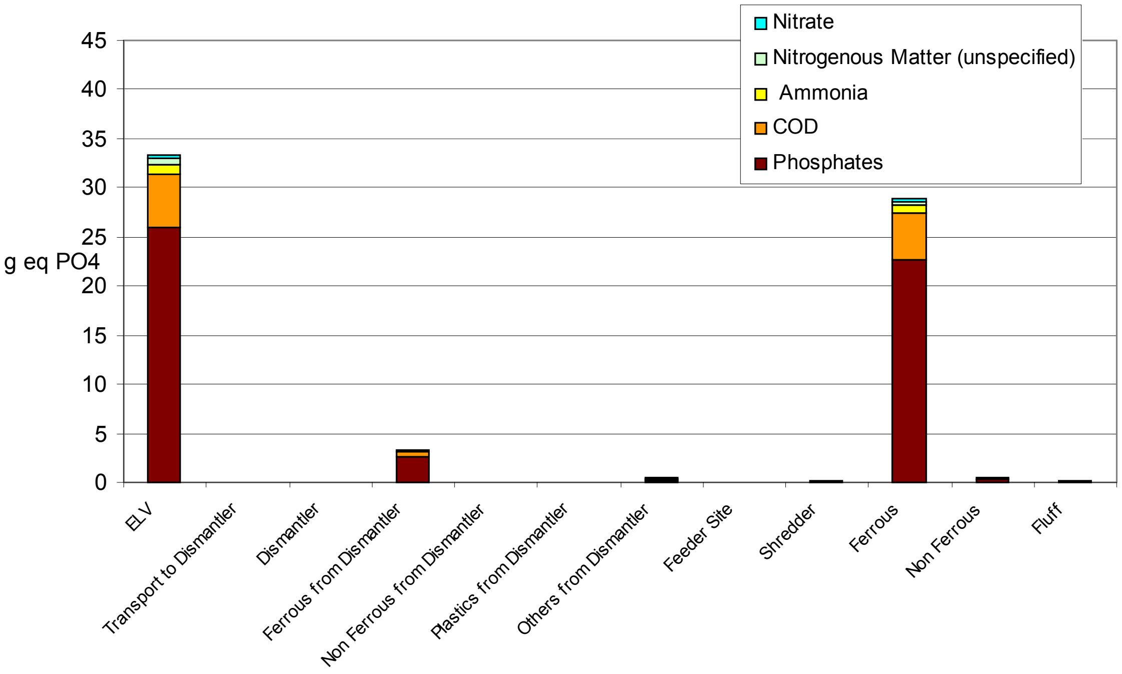
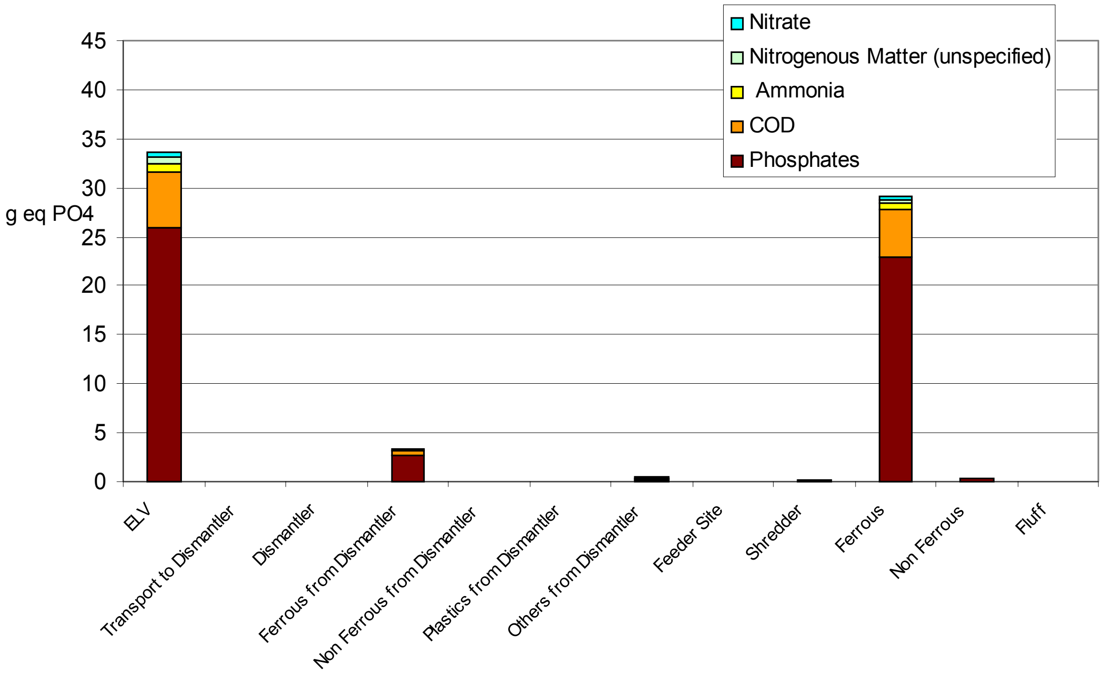


Figure 4.5f Eutrophication of Water Impact Potential broken down by Contributing System in the ELV Processing and Disposal Chain for the Draft EC ELV Directive 11034/971 Option



Figures 4.5d to 4.5f show the following:

Transport and processing of ferrous scrap is the largest contributor (with 97% for each option) to the calculated impact potential for eutrophication of water. This is mainly due to the processing of ferrous scrap into secondary material.

The combined contribution from all other stages in the ELV processing and disposal chain is approximately 3%.

4.4 Summary of findings

The following points summarise the main findings in this section:

Stricter recycling and recovery targets in the draft EC ELV Directive 11034/971 and 1995 ACORD plan have the potential to reduce the environmental impacts associated with ELV processing and disposal in comparison with 1997 ELV practices, albeit marginally in some cases.

The draft EC ELV Directive 11034/971 potentially provides marginal improvements of 6% or less on the 1995 ACORD plan for certain impacts (global warming and air acidification), but provides no further improvement for non renewable resource depletion and eutrophication of water.

The greatest benefit (defined as the largest reduction in impact potential) arising from adoption of the draft EC ELV Directive 11034/971 or 1995 ACORD plan comes from avoidance of depletion of non renewable resources (up to 60%) and a reduction in the potential for air acidification (up to 23%).

The smallest improvement (defined as the least reduction in impact potential) when comparing the draft EC ELV Directive 11034/971 with other options relates to global warming for which only marginal reductions in impact potential have been calculated of 6%.

All options have a negligible impact on stratospheric ozone depletion of less than 0.1 g eq CFC 11, which is likely to continue to decrease given ongoing efforts to remove ozone depleting substances as part of measures agreed in the Montreal Protocol.

A limited number of specific flows have been found to dominate each of the impact potentials calculated for this assessment. These are as follows:

- The global warming impact potential is dominated by emissions of carbon dioxide from fossil fuels. The emissions of carbon dioxide associated with the processing and disposal of one ELV would require about 0.04 hectares of temperate forest to compensate. Methane emissions, which also make a contribution, are equivalent to emissions from 6 to 10 cows (depending on the option).
- Sulphur oxides and nitrogen oxides associated with combustion processes dominate the air acidification impact potential. Sulphur oxides emissions associated with processing and disposal of one ELV are equivalent to the emissions from a petrol driven car travelling between 6840 miles (for the draft EC ELV Directive 11034/971 option) and 9790 miles (for 1997 practices). Nitrogen oxides emissions from the same car are equivalent to a journey of 3560 miles in the case of 1997 practices up to 3900 miles for the 1995 ACORD plan.
- Potential impacts from resource extraction and use are mainly caused by natural gas and oil. Natural gas use equates to average daily natural gas use by 23 –35 people in the UK. Oil consumption is equivalent to the oil consumed to make petrol that will transport a car between 450 – 680 miles.
- The eutrophication of water potential impact is largely due to release of phosphates and COD (caused by release of organic compounds that are biologically or chemically oxidised in the aquatic environment). The phosphate emissions associated with processing and disposal of an ELV would need to be diluted with between 14 400 – 16 180 litres of water in order to attain the UK average phosphate concentration of 0.59 mg/litre for watercourses. The COD results would need to be diluted with between 337 – 360 litres of water, in order to ensure the typical COD consent figure of 750 mg/litre for effluent entering a sewer.
- The potential impact on stratospheric ozone depletion is due almost entirely to release of halon 1301, which is conventionally used as a fire retardant.

Other assessment methods that use value based judgements to assess toxicological effects have been used in this study. As these values are based on Swiss or Swedish conditions, their applicability to the UK should be borne in mind. Nevertheless, the assessments show that the draft EC ELV Directive 11034/971 and 1995 ACORD plan produce environmental benefits of at least 20% when compared to 1997 practices. The exception to this relates to water releases for which only a marginal improvement of 5% was obtained.

In terms of potentially harmful emissions to air, the draft EC ELV Directive 11034/971 shows only a marginal improvement on the 1995 ACORD plan of 6%. Both produce a benefit over 1997 practices of 20%, due mainly to a cut in the emission of sulphur oxides.

Using an Ecopoints methodology, neither the draft EC ELV Directive 11034/971 or the 1995 ACORD plan are different although both show improvements of 32% on 1997 practices due, primarily, to the diversion of waste away from landfill.

The EPS methodology does show advantages for the draft EC ELV Directive 11034/971 over the 1995 ACORD plan of 14% and both show benefits over current practices due to the avoided need to mine for lead ore.

The small differences in results arising from comparison of the draft EC ELV Directive 11034/971 and the 1995 ACORD plan are not surprising when considered in the context of their respective recycling and recovery targets. The draft Directive allows for 85% reuse and recycling compared to 82% for the 1995 ACORD plan, a difference of just 3% (or 32 kg of material). Additionally the draft Directive allows for 10% energy recovery with an additional 5% of material going to landfill. This compares to 18% energy recovery in the 1995 ACORD plan, of which 5% is inerts that pass through the combustion process and are landfilled as ash (meaning that energy is potentially obtained from 13% of material passing through the combustion process). In essence, the study results compare recycling of this 32 kg of material in the draft EC ELV Directive 11034/971 option), as opposed to combustion for energy (in the 1995 ACORD option) or landfilling (through 1997 practices).

Within the ELV processing and disposal chain, ferrous transport and processing has been found to be the dominant stage with respect to its potential impact on global warming, air acidification, non renewable resource depletion and eutrophication of water. Given that ferrous metal comprises nearly 70% of the generic ELV used in the study, this result is by virtue of the mass of material that needs to be processed.

Certain activities consistently show low potential for impacting on the environment (of those impact assessment methodologies considered in this study). This includes transportation to, and the activities of, the dismantler. The dismantler can provide a useful first stage of processing, by removing parts that may be reused, depolluting the ELV and source separating other key materials (such as tyres and engine blocks). In terms of the impacts assessed in this study, this activity comes at a negligible environmental cost, although other issues that are not part of this study may be of more importance, such as potential for local contamination of soil, etc.

In order to meet the recycling targets of the draft EC ELV Directive 11034/971 further removal and processing of material is necessary. Since ferrous and non ferrous metals are already recovered to a high degree, most of the material that will need to be recovered to meet the conditions of the draft directive is likely to be plastics, glass and rubber. Further processing of fluff arising from the shredder (and therefore energy consumption) is likely to be necessary. However, it would appear from this study, that such energy is worth expending from an environmental standpoint, if it offsets the need to extract and process ore to produce virgin materials and products, with the associated energy demands.

Similarly, use of some of this extra material as a source of fuel energy (and/or electricity) as in the case of the 1995 ACORD plan, appears to have environmental advantages, although depending on the impact potential chosen, such advantages may be marginal.

The higher recycling and recovery targets that are contained in the draft EC ELV Directive 11034/971 and 1995 ACORD plan, generally lower the impact potential associated with processing and disposal of ELVs (for impact methods calculated in this study) due to the more efficient use of resources and energy.

5 COMPARISON OF ELV PROCESSING AND DISPOSAL PRACTICES IN 1997 WITH 'ZERO RECYCLING'

To put the results in context, an analysis has been undertaken which compares the 1997 Current Practice option with 'zero recycling'. The 'zero recycling' scenario assumes that there is no reuse, recycling or energy recovery from the ELV, therefore all materials, products and energy must come solely from the primary systems. The energy and mass of materials and products delivered by the primary systems in the 'zero recycling' scenario is equal to the energy and mass of materials and products delivered by the processing and disposal system in the 1997 Current Practice option (as shown in the inventory tables in Appendix A). All other assumptions remain the same.

Consequently, this exercise is a comparison of the delivery of equal energy, materials and products from a secondary source (one ELV) or a primary source. The results of the impact assessment are displayed in Table 5.1.

Table 5. 1 Comparison of the Impact Assessment Results for the 1997 Current Practice Option and 'Zero Recycling' Scenario

Methodology	Units	1997 Current Practice	Zero Recycling	Current Practice as a % of Zero Recycling
Greenhouse effect (direct, 100 years)	tonnes eq. CO_2	0.84	2.8	30
Air acidification	g eq. H^+	136.1	376.4	36
Stratospheric ozone depletion	g eq. CFC 11	0.05	0.40	13
Depletion of non renewable resources	kg/yr	1.96	12.25	16
Eutrophication of water	g eq. PO_4	33.3	99.4	34
Other Assessment:				
Critical volume (air)	m^3	1.9×10^8	7.6×10^8	25
Critical volume (water)	litres	190358.6	333962.5	57
Ecopoints (total)	ecopoints	306812.9	681461.5	45
EPS (total)	ELU	127.5	3289.2	4

Table 5.1 shows that practices of the vehicle dismantling and shredding industry in 1997, and associated activities of the industries that process the recovered material from the ELV, are environmentally preferable in terms of all assessed methodologies, when compared to a scenario with no recycling. Thus recycling of ELVs as undertaken in 1997 is better environmentally than not recycling ELVs at all.

The results in Chapter 4 show that proposed ELV reuse, recycling and energy recovery strategies such as that produced by ACORD or the EC, should improve further on this finding.

6 SENSITIVTIY ANALYSIS OF THE RESULTS

6.1 Introduction

A strength of undertaking life cycle based investigations is the ability to quantify uncertainty and investigate alternative scenarios by varying key parameters in the model.

Five sensitivity analyses have been carried out as part of this work, which are:

1. Sensitivity to the net heat value of the fluff fraction.

2. Sensitivity to an increase in energy required for further material recovery from the fluff fraction.

3. Sensitivity to a change in the number of ELVs, and distance transported, to the dismantler.

4. Sensitivity to an increase in the availability of parts for reuse at the dismantler.

5. Sensitivity to a possible change in the UK fuel mix supplying electricity to the national grid by 2015.

The following sections offer an analysis of the overall results for each of the studied options (1997 practices, the 1995 ACORD plan and the draft EC ELV Directive 11034/971).

6.2 Sensitivity to the net heat value of the fluff fraction

The net heat value of the fluff fraction is important if it is to be used as a source of fuel (possibly mixed with other combustible material). At the time that this study was carried out, widely differing figures were quoted for the net heat value of the fluff, which is dependent on its composition, e.g. the proportion of plastics and rubber.

The study considered the combustion of fluff in a blast furnace and cement kiln (where it contributes fuel energy, displacing the need to burn fossil fuels) and a MSW incinerator (where it is used to generate electricity for the national grid).

In the case of the 1995 ACORD plan, a net heat value of 13.7 MJ/kg was adopted for the blast furnace and MSW incinerator compared to 17.4 MJ/kg for the cement kiln. The difference in net heat value arises because of further treatment of the fluff destined for the cement kiln, to remove metals, PVC and inerts, so that it is suitable for use. The removal of inerts and metal causes the increase in net heat value of the leftover material.

Since material of a higher net heat value that cannot be reused or recycled is separated specifically for combustion with energy recovery in the draft EC ELV Directive 11034/971 option, a figure of 21.7 MJ/kg was adopted. It was assumed that this material was suitable for use in a cement kiln and needed no further processing.

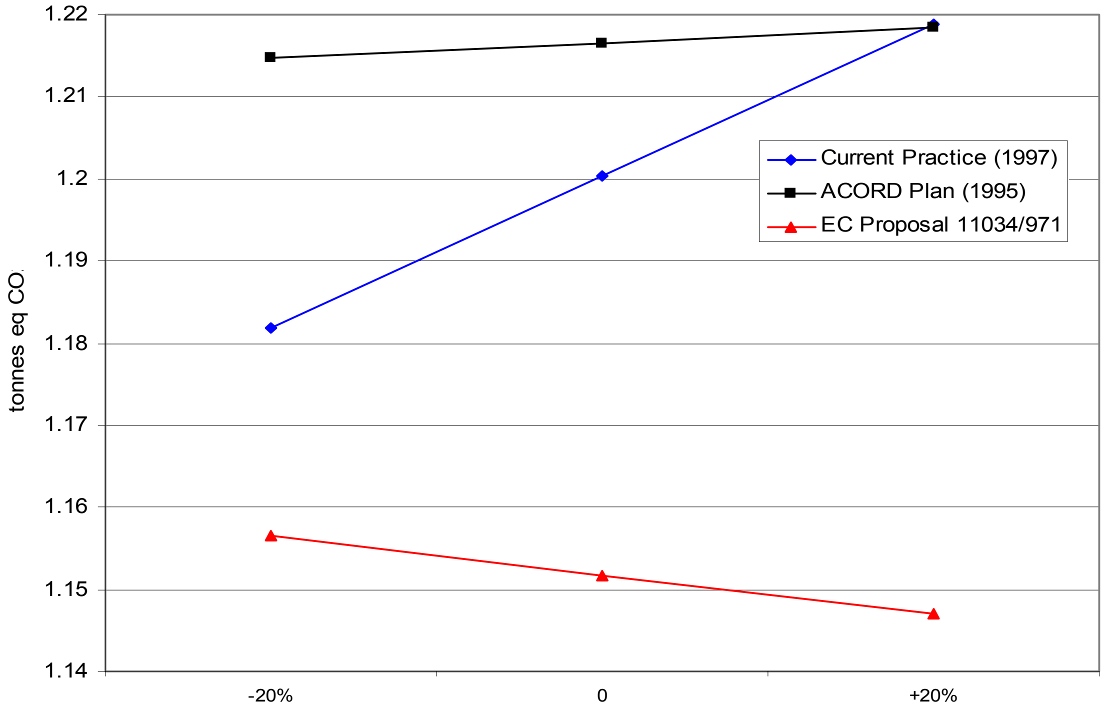
Given the uncertainty associated with the net heat value of the fluff for combustion, this sensitivity analysis featured a change of ±20% as summarised in Table 6.1.

Table 6.1 Net Heat Value of Fluff[7] (in MJ) adopted for this Sensitivity Analysis.

	Baseline	-20%	+20%
1995 ACORD plan:			
Blast Furnace/MSW Incinerator	13.7	11.0	16.4
Cement Kiln	17.4	13.9	20.9
Draft EC ELV Directive 11034/971	21.7	17.4	26.0

Figures 6.1a to 6.1d illustrate the effects of this variation in the net heat value of fluff in terms of the impact potential on global warming, air acidification, non renewable resource depletion and eutrophication of water. The potential impact on stratospheric ozone depletion has been omitted due to the negligible result shown in Chapter 4 .

Figure 6.1a Sensitivity of the Global Warming Impact Potential (Direct, 100 years) to Variation in the Net Heat Value of the Fluff Fraction for Assessed ELV Processing and Disposal Options



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[7] Rounded to one decimal place.

Figure 6.1b Sensitivity of the Air Acidification Impact Potential to Variation in the Net Heat Value of the Fluff Fraction for Assessed ELV Processing and Disposal Options

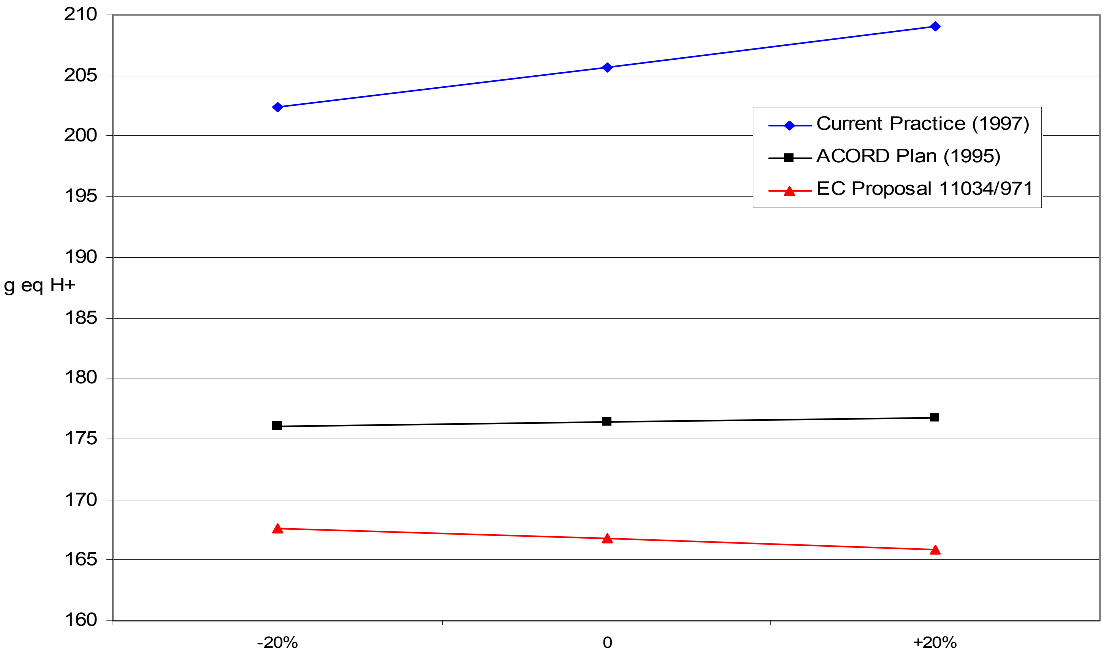


Figure 6.1c Sensitivity of the Non Renewable Resource Depletion Impact Potential to Variation in the Net Heat Value of the Fluff Fraction for Assessed ELV Processing and Disposal Options

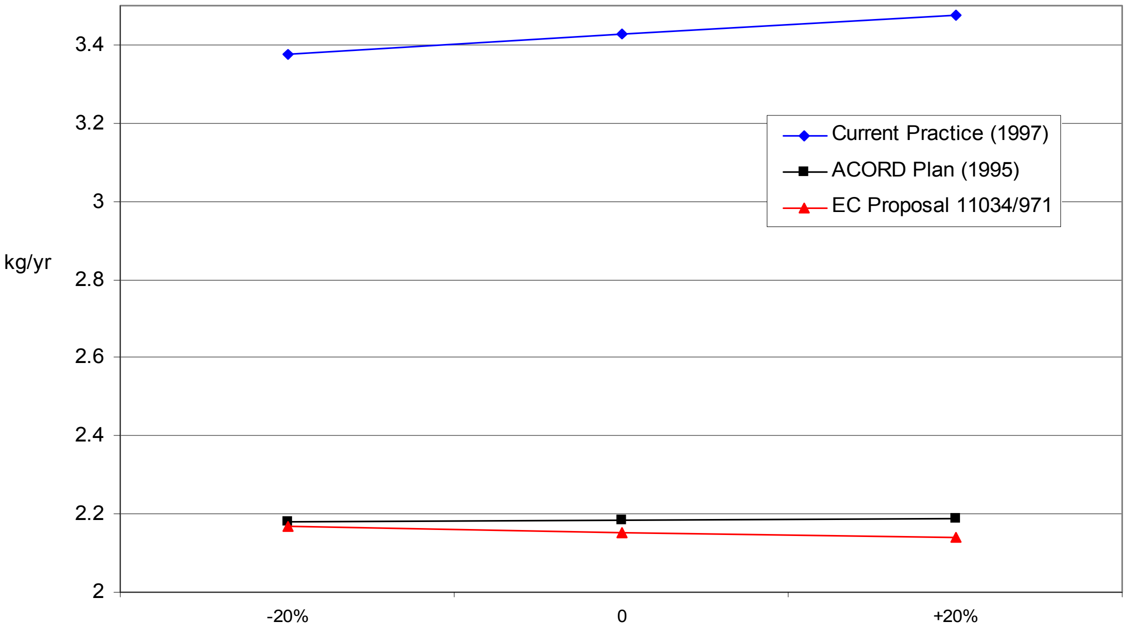
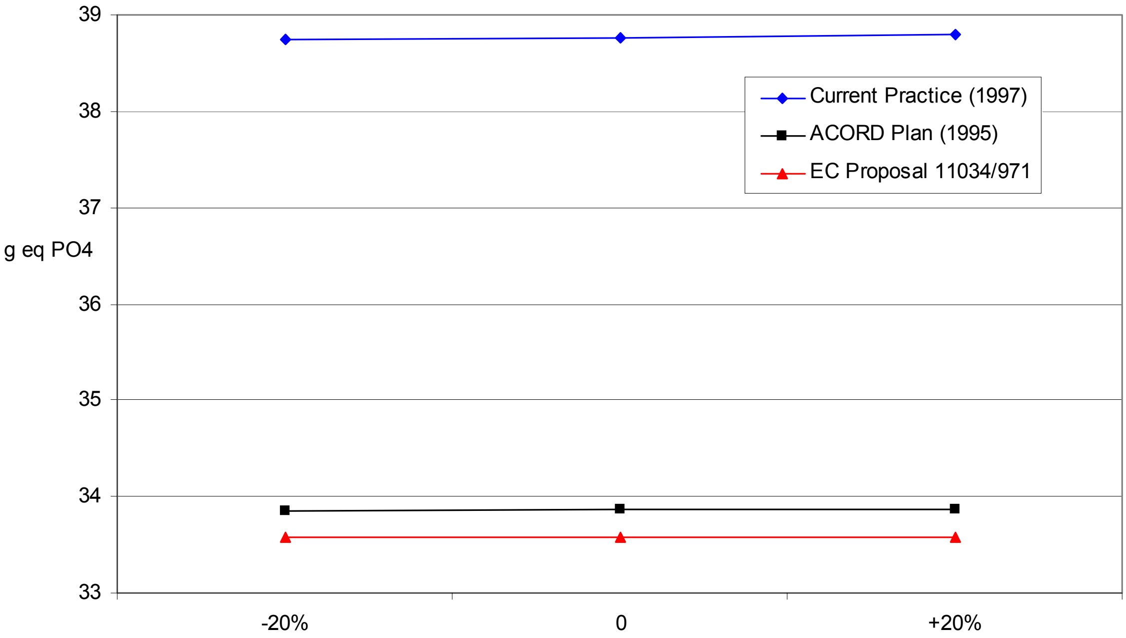


Figure 6.1d Sensitivity of the Eutrophication of Water Impact Potential to Variation in the Net Heat Value of the Fluff Fraction for Assessed ELV Processing and Disposal Options



Figures 6.1a to 6.1d show the following trends:

The 1997 Current Practice option appears to be the most sensitive (judged by the gradient of the line) to a change in the net heat value of the fluff for potential impacts on global warming, air acidification and non renewable resource depletion. As the net heat value of the fluff fraction increases or decreases, so the potential for fuel energy that can be derived from it (or electricity that can be generated from it) increases or decreases accordingly. In the 1997 Current Practice option, the fluff goes to landfill. However, its inherent energy, which is realised in the 1995 ACORD plan and the draft EC ELV Directive 11034/971 options, means that more or less fossil fuels must be combusted to produce equivalent fuel energy (or the UK fuel mix to provide more or less national grid electricity). This greater or lesser reliance on fossil fuels and the UK fuel mix produces the observed sensitivity of 1997 practices to the global warming, air acidification and non renewable resource depletion impact potentials.

Although the 1997 Current Practice option is the most sensitive of the three options to a variation in the net heat value of fluff, even this option shows only a 1.5% change in global warming, air acidification and non renewable resource depletion impacts for a 20% change in the net heat value of the fluff.

The 1995 ACORD plan and draft EC ELV Directive 11034/971 options are not sensitive to a variation in the net heat value of the fluff for global warming, air acidification and non renewable resource depletion impact potentials. In each case, a 20% change in the net heat value of the fluff produces no more than a 0.6% change in any of these impact potentials.

The eutrophication of water impact potential is least sensitive to a change in the net heat value of the fluff fraction for all options.

6.3 Sensitivity to an increase in energy required for further material recovery from the fluff fraction

During the data collection phase of the study, a question arose regarding how more stringent recycling targets could be met (as required by the draft EC ELV Directive 11034/971). Some of this material could be removed by the dismantling activity. However, dismantlers mostly remove those items that are economic to take from the ELV. Removal of other items would most likely introduce further costs that would need to be borne by a party or parties. Whereas, we assumed that some items not routinely removed in 1997 might be removed in the future (such as tyres for incineration at Elm Energy), further material recovery was necessary that could not be fulfilled by the activities of the dismantler.

Information was obtained about a plant that could be constructed to process fluff. Although not economically viable at the time of the study, such a plant was thought to be technically feasible. Such plants would take fluff from a number of shredders and process it, thereby separating plastics for material or energy recovery (further information is provided in Appendix D).

This sensitivity analysis is concerned with the energy requirements of such a plant, which is assumed to use national grid electricity and diesel oil. The energy requirements of the plant have been increased by 50% and 100% compared to the baseline figure, in order to assess whether greater energy needs associated with further recycling would offset the benefits obtained through more efficient use of resources.

Figures 6.2a to 6.2d show the results for each of the assessed impact potentials:

Figure 6.2a Sensitivity of the Global Warming Impact Potential (Direct, 100 years) to Variation in Energy required for further Material Recovery for Assessed ELV Processing and Disposal Options

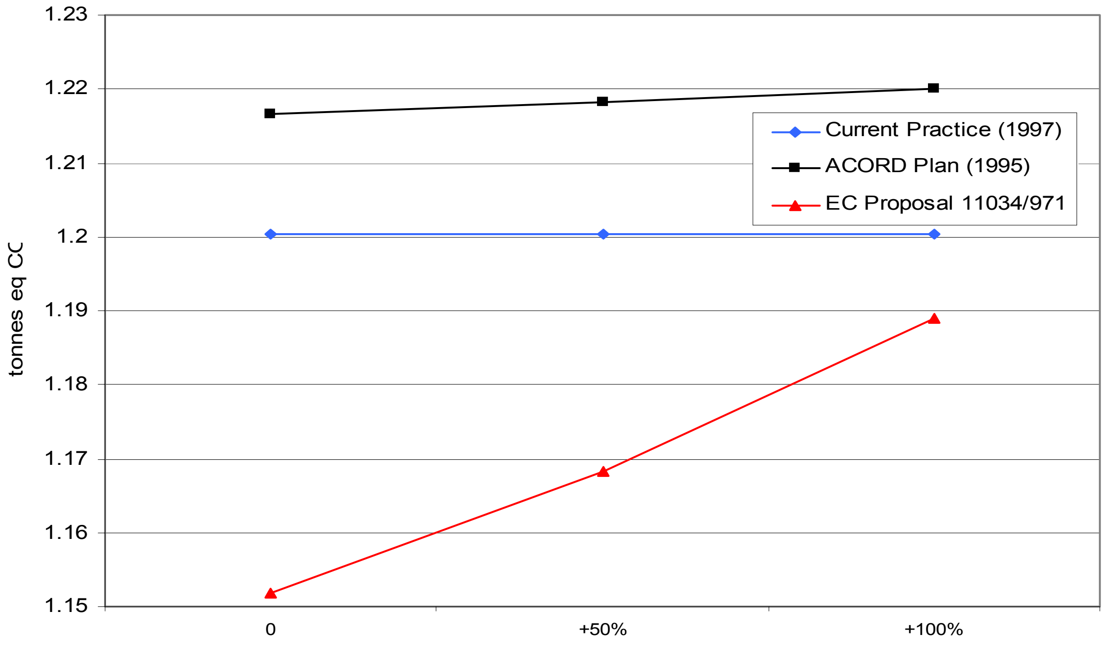


Figure 6.2b Sensitivity of the Air Acidification Impact Potential to Variation in Energy required for further Material Recovery for Assessed ELV Processing and Disposal Options

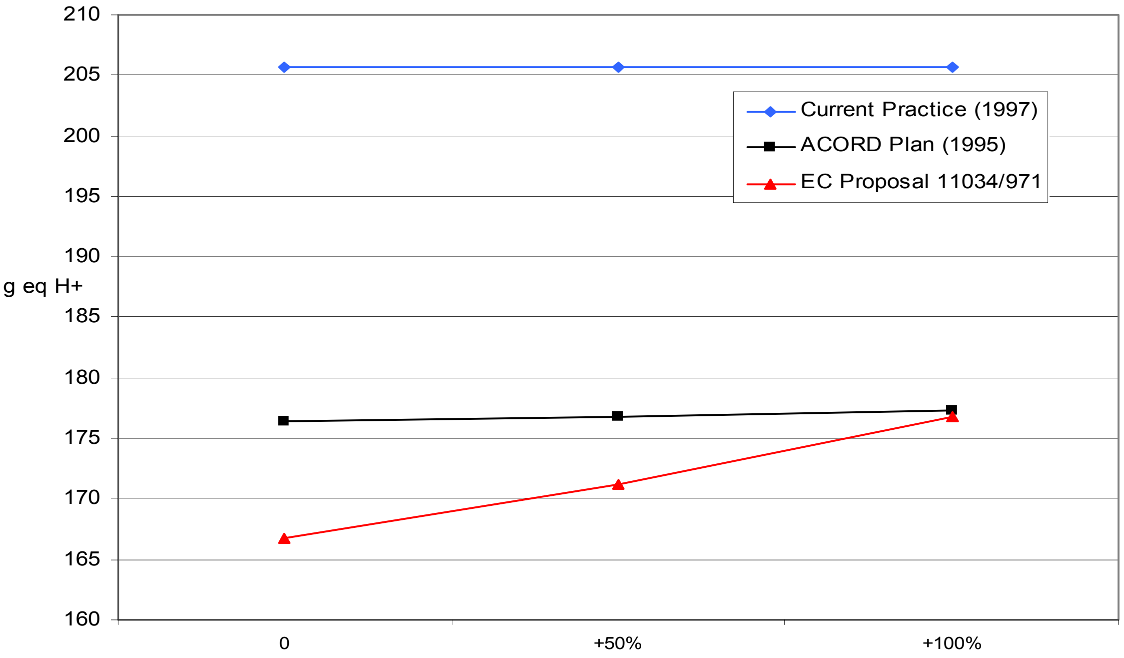


Figure 6.2c Sensitivity of the Non Renewable Resource Depletion Impact Potential to Variation in Energy required for further Material Recovery for Assessed ELV Processing and Disposal Options

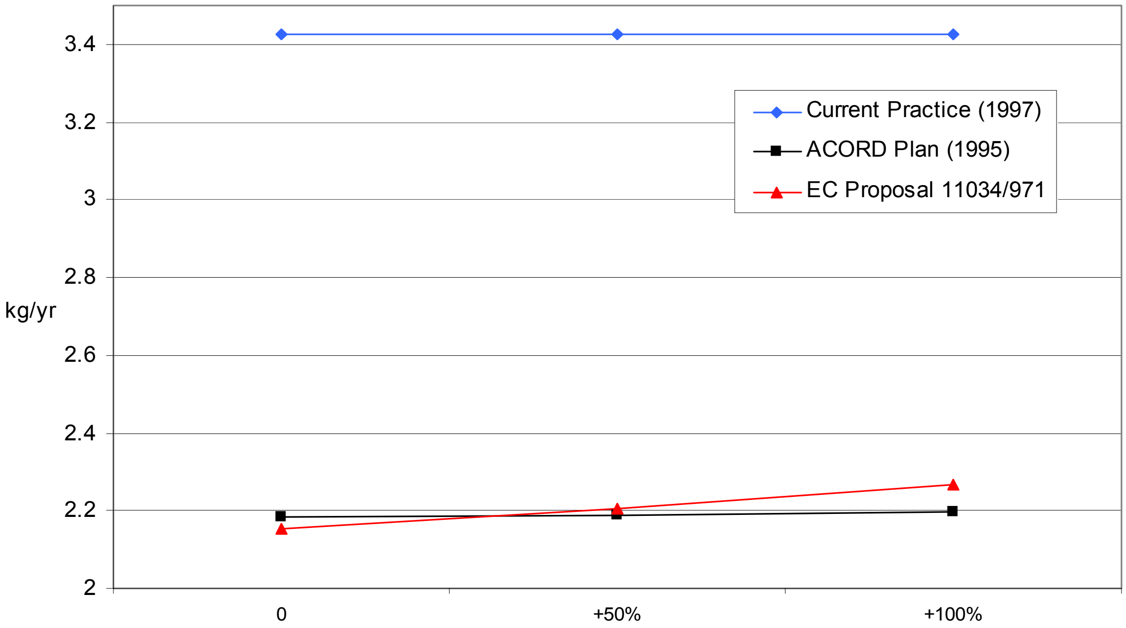
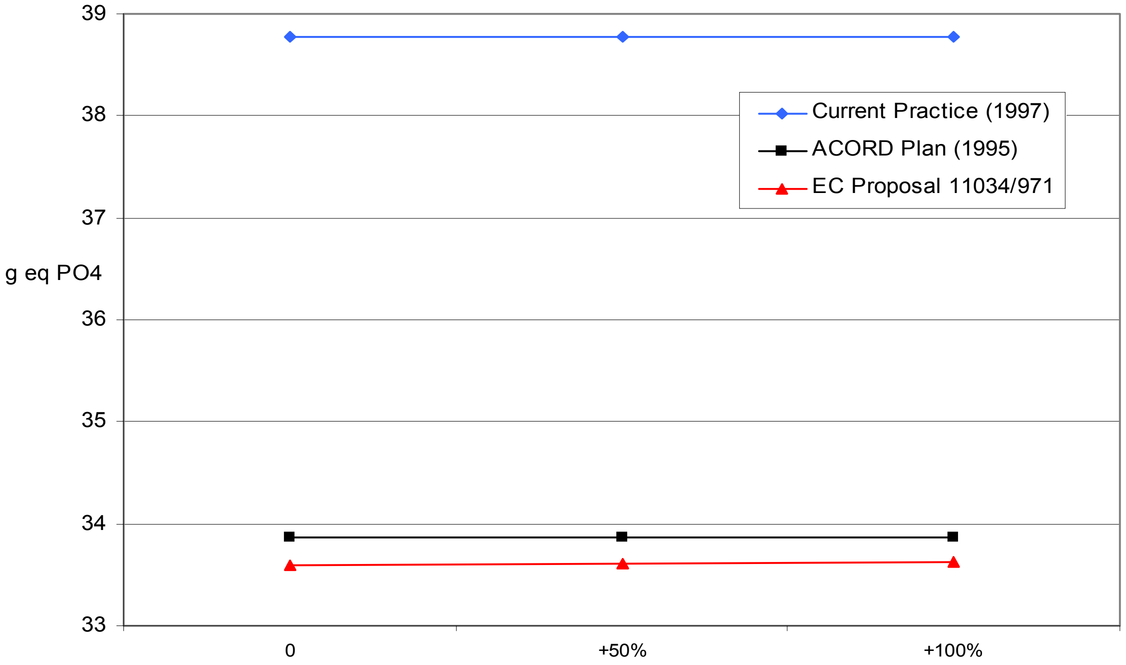


Figure 6.2d Sensitivity of the Eutrophication of Water Impact Potential to Variation in Energy required for further Material Recovery for Assessed ELV Processing and Disposal Options



Figures 6.2a to 6.2d reveal the following trends:

The draft EC ELV Directive 11034/971 shows the greatest sensitivity to an increase in the energy required by a plant that sorts fluff for more material recovery, for the impact potential on global warming, air acidification and non renewable resource depletion. This is unsurprising since the activities of such a plant are more applicable to this option than to 1997 practices (in which there is no recovery of material from fluff) and the 1995 ACORD plan (in which the fluff is combusted for energy recovery). These options are not sensitive to the energy requirements of such a plant.

Although the draft EC ELV Directive 11034/971 shows the greatest sensitivity, this is still small since a doubling of the energy requirements of such a plant, increases the global warming, air acidification and non renewable resource depletion impact potentials by 3%, 6% and 5% respectively.

As the energy required by such a plant to achieve greater material recovery targets increases, so the margin of benefit for the draft EC ELV Directive 11034/971 compared to the 1995 ACORD plan decreases.

The eutrophication of water impact potential is not sensitive to the energy requirements of such a plant.

6.4 Sensitivity to a change in the number of ELVs, and distance transported, to the dismantler

This sensitivity analysis assume that, by 2015, most dismantlers will be licensed to carry out their activities, since it would be a legal or regulatory requirement that ELVs are disposed at a licensed site (which would provide a certificate of destruction). As a result, smaller, less efficient or unlicensed dismantlers may close down and the dismantling operation may be concentrated at a fewer number of larger sites. Such a change may impact on the way in which ELVs are transported to the dismantler.

The assumption for the study is that 10% of ELVs are collected and transported by the dismantler who makes a round trip of 40 miles (on average). Most ELVs are transported privately, by being towed or driven to the dismantler who provides an economic incentive. However, if the dismantling activity is concentrated in a smaller number of operations, the average distance to the nearest dismantler may increase meaning that fewer vehicles reaching their end of life would be able to make the journey to the dismantler. Therefore, it is possible that there would be proportionately more ELVs that would need to be collected by the dismantler, who might have to travel greater distances in order to collect the ELV.

In order to assess whether such a change might be significant environmentally, two variations on the basic assumptions used in the study have been modelled for this sensitivity analysis. These scenarios are as follows:

- 20% of ELVs are collected by the dismantler, who makes a return journey of 80 miles;
- 50% of ELVs are collected by the dismantler, who makes a return journey of 200 miles.

Figures 6.3a to 6.3d illustrate the findings of this sensitivity analysis for each of the impact potentials.

Figure 6.3a Sensitivity of the Global Warming Impact Potential (Direct, 100 years) to Variation in ELV Collection Rates and Distances for Assessed ELV Processing and Disposal Options

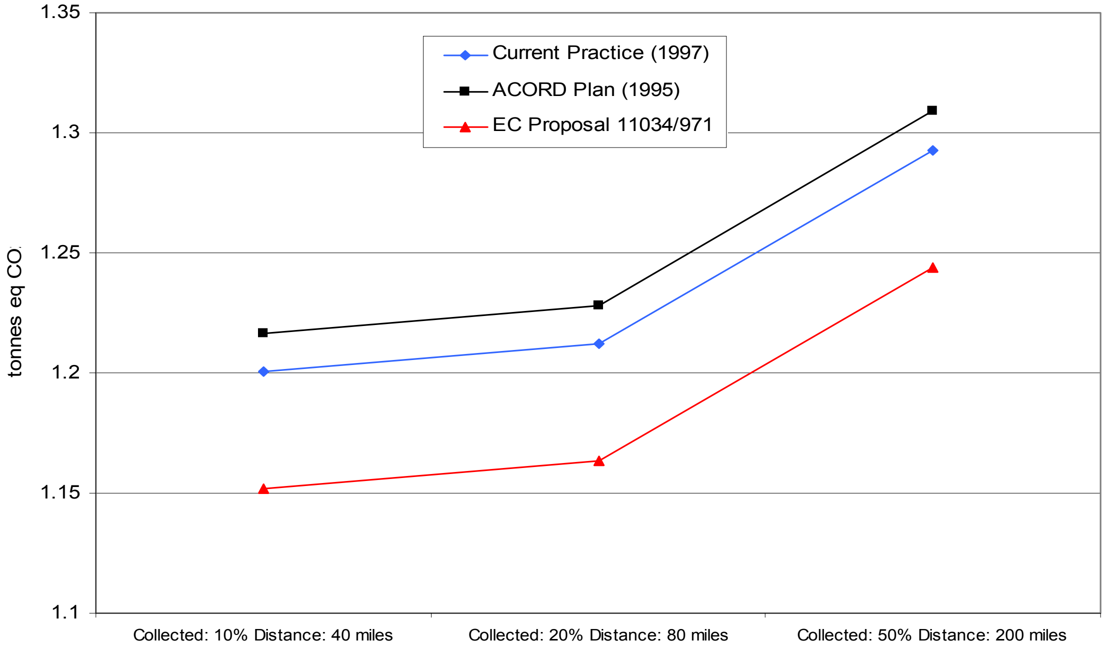


Figure 6.3b Sensitivity of the Air Acidification Impact Potential to Variation in ELV Collection Rates and Distances for Assessed ELV Processing and Disposal Options

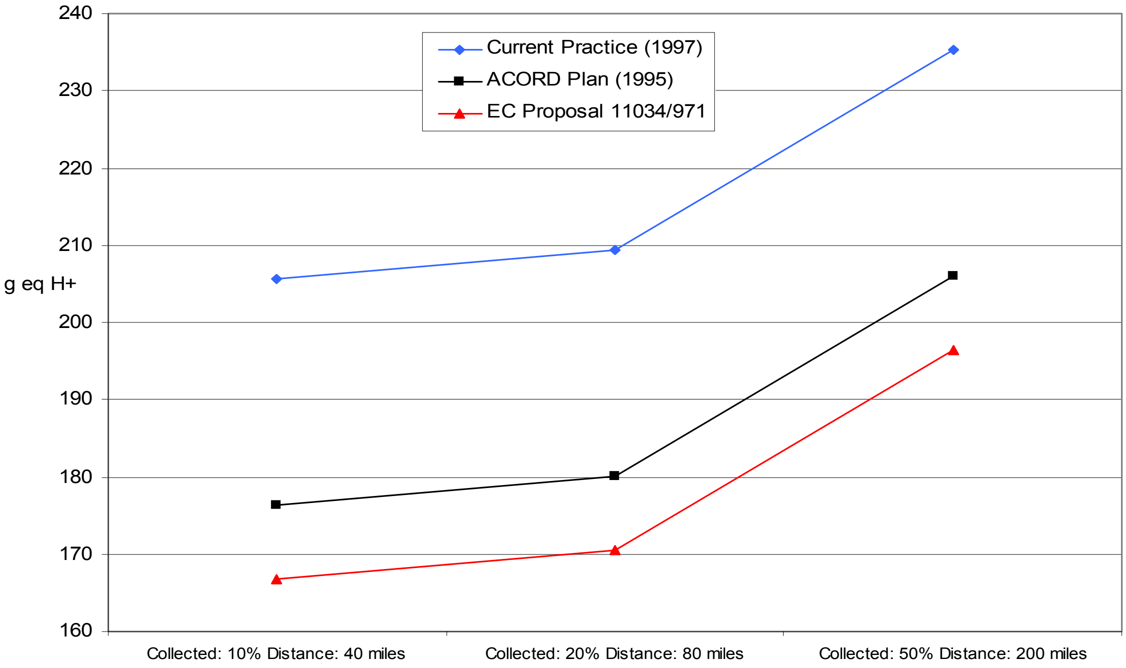


Figure 6.3c **Sensitivity of the Non Renewable Resource Depletion Impact Potential to Variation in ELV Collection Rates and Distances for Assessed ELV Processing and Disposal Options**

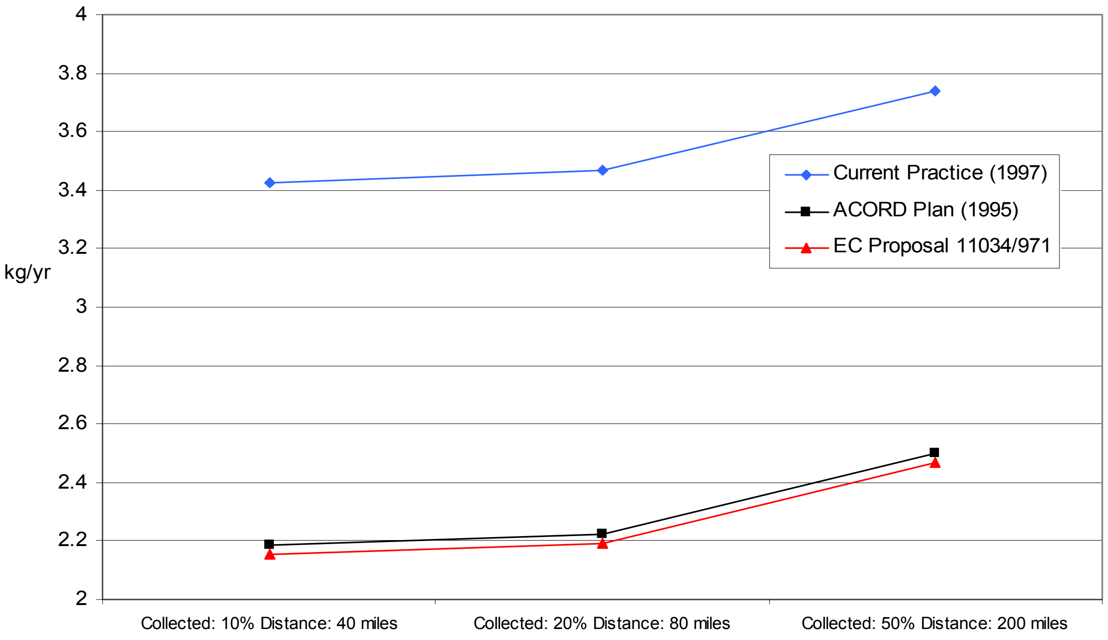
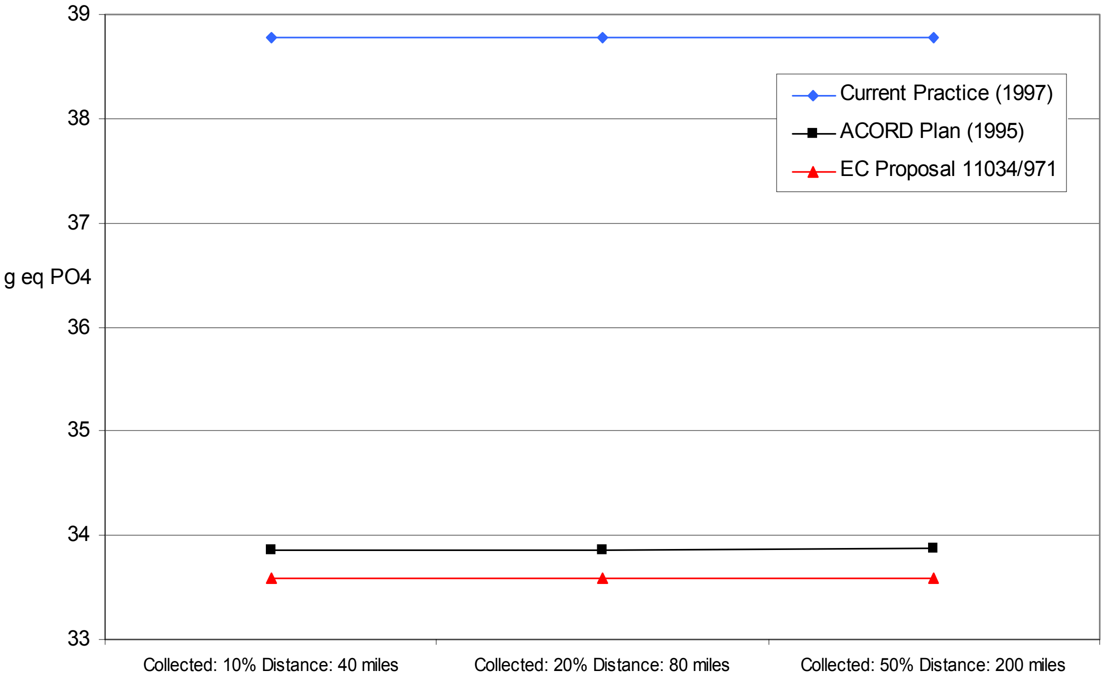


Figure 6.3d **Sensitivity of the Eutrophication of Water Impact Potential to Variation in ELV Collection Rates and Distances for Assessed ELV Processing and Disposal Options**



Figures 6.3a to 6.3d show the following:

Since all options feature the same assumptions with respect to the collection characteristics of the ELVs, all show the same trend in sensitivity for each impact assessment potential. All options are not sensitive to a change in this parameter, although the level of sensitivity varies depending on the impact assessment potential concerned.

If the number of ELVs that are collected and the transport distance necessary to collect them is increased five times, the global warming impact potential only increases by about 8% for all options (less than a 2% increase in global warming impact potential for every 10% more vehicles collected and 40 miles travelled).

The same change in transport characteristics increases the air acidification impact potential by 14 – 18%, showing a greater sensitivity than the global warming impact due to a greater emission of sulphur oxides and nitrogen oxides associated with diesel combustion.

The increasing need for diesel fuel to transport a greater number of ELVs a longer distance produces an increase of 9 – 15% in the non renewable resource depletion impact for each option.

The eutrophication of water impact is not sensitive to an increase in the number of ELVs collected by the dismantler and the transport distance that must be covered.

An increase in the frequency with which the dismantler must collect ELVs would be matched by a decrease in the frequency of private deliveries direct to the dismantler, which would partly offset the increase in potential impact calculated for this sensitivity analysis. Since this was outside the scope of this study, a numerical value cannot be put on this saving.

6.5 Sensitivity to an increase in the availability of parts for reuse at the dismantler

This sensitivity analysis looks at the effect that greater reuse of parts removed at the dismantler might have on the results. We assume that the total mass of parts and material remains the same as in the baseline scenarios, but increase the proportion of reusable parts at the expense of recyclable material (at the dismantler).

Figures 4.4a to 4.4d show the results of an increase in reused parts of 20% and 40%, on the basis of mass.

Figure 6.4a Sensitivity of the Global Warming Impact Potential (Direct, 100 years) to Variation in Availability of Reusable Parts at the Dismantler for Assessed ELV Processing and Disposal Options

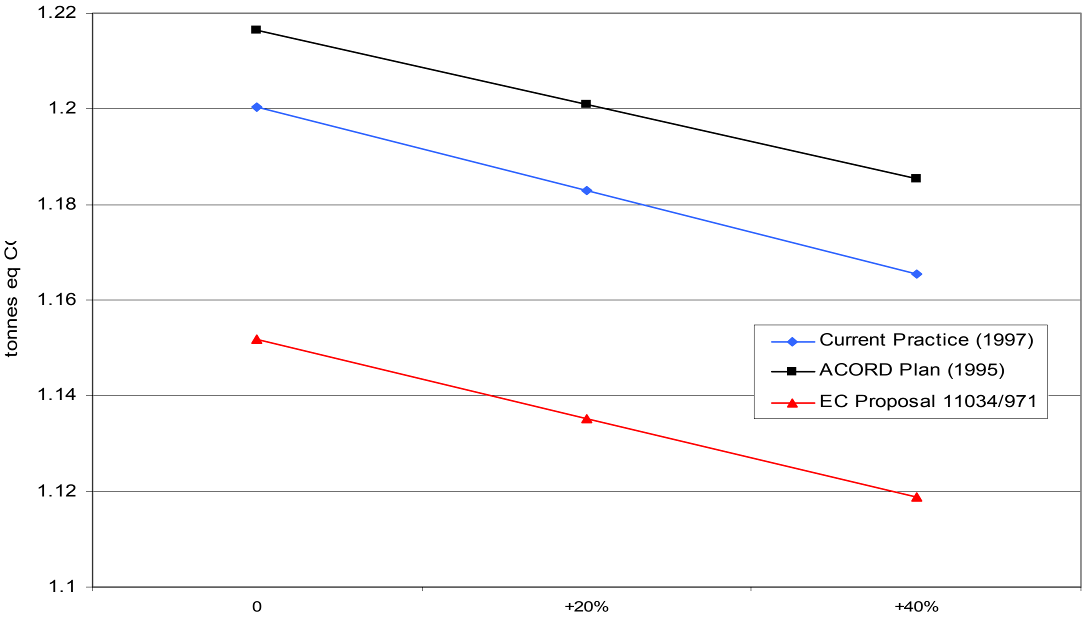


Figure 6.4b Sensitivity of the Air Acidification Impact Potential to Variation in Availability of Reusable Parts at the Dismantler for Assessed ELV Processing and Disposal Options

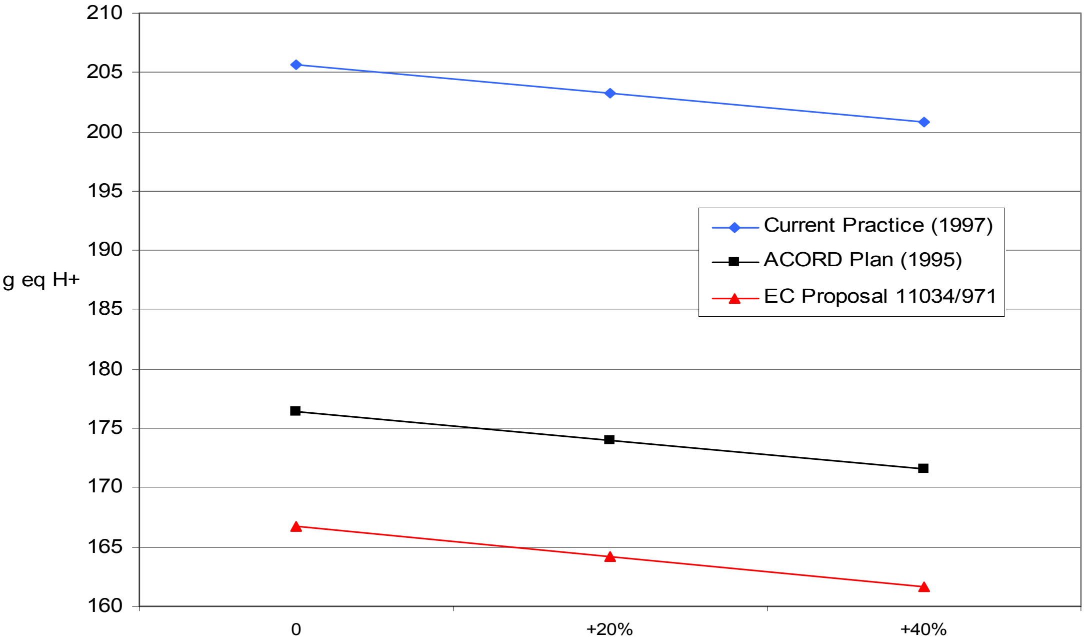


Figure 6.4c **Sensitivity of the Non Renewable Resource Depletion Impact Potential to Variation in Availability of Reusable Parts at the Dismantler for Assessed ELV Processing and Disposal Options**

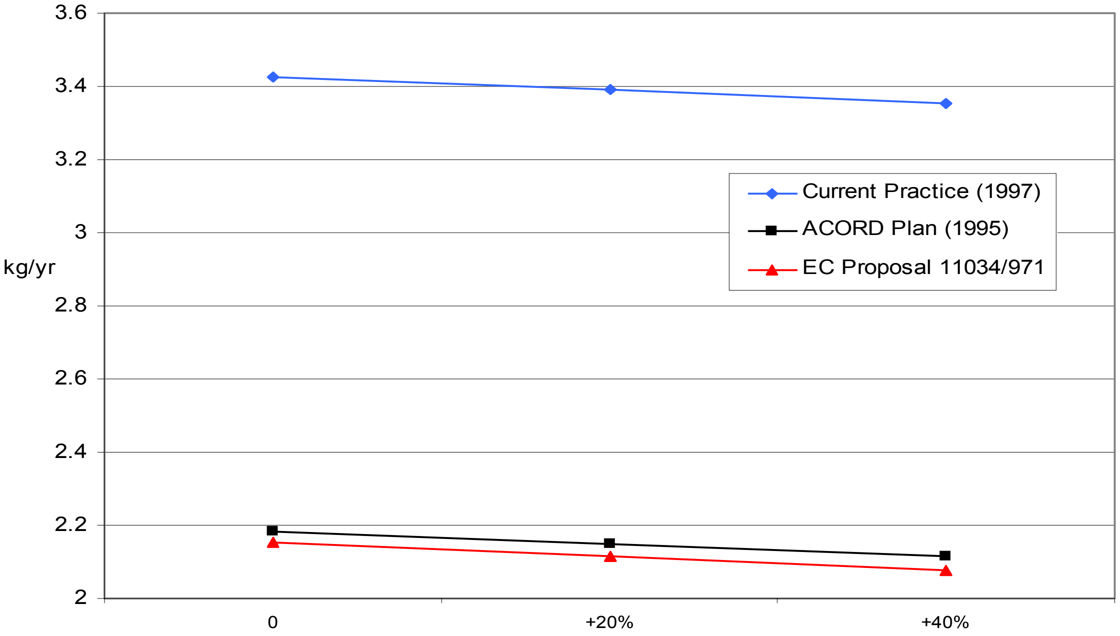
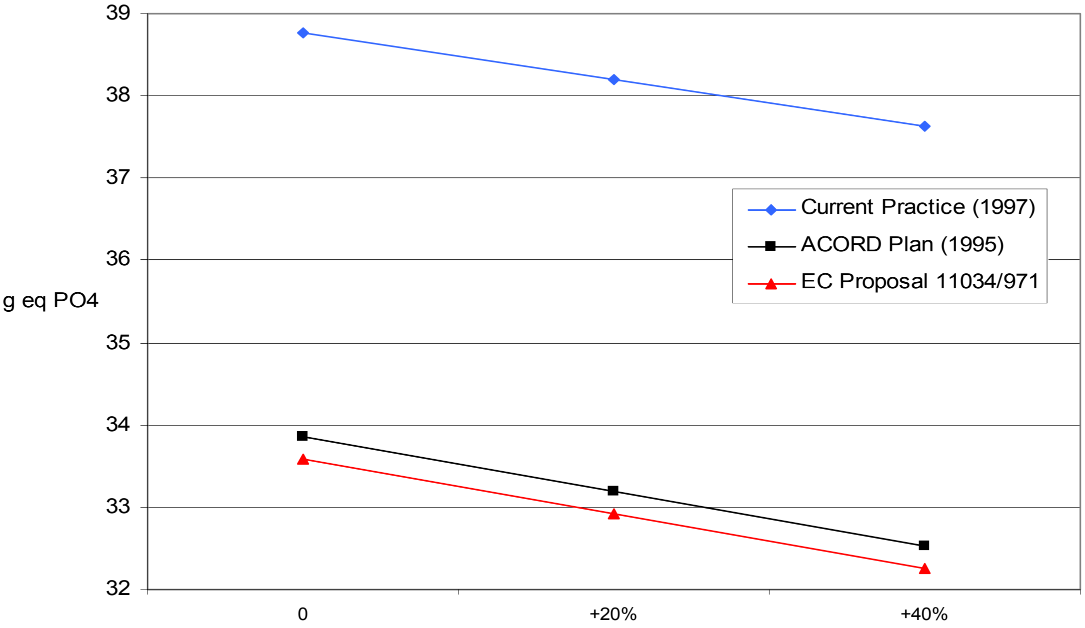


Figure 6.4d **Sensitivity of the Eutrophication of Water Impact Potential to Variation in Availability of Reusable Parts at the Dismantler for Assessed ELV Processing and Disposal Options**



Figures 6.4a to 6.4d show the following trends:

All assessed impact potential methodologies show a decreasing trend in environmental impact potential for all options.

Although the trends are decreasing, all impact assessment potentials are not sensitive to a 40% increase in reuse of parts at the dismantler instead of material for recovery. Increasing reuse in this way negates the need to transport and process as much scrap material derived from the ELV. However, a 40% increase in reuse only reduces all calculated impact potentials by 2 - 4% for each option.

Eutrophication of water is the impact potential that is most affected (with a 4% change for 40% more reuse) which is due to less need to process secondary material derived from the ELV.

6.6 Sensitivity to a change in the UK fuel mix supplying electricity to the national grid by 2015

Over the last few years, UK energy policy has moved away from coal towards natural gas. It is likely that the fuel mix that provides electricity for the national grid in the UK in 2015 may be somewhat different to that which supplies the grid in 1996.

The purpose of this sensitivity analysis is to assess the likely impact of an alternative fuel mix supplying the UK national grid in 2015. Data for a possible UK fuel mix in 2015 was supplied by the DTI's Energy Policy and Analysis Unit when the study was undertaken in 1997. A breakdown and comparison with the fuel mix for 1996 is provided in Table 6.2.

Table 6.2 UK Fuel Mix supplying the National Grid in 1996 and predicted for 2015[8]

Source of Energy	UK Fuel Mix (1996) %	UK Fuel Mix (2015) %
Coal	43	14.1
Oil	5	6.7
Natural Gas	22	62.4
Nuclear	29	6.7
Renewables	1	5.2
Other	2	1.0
Imports[9]	-	4.0

Please note that some process data in the model are aggregated to include electricity production. Consequently, any findings in this analysis are likely to be under-reported as the fuel mix generating the electricity used by these processes will be unchanged.

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[8] Due to rounding, these figures may not add to 100.

[9] The 4% imports for the 2015 figures are assumed to come from France. As an approximation, it was assumed that this 4% comprised of 3% nuclear and 1% hydroelectric.

Figures 6.5a to 6.5d provide the results for each of the impact assessment potentials assessed in this study.

Figure 6.5a Sensitivity of the Global Warming Impact Potential (Direct, 100 years) to a Possible UK Fuel Mix in 2015 for Assessed ELV Processing and Disposal Options

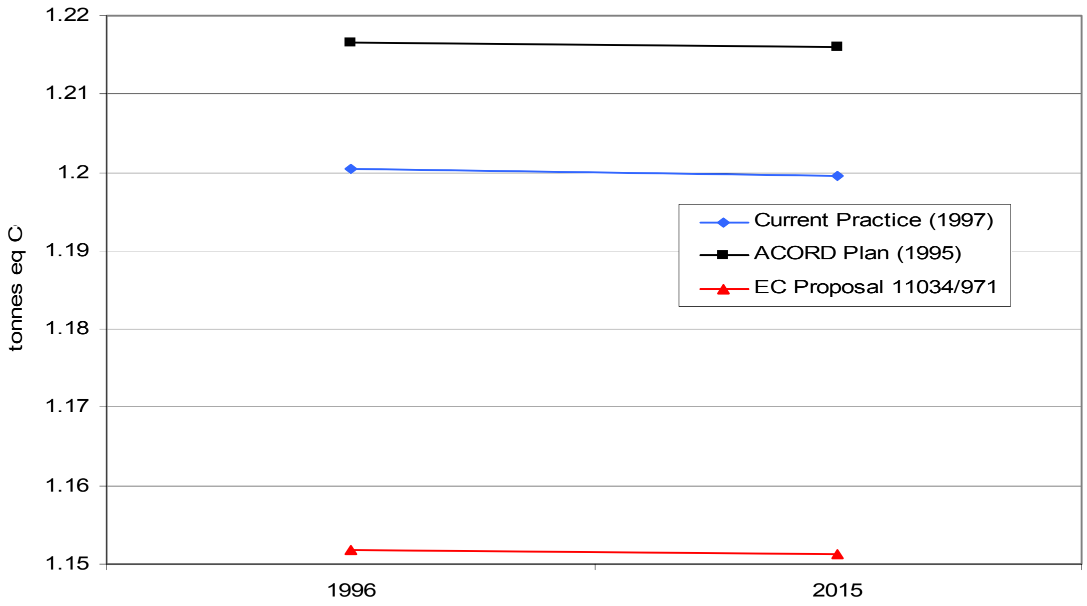


Figure 6.5b Sensitivity of the Air Acidification Impact Potential to a Possible UK Fuel Mix in 2015 for Assessed ELV Processing and Disposal Options

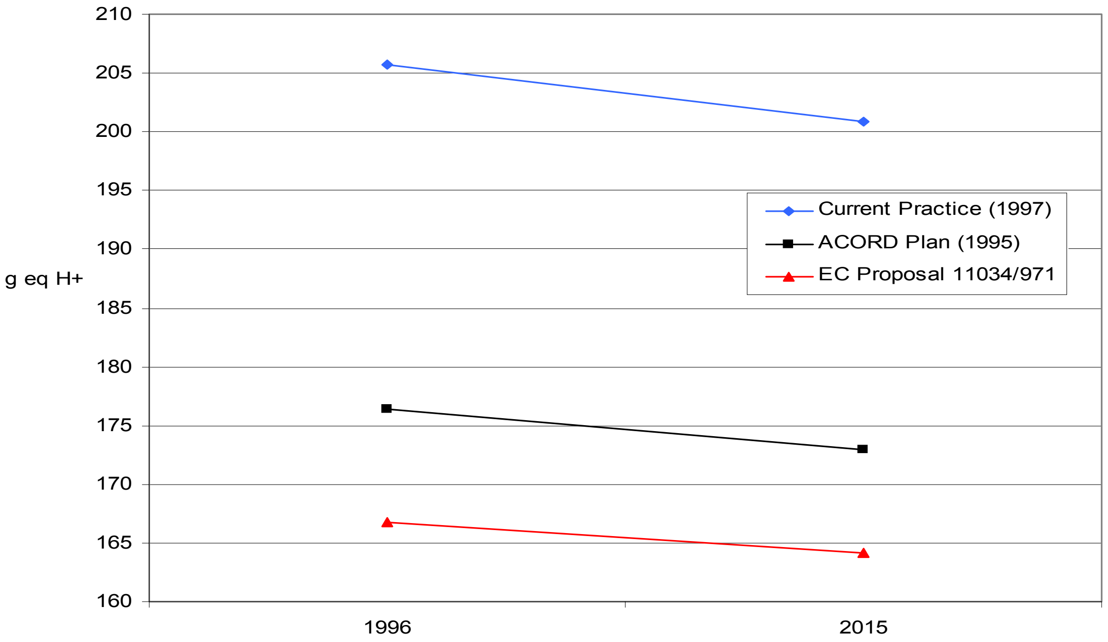


Figure 6.5c Sensitivity of the Non Renewable Resource Depletion Impact Potential to a Possible UK Fuel Mix in 2015 for Assessed ELV Processing and Disposal Options

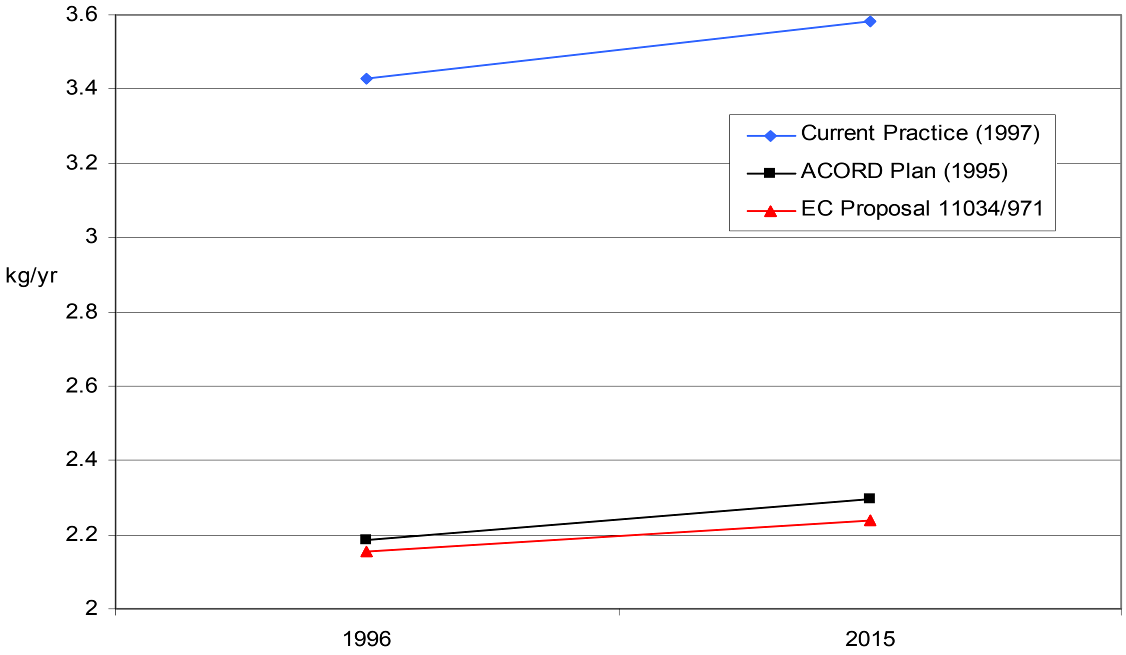
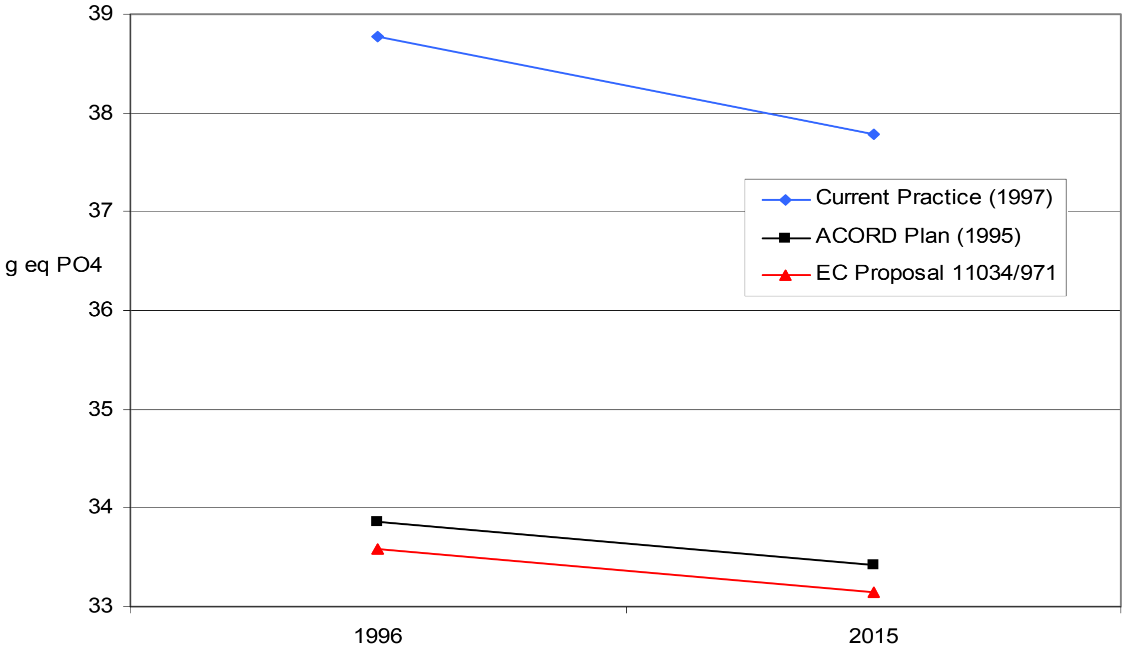


Figure 6.5d Sensitivity of the Eutrophication of Water Impact Potential to a Possible UK Fuel Mix in 2015 for Assessed ELV Processing and Disposal Options



Figures 6.5a to 6.5d show the following trends:

The change in fuel mix is relatively carbon neutral with respect to the calculated impact on global warming for each of the options. Although Table 6.2 shows a decrease in the use of coal for supplying the UK national grid with electricity, the contribution of fossil fuels (as a total) is seen to increase from 70% in 1996 to over 83% in 2015. The greater carbon efficiency of natural gas as a supplier of energy (per MJ of electricity supplied) is offset by the greater reliance on fossil fuels in total.

The air acidification impact for all options is seen to decrease due to the lower reliance on coal from 43% in 1996 to 14% in 2015. The reduction in the air acidification impact is small (approximately 2%).

The non renewable resource depletion impact potential is actually seen to increase for all options by 4 – 5%. Again, this is due to the increasing reliance on natural gas at the expense of coal, since known reserves of natural gas are less than those of coal.
There is a marginal reduction in the eutrophication of water impact potential of less than 3% for all options.

6.7 Summary of findings

On the basis of the sensitivity analyses carried out in this section, the following points have been identified:

Global warming, air acidification, non renewable resource depletion and eutrophication of water impact assessment potentials are not sensitive to a ±20% variation in the net heat value of the fluff arising from the shredder.

The impact potential of the draft EC ELV Directive 11034/971 which contains greater recycling targets than the other two options displays the greatest sensitivity to an increase in energy required for the plant that would help generate the extra material. The impact assessment potential showing the greatest sensitivity is air acidification with a 6% increase for a doubling in energy requirements. Eutrophication of water shows no sensitivity to a variation in the energy requirements of such a plant.

If the dismantler is required to collect more ELVs and travel further to provide such a service, the impact potentials that are most affected are air acidification and non renewable resource depletion. Eutrophication of water shows the least sensitivity for all options.

If more parts can be removed from the ELV at the dismantler for reuse, the impact potential that benefits the most is eutrophication of water, due to a reduction in processing operations to transport and convert scrap material into useful secondary material.

A change in the UK fuel mix that generates electricity for the national grid produces a mixed result. Whereas the global warming impact potentials shows almost no variation, the non renewable resource depletion impact potential shows a greater effect for all options, compared to an improvement in terms of air acidification and eutrophication of water.

Global warming, air acidification and non renewable resource depletion impact potentials appear to be most sensitive to the net heat value of the fluff and the amount of reuse of parts removed at the dismantler.

The eutrophication of water impact potential appears to be most sensitive to the amount of reuse of parts derived from the dismantler.

The shift from predominately coal to natural gas in order to provide electricity for the UK national grid, provides small benefits in terms of air acidification and eutrophication of water impact potentials, and a small burden in terms of non renewable resource depletion. The change appears to be carbon neutral with respect to the global warming impact potential.

7 COMPARISON OF THE UK RESULT WITH OTHER EUROPEAN COUNTRIES

Germany and France were selected for comparison, representing two of the major economies in Europe.

To enable a comparison of the results for the UK with the situation in Germany and France, inventories for the scenarios (1997 Current Practice, the 1995 ACORD plan and the draft EC ELV Directive 11034/971) were recalculated using the fuel mixes for these countries. The only parts of each scenario that are changed relate to the ELV processing and disposal chain and the primary energy and electricity systems. All the primary material and product systems assume that production and manufacture of parts and materials occur in Europe, using a European average fuel mix, which is unchanged. The fuel mixes themselves are shown below in Table 7.1

Table 7. 1 Fuel Mix for UK, Germany and France

Fuel	UK (1996)[10] (% fuel mix)	Germany (1994) (% fuel mix)	France (1994) (% fuel mix)
Nuclear	29	29.1	75.6
Coal	43	27.9	0.3
Lignite	0	27.7	4.0
Natural Gas	22	7.6	0.8
Oil	5	1.7	1.2
Hydroelectric	1	4.5	17.1
Other	2	1.5	1.0

Inventories were generated for France and Germany, using the same assumptions as the UK case (Appendix D), except for a change in the fuel mix for the appropriate national grid. It should be noted that some process data in the model are aggregated to include electricity production. Consequently, any findings in this section are likely to be under-reported as the fuel mix generating the electricity used by these processes will remain unchanged.

The same range of impact assessment methodologies was applied to these inventories as was applied to the UK inventory. For ease of comparison the results are expressed in Table 7.2 in the form of percentage differences, relative to the UK options (Chapter 4). The results are rounded up to a single percentage point. Results are not shown for stratospheric ozone depletion (high) as the impact is negligible (as was the case in the UK (Chapter 4)).

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[10] Due to rounding these figures do not add to 100.

Table 7. 2 Impact Assessment Results for France and Germany (expressed as a percentage of UK impact)

Impact/Valuation Methodology	France (% of UK Impact)			Germany (% of UK Impact)		
	Current Practice (1997)	ACORD Plan (1995)	EC Proposal 11034/971	Current Practice (1997)	ACORD Plan (1995)	EC Proposal 11034/971
Greenhouse effect (direct, 100 years)	95	97	97	101	101	100
Air acidification	95	96	97	99	99	99
Depletion of non renewable resources	96	95	96	100	100	100
Eutrophication (water)	97	99	99	97	99	99
Critical volume (air)	95	96	96	99	99	99
Critical volume (water)	98	99	99	99	99	99
Ecopoints method (total)	96	97	97	100	100	100
EPS method (total)	98	97	97	100	99	100

The first point to note is the similarity of the results, both to each other and the United Kingdom.

All of the impacts for the German fuel mix are within 3% of those for the UK. Where impacts are greater or lesser than for the UK fuel mix, the discrepancy is in the same direction for all three scenarios, preserving the interpretation of the results.

Germany's reliance on fossil fuels amounts to 65% compared to the UK total of 70%. The UK uses more coal, oil and natural gas compared to the greater use of lignite in Germany. This difference in emphasis on fossil fuel use appears to have a minimal influence on the impact of atmospheric emissions associated with global warming and air acidification. Table 7.2 shows that in the former case, the results are marginally worse and marginally better in the latter case. The emissions of carbon dioxide, sulphur oxides and nitrogen oxides would appear to be similar.

There are greater differences between the impact of the scenarios based on a French fuel mix and those for the UK, although these impacts are all still within 5% of that for the UK fuel mix. French electricity is generated primarily from nuclear and hydroelectric plant. Consequently emissions of carbon dioxide, sulphur oxides, nitrogen oxides and particulates, which contribute to the air-oriented impact assessment methodologies, are lower than for the UK scenarios. The reduced consumption of coal, oil and natural gas also leads to a lower impact on the depletion of non renewable resources.

The full results of the impact assessment for France and Germany are shown in Table 7.3.

Table 7.3 Impact Assessment Results for France and Germany

Impact Assessment Methodology	France			Germany		
	Current Practice (1997)	ACORD Plan (1995)	EC Proposal 11034/971	Current Practice (1997)	ACORD Plan (1995)	EC Proposal 11034/971
Greenhouse effect (direct, 100 years)	1.14	1.18	1.12	1.21	1.22	1.16
Air acidification	195.0	168.8	161.0	203.1	174.5	165.4
Depletion of non renewable resources	3.3	2.1	2.1	3.4	2.2	2.1
Eutrophication (water)	37.7	33.4	33.1	37.8	33.4	33.1
Critical volume (air)	2.8E+08	2.6E+08	2.4E+08	3.0E+08	2.7E+08	2.5E+08
Critical volume (water)	200703	192938	191934	201969	193830	192615
Ecopoints method (total)	415519	314945	320859	430140	325252	328719
EPS method (total)	439.8	171.4	150.5	446.2	175.9	154.0

Comparing 1997 practices[11] to the 1995 ACORD plan and draft EC ELV Directive 11034/971, the latter performs best in France and Germany for all assessed environmental impacts (except Ecopoints for which the 1995 ACORD plan shows a slight improvement). This is the same situation as for the UK based scenarios described above (Chapter 4). The order of performance, i.e. draft EC ELV Directive 11034/971>1995 ACORD plan>1997 Current Practice for any <u>one</u> impact measure is generally the same both for Germany and the UK. The results for Germany are therefore essentially the same as those for the UK.

For the French scenarios the order of environmental performance is also broadly the same as calculated for the UK. Generally speaking, and within the limitations of this exercise, the findings for the UK in Chapter 4 are likely to be similar for France and Germany.

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[11] Please note that this based on practices in the UK and not those in France and Germany, i.e. the figures are calculated on the basis that practices in France and Germany were the same as the UK in 1997.

8 COMPARISON WITH THE 1996 DRAFT OF THE EC ELV DIRECTIVE

8.1 Introduction

As highlighted in Chapter 1, the original scope of work required an assessment of an earlier draft of the ELV Directive (EC; 1996), which was subsequently superseded during the course of the study by a revision published in October 1997 (EC, 1997). As a result, the scope of work was amended to include the latter revision of the Directive as well as the original. The 1996 version of the Directive set mandatory targets for 2015, which included 90% reuse or recycling, 5% incineration with energy recovery, with the remainder of material going to landfill. The results of this version of the Directive (which are now of more historical significance), in comparison with the other options listed above, are produced in this section, for interest.

Underlying assumptions for this original version of the draft ELV Directive are provided at the end of Appendix D.

8.2 Analysis of results

Results have been produced for each of the impact assessment methodologies used in Chapter 4 and displayed as a comparison with 1997 practices, the 1995 ACORD proposal and the draft EC ELV Directive 11034/971. The findings are reproduced in Tables 8.1 and 8.2 below.

Table 8.1 Impact Assessment Results for the 1996 Version of the Draft EC ELV Directive in comparison with Options assessed in this Study

Impact Category	Units	Current practice (1997)	ACORD proposal (1995)	EC proposal 11034/971	EC proposal (1996)
Greenhouse effect (direct, 20 years)[12]	tonnes eq CO_2	1.35	1.34	1.29	1.15
Air acidification	g eq H^+	240.6	211.2	201.6	170.0
Stratospheric ozone depletion	g eq CFC 11	0.07	0.06	0.06	0.06
Non renewable resource depletion	kg/yr	4.18	2.99	2.96	2.15
Eutrophication	g eq PO_4	54.8	49.9	49.7	33.7

The magnitude of the results in Table 8.1 is different from those produced in Chapter 4. This is primarily because of the application of the system boundary expansion methodology. The reuse and recycling targets of the 1996 draft EC ELV Directive were an ambitious 90%. In order to meet with these reuse and recycling targets, the draft 1996 EC ELV Directive produced the most secondary material in comparison with the other options. This meant that each of the other three options required some

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[12] Please note that global warming impact figures produced in the original work were calculated over a 20 year period, compared to 100 years for the work reported in Chapter 4.

supplementary production of primary material such that the total material generated was the same for all options.

The main findings are as follows:

The higher reuse and recycling targets of the 1996 version of the draft EC ELV Directive produce material environmental benefits of at least 12% for all assessed impact potentials, except for stratospheric ozone depletion.

The smallest margin of improvement between the 1996 draft EC ELV Directive and the 1997 draft EC ELV Directive 11034/971 is for the global warming impact potential (12%) and the air acidification impact potential (19%). These improvements are based on the ability to reuse and recycle 90% of the mass of an ELV, compared to 85% for the 1997 version of the Directive. Given the embryonic state of markets for recycled material, and difficulty in recycling ELVs such a target may be ambitious in the near future. However, as cars are increasingly designed with end of life in mind, such a reuse and recycling target may be more easily achievable in the future, yielding potential benefits as calculated here.

The largest environmental benefit of those assessed in this study (in terms of decrease in environmental impact compared to the draft EC ELV Directive 11034/971) is derived for the non renewable resource depletion and eutrophication of water impact potentials, each decreasing by 38% and 47% respectively. These benefits are related to greater reuse and material recovery, thereby reducing the need to extract virgin materials from the earth, and emitting potentially eutrophicating substances during processing and manufacturing operations.

Table 8.2 below provides results for the other assessment methodologies.

Table 8.2 Other Assessment Results for the 1996 Version of the Draft EC ELV Directive in comparison with Options assessed in this Study

Assessment Method	Units	Current practice (1997)	ACORD Proposal (1995)	EC proposal 11034/971	EC Proposal (1996)
Critical volume:	m^3	5.0x10^8	4.7x10^8	4.5x10^8	3.76x10^8
Air	litres	224337	215257	213562	196210
Water					
Ecopoints (total)	ecopoints	492099	386837	390100	328234
EPS (total)	ELU	489.7	219.0	196.9	158.2

As with the results in Table 8.1, these figures are different to those presented in Chapter 4, primarily because of application of the system boundary expansion methodology. The findings are as follows:

The 1996 draft of the EC ELV Directive has less of a toxicological impact for all assessment methods.

The critical volumes (air) methodology which uses value judgements to quantify potential toxicological impacts to air shows an improvement of 20% on the draft EC ELV Directive 11034/971 due primarily to further savings in emission of sulphur oxides and nitrogen oxides.;

The critical volumes (water) methodology which uses value judgements to quantify potential toxicological impact s to water shows the least improvement of 9% in comparison with the rest of these assessment methods. This improvement is based on savings in the release of iron.

The Ecopoints and EPS methodologies show a 19% and 24% improvement for the 1996 draft EC ELV Directive option in comparison with the draft EC ELV Directive 11034/971.

9 COMPARISON OF END OF LIFE WITH THE REMAINDER OF THE VEHICLE LIFE CYCLE

This section of the report considers the ELV phase in the context of the whole vehicle life cycle (which includes manufacture of the vehicle and use).

For those products that consume materials and/or energy during their use phase, this part of the life cycle is generally considered to contribute the majority of the environmental load from *cradle to grave*. For the generic vehicle that is assumed to become an ELV in this study, one might reasonably assume that this convention would hold true. Evidence in the public domain supports this assumption.

One study of an individual vehicle[13] concluded that the end of life phase of the car consumed approximately 1% of the total energy requirements of the life cycle (Schweimer and Schuckert; 1996). The paper also quotes a figure of 0.2% for total primary energy, although it is not possible to establish the relationship between the two values. The end of life phase of the life cycle was assumed in this case to consist of 75% material recycling and 25% disposal of fluff to landfill. The study did not consider the benefits of secondary materials recovered other than from shredders and so may overestimate the net impacts of the end of life phase.

Energy consumption is often regarded as a useful analogue for overall environmental impact, and this study suggests that the impacts of the end of life phase are of low significance in comparison with those of the whole life cycle of the vehicle. Schweimer and Schuckert (1996) also report over 80% of carbon dioxide emissions to be associated with the use phase of the vehicle. They go on to state that the use phase, production of the vehicle and fuel processing account for the majority of emissions of nitrogen oxides.

Another study (Kobayashi, 1997) concluded that only 0.1% of the energy consumption of the full vehicle life cycle was attributable to the end of life phase[14]. This study also reports 0.04% of the lifetime carbon dioxide emissions to be linked to the ELV. It agrees with Schweimer and Schuckert in linking the use phase with over 80% of lifetime carbon dioxide emissions.

Schuckert *et al* (1997) quote a number of environmental flows for the production, fuel processing and use phase of a vehicle. In order to enable a rough comparison with the environmental impact of the ELV, these have been used in the impact assessment methodologies described above (Chapter 4). The results are shown in Table 9.1, and compared with those for the ELV in this study. The 1997 Current Practice option, with a UK fuel mix, is used for this comparison.

It should be noted that the LCI data in Schuckert *et al* (1997) are not as complete as the inventories developed for this study. Many of the environmental flows contributing to the impacts in Table 9.1 were not reported in the paper, and one might therefore expect

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[13] VW Golf, assumed kerb weight 1025 kg, including FULL fuel tank. Composition 64% ferrous metal, 16% plastics, 5.5% fuel/oil, 4.0% rubber, 3.1% glass, 2.5% alloys, 1.6% non-ferrous metal, 1.3% electrics, 1.1% insulation, 0.9% paint and 0.2% other materials.

[14] Unspecified vehicle, body weight 1270 kg. Composition: 72.2% ferrous metal, 10.1% plastics, 6.2% aluminium, 3.4% oil, 3.1% rubber, 2.8% glass, 1.8% electrical copper, 0.4% wood.

the overall impacts to be under-reported as a result. Nevertheless, the paper is of a high quality, and those flows which have not been reported are probably of relatively minor importance.

Table 9. 1 Comparison of Environmental Impact Potentials at End of Life in Comparison with the Remainder of the Vehicle Life Cycle

Impact Category	Units	Vehicle Life Cycle (excluding end of life)[1]	End of Life[2]
Greenhouse Effect (direct, 100 years)	tonnes eq. CO_2	38	0.84
Air Acidification	g eq H^+	2.55x10^{6}	1.36x10^{2}
Non Renewable Resource Depletion	kg/yr	174	1.96
Eutrophication of Water	g eq PO_4	277	33.3
Critical Volume (air)	m^{3}	8.50x10^{10}	1.90x10^{8}
Critical Volume (water)	litres	2.10x10^{9}	1.90x10^{5}
Ecopoints (total)	ecopoints	6.07x10^{6}	3.07x10^{5}
EPS	ELU	6.20x10^{7}	1.28x10^{2}

[1] Data from Schuckert *et al* 1997

[2] Data from this study, 1997 Current Practice option, UK fuel mix

Table 9.1 shows the potential environmental impact of the ELV to be between approximately 1 and 4 orders of magnitude less than that of the remainder of the vehicle life cycle. This is broadly consistent with the results of Schweimer and Schuckert, and of Kobayashi.

The potential impacts for which end of life is the most significant in comparison with the remainder of the life cycle are eutrophication, global warming, non renewable resource depletion and Ecopoints. Of these the ELV contributes only 2% and 1% respectively to the potential impacts of the full vehicle life cycle for global warming and non renewable resource depletion. Non renewable resource depletion is the impact assessment methodology for which the data in Schuckert *et al* are least complete and suitable. The contribution of the ELV is thus likely to be overestimated here.

The ELV contributes approximately 12% of the total eutrophication impact of the full vehicle life cycle. However, as described above, the eutrophication impact potential of the 1995 ACORD plan and draft EC ELV Directive 11034/971 is less than the 1997 Current Practice option for which the comparison is made in Table 9.1.

For Ecopoints the ELV contributes approximately 5% of the total potential impact of the full vehicle life cycle. There is also some under-reporting of Ecopoints criteria in the Schuckert *et al* data, and therefore the contribution of the ELV is likely to be overestimated. However, the significance of the ELV for this methodology hinges on emissions of nitrogen and sulphur oxides and of municipal and industrial wastes, which suggests that these may be the most important environmental flows for the ELV in the context of the full vehicle life cycle.

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APPENDICES

Appendix A: Life cycle inventories.

Appendix B: Composition of the generic ELV used in the study.

Appendix C: Background information on system boundaries.

Appendix D: Assumptions used in the study.

Appendix E: Background information on life cycle impact assessment methodologies.

Appendix F: Assumptions used for indicators of performance.

Appendix A: Life cycle inventories

Table A1: Life Cycle Inventories for the Three Options assessed in the Study

	Flow	Units	Current Practice (1997)	ACORD Plan (1995)	EC Proposal 11034/971
Inputs:	(r) Argon (Ar)	kg	0.00560501	0	0
	(r) Barium Sulphate (BaSO4, in ground)	kg	0.0114878	0.00754983	0.00564294
	(r) Bauxite (Al2O3, ore)	kg	18.5275	1.0948	0.00836174
	(r) Bentonite (Al2O3.4SiO2.H2O, in ground)	kg	0.00135069	0.000740182	0.000533056
	(r) Chromium (Cr, ore)	kg	2.02E-06	1.42E-06	1.08E-06
	(r) Clay (in ground)	kg	0.0299913	0.0123986	0.00935172
	(r) Coal (in ground)	kg	196.928	126.365	123.41
	(r) Copper (Cu, ore)	kg	0.214586	0.0400072	5.52E-06
	(r) Dolomite (CaCO3.MgCO3, in ground)	kg	4.51819	2.85765	2.0885
	(r) Feldspar (ore)	kg	1.67713	0.822681	0.426902
	(r) Iron (Fe, ore)	kg	31.2089	3.56339	1.51836
	(r) Iron Sulphate (FeSO4, ore)	kg	0.000846226	0.000596437	0.000454854
	(r) Lead (Pb, ore)	kg	0.881813	0.0554423	1.72E-06
	(r) Lignite (in ground)	kg	150.771	149.867	150.134
	(r) Limestone (CaCO3, in ground)	kg	16.1019	20.6522	15.7674
	(r) Manganese (Mn, ore)	kg	1.18E-06	8.29E-07	6.32E-07
	(r) Natural Gas (in ground)	kg	108.991	71.3236	72.7774
	(r) Nickel (Ni, ore)	kg	6.83E-07	4.82E-07	3.67E-07
	(r) Oil (in ground)	kg	72.0694	49.5442	47.2683
	(r) Pyrite (FeS2, ore)	kg	0.143229	0.0330596	0.00904436
	(r) Sand (in ground)	kg	27.3624	10.5582	6.13214
	(r) Silver (Ag, ore)	kg	5.09E-08	3.59E-08	2.74E-08
	(r) Sodium Carbonate (Na2CO3, in ground)	kg	2.59184	1.44753	1.45559
	(r) Sodium Chloride (NaCl, in ground or in sea)	kg	5.69505	1.56558	0.920515
	(r) Sulphur (S, in ground)	kg	0.019797	0.00287336	0
	(r) Uranium (U, ore)	kg	0.00916041	0.00813923	0.00801256
	(r) Zinc (Zn, ore)	kg	0.12553	5.26E-08	4.01E-08
	_Catalyser (Demetalization)	kg	0.00202552	0.00202678	0.00251587
	_Catalyser (Hydrotreating)	kg	0.00281322	0.00281497	0.00349426
	_Catalyser (Unspecified)	kg	1.29E-05	1.29E-05	2.09E-06
	_Dewaxing aid	kg	0.000630787	0.00063135	0.000102422
	_Furfural	kg	0.00147526	0.00147658	0.00023954
	Adjuvant (unspecified)	kg	-0.000546134	-0.000546442	-0.0008011
	Amine (unspecified)	kg	1.48E-05	1.48E-05	-2.98E-06
	Chalcopyrite (Cu2S.Fe2S3, ore)	kg	312.133	0	0
	Chlorine (Cl2)	kg	0.0162856	0.0170782	0.0172128
	Explosive (unspecified)	kg	0.000206666	0.000135128	0.000103143
	Fluorspar (CaF2)	kg	0.0513105	0.00744728	0
	Iron Scrap	kg	2.54953	0.399085	0.141567
	Raw Materials (unspecified)	kg	20.3441	19.7721	19.4971
	Water Used (total)	litre	10066.6	7630.44	7460.39
	Water: Industrial Water	litre	5.76	26.3977	18.96
	Water: Mine Supply	litre	0.0528155	0.0531101	0.0535852
	Water: Public Network	litre	6.77243	6.74593	7.8715
	Water: Unspecified Origin	litre	9971.53	7511.06	7345.9
	Water: Urban Supply Network	litre	82.44	86.1485	87.5853
	Wood (standing)	m3	0.00144919	0.0013445	0.00127747
Outputs:	(a) Acetaldehyde (CH3CHO)	g	0.00848663	0.00598154	0.00456163
	(a) Acetic Acid (CH3COOH)	g	0.0717061	0.0505399	0.0385426
	(a) Acetone (CH3COCH3)	g	0.00825907	0.00582116	0.00443932
	(a) Acetylene (C2H2)	g	0.235158	0.165744	0.1264
	(a) Alcohol (unspecified)	g	0.00079664	0	0
	(a) Aldehyde (unspecified)	g	3.5138	2.66898	1.49044
	(a) Alkane (unspecified)	g	1.25877	0.77732	0.578047
	(a) Alkene (unspecified)	g	0.282431	0.170111	0.128155
	(a) Alkyne (unspecified)	g	0.00127243	1.21E-05	9.21E-06
	(a) Aluminium (Al)	g	4.81719	3.37334	2.60817
	(a) Ammonia (NH3)	g	3.96548	1.88771	1.70767
	(a) Antimony (Sb)	g	0.000871244	0.00061407	0.000468301
	(a) AOX (Adsorbable Organic Halogens)	g	2.07E-07	5.91E-09	8.31E-10
	(a) Aromatic Hydrocarbons (unspecified)	g	5.9428	5.91311	5.91463
	(a) Arsenic (As)	g	0.286625	0.0233308	0.00510068
	(a) Barium (Ba)	g	0.0545332	0.0381755	0.0291133
	(a) Benzaldehyde (C6H5CHO)	g	3.09E-09	2.18E-09	1.66E-09
	(a) Benzene (C6H6)	g	1.05427	0.847131	0.765813
	(a) Benzo(a)pyrene (C20H12)	g	0.000765812	0.000514081	0.000392048
	(a) Berylium (Be)	g	0.000886939	0.000625132	0.000476737
	(a) Boron (B)	g	0.447477	0.303236	0.23065
	(a) Bromium (Br)	g	0.0885474	0.0605853	0.0461111

	(a) Butane (n-C4H10)	g	0.447339	0.315294	0.240449
	(a) Butene (1-CH3CH2CHCH2)	g	0.00282828	0.00199343	0.00152023
	(a) Cadmium (Cd)	g	0.0453793	0.0312294	0.0870715
	(a) Calcium (Ca)	g	0.556241	0.386185	0.294512
	(a) Carbon Dioxide (CO2, biomass)	g	43606	6983.59	26246
	(a) Carbon Dioxide (CO2, fossil)	g	1.13E+06	1.18E+06	1.10E+06
	(a) Carbon Monoxide (CO)	g	3473.64	3245.03	2889.64
	(a) Carbon Tetrafluoride (CF4)	g	0.883728	0.117282	1.34E-06
	(a) CFC 11 (CFCl3)	g	1.85E-12	0	0
	(a) CFC 114 (CF2ClCF2Cl)	g	4.90E-11	0	0
	(a) CFC 12 (CCl2F2)	g	3.99E-13	0	0
	(a) CFC 13 (CF3Cl)	g	2.51E-13	0	0
	(a) Chlorides (Cl-)	g	2.06E-06	1.45E-06	1.11E-06
	(a) Chlorinated Matter (unspecified, as Cl)	g	1.28756	0	0.00706356
	(a) Chlorine (Cl2)	g	0.00364463	1.67E-06	2.13E-05
	(a) Chromium (Cr III, Cr VI)	g	0.0115151	0.00811609	0.00618947
	(a) Chromium (Cr)	g	0.101012	0.100954	0.101055
	(a) Cobalt (Co)	g	0.0033068	0.00229616	0.00175109
	(a) Copper (Cu)	g	0.356724	0.306188	0.303996
	(a) Cyanide (CN-)	g	0.00119291	0.000840784	0.000641196
	(a) Dioxins (unspecified)	g	8.70E-09	6.13E-09	4.68E-09
	(a) Ethane (C2H6)	g	3.60354	2.53985	1.93693
	(a) Ethanol (C2H5OH)	g	0.016456	0.0115986	0.00884526
	(a) Ethylbenzene (C8H10)	g	0.00326274	0.00199902	0.0015206
	(a) Ethylene (C2H4)	g	5.09108	3.58829	2.7365
	(a) Fluorides (F-)	g	1.66824	0.241801	0.00019858
	(a) Fluorine (F2)	g	1.00E-05	7.08E-06	5.40E-06
	(a) Fluorinous Matter (unspecified, as F)	g	1.41182	0	0
	(a) Formaldehyde (CH2O)	g	0.0848462	0.0598013	0.0456056
	(a) Halogenated Matter (unspecified)	g	0.000166171	0.000162923	0.000162775
	(a) Halon 1301 (CF3Br)	g	0.00432671	0.00363507	0.00345106
	(a) HCFC 22 (CHF2Cl)	g	4.39E-13	0	0
	(a) Heptane (C7H16)	g	0.0279059	0.0196686	0.0149996
	(a) Hexafluoroethane (C2F6, FC116)	g	0.00756675	0	0
	(a) Hexane (C6H14)	g	0.0558373	0.0393552	0.030013
	(a) Hydrocarbons (except methane)	g	2131.09	823.227	916.851
	(a) Hydrocarbons (unspecified)	g	281.212	64.8601	48.0964
	(a) Hydrogen (H2)	g	0.863548	0.0872917	0.0917637
	(a) Hydrogen Chloride (HCl)	g	101.893	93.3762	93.9166
	(a) Hydrogen Fluoride (HF)	g	9.62158	9.10611	8.96241
	(a) Hydrogen Sulphide (H2S)	g	0.796571	0.514002	0.37713
	(a) Iodine (I)	g	0.0214445	0.0151145	0.0115266
	(a) Iron (Fe)	g	2.65746	2.05107	1.72571
	(a) Ketone (unspecified)	g	2.5567	2.55898	0.415135
	(a) Lanthanum (La)	g	0.00142364	0.00100341	0.000765221
	(a) Lead (Pb)	g	8.31512	5.42462	5.24948
	(a) Magnesium (Mg)	g	1.59325	1.1157	0.850856
	(a) Manganese (Mn)	g	1.889	1.88673	1.88852
	(a) Mercury (Hg)	g	0.042553	0.0407726	0.0975161
	(a) Metals (unspecified)	g	20.42	19.9519	21.6133
	(a) Methane (CH4)	g	2098.7	1370.75	1656.36
	(a) Methanol (CH3OH)	g	0.027957	0.0197047	0.0150271
	(a) Molybdenum (Mo)	g	0.00267479	0.00188524	0.00143772
	(a) Nickel (Ni)	g	0.216492	0.186106	0.172622
	(a) Nitrogen Oxides (NOx as NO2)	g	3179.09	3484.58	3245.73
	(a) Nitrous Oxide (N2O)	g	79.6947	38.2657	41.6778
	(a) Organic Matter (unspecified)	g	7.03192	1.81353	1.93143
	(a) Particulates (unspecified)	g	2603.64	2663.42	1972.27
	(a) Pentane (C5H12)	g	0.450021	0.317184	0.24189
	(a) Phenol (C6H5OH)	g	0.0561891	1.67E-08	1.28E-08
	(a) Phosphorus (P)	g	0.0399272	0.0281415	0.0214612
	(a) Phosphorus Pentoxide (P2O5)	g	2.71E-05	1.91E-05	1.46E-05
	(a) Polycyclic Aromatic Hydrocarbons (PAH, unspecified)	g	0.0974635	0.0266718	0.0144977
	(a) Potassium (K)	g	0.551467	0.385469	0.293966
	(a) Propane (C3H8)	g	1.5021	1.13286	0.63719
	(a) Propionaldehyde (CH3CH2CHO)	g	8.51E-09	6.00E-09	4.57E-09
	(a) Propylene (CH2CHCH3)	g	0.261933	0.184616	0.140791
	(a) Scandium (Sc)	g	0.000483013	0.000340437	0.000259624
	(a) Selenium (Se)	g	0.00935898	0.0065964	0.00503053
	(a) Silicon (Si)	g	6.85132	4.77635	3.63841

	(a) Sodium (Na)	g	0.31405	0.221349	0.168804
	(a) Sodium Sulphate (Na2SO4)	g	0.0130728	0.00328048	0.00326819
	(a) Strontium (Sr)	g	0.0883962	0.0623034	0.0475137
	(a) Sulphur Oxides (SOx as SO2)	g	4257.14	3118.8	2977.64
	(a) Tars (unspecified)	g	1.35389	0.000212046	0.000213724
	(a) Thallium (Tl)	g	0.000593416	0.000424263	0.000266092
	(a) Thorium (Th)	g	0.000911016	0.000642103	0.000489679
	(a) Tin (Sn)	g	0.000284728	0.000200682	0.000153044
	(a) Titanium (Ti)	g	0.158271	0.111552	0.0850718
	(a) Toluene (C6H5CH3)	g	0.134447	0.0947715	0.0722507
	(a) Uranium (U)	g	0.000883936	0.000623016	0.000475123
	(a) Vanadium (V)	g	0.167533	0.118082	0.0900374
	(a) VOC (Volatile Organic Compounds)	g	199.885	187.661	188.654
	(a) Water Vapour (H2O)	g	19181.9	46651.3	36228.9
	(a) Xylene (C6H4(CH3)2)	g	0.0563709	0.0381762	0.0290983
	(a) Zinc (Zn)	g	2.1877	0.542169	0.498232
	(a) Zirconium (Zr)	g	0.000676983	0.000477151	0.000363884
	(ar) Lead (Pb210)	kBq	0.0206484	0.0145534	0.0110987
	(ar) Radioactive Substance (unspecified)	kBq	575487	564603	563921
	(ar) Radium (Ra226)	kBq	0.0165203	0.0116438	0.0088798
	(ar) Radon (Rn222)	kBq	0.196324	0.138373	0.105526
	(s) Aluminium (Al)	g	0.147364	0.0964993	0.0720333
	(s) Arsenic (As)	g	5.89E-05	3.86E-05	2.88E-05
	(s) Cadmium (Cd)	g	2.25E-07	4.68E-08	1.30E-08
	(s) Calcium (Ca)	g	0.588732	0.38553	0.287789
	(s) Carbon (C)	g	0.442917	0.289527	0.216009
	(s) Chromium (Cr III, Cr VI)	g	0.000670301	0.000472442	0.000360292
	(s) Chromium (Cr)	g	6.66E-05	1.02E-05	0
	(s) Cobalt (Co)	g	2.54E-07	5.14E-08	1.32E-08
	(s) Copper (Cu)	g	1.27E-06	2.57E-07	6.61E-08
	(s) Iron (Fe)	g	0.294293	0.192713	0.143855
	(s) Lead (Pb)	g	5.80E-06	1.17E-06	3.02E-07
	(s) Manganese (Mn)	g	0.00588732	0.0038553	0.00287789
	(s) Mercury (Hg)	g	3.97E-08	8.42E-09	2.40E-09
	(s) Nickel (Ni)	g	1.91E-06	3.85E-07	9.92E-08
	(s) Nitrogen (N)	g	4.31E-06	1.48E-06	1.13E-06
	(s) Oils (unspecified)	g	0.00832445	0.00167068	0.000427342
	(s) Phosphorus (P)	g	0.00740229	0.0048321	0.00360329
	(s) Sulphur (S)	g	0.0883327	0.0578363	0.0431705
	(s) Zinc (Zn)	g	0.00222393	0.00145059	0.00108157
	(w) Acids (H+)	g	4.90766	1.0235	0.894417
	(w) Acrylonitrile (CH2CHCN)	g	1.83928	0	0.012263
	(w) Adiponitrile (NC(CH2)4CN)	g	0.0689729	0	0.000459861
	(w) Alcohol (unspecified)	g	0.00120948	0.000852464	0.000650104
	(w) Alkane (unspecified)	g	0.0211345	0.014896	0.01136
	(w) Alkene (unspecified)	g	0.00197006	0.00137374	0.00104764
	(w) Aluminium (Al3+)	g	171.161	163.592	159.264
	(w) Aluminium Hydroxide (Al(OH)3)	g	2.11E-05	1.49E-05	1.14E-05
	(w) Ammonia (NH4+, NH3, as N)	g	3.37471	2.34955	2.26633
	(w) AOX (Adsorbable Organic Halogens)	g	0.00920722	0.00426292	0.00306902
	(w) Aromatic Hydrocarbons (unspecified)	g	0.922677	0.794211	0.75758
	(w) Arsenic (As3+, As5+)	g	0.341724	0.328078	0.319523
	(w) Barium (Ba++)	g	15.9249	14.9762	14.5061
	(w) Barytes	g	2.05197	1.36707	1.02083
	(w) Benzene (C6H6)	g	0.0220447	0.0150716	0.0113661
	(w) BOD5 (Biochemical Oxygen Demand)	g	95.6603	91.2024	91.3357
	(w) Boric Acid (H3BO3)	g	0.0246225	0.0173544	0.0132348
	(w) Boron (B III)	g	0.00264357	0.00186474	0.00141863
	(w) Cadmium (Cd++)	g	0.0101892	0.00965642	0.00939917
	(w) Calcium (Ca++)	g	48.0055	12.9409	6.4817
	(w) Carbonates (CO3--, HCO3-, CO2, as C)	g	0.0217706	0.0153443	0.0117019
	(w) Cesium (Cs++)	g	0.000150893	0.000106352	8.11E-05
	(w) Chlorides (Cl-)	g	3969.39	4334.52	4126.57
	(w) Chlorinated Matter (unspecified, as Cl)	g	0.56802	0.479196	0.429693
	(w) Chloroform (CHCl3)	g	3.24E-07	2.28E-07	1.74E-07
	(w) Chromium (Cr III)	g	0.00140718	0.000991808	0.00075637
	(w) Chromium (Cr III, Cr VI)	g	3.83735	3.76313	3.72038
	(w) Chromium (Cr VI)	g	2.64E-08	1.86E-08	1.42E-08
	(w) Cobalt (Co I, Co II, Co III)	g	8.69E-05	6.12E-05	4.67E-05
	(w) COD (Chemical Oxygen Demand)	g	271.09	252.893	252.915

(w) Copper (Cu+, Cu++)	g	1.00371	0.968038	0.94746
(w) Cyanides (CN-)	g	0.0425735	0.029669	0.0237789
(w) Dissolved Matter (unspecified)	g	481.388	382.065	387.349
(w) Dissolved Organic Carbon (DOC)	g	1.15174	1.10572	1.08652
(w) Edetic Acid (C10H16N2O8, EDTA)	g	4.18E-05	2.95E-05	2.25E-05
(w) Ethylbenzene (C6H5C2H5)	g	0.00365122	0.00257346	0.00196256
(w) Fluoranthene	g	4.20E-06	0	0
(w) Fluorides (F-)	g	0.477623	0.0807859	0.0671144
(w) Fluorinous Matter (unspecified, as F)	g	0.0809922	0	0
(w) Formaldehyde (CH2O)	g	4.10E-09	2.89E-09	2.21E-09
(w) Halogenous Matter (organic)	g	2.74E-06	4.17E-09	1.73E-08
(w) Hexachloroethane (C2Cl6)	g	5.71E-13	4.03E-13	3.07E-13
(w) Hydrazine (N2H4)	g	1.92E-05	1.35E-05	1.03E-05
(w) Hydrocarbons (unspecified)	g	3.94967	0.751236	0.761116
(w) Inorganic Dissolved Matter (unspecified)	g	111.428	46.2818	36.5455
(w) Iodine (I-)	g	0.0151265	0.0106614	0.00813061
(w) Iron (Fe++, Fe3+)	g	315.288	311.994	311.077
(w) Lead (Pb++, Pb4+)	g	1.02429	0.98167	0.95725
(w) Lithium Salts (Lithine)	g	2.15E-06	1.51E-06	1.15E-06
(w) Magnesium (Mg++)	g	0.760997	0.223724	0.137969
(w) Manganese (Mn II, Mn IV, Mn VII)	g	0.0693077	0.0436568	0.0332917
(w) Mercury (Hg+, Hg++)	g	0.00844885	0.00842484	0.00842357
(w) Metals (unspecified)	g	97.5759	26.6298	26.3849
(w) Methane (CH4)	g	0.0563891	0.0397442	0.0303096
(w) Methylene Chloride (CH2Cl2)	g	0.000928215	0.000654224	0.000498923
(w) Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	g	0.00141757	0.000999169	0.000761895
(w) Morpholine (C4H9NO)	g	0.000203305	0.000143294	0.000109278
(w) Nickel (Ni++, Ni3+)	g	1.01375	0.980244	0.959402
(w) Nitrate (NO3-)	g	9.82302	4.26367	4.26154
(w) Nitrite (NO2-)	g	0.000679522	9.63E-05	1.30E-05
(w) Nitrogenous Matter (Kjeldahl, as N)	g	0.00855507	0.00602979	0.00459842
(w) Nitrogenous Matter (unspecified, as N)	g	2.9377	1.49592	1.51002
(w) Oils (unspecified)	g	34.0432	27.2074	26.6467
(w) Organic Dissolved Matter (chlorinated)	g	0.118094	0	0.00067608
(w) Organic Dissolved Matter (unspecified)	g	8.56641	0.0837078	0.199309
(w) Organic Matter (unspecified)	g	2.31399	0	0.014056
(w) Oxalic Acid ((COOH)2)	g	8.36E-05	5.89E-05	4.49E-05
(w) Phenol (C6H5OH)	g	0.20443	0.14892	0.150471
(w) Phosphates (PO4 3-, HPO4--, H2PO4-, H3PO4, as P)	g	9.54691	8.58555	8.50495
(w) Phosphorous Matter (unspecified, as P)	g	0.000498667	0.000498979	0.000610597
(w) Phosphorus (P)	g	0.000665594	0.000469124	0.000357762
(w) Phosphorus Pentoxide (P2O5)	g	0.000807304	0.000569004	0.000433932
(w) Polycyclic Aromatic Hydrocarbons (PAH, unspecified)	g	0.0474504	0.0158598	0.0101569
(w) Potassium (K+)	g	0.929744	0.519711	0.380268
(w) Rubidium (Rb+)	g	0.00151171	0.00106549	0.000812559
(w) Salts (unspecified)	g	1330.69	1324.48	1312.96
(w) Saponifiable Oils and Fats	g	0.780591	0.526311	0.396533
(w) Selenium (Se II, Se IV, Se VI)	g	0.00294652	0.000876307	0.000668199
(w) Silicon Dioxide (SiO2)	g	0.00033296	0.000234677	0.000178969
(w) Silver (Ag+)	g	9.63E-05	6.39E-05	4.88E-05
(w) Sodium (Na+)	g	335.088	779.537	718.787
(w) Strontium (Sr II)	g	1.05571	0.711318	0.536271
(w) Sulphate (SO4--)	g	1838.03	1728.7	1698.12
(w) Sulphide (S--)	g	0.0358535	0.0272331	0.0262253
(w) Sulphite (SO3--)	g	0.000385693	7.91E-05	2.71E-05
(w) Sulphurated Matter (unspecified, as S)	g	0.00659529	1.54E-05	4.35E-05
(w) Surfactant Agent (unspecified)	g	0.0002242	0	0
(w) Suspended Matter (organic)	g	0.827466	-0.0934925	-0.157154
(w) Suspended Matter (unspecified)	g	205.019	141.25	134.876
(w) Tars (unspecified)	g	0.000124072	3.03E-06	3.05E-06
(w) Tetrachloroethylene (C2Cl4)	g	1.40E-09	9.84E-10	7.51E-10
(w) Tin (Sn++, Sn4+)	g	1.02E-05	3.25E-06	2.48E-06
(w) Titanium (Ti3+, Ti4+)	g	0.0244838	0.00297397	0.002268
(w) TOC (Total Organic Carbon)	g	81.8414	79.1742	78.5745
(w) Toluene (C6H5CH3)	g	0.126662	0.107553	0.101598
(w) Tributyl Phosphate ((C4H9)3PO4, TBP)	g	0.000791862	0.00055812	0.000425632
(w) Trichlorethane (1,1,1-CH3CCl3)	g	3.15E-09	2.22E-09	1.69E-09
(w) Trichloroethylene (CHClCl2)	g	8.66E-08	6.11E-08	4.66E-08
(w) Triethylene Glycol (C6H14O4)	g	0.106861	0.075318	0.0574389

(w) Vanadium (V3+, V5+)	g	0.0066141	0.00329676	0.00251408
(w) VOC (Volatile Organic Compounds)	g	0.0528127	0.0372234	0.0283873
(w) Water (unspecified)	litre	25.4296	19.4805	14.2399
(w) Water: Chemically Polluted	litre	2704.16	2720.66	2719.95
(w) Xylene (C6H4(CH3)2)	g	0.235147	0.100918	0.0775752
(w) Zinc (Zn++)	g	1.71558	1.64385	1.60039
(wr) Radioactive Substance (unspecified)	kBq	5295.82	5195.62	5189.31
(wr) Radium (Ra224)	kBq	0.00755855	0.00532742	0.00406279
(wr) Radium (Ra226)	kBq	5.8061	4.09226	3.12083
(wr) Radium (Ra228)	kBq	0.0151171	0.0106549	0.00812559
(wr) Thorium (Th228)	kBq	0.0302344	0.0213098	0.0162512
_(PE) Electricity	MJ	244.757	58.456	0
_(PE) Fossil Fuels (fuel energy)	MJ	1423.04	0	258.92
_(PM) Total	kg	42.4768	11.1336	0.05889
_(PM) Total: Ferrous	kg	3.006	2.087	0
_(PM) Total: Non Ferrous	kg	2.28709	0.38864	0
_(PM) Total: Other	kg	27.3498	8.658	0
_(PM) Total: Plastics	kg	9.83385	0	0.05889
_(PP) Total	kg	35.9497	1.79725	0
_(PP) Total: Ferrous	kg	22.024	0	0
_(PP) Total: Fluids	kg	1.78858	1.78858	0
_(PP) Total: Non Ferrous	kg	4.6223	0	0
_(PP) Total: Other	kg	6.9168	0.00867	0
_(PP) Total: Plastics	kg	0.598	0	0
_(SE) Electricity	MJ	37.6301	223.931	282.387
_(SE) Waste (fuel energy)	MJ	0	1423.04	1164.12
_(SM) ABS	kg	0	0.939472	0.933953
_(SM) Aluminium (sheet)	kg	35.4806	37.2075	37.5007
_(SM) Copper	kg	4.56419	4.67593	4.71593
_(SM) Ferrous (steel plate)	kg	528.339	529.258	531.345
_(SM) Glass	kg	0.666667	19.3585	28.0165
_(SM) Lead	kg	6.1618	6.19617	6.25161
_(SM) Other Metals	kg	0.521146	0.53293	0.53293
_(SM) Other Plastics	kg	0	1.51409	1.50511
_(SM) PA66	kg	0	1.0694	1.06193
_(SM) PE	kg	0	0.553138	0.550025
_(SM) PP	kg	0	3.42946	3.40953
_(SM) PUR	kg	0	1.26624	1.25866
_(SM) PVC	kg	0	1.06201	1.0558
_(SM) Rubber	kg	3.1	3.1	3.1
_(SM) Total	kg	579.593	610.935	622.01
_(SM) Total: Ferrous	kg	528.339	529.258	531.345
_(SM) Total: Non Ferrous	kg	47.4869	49.3855	49.7741
_(SM) Total: Other	kg	3.76667	22.4585	31.1165
_(SM) Total: Plastics	kg	0	9.83382	9.775
_(SM) Zinc	kg	0.759251	0.772909	0.772909
_(SP) ABS Product	kg	0.3	0.35	0.35
_(SP) Aluminium Product (cast)	kg	11.781	14.5992	14.5992
_(SP) Coolant	kg	3	3	3
_(SP) Copper Product (wire)	kg	2.193	3.0401	3.0401
_(SP) Ferrous Product (cast)	kg	73.976	96	96
_(SP) Fluids (unspecified)	kg	3.03282	3.03282	3.03282
_(SP) Glass Product	kg	0	6.90813	6.9168
_(SP) Lead Product	kg	1.89	2.682	2.682
_(SP) Lubricant	kg	3.57718	3.57718	5.36576
_(SP) Other Materials Product	kg	1.6	1.6	1.6
_(SP) Other Metals Product	kg	0.204	0.286	0.286
_(SP) Other Plastics Product	kg	0.5	0.55	0.55
_(SP) PA66 Product	kg	0.2	0.25	0.25
_(SP) PE Product	kg	0.2	0.25	0.25
_(SP) PP Product	kg	1.2	1.45	1.45
_(SP) PUR Product	kg	0.4	0.45	0.45
_(SP) PVC Product	kg	0.3	0.4	0.4
_(SP) Rubber Product (tyre)	kg	18.8	18.8	18.8
_(SP) Total	kg	123.409	157.563	159.361
_(SP) Total: Ferrous	kg	73.976	96	96
_(SP) Total: Fluids	kg	9.61	9.61	11.3986
_(SP) Total: Non Ferrous	kg	16.323	20.9453	20.9453
_(SP) Total: Other	kg	20.4	27.3081	27.3168
_(SP) Total: Plastics	kg	3.1	3.7	3.7

	_(SP) Zinc Product (wire)	kg	0.255	0.338	0.338
	_Recovered Matter: Steel Scrap	kg	17.7186	17.7173	17.7173
	Aluminium Scrap	kg	0	0.0659544	0
	Iron Scrap	kg	0	0.54469	0
	Recovered Energy	MJ	0.000125955	1609.34	1322.64
	Recovered Matter (total)	kg	91.3759	78.5644	77.6155
	Recovered Matter (unspecified)	kg	70.1399	58.5203	57.6339
	Recovered Matter: Aluminium Drosses	kg	0.0336301	0	0
	Recovered Matter: Aluminium Scrap	kg	2.13888	2.22109	2.23504
	Recovered Matter: Ash	kg	1.32225	0	0
	Recovered Matter: Carbon Monoxide (CO)	kg	0.398691	0.406204	0.406204
	Recovered Matter: Iron Scrap	kg	0.000496023	0.00110257	0.00101511
	Waste (hazardous)	kg	1.0236	6.67817	6.13155
	Waste (incineration)	kg	0.0376398	0.00121043	0.00108819
	Waste (municipal and industrial)	kg	283.71	32.2081	95.4665
	Waste (municipal and industrial, to incineration)	kg	0.008376	0	0
	Waste (total)	kg	756.529	89.588	187.386
	Waste (unspecified)	kg	196.453	15.7741	58.1764
	Waste: Bauxite Residues (red mud)	kg	3.46706	0	0
	Waste: Highly Radioactive (class C)	kg	5.35E-05	3.77E-05	2.87E-05
	Waste: Intermediate Radioactive (class B)	kg	0.000408485	0.000287908	0.000219564
	Waste: Low Radioactive (class A)	kBq	0.00530189	0.00373688	0.00284981
	Waste: Mineral (inert)	kg	261.067	12.7475	10.8402
	Waste: Mining	kg	4.54641	3.2044	2.44373
	Waste: Non Mineral (inert)	kg	0.50024	0.461082	0.457548
	Waste: Non Toxic Chemicals (unspecified)	kg	0.0547934	-0.004763	-0.00442578
	Waste: Oil (hazardous)	kg	2.3	0	0
	Waste: Radioactive (unspecified)	kg	0.000147098	0.000103677	7.91E-05
	Waste: Slags and Ash (unspecified)	kg	7.778	21.6893	16.2863
	Waste: Treatment	kg	0.253385	0.178591	0.136197
Reminders:	E Feedstock Energy	MJ	11275.6	4123.5	5300.98
	E Fuel Energy	MJ	14146.2	16024.4	14782.3
	E Non Renewable Energy	MJ	24827.1	19784.5	19735.6
	E Renewable Energy	MJ	594.547	363.272	347.606
	E Total Primary Energy	MJ	25421.6	20147.7	20083.2
	Electricity	MJ elec	7916.9	7294.13	7199.1

Table A2 Breakdown of the Current Practice (1997) Option

	Flow	Units	ELV	Energy/Electricity	Primary Ferrous	Primary Non Ferrous	Primary Plastics	Primary Other
Inputs:	(r) Argon (Ar)	kg	0	0	0	0.00560501	0	0
	(r) Barium Sulphate (BaSO4, in ground)	kg	0.00335511	0.00714321	0	0.000989525	0	0
	(r) Bauxite (Al2O3, ore)	kg	0.00595774	0.012513264	0.00302812	18.50090097	0.004401735	0.00072797
	(r) Bentonite (Al2O3.4SiO2.H2O, in ground)	kg	0.000316938	0.000674779	0	0.000358892	0	0
	(r) Chromium (Cr, ore)	kg	0.000000645	0.00000137	0	0	0	0
	(r) Clay (in ground)	kg	0.00566451	0.0115085	0.0114177	0.001153688	0.000192356	0.0000546
	(r) Coal (in ground)	kg	111.573	42.9248	24.00962	12.108356	2.77193581	3.53988416
	(r) Copper (Cu, ore)	kg	0.00000328	0.00000699	0	0.21457528	0	0
	(r) Dolomite (CaCO3.MgCO3, in ground)	kg	0.0197417	0	0	0	0	4.49845
	(r) Feldspar (ore)	kg	0.0101583	0	0	0	0	1.66697
	(r) Iron (Fe, ore)	kg	1.5747	0.0519269	29.4704	0.104568248	0.004862865	0.002502934
	(r) Iron Sulphate (FeSO4, ore)	kg	0.000270441	0.000575785	0	0	0	0
	(r) Lead (Pb, ore)	kg	0.00000102	0.00000218	0	0.88181	0	0
	(r) Lignite (in ground)	kg	149.226	0.0113226	0.3186693	0.83851788	0.375235148	0.000957115
	(r) Limestone (CaCO3, in ground)	kg	3.23319	2.99272	5.1006	0.869172773	0.332698675	3.573530975
	(r) Manganese (Mn, ore)	kg	0.000000376	0.0000008	0	0	0	0
	(r) Natural Gas (in ground)	kg	62.4323	21.57322	4.903897	3.98943917	9.5577646	6.534289
	(r) Nickel (Ni, ore)	kg	0.000000218	0.000000465	0	0	0	0
	(r) Oil (in ground)	kg	46.0937	1.655285	2.443456	8.83274647	9.999728	3.044517
	(r) Pyrite (FeS2, ore)	kg	0.00537749	0.011449	0	0.12640213	0	0
	(r) Sand (in ground)	kg	0.200815	0.00979846	3.34564	0.095274687	0.003132632	23.70773029
	(r) Silver (Ag, ore)	kg	1.63E-08	3.46E-08	0	0	0	0
	(r) Sodium Carbonate (Na2CO3, in ground)	kg	1.05631	0	0	0	0	1.53553
	(r) Sodium Chloride (NaCl, in ground or in sea)	kg	0.095953	0.01829895	0.00139323	0.583912328	2.145806159	2.84968486
	(r) Uranium (U, ore)	kg	0.0077907	0.000445774	0.000218151	0.00042921	0.000114724	0.00016186
	(r) Zinc (Zn, ore)	kg	2.39E-08	5.08E-08	0	0.12552961	0	0
	_Catalyser (Demetalization)	kg	0.00202552	0	0	0	0	0
	_Catalyser (Hydrotreating)	kg	0.00281322	0	0	0	0	0
	_Catalyser (Unspecified)	kg	0.00000206	0	0	0	0	0.0000108
	_Dewaxing aid	kg	0.000100951	0	0	0	0	0.000529836
	_Furfural	kg	0.000236099	0	0	0	0	0.00123916
	Adjuvant (unspecified)	kg	-0.000641632	0	0	0	0	0.0000955
	Amine (unspecified)	kg	-0.00000182	0	0	0	0	0.0000166
	Chalcopyrite (Cu2S.Fe2S3, ore)	kg	0	0	0	312.133	0	0
	Chlorine (Cl2)	kg	0.0162856	0	0	0	0	0
	Explosive (unspecified)	kg	0.0000615	0.000130085	0.0000151	0	0	0
	Fluorspar (CaF2)	kg	0	0	0	0.0513105	0	0
	Iron Scrap	kg	0.147583	0.00441828	2.397532	0	0	0
	Raw Materials (unspecified)	kg	19.0147	0.825192	0.1658563	0.1714214	0	0.166834436
	Water Used (total)	litre	7291.48	91.439288	1915.5634	83.12346	522.09535	162.9056
	Water: Industrial Water	litre	5.76	0	0	0	0	0
	Water: Mine Supply	litre	0.0528155	0	0	0	0	0
	Water: Public Network	litre	6.77243	0	0	0	0	0
	Water: Unspecified Origin	litre	7196.44	91.405888	1915.5634	83.12346	522.09535	162.9056
	Water: Urban Supply Network	litre	82.44	0	0	0	0	0
	Wood (standing)	m3	0.00123433	0.000115341	5.30278E-05	4.45181E-05	1.11724E-06	8.60713E-07
Outputs:	(a) Acetaldehyde (CH3CHO)	g	0.0027122	0.00577443	0	0	0	0
	(a) Acetic Acid (CH3COOH)	g	0.0229162	0.0487899	0	0	0	0
	(a) Acetone (CH3COCH3)	g	0.00263948	0.0056196	0	0	0	0
	(a) Acetylene (C2H2)	g	0.0751531	0.160005	0	0	0	0
	(a) Alcohol (unspecified)	g	0	0	0	0.000796571	0	0

	(a) Aldehyde (unspecified)	g	1.42435	0.24512433	0.247708135	0.286320026	0.027111737	1.28319175
	(a) Alkane (unspecified)	g	0.343738	0.731626	0	0.1824834	0	0.000926148
	(a) Alkene (unspecified)	g	0.0761985	0.162225	0	0.043981424	0	0.0000257
	(a) Alkyne (unspecified)	g	0.00000547	0.0000117	0	0.00125532	0	0
	(a) Aluminium (Al)	g	1.64053	3.07391	0	0.102748281	0	0
	(a) Ammonia (NH3)	g	1.67339	0.0632397	1.6637532	0.138105975	0.246392914	0.18060123
	(a) Antimony (Sb)	g	0.000278437	0.000592807	0	0	0	0
	(a) AOX (Adsorbable Organic Halogens)	g	3.11E-10	2.56E-12	4.499E-09	1.593E-11	8.2896E-08	1.19104E-07
	(a) Aromatic Hydrocarbons (unspecified)	g	5.78294	0.00558991	0.0157989	0.117772275	0.018624023	0.00207614
	(a) Arsenic (As)	g	0.0030327	0.00645679	0	0.277134981	0	0
	(a) Barium (Ba)	g	0.0173098	0.0368536	0	0.000369707	0	0
	(a) Benzaldehyde (C6H5CHO)	g	9.88E-10	2.1E-09	0	0	0	0
	(a) Benzene (C6H6)	g	0.667203	0.295699	0.006981194	0.046190372	0.033961556	0.00423942
	(a) Benzo(a)pyrene (C20H12)	g	0.000233099	0.000496281	0	0.0000364	0	0
	(a) Berylium (Be)	g	0.000283453	0.000603486	0	0	0	0
	(a) Boron (B)	g	0.137137	0.291973	0	0.018367169	0	0
	(a) Bromium (Br)	g	0.0274162	0.0583706	0	0.002760514	0	0
	(a) Butane (n-C4H10)	g	0.142963	0.304376	0	0	0	0
	(a) Butene (1-CH3CH2CHCH2)	g	0.000903878	0.00192441	0	0	0	0
	(a) Cadmium (Cd)	g	0.0295461	0.00163637	0.000321651	0.013871241	3.74485E-06	2.368E-07
	(a) Calcium (Ca)	g	0.175107	0.372813	0	0.008321003	0	0
	(a) Carbon Dioxide (CO2, biomass)	g	37422.5	0	0	0	6183.51	0
	(a) Carbon Dioxide (CO2, fossil)	g	787344	143749.1	81349.24	62676.3229	20906.70405	30438.13
	(a) Carbon Monoxide (CO)	g	2726.97	121.8254	194.8759	389.9032005	27.29693	12.776021
	(a) Carbon Tetrafluoride (CF4)	g	0.000000794	0.00000169	0	0.883725896	0	0
	(a) CFC 11 (CFCl3)	g	0	0	0	1.8549E-12	0	0
	(a) CFC 114 (CF2ClCF2Cl)	g	0	0	0	4.901E-11	0	0
	(a) CFC 12 (CCl2F2)	g	0	0	0	3.992E-13	0	0
	(a) CFC 13 (CF3Cl)	g	0	0	0	2.5116E-13	0	0
	(a) Chlorides (Cl-)	g	0.000000658	0.0000014	0	0	0	0
	(a) Chlorinated Matter (unspecified, as Cl)	g	0	0	0	0	1.287557	0
	(a) Chlorine (Cl2)	g	0.000000757	0.00000161	0	0	0.00364226	0
	(a) Chromium (Cr III, Cr VI)	g	0.00368006	0.00783506	0	0	0	0
	(a) Chromium (Cr)	g	0.100494	0	0.00042084	0.00009714	0	0
	(a) Cobalt (Co)	g	0.00104114	0.00221665	0	0.00004902	0	0
	(a) Copper (Cu)	g	0.301952	0.0064692	0.00078156	0.047522019	0	0
	(a) Cyanide (CN-)	g	0.000381235	0.00081167	0	0	0	0
	(a) Dioxins (unspecified)	g	2.78E-09	5.92E-09	0	0	0	0
	(a) Ethane (C2H6)	g	1.15164	2.4519	0	0	0	0
	(a) Ethanol (C2H5OH)	g	0.00525911	0.0111969	0	0	0	0
	(a) Ethylbenzene (C8H10)	g	0.000904377	0.0019243	0	0.000428876	0	0.00000515
	(a) Ethylene (C2H4)	g	1.62703	3.46404	0	0	0	0
	(a) Fluorides (F-)	g	0.000164408	0.0000136	0.003128181	1.664803247	0.000050973	0.000080012
	(a) Fluorine (F2)	g	0.00000321	0.00000684	0	0	0	0
	(a) Fluorinous Matter (unspecified, as F)	g	0	0	0	1.41182	0	0
	(a) Formaldehyde (CH2O)	g	0.0271156	0.0577306	0	0	0	0
	(a) Halogenated Matter (unspecified)	g	0.000161702	3.37E-14	3.01052E-07	4.06E-06	1.06122E-07	1.706E-09
	(a) Halon 1301 (CF3Br)	g	0.00335031	0.000217715	6.2205E-05	0.000692541	3.73102E-06	1.5475E-07
	(a) HCFC 22 (CHF2Cl)	g	0	0	0	4.384E-13	0	0
	(a) Heptane (C7H16)	g	0.0089183	0.0189876	0	0	0	0
	(a) Hexafluoroethane (C2F6, FC116)	g	0	0	0	0.00756675	0	0
	(a) Hexane (C6H14)	g	0.0178448	0.0379925	0	0	0	0
	(a) Hydrocarbons (except methane)	g	708.6	572.0647	472.14814	224.7430235	20.611187	132.92378
	(a) Hydrocarbons (unspecified)	g	6.2522	38.833578	26.70558457	0.018031185	174.386715	35.016376
	(a) Hydrogen (H2)	g	0.0872913	0.000000691	0	0	0.77625566	0

	(a) Hydrogen Chloride (HCl)	g	80.5061	14.789478	0.3251431	3.27212874	1.51187124	1.488762538
	(a) Hydrogen Fluoride (HF)	g	8.7224	0.53167	0.0439403	0.180447286	0.021322551	0.12179322
	(a) Hydrogen Sulphide (H2S)	g	0.226716	0.470697	0.03000591	0.003846969	0.065293917	0.0000112
	(a) Iodine (I)	g	0.00685333	0.0145911	0	0	0	0
	(a) Iron (Fe)	g	1.39872	1.23964	0	0.019093504	0	0
	(a) Ketone (unspecified)	g	0.409171	0	0	0	0	2.14753
	(a) Lanthanum (La)	g	0.000454976	0.000968669	0	0	0	0
	(a) Lead (Pb)	g	5.21636	0.0264605	0.013767621	3.0584885	3.71521E-05	3.6954E-06
	(a) Magnesium (Mg)	g	0.505892	1.07707	0	0.010286209	0	0
	(a) Manganese (Mn)	g	1.87559	0.00746858	0.005230549	0.000690874	1.70508E-05	3.0123E-06
	(a) Mercury (Hg)	g	0.0401397	0.000926831	0.00004779	0.001262282	0.000161417	0.000014984
	(a) Metals (unspecified)	g	19.7819	0.0000372	0.0767246	0.47674425	0.058431364	0.0261649
	(a) Methane (CH4)	g	1750.14	157.13285	38.1319	73.632636	17.8598595	61.80662
	(a) Methanol (CH3OH)	g	0.00893465	0.0190224	0	0	0	0
	(a) Molybdenum (Mo)	g	0.000854822	0.00181996	0	0	0	0
	(a) Nickel (Ni)	g	0.161405	0.031642	0.005290744	0.017938501	0.00021059	0.000005199
	(a) Nitrogen Oxides (NOx as NO2)	g	2246.4	362.4066	129.2035	145.319163	176.52991	119.22428
	(a) Nitrous Oxide (N2O)	g	37.4375	15.267663	6.6513066	5.126362761	13.58901378	1.6228683
	(a) Organic Matter (unspecified)	g	1.80156	0.49088219	0.47079278	0.426475903	3.76395702	0.07825042
	(a) Particulates (unspecified)	g	899.962	307.3841	624.628	106.0256428	35.577236	630.062536
	(a) Pentane (C5H12)	g	0.14382	0.306201	0	0	0	0
	(a) Phenol (C6H5OH)	g	7.58E-09	1.61E-08	0	0.05618916	0	0
	(a) Phosphorus (P)	g	0.0127601	0.0271671	0	0	0	0
	(a) Phosphorus Pentoxide (P2O5)	g	0.00000865	0.0000184	0	0	0	0
	(a) Polycyclic Aromatic Hydrocarbons (PAH, unspecified)	g	0.0138386	0.00178646	0.00008705	0.080804013	0.000845536	0.000101896
	(a) Potassium (K)	g	0.174783	0.372122	0	0.004562563	0	0
	(a) Propane (C3H8)	g	0.380765	0.851686	0	0	0	0.269645
	(a) Propionaldehyde (CH3CH2CHO)	g	2.72E-09	5.79E-09	0	0	0	0
	(a) Propylene (CH2CHCH3)	g	0.0837099	0.178223	0	0	0	0
	(a) Scandium (Sc)	g	0.000154364	0.000328649	0	0	0	0
	(a) Selenium (Se)	g	0.00299099	0.00636799	0	0	0	0
	(a) Silicon (Si)	g	2.16328	4.60575	0	0.0822803	0	0
	(a) Sodium (Na)	g	0.100366	0.213684	0	0	0	0
	(a) Sodium Sulphate (Na2SO4)	g	0	0	0	0	0	0.0130728
	(a) Strontium (Sr)	g	0.0282501	0.0601461	0	0	0	0
	(a) Sulphur Oxides (SOx as SO2)	g	2704.5	605.229	214.379	442.381069	181.432047	109.21991
	(a) Tars (unspecified)	g	0.000210387	0.000000861	0.0084738	1.3452	0	0
	(a) Thallium (Tl)	g	0.000172454	0.000300722	0.00012024	0	0	0
	(a) Thorium (Th)	g	0.000291147	0.000619869	0	0	0	0
	(a) Tin (Sn)	g	0.000091	0.000193733	0	0	0	0
	(a) Titanium (Ti)	g	0.050581	0.10769	0	0	0	0
	(a) Toluene (C6H5CH3)	g	0.0429596	0.0914563	0	0	0	0.0000314
	(a) Uranium (U)	g	0.000282493	0.000601443	0	0	0	0
	(a) Vanadium (V)	g	0.0535369	0.113966	0.0000301	0	0	0
	(a) VOC (Volatile Organic Compounds)	g	199.885	0	0	0	0	0
	(a) Water Vapour (H2O)	g	19181.9	0	0	0	0	0
	(a) Xylene (C6H4(CH3)2)	g	0.017302	0.0368323	0	0.002215992	0	0.0000206
	(a) Zinc (Zn)	g	0.526476	0.0203483	0.000799818	1.63999003	7.55741E-05	5.9837E-06
	(a) Zirconium (Zr)	g	0.000216354	0.000460629	0	0	0	0
	(ar) Lead (Pb210)	kBq	0.00659894	0.0140495	0	0	0	0
	(ar) Radioactive Substance (unspecified)	kBq	560233	0.000111847	1400.99296	13494.3007	353.8419753	5.659538
	(ar) Radium (Ra226)	kBq	0.00527964	0.0112407	0	0	0	0
	(ar) Radon (Rn222)	kBq	0.0627421	0.133581	0	0	0	0
	(s) Aluminium (Al)	g	0.0428287	0.0911847	0	0.013351106	0	0
	(s) Arsenic (As)	g	0.0000171	0.0000364	0	0.000005338	0	0
	(s) Cadmium (Cd)	g	7.74E-09	1.65E-08	0	2.0076E-07	0	0

	(s) Calcium (Ca)	g	0.17111	0.364303	0	0.05331864	0	0
	(s) Carbon (C)	g	0.128432	0.273439	0	0.041046084	0	0
	(s) Chromium (Cr III, Cr VI)	g	0.000214218	0.000456083	0	0	0	0
	(s) Chromium (Cr)	g	0	0	0	0.00006665	0	0
	(s) Cobalt (Co)	g	7.85E-09	1.67E-08	0	2.2957E-07	0	0
	(s) Copper (Cu)	g	3.93E-08	8.37E-08	0	1.1477E-06	0	0
	(s) Iron (Fe)	g	0.0855317	0.182102	0	0.026659302	0	0
	(s) Lead (Pb)	g	0.00000018	0.000000383	0	0.000005233	0	0
	(s) Manganese (Mn)	g	0.0017111	0.00364303	0	0.00053321	0	0
	(s) Mercury (Hg)	g	1.43E-09	3.04E-09	0	3.5177E-08	0	0
	(s) Nickel (Ni)	g	0.000000059	0.000000126	0	1.7212E-06	0	0
	(s) Nitrogen (N)	g	0.000000671	0.00000143	0	2.2142E-06	0	0
	(s) Oils (unspecified)	g	0.000254084	0.000540958	0	0.007529404	0	0
	(s) Phosphorus (P)	g	0.0021424	0.00456129	0	0.0006986	0	0
	(s) Sulphur (S)	g	0.0256678	0.0546482	0	0.008016762	0	0
	(s) Zinc (Zn)	g	0.000643064	0.00136912	0	0.000211828	0	0
	(w) Acids (H+)	g	0.278294	1.24332132	0.299639	0.0339437	1.68967399	1.36279624
	(w) Acrylonitrile (CH2CHCN)	g	0	0	0	0	1.8392831	0
	(w) Adiponitrile (NC(CH2)4CN)	g	0	0	0	0	0.06897291	0
	(w) Alcohol (unspecified)	g	0.000386531	0.000822946	0	0	0	0
	(w) Alkane (unspecified)	g	0.00675427	0.0143802	0	0	0	0
	(w) Alkene (unspecified)	g	0.00062289	0.00132617	0	0.000021037	0	0
	(w) Aluminium (Al3+)	g	158.328	0.228164	5.77491903	6.6051423	0.134621336	0.0901497
	(w) Aluminium Hydroxide (Al(OH)3)	g	0.00000676	0.0000144	0	0	0	0
	(w) Ammonia (NH4+, NH3, as N)	g	2.17013	0.242532	0.3603801	0.161470644	0.432172386	0.008027804
	(w) AOX (Adsorbable Organic Halogens)	g	0.003017	0.000193677	0.0015511	0.00444488	0	0.0000006
	(w) Aromatic Hydrocarbons (unspecified)	g	0.73139	0.0612654	0.0117394	0.112722057	0.005130675	0.000430142
	(w) Arsenic (As3+, As5+)	g	0.317688	0.000325226	0.01157988	0.0116855	0.000264482	0.000180381
	(w) Barium (Ba++)	g	14.337	0.264978	0.496264473	0.806770343	0.012615877	0.007286241
	(w) Barytes	g	0.606953	1.29224	0	0.15277774	0	0
	(w) Benzene (C6H6)	g	0.0067579	0.0143879	0	0.000898883	0	1.17E-08
	(w) BOD5 (Biochemical Oxygen Demand)	g	90.6861	0.00916785	1.198713	0.040363364	3.70827745	0.017711158
	(w) Boric Acid (H3BO3)	g	0.00786897	0.0167535	0	0	0	0
	(w) Boron (B III)	g	0.000843714	0.00179528	0	0	0	0.00000457
	(w) Cadmium (Cd++)	g	0.00931986	0.0000777	0.000306784	0.000472242	7.94811E-06	0.000004664
	(w) Calcium (Ca++)	g	1.75238	3.73078	0	0.852441	41.66929	0.000600281
	(w) Carbonates (CO3--, HCO3-, CO2, as C)	g	0.00695755	0.014813	0	0	0	0
	(w) Cesium (Cs++)	g	0.0000482	0.00010267	0	0	0	0
	(w) Chlorides (Cl-)	g	2788.93	208.022	42.7143275	117.6331036	671.277875	140.8120071
	(w) Chlorinated Matter (unspecified, as Cl)	g	0.362369	0.205465	0.000017614	0.000125852	3.84483E-05	3.4663E-06
	(w) Chloroform (CHCl3)	g	0.000000103	0.00000022	0	0	0	0
	(w) Chromium (Cr III)	g	0.000449713	0.000957465	0	0	0	0
	(w) Chromium (Cr III, Cr VI)	g	3.69974	0.000654659	0.0700746	0.064370731	0.001588174	0.000923148
	(w) Chromium (Cr VI)	g	8.45E-09	0.000000018	0	0	0	0
	(w) Cobalt (Co I, Co II, Co III)	g	0.0000278	0.0000591	0	0	0	0
	(w) COD (Chemical Oxygen Demand)	g	251.051	0.121958	1.4761786	0.704188684	17.3110134	0.4255864
	(w) Copper (Cu+, Cu++)	g	0.942094	0.000449135	0.0289046	0.031142178	0.000669023	0.00045089
	(w) Cyanides (CN-)	g	0.0162565	0.0233451	0.00210726	0.000740899	5.38031E-05	0.00006993
	(w) Dissolved Matter (unspecified)	g	376.604	11.6237	15.8900055	65.4365143	4.7582896	7.075856
	(w) Dissolved Organic Carbon (DOC)	g	1.05484	0.0727103	0.005155465	0.012953399	0.002492633	0.003592148
	(w) Edetic Acid (C10H16N2O8, EDTA)	g	0.0000134	0.0000284	0	0	0	0
	(w) Ethylbenzene (C6H5C2H5)	g	0.00116688	0.00248435	0	0	0	0
	(w) Fluoranthene	g	0	0	0	0.0000042	0	0
	(w) Fluorides (F-)	g	0.045757	0.0488213	0.3023381	0.055751464	0.009703236	0.01525182
	(w) Fluorinous Matter (unspecified, as F)	g	0	0	0	0.0809922	0	0

	(w) Formaldehyde (CH2O)	g	1.31E-09	2.79E-09	0	0	0	0
	(w) Halogenous Matter (organic)	g	6.66E-10	0	0	0	2.73434E-06	3.5E-09
	(w) Hexachloroethane (C2Cl6)	g	1.83E-13	3.89E-13	0	0	0	0
	(w) Hydrazine (N2H4)	g	0.00000614	0.0000131	0	0	0	0
	(w) Hydrocarbons (unspecified)	g	0.711406	0.1547644	0.0377593	0.08340487	2.92577706	0.0365564
	(w) Inorganic Dissolved Matter (unspecified)	g	34.2848	1.08436092	0.28219573	69.89555444	5.211088807	0.6699944
	(w) Iodine (I-)	g	0.0048342	0.0102923	0	0	0	0
	(w) Iron (Fe++, Fe3+)	g	309.164	0.253969	2.37587475	3.32941277	0.136561318	0.028719814
	(w) Lead (Pb++, Pb4+)	g	0.948145	0.00914455	0.0292955	0.036506014	0.000739886	0.000454006
	(w) Lithium Salts (Lithine)	g	0.000000686	0.00000146	0	0	0	0
	(w) Magnesium (Mg++)	g	0.0820448	0.174625	0	0.5040928	0	0.000234395
	(w) Manganese (Mn II, Mn IV, Mn VII)	g	0.0197943	0.0421426	0	0.007368465	0	0.00000234
	(w) Mercury (Hg+, Hg++)	g	0.00837585	0.000000505	4.69263E-05	1.66227E-05	8.20297E-06	0.000000802
	(w) Metals (unspecified)	g	25.7321	0.1561362	0.7158455	1.349435027	69.2639381	0.35842526
	(w) Methane (CH4)	g	0.0180211	0.038368	0	0	0	0
	(w) Methylene Chloride (CH2Cl2)	g	0.000296644	0.000631571	0	0	0	0
	(w) Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	g	0.000453005	0.000964446	0	0	0	0.000000117
	(w) Morpholine (C4H9NO)	g	0.000065	0.000138332	0	0	0	0
	(w) Nickel (Ni++, Ni3+)	g	0.953537	0.00180378	0.0291452	0.028135904	0.000677268	0.000453926
	(w) Nitrate (NO3-)	g	4.18887	0.0349183	0.025225	0.217939496	5.35197497	0.004095568
	(w) Nitrite (NO2-)	g	0.00000772	0.0000164	0	0.000655339	0	0
	(w) Nitrogenous Matter (Kjeldahl, as N)	g	0.00273407	0.005821	0	0	0	0
	(w) Nitrogenous Matter (unspecified, as N)	g	1.42754	0.0580216	0.01683961	0.181345324	1.253552432	0.000399808
	(w) Oils (unspecified)	g	25.9302	1.360839	0.860568	4.52334272	1.01657837	0.3516033
	(w) Organic Dissolved Matter (chlorinated)	g	0	0	0	0	0.1180931	0
	(w) Organic Dissolved Matter (unspecified)	g	0.0336281	0.619622017	0.15153	0.195257	7.52702709	0.0393362
	(w) Organic Matter (unspecified)	g	0	0	0	0	2.313992991	0
	(w) Oxalic Acid ((COOH)2)	g	0.0000267	0.0000569	0	0	0	0
	(w) Phenol (C6H5OH)	g	0.136173	0.0290312	0.01159399	0.019899138	0.007687727	0.0000443
	(w) Phosphates (PO4 3-, HPO4--, H2PO4-, H3PO4, as P)	g	8.45381	0.000708651	0.143416005	0.137229342	0.806353737	0.005393107
	(w) Phosphorous Matter (unspecified, as P)	g	0.000491829	0	0	0	0	0.00000684
	(w) Phosphorus (P)	g	0.000212714	0.00045288	0	0	0	0
	(w) Phosphorus Pentoxide (P2O5)	g	0.000258002	0.000549301	0	0	0	0
	(w) Polycyclic Aromatic Hydrocarbons (PAH, unspecified)	g	0.00958601	0.00151818	0.000170475	0.03616428	1.05243E-05	9.387E-07
	(w) Potassium (K+)	g	0.226101	0.481355	0	0.22217018	0	0.000117198
	(w) Rubidium (Rb+)	g	0.000483122	0.00102859	0	0	0	0
	(w) Salts (unspecified)	g	1305.98	0.341549	23.5069	0.8648842	0	0
	(w) Saponifiable Oils and Fats	g	0.235766	0.501958	0	0.042867505	0	0
	(w) Selenium (Se II, Se IV, Se VI)	g	0.000397296	0.000845839	0	0.001703274	0	0.000000117
	(w) Silicon Dioxide (SiO2)	g	0.000106409	0.000226551	0	0	0	0
	(w) Silver (Ag+)	g	0.000029	0.0000617	0	0.00000561	0	0
	(w) Sodium (Na+)	g	20.4272	42.1187	0.00491292	3.408252857	249.3246714	19.80487553
	(w) Strontium (Sr II)	g	0.31885	0.678847	0	0.0580077	0	0.00000829
	(w) Sulphate (SO4--)	g	1672.08	33.0405	26.9283231	47.06009407	39.61166457	19.3099115
	(w) Sulphide (S--)	g	0.0252214	0.00170289	0.004449834	0.004337574	7.15753E-05	0.00007013
	(w) Sulphite (SO3--)	g	0.0000161	0.0000343	0	0.000335297	0	0
	(w) Sulphurated Matter (unspecified, as S)	g	0.00000242	0.000000673	0	0	0.006579603	0.0000126
	(w) Surfactant Agent (unspecified)	g	0	0	0	0.0002242	0	0
	(w) Suspended Matter (organic)	g	-0.156523	0	0	0	0.921125	0.0628638
	(w) Suspended Matter (unspecified)	g	128.225	6.87034	2.87502	11.41509914	49.0394986	6.593398
	(w) Tars (unspecified)	g	0.00000301	1.23E-08	0.000121054	0	0	0
	(w) Tetrachloroethylene (C2Cl4)	g	4.46E-10	9.5E-10	0	0	0	0
	(w) Tin (Sn++, Sn4+)	g	0.00000148	0.00000314	0	0.00000561	0	0
	(w) Titanium (Ti3+, Ti4+)	g	0.00134848	0.00287099	0	0.020264301	0	0
	(w) TOC (Total Organic Carbon)	g	77.2777	1.71738	0.45701269	1.97928008	0.16781368	0.242237605

	(w) Toluene (C6H5CH3)	g	0.0968863	0.0120251	0.00160362	0.015615405	0.000493202	0.000038391
	(w) Tributyl Phosphate ((C4H9)3PO4, TBP)	g	0.000253067	0.000538794	0	0	0	0
	(w) Trichlorethane (1,1,1-CH3CCl3)	g	1.01E-09	2.14E-09	0	0	0	0
	(w) Trichloroethylene (CHClCl2)	g	2.77E-08	5.89E-08	0	0	0	0
	(w) Triethylene Glycol (C6H14O4)	g	0.0341513	0.07271	0	0	0	0
	(w) Vanadium (V3+, V5+)	g	0.0014948	0.00318248	0	0.001936746	0	0.000000117
	(w) VOC (Volatile Organic Compounds)	g	0.0168782	0.0359345	0	0	0	0
	(w) Water (unspecified)	litre	8.12693	17.3027	0	0	0	0
	(w) Water: Chemically Polluted	litre	2655.7	4.29522	15.252929	3.94149651	24.446192	0.5227266
	(w) Xylene (C6H4(CH3)2)	g	0.0457592	0.0974238	0	0	0.09196385	0
	(w) Zinc (Zn++)	g	1.59034	0.00393873	0.0580499	0.060988413	0.00135521	0.000906717
	(wr) Radioactive Substance (unspecified)	kBq	5155.36	0.00000103	12.9275919	124.2360064	3.243694906	0.05207294
	(wr) Radium (Ra224)	kBq	0.0024156	0.00514295	0	0	0	0
	(wr) Radium (Ra226)	kBq	1.85554	3.95056	0	0	0	0
	(wr) Radium (Ra228)	kBq	0.00483122	0.0102859	0	0	0	0
	(wr) Thorium (Th228)	kBq	0.00966246	0.0205719	0	0	0	0
	_(PE) Electricity	MJ	0	244.757	0	0	0	0
	_(PE) Fossil Fuels (fuel energy)	MJ	0	1423.04	0	0	0	0
	_(PM) Total	kg	0	0	3.006	2.287092	9.83385	27.3498
	_(PM) Total: Ferrous	kg	0	0	3.006	0	0	0
	_(PM) Total: Non Ferrous	kg	0	0	0	2.287092	0	0
	_(PM) Total: Other	kg	0	0	0	0	0	27.3498
	_(PM) Total: Plastics	kg	0	0	0	0	9.83385	0
	_(PP) Total	kg	0	0	22.024	4.6223	0.598	8.70538
	_(PP) Total: Ferrous	kg	0	0	22.024	0	0	0
	_(PP) Total: Fluids	kg	0	0	0	0	0	1.78858
	_(PP) Total: Non Ferrous	kg	0	0	0	4.6223	0	0
	_(PP) Total: Other	kg	0	0	0	0	0	6.9168
	_(PP) Total: Plastics	kg	0	0	0	0	0.598	0
	_(SE) Electricity	MJ	37.6301	0	0	0	0	0
	_(SE) Waste (fuel energy)	MJ	0	0	0	0	0	0
	_(SM) ABS	kg	0	0	0	0	0	0
	_(SM) Aluminium (sheet)	kg	35.4806	0	0	0	0	0
	_(SM) Copper	kg	4.56419	0	0	0	0	0
	_(SM) Ferrous (steel plate)	kg	528.339	0	0	0	0	0
	_(SM) Glass	kg	0.666667	0	0	0	0	0
	_(SM) Lead	kg	6.1618	0	0	0	0	0
	_(SM) Other Metals	kg	0.521146	0	0	0	0	0
	_(SM) Other Plastics	kg	0	0	0	0	0	0
	_(SM) PA66	kg	0	0	0	0	0	0
	_(SM) PE	kg	0	0	0	0	0	0
	_(SM) PP	kg	0	0	0	0	0	0
	_(SM) PUR	kg	0	0	0	0	0	0
	_(SM) PVC	kg	0	0	0	0	0	0
	_(SM) Rubber	kg	3.1	0	0	0	0	0
	_(SM) Total	kg	579.593	0	0	0	0	0
	_(SM) Total: Ferrous	kg	528.339	0	0	0	0	0
	_(SM) Total: Non Ferrous	kg	47.4869	0	0	0	0	0
	_(SM) Total: Other	kg	3.76667	0	0	0	0	0
	_(SM) Total: Plastics	kg	0	0	0	0	0	0
	_(SM) Zinc	kg	0.759251	0	0	0	0	0
	_(SP) ABS Product	kg	0.3	0	0	0	0	0
	_(SP) Aluminium Product (cast)	kg	11.781	0	0	0	0	0
	_(SP) Coolant	kg	3	0	0	0	0	0
	_(SP) Copper Product (wire)	kg	2.193	0	0	0	0	0
	_(SP) Ferrous Product (cast)	kg	73.976	0	0	0	0	0

	_(SP) Glass Product	kg	0	0	0	0	0	0
	_(SP) Lead Product	kg	1.89	0	0	0	0	0
	_(SP) Lubricant	kg	3.57718	0	0	0	0	0
	_(SP) Other Materials Product	kg	1.6	0	0	0	0	0
	_(SP) Other Metals Product	kg	0.204	0	0	0	0	0
	_(SP) Other Plastics Product	kg	0.5	0	0	0	0	0
	_(SP) PA66 Product	kg	0.2	0	0	0	0	0
	_(SP) PE Product	kg	0.2	0	0	0	0	0
	_(SP) PP Product	kg	1.2	0	0	0	0	0
	_(SP) PUR Product	kg	0.4	0	0	0	0	0
	_(SP) PVC Product	kg	0.3	0	0	0	0	0
	_(SP) Rubber Product (tyre)	kg	18.8	0	0	0	0	0
	_(SP) Total	kg	123.409	0	0	0	0	0
	_(SP) Total: Ferrous	kg	73.976	0	0	0	0	0
	_(SP) Total: Fluids	kg	9.61	0	0	0	0	0
	_(SP) Total: Non Ferrous	kg	16.323	0	0	0	0	0
	_(SP) Total: Other	kg	20.4	0	0	0	0	0
	_(SP) Total: Plastics	kg	3.1	0	0	0	0	0
	_(SP) Zinc Product (wire)	kg	0.255	0	0	0	0	0
	_Recovered Matter: Steel Scrap	kg	17.6195	0	0.099198	0	0	0
	Recovered Energy	MJ	0	0	0	0.000125955	0	0
	Recovered Matter (total)	kg	76.2636	0.4237106	12.05906	2.16311825	0.366059123	0.1002873
	Recovered Matter (unspecified)	kg	56.5072	0.4233731	11.95986	0.78300165	0.366059123	0.1002873
	Recovered Matter: Aluminium Drosses	kg	0	0	0	0.0336301	0	0
	Recovered Matter: Aluminium Scrap	kg	2.11464	0	0	0.0242412	0	0
	Recovered Matter: Ash	kg	0	0	0	1.32225	0	0
	Recovered Matter: Carbon Monoxide (CO)	kg	0.398691	0	0	0	0	0
	Recovered Matter: Iron Scrap	kg	0.000158522	0.000337501	0	0	0	0
	Waste (hazardous)	kg	0.0458326	0.00302212	2.47E-08	0.09310312	0.880423547	0.00122011
	Waste (incineration)	kg	0.000548843	0.00116852	0	0.0111612	0.02476132	0
	Waste (municipal and industrial)	kg	280.254	1.55766135	0.75607797	0.74802139	0.31178606	0.082822921
	Waste (municipal and industrial, to incineration)	kg	0	0	0	0.008376	0	0
	Waste (total)	kg	374.318	25.59082	30.691646	319.3338388	2.51137167	4.08413491
	Waste (unspecified)	kg	75.6865	17.40278	13.859402	85.48033607	0.379977457	3.64410701
	Waste: Bauxite Residues (red mud)	kg	0	0	0	3.46706	0	0
	Waste: Highly Radioactive (class C)	kg	0.0000171	0.0000364	0	0	0	0
	Waste: Intermediate Radioactive (class B)	kg	0.000130546	0.000277939	0	0	0	0
	Waste: Low Radioactive (class A)	kBq	0.00169441	0.00360749	0	0	0	0
	Waste: Mineral (inert)	kg	8.87018	5.7707381	16.074002	229.372543	0.7105651	0.268831668
	Waste: Mining	kg	1.45297	3.09345	0	0	0	0
	Waste: Non Mineral (inert)	kg	0.44134	0.000245801	0.00000121	0.000000546	0.024847403	0.03380496
	Waste: Non Toxic Chemicals (unspecified)	kg	-0.00477342	0.000310121	0.0000815	0	0.059173305	0.0000019
	Waste: Oil (hazardous)	kg	2.3	0	0	0	0	0
	Waste: Radioactive (unspecified)	kg	0.000047	0.000100087	0	0	0	0
	Waste: Slags and Ash (unspecified)	kg	6.72473	0.8540887	0.00222616	0.000000546	0.143610036	0.05334608
	Waste: Treatment	kg	0.0809781	0.172407	0	0	0	0
Reminders:	E Feedstock Energy	MJ	10011.1	201.4083	355.83978	73.24641043	552.70169	81.31576
	E Fuel Energy	MJ	9158.91	2072.677	788.051	1142.82744	467.99601	515.687
	E Non Renewable Energy	MJ	18827.5	2269.319	1104.251	1030.36856	1009.01987	586.658
	E Renewable Energy	MJ	342.552	4.76168	39.63869	185.7068659	11.6774889	10.2100215
	E Total Primary Energy	MJ	19170	2274.083	1143.891	1216.07607	1020.69074	596.8683
	Electricity	MJ elec	7042.27	285.1797	15.18290001	464.626441	47.98733741	61.644539

Table A3   Breakdown of the 1995 ACORD Plan Option

	Flow	Units	ELV	Energy/Electricity	Primary Ferrous	Primary Non Ferrous	Primary Plastics	Primary Other
Inputs:	(r) Barium Sulphate (BaSO4, in ground)	kg	0.00569339	0.00170603	0	0.0001504	0	0
	(r) Bauxite (Al2O3, ore)	kg	0.00620735	0.0000332	0	1.087834	0	0.00072797
	(r) Bentonite (Al2O3.4SiO2.H2O, in ground)	kg	0.000537823	0.000161159	0	0.0000412	0	0
	(r) Chromium (Cr, ore)	kg	0.00000109	0.000000328	0	0	0	0
	(r) Clay (in ground)	kg	0.0094334	0.00274862	0	0.000162	0	0.0000546
	(r) Coal (in ground)	kg	118.676	4.25563	2.49053	0.5383927	0	0.40435503
	(r) Copper (Cu, ore)	kg	0.00000557	0.00000167	0	0.04	0	0
	(r) Dolomite (CaCO3.MgCO3, in ground)	kg	1.83053	0	0	0	0	1.02711794
	(r) Feldspar (ore)	kg	0.294976	0	0	0	0	0.527705
	(r) Iron (Fe, ore)	kg	1.56064	0.0124018	1.98265	0.00671967	0	0.000977087
	(r) Iron Sulphate (FeSO4, ore)	kg	0.000458921	0.000137516	0	0	0	0
	(r) Lead (Pb, ore)	kg	0.00000174	0.000000521	0	0.05544	0	0
	(r) Lignite (in ground)	kg	149.54	0.00270421	0.221225	0.1024012	0	0.000114256
	(r) Limestone (CaCO3, in ground)	kg	17.8008	0.71476	1.05468	0.05957685	0	1.022413488
	(r) Manganese (Mn, ore)	kg	0.000000638	0.000000191	0	0	0	0
	(r) Natural Gas (in ground)	kg	67.8478	1.13074	0.279188	0.1418691	0	1.92395965
	(r) Nickel (Ni, ore)	kg	0.000000371	0.000000111	0	0	0	0
	(r) Oil (in ground)	kg	46.5652	0.26543	0.186251	0.41724006	0	2.110060606
	(r) Pyrite (FeS2, ore)	kg	0.00912524	0.00273439	0	0.0212	0	0
	(r) Sand (in ground)	kg	4.65865	0.0023402	0	0.0060471	0	5.891136094
	(r) Silver (Ag, ore)	kg	2.76E-08	8.27E-09	0	0	0	0
	(r) Sodium Carbonate (Na2CO3, in ground)	kg	1.4456	0	0	0	0	0.00192474
	(r) Sodium Chloride (NaCl, in ground or in sea)	kg	0.643059	0.00326212	0	0.016049	0	0.903214791
	(r) Sulphur (S, in ground)	kg	0	0	0	0.00287336	0	0
	(r) Uranium (U, ore)	kg	0.00798553	0.000106465	0.0000117	0.000025585	0	0.00001002
	(r) Zinc (Zn, ore)	kg	4.05E-08	1.21E-08	0	0	0	0
	_Catalyser (Demetalization)	kg	0.00202678	0	0	0	0	0
	_Catalyser (Hydrotreating)	kg	0.00281497	0	0	0	0	0
	_Catalyser (Unspecified)	kg	0.00000207	0	0	0	0	0.0000108
	_Dewaxing aid	kg	0.000101514	0	0	0	0	0.000529836
	_Furfural	kg	0.000237416	0	0	0	0	0.00123916
	Adjuvant (unspecified)	kg	-0.00064194	0	0	0	0	0.0000955
	Amine (unspecified)	kg	-0.00000181	0	0	0	0	0.0000166
	Chlorine (Cl2)	kg	0.0170782	0	0	0	0	0
	Explosive (unspecified)	kg	0.000104059	0.0000311	0	0	0	0
	Fluorspar (CaF2)	kg	0	0	0	0.00744728	0	0
	Iron Scrap	kg	0.143416	0.00105523	0.254614	0	0	0
	Raw Materials (unspecified)	kg	19.404	0.197083	0.115119	0.00310792	0	0.052814236
	Water Used (total)	litre	7433.16	21.6651	34.2303	6.297478	0	135.0879707
	Water: Industrial Water	litre	26.3977	0	0	0	0	0
	Water: Mine Supply	litre	0.0531101	0	0	0	0	0
	Water: Public Network	litre	6.74593	0	0	0	0	0
	Water: Unspecified Origin	litre	7313.79	21.6571	34.2303	6.297478	0	135.0879707
	Water: Urban Supply Network	litre	86.1485	0	0	0	0	0
	Wood (standing)	m3	0.00127394	0.0000275	0.0000368	6.20801E-06	0	3.8245E-08
Outputs:	(a) Acetaldehyde (CH3CHO)	g	0.00460242	0.00137912	0	0	0	0
	(a) Acetic Acid (CH3COOH)	g	0.0388873	0.0116526	0	0	0	0
	(a) Acetone (CH3COCH3)	g	0.00447902	0.00134214	0	0	0	0
	(a) Acetylene (C2H2)	g	0.12753	0.0382145	0	0	0	0
	(a) Aldehyde (unspecified)	g	1.42551	0.000545574	0.000145198	0.000032065	0	1.24275499

(a) Alkane (unspecified)	g	0.583232	0.174736	0	0.01842543	0	0.000926148
(a) Alkene (unspecified)	g	0.129302	0.0387447	0	0.00203829	0	0.0000257
(a) Alkyne (unspecified)	g	0.00000929	0.00000278	0	0	0	0
(a) Aluminium (Al)	g	2.63457	0.734151	0	0.00461505	0	0
(a) Ammonia (NH3)	g	1.69189	0.0151037	0.004154	0.004610476	0	0.171949389
(a) Antimony (Sb)	g	0.000472488	0.000141582	0	0	0	0
(a) AOX (Adsorbable Organic Halogens)	g	3.18E-10	6.12E-13	3.74E-10	1E-12	0	5.21371E-09
(a) Aromatic Hydrocarbons (unspecified)	g	5.88365	0.00133505	0.0109214	0.017093617	0	0.00011183
(a) Arsenic (As)	g	0.00514629	0.00154209	0	0.01664235	0	0
(a) Barium (Ba)	g	0.0293737	0.00880186	0	0	0	0
(a) Benzaldehyde (C6H5CHO)	g	1.68E-09	5.02E-10	0	0	0	0
(a) Benzene (C6H6)	g	0.765586	0.0706227	0.00475059	0.005928623	0	0.000242981
(a) Benzo(a)pyrene (C20H12)	g	0.000395553	0.000118528	0	0	0	0
(a) Berylium (Be)	g	0.000481	0.000144132	0	0	0	0
(a) Boron (B)	g	0.232712	0.0697327	0	0.000790612	0	0
(a) Bromium (Br)	g	0.0465234	0.0139408	0	0.000121019	0	0
(a) Butane (n-C4H10)	g	0.242599	0.0726951	0	0	0	0
(a) Butene (1-CH3CH2CHCH2)	g	0.00153382	0.000459612	0	0	0	0
(a) Cadmium (Cd)	g	0.0300894	0.000390819	0.00022331	0.000525871	0	1.4721E-08
(a) Calcium (Ca)	g	0.297145	0.0890401	0	0	0	0
(a) Carbon Dioxide (CO2, biomass)	g	6983.59	0	0	0	0	0
(a) Carbon Dioxide (CO2, fossil)	g	1150000	10342.5	6795	2738.999	0	7618.7771
(a) Carbon Monoxide (CO)	g	3175.52	10.1827	38.6518	18.3110557	0	2.37374772
(a) Carbon Tetrafluoride (CF4)	g	0.00000135	0.000000404	0	0.11728	0	0
(a) Chlorides (Cl-)	g	0.00000112	0.000000334	0	0	0	0
(a) Chlorinated Matter (unspecified, as Cl)	g	0	0	0	0	0	0
(a) Chlorine (Cl2)	g	0.00000129	0.000000385	0	0	0	0
(a) Chromium (Cr III, Cr VI)	g	0.00624482	0.00187127	0	0	0	0
(a) Chromium (Cr)	g	0.100661	0	0.00029218	0	0	0
(a) Cobalt (Co)	g	0.00176675	0.000529409	0	0	0	0
(a) Copper (Cu)	g	0.303386	0.00154506	0.00054262	0.000713905	0	0
(a) Cyanide (CN-)	g	0.00064693	0.000193854	0	0	0	0
(a) Dioxins (unspecified)	g	4.72E-09	1.41E-09	0	0	0	0
(a) Ethane (C2H6)	g	1.95425	0.585595	0	0	0	0
(a) Ethanol (C2H5OH)	g	0.00892436	0.0026742	0	0	0	0
(a) Ethylbenzene (C8H10)	g	0.00153429	0.000459586	0	0	0	0.00000515
(a) Ethylene (C2H4)	g	2.76097	0.827328	0	0	0	0
(a) Fluorides (F-)	g	0.000194732	0.00000326	0.00000023	0.241597001	0	5.8016E-06
(a) Fluorine (F2)	g	0.00000545	0.00000163	0	0	0	0
(a) Formaldehyde (CH2O)	g	0.0460134	0.013788	0	0	0	0
(a) Halogenated Matter (unspecified)	g	0.000162125	8.04E-15	0.000000209	5.89E-07	0	2.035E-10
(a) Halon 1301 (CF3Br)	g	0.00343902	0.000052	0.0000432	0.0001008	0	1.1192E-08
(a) Heptane (C7H16)	g	0.0151338	0.00453485	0	0	0	0
(a) Hexane (C6H14)	g	0.0302814	0.00907386	0	0	0	0
(a) Hydrocarbons (except methane)	g	782.673	3.63567	3.21391	3.492430975	0	30.2119899
(a) Hydrocarbons (unspecified)	g	51.579	0.0391635	0.000128145	0.000000344	0	13.2417999
(a) Hydrogen (H2)	g	0.0872916	0.000000165	0	0	0	0

	(a) Hydrogen Chloride (HCl)	g	89.1731	3.49527	0.18246	0.2624177	0	0.262957357
	(a) Hydrogen Fluoride (HF)	g	8.93095	0.12698	0.0229572	0.02506326	0	0.00015896
	(a) Hydrogen Sulphide (H2S)	g	0.380322	0.112418	0.0206613	0.0005904	0	0.0000112
	(a) Iodine (I)	g	0.0116296	0.00348484	0	0	0	0
	(a) Iron (Fe)	g	1.75395	0.296067	0	0.0010522	0	0
	(a) Ketone (unspecified)	g	0.411454	0	0	0	0	2.14753
	(a) Lanthanum (La)	g	0.000772063	0.00023135	0	0	0	0
	(a) Lead (Pb)	g	5.23032	0.00631964	0.00955847	0.178422188	0	2.0436E-07
	(a) Magnesium (Mg)	g	0.858465	0.25724	0	0	0	0
	(a) Manganese (Mn)	g	1.88122	0.00178374	0.00363139	0.000100274	0	1.5055E-07
	(a) Mercury (Hg)	g	0.0404822	0.000221358	0.0000328	3.55001E-05	0	0.000000839
	(a) Metals (unspecified)	g	19.8263	0.00000889	0.0532224	0.069195211	0	0.00314797
	(a) Methane (CH4)	g	1288.16	35.903	23.1818	5.970311	0	17.536951
	(a) Methanol (CH3OH)	g	0.0151615	0.00454317	0	0	0	0
	(a) Molybdenum (Mo)	g	0.00145058	0.000434667	0	0	0	0
	(a) Nickel (Ni)	g	0.172272	0.00755716	0.00367314	0.00260362	0	4.8036E-07
	(a) Nitrogen Oxides (NOx as NO2)	g	3423.95	20.4667	9.77927	5.77487	0	24.6060289
	(a) Nitrous Oxide (N2O)	g	37.7851	0.112888	0.0313998	0.0186413	0	0.317656771
	(a) Organic Matter (unspecified)	g	1.8062	0.00124269	0.000248399	1.7673E-06	0	0.00584051
	(a) Particulates (unspecified)	g	2362.68	54.9108	78.9209	6.5379745	0	160.374122
	(a) Pentane (C5H12)	g	0.244053	0.0731309	0	0	0	0
	(a) Phenol (C6H5OH)	g	1.29E-08	3.85E-09	0	0	0	0
	(a) Phosphorus (P)	g	0.0216531	0.00648839	0	0	0	0
	(a) Phosphorus Pentoxide (P2O5)	g	0.0000147	0.0000044	0	0	0	0
	(a) Polycyclic Aromatic Hydrocarbons (PAH, unspecified)	g	0.0144536	0.000426666	0.0000581	0.011728001	0	0.000005405
	(a) Potassium (K)	g	0.296594	0.0888749	0	0	0	0
	(a) Propane (C3H8)	g	0.659801	0.203411	0	0	0	0.269645
	(a) Propionaldehyde (CH3CH2CHO)	g	4.61E-09	1.38E-09	0	0	0	0
	(a) Propylene (CH2CHCH3)	g	0.14205	0.0425655	0	0	0	0
	(a) Scandium (Sc)	g	0.000261945	0.0000785	0	0	0	0
	(a) Selenium (Se)	g	0.00507551	0.00152089	0	0	0	0
	(a) Silicon (Si)	g	3.67095	1.10001	0	0.00539609	0	0
	(a) Sodium (Na)	g	0.170314	0.0510348	0	0	0	0
	(a) Sodium Sulphate (Na2SO4)	g	0.00326409	0	0	0	0	0.0000164
	(a) Strontium (Sr)	g	0.0479386	0.0143649	0	0	0	0
	(a) Sulphur Oxides (SOx as SO2)	g	3012.66	47.6984	13.1364	22.80272	0	22.4950352
	(a) Tars (unspecified)	g	0.00021184	0.000000206	0	0	0	0
	(a) Thallium (Tl)	g	0.000268961	0.0000718	0.0000835	0	0	0
	(a) Thorium (Th)	g	0.000494057	0.000148045	0	0	0	0
	(a) Tin (Sn)	g	0.000154412	0.0000463	0	0	0	0
	(a) Titanium (Ti)	g	0.0858325	0.0257199	0	0	0	0
	(a) Toluene (C6H5CH3)	g	0.0728973	0.0218428	0	0	0	0.0000314
	(a) Uranium (U)	g	0.000479371	0.000143644	0	0	0	0
	(a) Vanadium (V)	g	0.0908426	0.0272189	0.0000209	0	0	0
	(a) VOC (Volatile Organic Compounds)	g	187.661	0	0	0	0	0
	(a) Water Vapour (H2O)	g	46651.3	0	0	0	0	0
	(a) Xylene (C6H4(CH3)2)	g	0.0293589	0.00879677	0	0	0	0.0000206
	(a) Zinc (Zn)	g	0.507818	0.00485984	0.00055516	0.028936028	0	3.4909E-07
	(a) Zirconium (Zr)	g	0.000367138	0.000110013	0	0	0	0
	(ar) Lead (Pb210)	kBq	0.011198	0.00335548	0	0	0	0
	(ar) Radioactive Substance (unspecified)	kBq	561671	0.0000267	972.558	1958.580044	0	0.67610019
	(ar) Radium (Ra226)	kBq	0.0089592	0.00268464	0	0	0	0
	(ar) Radon (Rn222)	kBq	0.106469	0.0319036	0	0	0	0
	(s) Aluminium (Al)	g	0.0726774	0.0217779	0	0.002044	0	0
	(s) Arsenic (As)	g	0.000029	0.0000087	0	0.000000816	0	0
	(s) Cadmium (Cd)	g	1.31E-08	3.94E-09	0	2.97E-08	0	0

	(s) Calcium (Ca)	g	0.290363	0.0870076	0	0.00816	0	0
	(s) Carbon (C)	g	0.21794	0.0653062	0	0.00628	0	0
	(s) Chromium (Cr III, Cr VI)	g	0.000363514	0.000108928	0	0	0	0
	(s) Chromium (Cr)	g	0	0	0	0.0000102	0	0
	(s) Cobalt (Co)	g	1.33E-08	3.99E-09	0	0.000000034	0	0
	(s) Copper (Cu)	g	6.67E-08	0.00000002	0	0.00000017	0	0
	(s) Iron (Fe)	g	0.145142	0.0434919	0	0.00408	0	0
	(s) Lead (Pb)	g	0.000000305	9.14E-08	0	0.000000776	0	0
	(s) Manganese (Mn)	g	0.00290363	0.000870076	0	0.0000816	0	0
	(s) Mercury (Hg)	g	2.42E-09	7.25E-10	0	5.28E-09	0	0
	(s) Nickel (Ni)	g	0.0000001	0.00000003	0	0.000000255	0	0
	(s) Nitrogen (N)	g	0.00000114	0.000000341	0	0	0	0
	(s) Oils (unspecified)	g	0.000431163	0.000129199	0	0.00111032	0	0
	(s) Phosphorus (P)	g	0.00363551	0.00108939	0	0.0001072	0	0
	(s) Sulphur (S)	g	0.0435565	0.0130518	0	0.001228	0	0
	(s) Zinc (Zn)	g	0.00109124	0.000326991	0	0.0000324	0	0
	(w) Acids (H+)	g	0.549423	0.00140704	0	0.00492456	0	0.46774808
	(w) Alcohol (unspecified)	g	0.000655917	0.000196547	0	0	0	0
	(w) Alkane (unspecified)	g	0.0114615	0.00343447	0	0	0	0
	(w) Alkene (unspecified)	g	0.001057	0.000316733	0	0	0	0
	(w) Aluminium (Al3+)	g	158.673	0.054493	4.00732	0.8530642	0	0.00402817
	(w) Aluminium Hydroxide (Al(OH)3)	g	0.0000115	0.00000343	0	0	0	0
	(w) Ammonia (NH4+, NH3, as N)	g	2.25772	0.0579245	0.0129108	0.02017796	0	0.000818561
	(w) AOX (Adsorbable Organic Halogens)	g	0.00306918	0.0000463	0.00107689	0.00007002	0	0.0000006
	(w) Aromatic Hydrocarbons (unspecified)	g	0.755053	0.0146322	0.00814063	0.016360604	0	0.00002477
	(w) Arsenic (As3+, As5+)	g	0.318337	0.0000777	0.00803551	0.001619872	0	0.000008166
	(w) Barium (Ba++)	g	14.4541	0.0632854	0.344378	0.114146061	0	0.000328787
	(w) Barytes	g	1.02996	0.308629	0	0.02848	0	0
	(w) Benzene (C6H6)	g	0.0114677	0.00343632	0	0.00016756	0	1.17E-08
	(w) BOD5 (Biochemical Oxygen Demand)	g	90.8389	0.00218959	0.354803	0.001263277	0	0.005225168
	(w) Boric Acid (H3BO3)	g	0.0133531	0.00400128	0	0	0	0
	(w) Boron (B III)	g	0.00143139	0.000428771	0	0	0	0.00000457
	(w) Cadmium (Cd++)	g	0.00936426	0.0000186	0.000212888	6.04E-05	0	3.2093E-07
	(w) Calcium (Ca++)	g	11.9532	0.891033	0	0.09612	0	0.000600281
	(w) Carbonates (CO3--, HCO3-, CO2, as C)	g	0.0118065	0.00353783	0	0	0	0
	(w) Cesium (Cs++)	g	0.0000818	0.0000245	0	0	0	0
	(w) Chlorides (Cl-)	g	4194.15	49.6826	29.6374	16.61820537	0	44.43533419
	(w) Chlorinated Matter (unspecified, as Cl)	g	0.430093	0.0490719	0.0000121	1.83E-05	0	1.9601E-07
	(w) Chloroform (CHCl3)	g	0.000000176	5.26E-08	0	0	0	0
	(w) Chromium (Cr III)	g	0.000763134	0.000228674	0	0	0	0
	(w) Chromium (Cr III, Cr VI)	g	3.70616	0.000156354	0.04863	0.008151072	0	0.00004166
	(w) Chromium (Cr VI)	g	1.43E-08	4.3E-09	0	0	0	0
	(w) Cobalt (Co I, Co II, Co III)	g	0.0000471	0.0000141	0	0	0	0
	(w) COD (Chemical Oxygen Demand)	g	251.513	0.0291276	0.970569	0.030197254	0	0.3505228
	(w) Copper (Cu+, Cu++)	g	0.943848	0.000107268	0.0200575	0.00400556	0	0.000020276
	(w) Cyanides (CN-)	g	0.0239217	0.00557558	0.0000616	0.000106501	0	3.6352E-06
	(w) Dissolved Matter (unspecified)	g	378.133	2.77613	0.0356897	0.02093901	0	1.09887278
	(w) Dissolved Organic Carbon (DOC)	g	1.08279	0.0173656	0.00349655	0.00191025	0	0.000156972
	(w) Edetic Acid (C10H16N2O8, EDTA)	g	0.0000227	0.00000679	0	0	0	0
	(w) Ethylbenzene (C6H5C2H5)	g	0.00198011	0.000593344	0	0	0	0
	(w) Fluorides (F-)	g	0.066775	0.0116601	0.0000438	0.00120201	0	0.001105044
	(w) Formaldehyde (CH2O)	g	2.23E-09	6.67E-10	0	0	0	0
	(w) Halogenous Matter (organic)	g	6.7E-10	0	0	0	0	3.5E-09

	(w) Hexachloroethane (C2Cl6)	g	3.1E-13	9.28E-14	0	0	0	0
	(w) Hydrazine (N2H4)	g	0.0000104	0.00000312	0	0	0	0
	(w) Hydrocarbons (unspecified)	g	0.714161	0.0000206	0	0.00049844	0	0.0365564
	(w) Inorganic Dissolved Matter (unspecified)	g	36.0196	0.00038474	0.0012752	10.14470342	0	0.11588777
	(w) Iodine (I-)	g	0.00820331	0.00245813	0	0	0	0
	(w) Iron (Fe++, Fe3+)	g	309.863	0.0606561	1.64882	0.419731	0	0.001404524
	(w) Lead (Pb++, Pb4+)	g	0.954704	0.00218402	0.0203288	0.004433218	0	0.000020468
	(w) Lithium Salts (Lithine)	g	0.00000116	0.000000349	0	0	0	0
	(w) Magnesium (Mg++)	g	0.139207	0.0417061	0	0.042576	0	0.000234395
	(w) Manganese (Mn II, Mn IV, Mn VII)	g	0.0335894	0.010065	0	0	0	0.00000234
	(w) Mercury (Hg+, Hg++)	g	0.00839048	0.000000121	0.0000326	1.63001E-06	0	4.5558E-08
	(w) Metals (unspecified)	g	25.8505	0.000348266	0.46543	0.195858079	0	0.1176284
	(w) Methane (CH4)	g	0.0305807	0.00916354	0	0	0	0
	(w) Methylene Chloride (CH2Cl2)	g	0.000503384	0.00015084	0	0	0	0
	(w) Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	g	0.00076871	0.000230341	0	0	0	0.000000117
	(w) Morpholine (C4H9NO)	g	0.000110255	0.000033	0	0	0	0
	(w) Nickel (Ni++, Ni3+)	g	0.955757	0.000430803	0.0202245	0.003811604	0	0.000020388
	(w) Nitrate (NO3-)	g	4.21224	0.00833963	0.012616	0.029780428	0	0.000698554
	(w) Nitrite (NO2-)	g	0.0000131	0.00000392	0	0.0000793	0	0
	(w) Nitrogenous Matter (Kjeldahl, as N)	g	0.00463954	0.00139025	0	0	0	0
	(w) Nitrogenous Matter (unspecified, as N)	g	1.45111	0.0138575	0.0115202	0.0190287	0	0.000399808
	(w) Oils (unspecified)	g	26.2286	0.0664168	0.250879	0.53188905	0	0.129635116
	(w) Organic Dissolved Matter (unspecified)	g	0.0441544	0.000217103	0	0	0	0.0393362
	(w) Oxalic Acid ((COOH)2)	g	0.0000453	0.0000136	0	0	0	0
	(w) Phenol (C6H5OH)	g	0.14142	0.00323938	0.00134624	0.00290736	0	6.9524E-06
	(w) Phosphates (PO4 3-, HPO4--, H2PO4-, H3PO4, as P)	g	8.46806	0.000169249	0.099446	0.017641335	0	0.000235504
	(w) Phosphorous Matter (unspecified, as P)	g	0.000492141	0	0	0	0	0.00000684
	(w) Phosphorus (P)	g	0.000360962	0.000108163	0	0	0	0
	(w) Phosphorus Pentoxide (P2O5)	g	0.000437813	0.000131191	0	0	0	0
	(w) Polycyclic Aromatic Hydrocarbons (PAH, unspecified)	g	0.0101305	0.000362592	0.000118336	0.00524828	0	5.31E-08
	(w) Potassium (K+)	g	0.38367	0.114964	0	0.02096	0	0.000117198
	(w) Rubidium (Rb+)	g	0.000819825	0.000245662	0	0	0	0
	(w) Salts (unspecified)	g	1307.97	0.0815732	16.3203	0.104	0	0
	(w) Saponifiable Oils and Fats	g	0.400078	0.119884	0	0.006348	0	0
	(w) Selenium (Se II, Se IV, Se VI)	g	0.000674176	0.000202014	0	0	0	0.000000117
	(w) Silicon Dioxide (SiO2)	g	0.000180569	0.0000541	0	0	0	0
	(w) Silver (Ag+)	g	0.0000492	0.0000147	0	0	0	0
	(w) Sodium (Na+)	g	762.733	10.0593	0.00000719	0.470800019	0	6.27422268
	(w) Strontium (Sr II)	g	0.541066	0.162131	0	0.008112	0	0.00000829
	(w) Sulphate (SO4--)	g	1689.94	7.89115	18.6801	6.201898	0	5.991480149
	(w) Sulphide (S--)	g	0.0259021	0.000406707	0.000288212	0.000628597	0	7.4711E-06
	(w) Sulphite (SO3--)	g	0.0000273	0.00000819	0	0.0000436	0	0
	(w) Sulphurated Matter (unspecified, as S)	g	0.00000265	0.000000161	0	0	0	0.0000126
	(w) Suspended Matter (organic)	g	-0.156356	0	0	0	0	0.0628638
	(w) Suspended Matter (unspecified)	g	135.414	1.34532	0.823471	1.56229379	0	2.104605114
	(w) Tars (unspecified)	g	0.00000303	2.94E-09	0	0	0	0
	(w) Tetrachloroethylene (C2Cl4)	g	7.57E-10	2.27E-10	0	0	0	0
	(w) Tin (Sn++, Sn4+)	g	0.0000025	0.00000075	0	0	0	0
	(w) Titanium (Ti3+, Ti4+)	g	0.00228828	0.000685688	0	0	0	0
	(w) TOC (Total Organic Carbon)	g	78.153	0.410166	0.311721	0.28835303	0	0.010967856

	(w) Toluene (C6H5CH3)	g	0.101299	0.002872	0.00111249	0.00226644	0	2.2619E-06
	(w) Tributyl Phosphate ((C4H9)3PO4, TBP)	g	0.000429438	0.000128682	0	0	0	0
	(w) Trichlorethane (1,1,1-CH3CCl3)	g	1.71E-09	5.12E-10	0	0	0	0
	(w) Trichloroethylene (CHClCl2)	g	0.000000047	1.41E-08	0	0	0	0
	(w) Triethylene Glycol (C6H14O4)	g	0.0579525	0.0173655	0	0	0	0
	(w) Vanadium (V3+, V5+)	g	0.00253656	0.00076008	0	0	0	0.000000117
	(w) VOC (Volatile Organic Compounds)	g	0.0286411	0.00858235	0	0	0	0
	(w) Water (unspecified)	litre	15.348	4.13245	0	0	0	0
	(w) Water: Chemically Polluted	litre	2708.64	1.02584	10.4353	0.521896877	0	0.044153273
	(w) Xylene (C6H4(CH3)2)	g	0.0776502	0.023268	0	0	0	0
	(w) Zinc (Zn++)	g	1.59435	0.000940699	0.0402819	0.00823674	0	0.000041611
	(wr) Radioactive Substance (unspecified)	kBq	5168.6	0.000000246	8.97425	18.0318004	0	0.00620603
	(wr) Radium (Ra224)	kBq	0.00409912	0.00122831	0	0	0	0
	(wr) Radium (Ra226)	kBq	3.14873	0.943523	0	0	0	0
	(wr) Radium (Ra228)	kBq	0.00819825	0.00245662	0	0	0	0
	(wr) Thorium (Th228)	kBq	0.0163965	0.00491325	0	0	0	0
	_(PE) Electricity	MJ	0	58.456	0	0	0	0
	_(PE) Fossil Fuels (fuel energy)	MJ	0	0	0	0	0	0
	_(PM) Total	kg	0	0	2.087	0.38864	0	8.658
	_(PM) Total: Ferrous	kg	0	0	2.087	0	0	0
	_(PM) Total: Non Ferrous	kg	0	0	0	0.38864	0	0
	_(PM) Total: Other	kg	0	0	0	0	0	8.658
	_(PM) Total: Plastics	kg	0	0	0	0	0	0
	_(PP) Total	kg	0	0	0	0	0	1.79725
	_(PP) Total: Ferrous	kg	0	0	0	0	0	0
	_(PP) Total: Fluids	kg	0	0	0	0	0	1.78858
	_(PP) Total: Non Ferrous	kg	0	0	0	0	0	0
	_(PP) Total: Other	kg	0	0	0	0	0	0.00867
	_(PP) Total: Plastics	kg	0	0	0	0	0	0
	_(SE) Electricity	MJ	223.931	0	0	0	0	0
	_(SE) Waste (fuel energy)	MJ	1423.04	0	0	0	0	0
	_(SM) ABS	kg	0.939472	0	0	0	0	0
	_(SM) Aluminium (sheet)	kg	37.2075	0	0	0	0	0
	_(SM) Copper	kg	4.67593	0	0	0	0	0
	_(SM) Ferrous (steel plate)	kg	529.258	0	0	0	0	0
	_(SM) Glass	kg	19.3585	0	0	0	0	0
	_(SM) Lead	kg	6.19617	0	0	0	0	0
	_(SM) Other Metals	kg	0.53293	0	0	0	0	0
	_(SM) Other Plastics	kg	1.51409	0	0	0	0	0
	_(SM) PA66	kg	1.0694	0	0	0	0	0
	_(SM) PE	kg	0.553138	0	0	0	0	0
	_(SM) PP	kg	3.42946	0	0	0	0	0
	_(SM) PUR	kg	1.26624	0	0	0	0	0
	_(SM) PVC	kg	1.06201	0	0	0	0	0
	_(SM) Rubber	kg	3.1	0	0	0	0	0
	_(SM) Total	kg	610.935	0	0	0	0	0
	_(SM) Total: Ferrous	kg	529.258	0	0	0	0	0
	_(SM) Total: Non Ferrous	kg	49.3855	0	0	0	0	0
	_(SM) Total: Other	kg	22.4585	0	0	0	0	0
	_(SM) Total: Plastics	kg	9.83382	0	0	0	0	0
	_(SM) Zinc	kg	0.772909	0	0	0	0	0
	_(SP) ABS Product	kg	0.35	0	0	0	0	0
	_(SP) Aluminium Product (cast)	kg	14.5992	0	0	0	0	0
	_(SP) Coolant	kg	3	0	0	0	0	0
	_(SP) Copper Product (wire)	kg	3.0401	0	0	0	0	0
	_(SP) Ferrous Product (cast)	kg	96	0	0	0	0	0

	_(SP) Fluids (unspecified)	kg	3.03282	0	0	0	0	0
	_(SP) Glass Product	kg	6.90813	0	0	0	0	0
	_(SP) Lead Product	kg	2.682	0	0	0	0	0
	_(SP) Lubricant	kg	3.57718	0	0	0	0	0
	_(SP) Other Materials Product	kg	1.6	0	0	0	0	0
	_(SP) Other Metals Product	kg	0.286	0	0	0	0	0
	_(SP) Other Plastics Product	kg	0.55	0	0	0	0	0
	_(SP) PA66 Product	kg	0.25	0	0	0	0	0
	_(SP) PE Product	kg	0.25	0	0	0	0	0
	_(SP) PP Product	kg	1.45	0	0	0	0	0
	_(SP) PUR Product	kg	0.45	0	0	0	0	0
	_(SP) PVC Product	kg	0.4	0	0	0	0	0
	_(SP) Rubber Product (tyre)	kg	18.8	0	0	0	0	0
	_(SP) Total	kg	157.563	0	0	0	0	0
	_(SP) Total: Ferrous	kg	96	0	0	0	0	0
	_(SP) Total: Fluids	kg	9.61	0	0	0	0	0
	_(SP) Total: Non Ferrous	kg	20.9453	0	0	0	0	0
	_(SP) Total: Other	kg	27.3081	0	0	0	0	0
	_(SP) Total: Plastics	kg	3.7	0	0	0	0	0
	_(SP) Zinc Product (wire)	kg	0.338	0	0	0	0	0
	_Recovered Matter: Steel Scrap	kg	17.6484	0	0.068871	0	0	0
	Aluminium Scrap	kg	0.0659544	0	0	0	0	0
	Iron Scrap	kg	0.54469	0	0	0	0	0
	Recovered Energy	MJ	1609.34	0	0	0	0	0
	Recovered Matter (total)	kg	77.3219	0.00839918	1.21933	0.01017484	0	0.004545061
	Recovered Matter (unspecified)	kg	57.3503	0.00831858	1.15046	0.00665648	0	0.004545061
	Recovered Matter: Aluminium Scrap	kg	2.21757	0	0	0.0035184	0	0
	Recovered Matter: Carbon Monoxide (CO)	kg	0.406204	0	0	0	0	0
	Recovered Matter: Iron Scrap	kg	0.00102196	0.0000806	0	0	0	0
	Waste (hazardous)	kg	6.67597	0.000721782	0	0.000316656	0	0.00115398
	Waste (incineration)	kg	0.00093135	0.00027908	0	0	0	0
	Waste (municipal and industrial)	kg	32.1908	0.000685774	0.000237422	0.010204037	0	0.006142521
	Waste (total)	kg	85.7696	2.34764	0.247334	0.354292223	0	0.86917688
	Waste (unspecified)	kg	14.138	0.780835	0.107268	0.000434603	0	0.74758874
	Waste: Highly Radioactive (class C)	kg	0.000029	0.00000869	0	0	0	0
	Waste: Intermediate Radioactive (class B)	kg	0.000221527	0.0000664	0	0	0	0
	Waste: Low Radioactive (class A)	kBq	0.00287529	0.000861586	0	0	0	0
	Waste: Mineral (inert)	kg	10.8146	1.3631	0.139829	0.343337	0	0.086706785
	Waste: Mining	kg	2.46559	0.738817	0	0	0	0
	Waste: Non Mineral (inert)	kg	0.450312	0.0000587	0	0	0	0.010710801
	Waste: Non Toxic Chemicals (unspecified)	kg	-0.00476508	0.000000182	0	0	0	0.0000019
	Waste: Radioactive (unspecified)	kg	0.0000798	0.0000239	0	0	0	0
	Waste: Slags and Ash (unspecified)	kg	21.4707	0.201768	0	0	0	0.01687223
	Waste: Treatment	kg	0.137414	0.0411765	0	0	0	0
Reminders:	E Feedstock Energy	MJ	4004.24	37.5744	4.67442	2.9915961	0	74.01738751
	E Fuel Energy	MJ	15653.7	124.985	69.6765	49.70529	0	126.297629
	E Non Renewable Energy	MJ	19312.7	161.95	72.9117	38.281655	0	198.65376
	E Renewable Energy	MJ	345.284	0.60732	1.4393	14.4153585	0	1.52626406
	E Total Primary Energy	MJ	19657.9	162.558	74.351	52.697008	0	200.179973
	Electricity	MJ elec	7170.93	64.9158	10.5411	38.016917	0	9.7253417

Table A4 Breakdown of the Draft EC ELV Directive 11034/971 Option

	Flow	Units	ELV	Energy/Electricity	Primary Ferrous	Primary Non Ferrous	Primary Plastics
Inputs:	(r) Barium Sulphate (BaSO4, in ground)	kg	0.00564294	0	0	0	0
	(r) Bauxite (Al2O3, ore)	kg	0.00608554	0.00225148	0	0	0.000024719
	(r) Bentonite (Al2O3.4SiO2.H2O, in ground)	kg	0.000533056	0	0	0	0
	(r) Chromium (Cr, ore)	kg	0.00000108	0	0	0	0
	(r) Clay (in ground)	kg	0.00935064	0	0	0	1.0826E-06
	(r) Coal (in ground)	kg	118.825	4.56808	0	0	0.01640554
	(r) Copper (Cu, ore)	kg	0.00000552	0	0	0	0
	(r) Dolomite (CaCO3.MgCO3, in ground)	kg	2.0885	0	0	0	0
	(r) Feldspar (ore)	kg	0.426902	0	0	0	0
	(r) Iron (Fe, ore)	kg	1.51834	0	0	0	0.000027556
	(r) Iron Sulphate (FeSO4, ore)	kg	0.000454854	0	0	0	0
	(r) Lead (Pb, ore)	kg	0.00000172	0	0	0	0
	(r) Lignite (in ground)	kg	150.132	0	0	0	0.00218263
	(r) Limestone (CaCO3, in ground)	kg	15.7654	0	0	0	0.00191818
	(r) Manganese (Mn, ore)	kg	0.000000632	0	0	0	0
	(r) Natural Gas (in ground)	kg	69.6583	3.0638	0	0	0.0553092
	(r) Nickel (Ni, ore)	kg	0.000000367	0	0	0	0
	(r) Oil (in ground)	kg	47.1135	0.0989664	0	0	0.05589123
	(r) Pyrite (FeS2, ore)	kg	0.00904436	0	0	0	0
	(r) Sand (in ground)	kg	6.13213	0	0	0	1.74643E-05
	(r) Silver (Ag, ore)	kg	2.74E-08	0	0	0	0
	(r) Sodium Carbonate (Na2CO3, in ground)	kg	1.45559	0	0	0	0
	(r) Sodium Chloride (NaCl, in ground or in sea)	kg	0.907628	0.000844304	0	0	0.012042715
	(r) Uranium (U, ore)	kg	0.00801187	0	0	0	6.93648E-07
	(r) Zinc (Zn, ore)	kg	4.01E-08	0	0	0	0
	_Catalyser (Demetalization)	kg	0.00251587	0	0	0	0
	_Catalyser (Hydrotreating)	kg	0.00349426	0	0	0	0
	_Catalyser (Unspecified)	kg	0.00000209	0	0	0	0
	_Dewaxing aid	kg	0.000102422	0	0	0	0
	_Furfural	kg	0.00023954	0	0	0	0
	Adjuvant (unspecified)	kg	-0.0008011	0	0	0	0
	Amine (unspecified)	kg	-0.00000298	0	0	0	0
	Chlorine (Cl2)	kg	0.0172128	0	0	0	0
	Explosive (unspecified)	kg	0.000103143	0	0	0	0
	Iron Scrap	kg	0.141567	0	0	0	0
	Raw Materials (unspecified)	kg	19.4971	0	0	0	0
	Water Used (total)	litre	7457.32	0.132274	0	0	2.9432023
	Water: Industrial Water	litre	18.96	0	0	0	0
	Water: Mine Supply	litre	0.0535852	0	0	0	0
	Water: Public Network	litre	7.8715	0	0	0	0
	Water: Unspecified Origin	litre	7342.82	0.132274	0	0	2.9432023
	Water: Urban Supply Network	litre	87.5853	0	0	0	0
	Wood (standing)	m3	0.00127746	0	0	0	6.91703E-09
Outputs:	(a) Acetaldehyde (CH3CHO)	g	0.00456163	0	0	0	0
	(a) Acetic Acid (CH3COOH)	g	0.0385426	0	0	0	0
	(a) Acetone (CH3COCH3)	g	0.00443932	0	0	0	0
	(a) Acetylene (C2H2)	g	0.1264	0	0	0	0
	(a) Aldehyde (unspecified)	g	1.44609	0.0441843	0	0	0.0001672

	(a) Alkane (unspecified)	g	0.578047	0	0	0	0
	(a) Alkene (unspecified)	g	0.128155	0	0	0	0
	(a) Alkyne (unspecified)	g	0.00000921	0	0	0	0
	(a) Aluminium (Al)	g	2.60817	0	0	0	0
	(a) Ammonia (NH3)	g	1.70625	0	0	0	0.00142412
	(a) Antimony (Sb)	g	0.000468301	0	0	0	0
	(a) AOX (Adsorbable Organic Halogens)	g	3.1E-10	0	0	0	5.208E-10
	(a) Aromatic Hydrocarbons (unspecified)	g	5.91451	0	0	0	0.000113427
	(a) Arsenic (As)	g	0.00510068	0	0	0	0
	(a) Barium (Ba)	g	0.0291133	0	0	0	0
	(a) Benzaldehyde (C6H5CHO)	g	1.66E-09	0	0	0	0
	(a) Benzene (C6H6)	g	0.765606	0	0	0	0.000206963
	(a) Benzo(a)pyrene (C20H12)	g	0.000392048	0	0	0	0
	(a) Berylium (Be)	g	0.000476737	0	0	0	0
	(a) Boron (B)	g	0.23065	0	0	0	0
	(a) Bromium (Br)	g	0.0461111	0	0	0	0
	(a) Butane (n-C4H10)	g	0.240449	0	0	0	0
	(a) Butene (1-CH3CH2CHCH2)	g	0.00152023	0	0	0	0
	(a) Cadmium (Cd)	g	0.0870715	0	0	0	2.27764E-08
	(a) Calcium (Ca)	g	0.294512	0	0	0	0
	(a) Carbon Dioxide (CO2, biomass)	g	26210.4	0	0	0	35.664
	(a) Carbon Dioxide (CO2, fossil)	g	1090000	18275.7	0	0	119.4911356
	(a) Carbon Monoxide (CO)	g	2875.07	14.4085	0	0	0.157977
	(a) Carbon Tetrafluoride (CF4)	g	0.00000134	0	0	0	0
	(a) Chlorides (Cl-)	g	0.00000111	0	0	0	0
	(a) Chlorinated Matter (unspecified, as Cl)	g	0	0	0	0	0.00706356
	(a) Chlorine (Cl2)	g	0.00000127	0	0	0	0.00001998
	(a) Chromium (Cr III, Cr VI)	g	0.00618947	0	0	0	0
	(a) Chromium (Cr)	g	0.101055	0	0	0	0
	(a) Cobalt (Co)	g	0.00175109	0	0	0	0
	(a) Copper (Cu)	g	0.303996	0	0	0	0
	(a) Cyanide (CN-)	g	0.000641196	0	0	0	0
	(a) Dioxins (unspecified)	g	4.68E-09	0	0	0	0
	(a) Ethane (C2H6)	g	1.93693	0	0	0	0
	(a) Ethanol (C2H5OH)	g	0.00884526	0	0	0	0
	(a) Ethylbenzene (C8H10)	g	0.0015206	0	0	0	0
	(a) Ethylene (C2H4)	g	2.7365	0	0	0	0
	(a) Fluorides (F-)	g	0.00019826	0	0	0	3.199E-07
	(a) Fluorine (F2)	g	0.0000054	0	0	0	0
	(a) Formaldehyde (CH2O)	g	0.0456056	0	0	0	0
	(a) Halogenated Matter (unspecified)	g	0.000162775	0	0	0	6.4543E-10
	(a) Halon 1301 (CF3Br)	g	0.00345104	0	0	0	2.26419E-08
	(a) Heptane (C7H16)	g	0.0149996	0	0	0	0
	(a) Hexane (C6H14)	g	0.030013	0	0	0	0
	(a) Hydrocarbons (except methane)	g	815.405	101.317	0	0	0.12858677
	(a) Hydrocarbons (unspecified)	g	40.0942	7.03587	0	0	0.9663103
	(a) Hydrogen (H2)	g	0.0872915	0	0	0	0.004472132

	(a) Hydrogen Chloride (HCl)	g	93.8797	0.0281435	0	0	0.008731988
	(a) Hydrogen Fluoride (HF)	g	8.96229	0	0	0	0.000119215
	(a) Hydrogen Sulphide (H2S)	g	0.376758	0	0	0	0.0003718
	(a) Iodine (I)	g	0.0115266	0	0	0	0
	(a) Iron (Fe)	g	1.72571	0	0	0	0
	(a) Ketone (unspecified)	g	0.415135	0	0	0	0
	(a) Lanthanum (La)	g	0.000765221	0	0	0	0
	(a) Lead (Pb)	g	5.24948	0	0	0	2.2657E-07
	(a) Magnesium (Mg)	g	0.850856	0	0	0	0
	(a) Manganese (Mn)	g	1.88852	0	0	0	1.03996E-07
	(a) Mercury (Hg)	g	0.0975151	0	0	0	9.8184E-07
	(a) Metals (unspecified)	g	21.613	0	0	0	0.00031273
	(a) Methane (CH4)	g	1655.01	1.23831	0	0	0.10907244
	(a) Methanol (CH3OH)	g	0.0150271	0	0	0	0
	(a) Molybdenum (Mo)	g	0.00143772	0	0	0	0
	(a) Nickel (Ni)	g	0.17262	0	0	0	1.28081E-06
	(a) Nitrogen Oxides (NOx as NO2)	g	3194.38	50.3473	0	0	1.000597
	(a) Nitrous Oxide (N2O)	g	38.8954	2.69193	0	0	0.090464006
	(a) Organic Matter (unspecified)	g	1.82142	0.0883686	0	0	0.021643127
	(a) Particulates (unspecified)	g	1957.98	14.0957	0	0	0.1982783
	(a) Pentane (C5H12)	g	0.24189	0	0	0	0
	(a) Phenol (C6H5OH)	g	1.28E-08	0	0	0	0
	(a) Phosphorus (P)	g	0.0214612	0	0	0	0
	(a) Phosphorus Pentoxide (P2O5)	g	0.0000146	0	0	0	0
	(a) Polycyclic Aromatic Hydrocarbons (PAH, unspecified)	g	0.0144925	0	0	0	5.1569E-06
	(a) Potassium (K)	g	0.293966	0	0	0	0
	(a) Propane (C3H8)	g	0.63719	0	0	0	0
	(a) Propionaldehyde (CH3CH2CHO)	g	4.57E-09	0	0	0	0
	(a) Propylene (CH2CHCH3)	g	0.140791	0	0	0	0
	(a) Scandium (Sc)	g	0.000259624	0	0	0	0
	(a) Selenium (Se)	g	0.00503053	0	0	0	0
	(a) Silicon (Si)	g	3.63841	0	0	0	0
	(a) Sodium (Na)	g	0.168804	0	0	0	0
	(a) Sodium Sulphate (Na2SO4)	g	0.00326819	0	0	0	0
	(a) Strontium (Sr)	g	0.0475137	0	0	0	0
	(a) Sulphur Oxides (SOx as SO2)	g	2902.85	73.7826	0	0	1.003189
	(a) Tars (unspecified)	g	0.000213724	0	0	0	0
	(a) Thallium (Tl)	g	0.000266092	0	0	0	0
	(a) Thorium (Th)	g	0.000489679	0	0	0	0
	(a) Tin (Sn)	g	0.000153044	0	0	0	0
	(a) Titanium (Ti)	g	0.0850718	0	0	0	0
	(a) Toluene (C6H5CH3)	g	0.0722507	0	0	0	0
	(a) Uranium (U)	g	0.000475123	0	0	0	0
	(a) Vanadium (V)	g	0.0900374	0	0	0	0
	(a) VOC (Volatile Organic Compounds)	g	188.654	0	0	0	0
	(a) Water Vapour (H2O)	g	36228.9	0	0	0	0
	(a) Xylene (C6H4(CH3)2)	g	0.0290983	0	0	0	0
	(a) Zinc (Zn)	g	0.498231	0	0	0	4.60071E-07
	(a) Zirconium (Zr)	g	0.000363884	0	0	0	0
	(ar) Lead (Pb210)	kBq	0.0110987	0	0	0	0
	(ar) Radioactive Substance (unspecified)	kBq	563919	0	0	0	2.15013312
	(ar) Radium (Ra226)	kBq	0.0088798	0	0	0	0
	(ar) Radon (Rn222)	kBq	0.105526	0	0	0	0
	(s) Aluminium (Al)	g	0.0720333	0	0	0	0
	(s) Arsenic (As)	g	0.0000288	0	0	0	0
	(s) Cadmium (Cd)	g	0.000000013	0	0	0	0

	(s) Calcium (Ca)	g	0.287789	0	0	0	0
	(s) Carbon (C)	g	0.216009	0	0	0	0
	(s) Chromium (Cr III, Cr VI)	g	0.000360292	0	0	0	0
	(s) Cobalt (Co)	g	1.32E-08	0	0	0	0
	(s) Copper (Cu)	g	6.61E-08	0	0	0	0
	(s) Iron (Fe)	g	0.143855	0	0	0	0
	(s) Lead (Pb)	g	0.000000302	0	0	0	0
	(s) Manganese (Mn)	g	0.00287789	0	0	0	0
	(s) Mercury (Hg)	g	2.4E-09	0	0	0	0
	(s) Nickel (Ni)	g	9.92E-08	0	0	0	0
	(s) Nitrogen (N)	g	0.00000113	0	0	0	0
	(s) Oils (unspecified)	g	0.000427342	0	0	0	0
	(s) Phosphorus (P)	g	0.00360329	0	0	0	0
	(s) Sulphur (S)	g	0.0431705	0	0	0	0
	(s) Zinc (Zn)	g	0.00108157	0	0	0	0
	(w) Acids (H+)	g	0.659674	0.225148	0	0	0.009595468
	(w) Acrylonitrile (CH2CHCN)	g	0	0	0	0	0.012263
	(w) Adiponitrile (NC(CH2)4CN)	g	0	0	0	0	0.000459861
	(w) Alcohol (unspecified)	g	0.000650104	0	0	0	0
	(w) Alkane (unspecified)	g	0.01136	0	0	0	0
	(w) Alkene (unspecified)	g	0.00104764	0	0	0	0
	(w) Aluminium (Al3+)	g	159.263	0	0	0	0.000831268
	(w) Aluminium Hydroxide (Al(OH)3)	g	0.0000114	0	0	0	0
	(w) Ammonia (NH4+, NH3, as N)	g	2.26389	0	0	0	0.002444379
	(w) AOX (Adsorbable Organic Halogens)	g	0.00306902	0	0	0	0
	(w) Aromatic Hydrocarbons (unspecified)	g	0.757548	0	0	0	3.12272E-05
	(w) Arsenic (As3+, As5+)	g	0.319522	0	0	0	1.63339E-06
	(w) Barium (Ba++)	g	14.506	0	0	0	7.76517E-05
	(w) Barytes	g	1.02083	0	0	0	0
	(w) Benzene (C6H6)	g	0.0113661	0	0	0	0
	(w) BOD5 (Biochemical Oxygen Demand)	g	91.3132	0	0	0	0.02251989
	(w) Boric Acid (H3BO3)	g	0.0132348	0	0	0	0
	(w) Boron (B III)	g	0.00141863	0	0	0	0
	(w) Cadmium (Cd++)	g	0.00939912	0	0	0	4.89177E-08
	(w) Calcium (Ca++)	g	6.24137	0	0	0	0.240331
	(w) Carbonates (CO3--, HCO3-, CO2, as C)	g	0.0117019	0	0	0	0
	(w) Cesium (Cs++)	g	0.0000811	0	0	0	0
	(w) Chlorides (Cl-)	g	4122.72	0	0	0	3.85194569
	(w) Chlorinated Matter (unspecified, as Cl)	g	0.429693	0	0	0	2.33831E-07
	(w) Chloroform (CHCl3)	g	0.000000174	0	0	0	0
	(w) Chromium (Cr III)	g	0.00075637	0	0	0	0
	(w) Chromium (Cr III, Cr VI)	g	3.72037	0	0	0	9.7857E-06
	(w) Chromium (Cr VI)	g	1.42E-08	0	0	0	0
	(w) Cobalt (Co I, Co II, Co III)	g	0.0000467	0	0	0	0
	(w) COD (Chemical Oxygen Demand)	g	252.814	0	0	0	0.1010607
	(w) Copper (Cu+, Cu++)	g	0.947456	0	0	0	4.13237E-06
	(w) Cyanides (CN-)	g	0.0237786	0	0	0	3.37526E-07
	(w) Dissolved Matter (unspecified)	g	387.319	0	0	0	0.03002913
	(w) Dissolved Organic Carbon (DOC)	g	1.0865	0	0	0	0.00001568
	(w) Edetic Acid (C10H16N2O8, EDTA)	g	0.0000225	0	0	0	0
	(w) Ethylbenzene (C6H5C2H5)	g	0.00196256	0	0	0	0
	(w) Fluorides (F-)	g	0.0670534	0	0	0	0.00006098
	(w) Formaldehyde (CH2O)	g	2.21E-09	0	0	0	0

	(w) Halogenous Matter (organic)	g	6.76E-10	0	0	0	1.65935E-08
	(w) Hexachloroethane (C2Cl6)	g	3.07E-13	0	0	0	0
	(w) Hydrazine (N2H4)	g	0.0000103	0	0	0	0
	(w) Hydrocarbons (unspecified)	g	0.71653	0.0281435	0	0	0.016441895
	(w) Inorganic Dissolved Matter (unspecified)	g	36.318	0.197004	0	0	0.03044708
	(w) Iodine (I-)	g	0.00813061	0	0	0	0
	(w) Iron (Fe++, Fe3+)	g	311.076	0	0	0	0.000833792
	(w) Lead (Pb++, Pb4+)	g	0.957245	0	0	0	4.55947E-06
	(w) Lithium Salts (Lithine)	g	0.00000115	0	0	0	0
	(w) Magnesium (Mg++)	g	0.137969	0	0	0	0
	(w) Manganese (Mn II, Mn IV, Mn VII)	g	0.0332917	0	0	0	0
	(w) Mercury (Hg+, Hg++)	g	0.00842352	0	0	0	4.99806E-08
	(w) Metals (unspecified)	g	25.9577	0.0281435	0	0	0.39906035
	(w) Methane (CH4)	g	0.0303096	0	0	0	0
	(w) Methylene Chloride (CH2Cl2)	g	0.000498923	0	0	0	0
	(w) Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	g	0.000761895	0	0	0	0
	(w) Morpholine (C4H9NO)	g	0.000109278	0	0	0	0
	(w) Nickel (Ni++, Ni3+)	g	0.959398	0	0	0	4.18529E-06
	(w) Nitrate (NO3-)	g	4.22874	0	0	0	0.03279843
	(w) Nitrite (NO2-)	g	0.000013	0	0	0	0
	(w) Nitrogenous Matter (Kjeldahl, as N)	g	0.00459842	0	0	0	0
	(w) Nitrogenous Matter (unspecified, as N)	g	1.5028	0	0	0	0.00722044
	(w) Oils (unspecified)	g	26.4438	0.197004	0	0	0.005883241
	(w) Organic Dissolved Matter (chlorinated)	g	0	0	0	0	0.00067608
	(w) Organic Dissolved Matter (unspecified)	g	0.0439811	0.112574	0	0	0.042754205
	(w) Organic Matter (unspecified)	g	0	0	0	0	0.014055951
	(w) Oxalic Acid ((COOH)2)	g	0.0000449	0	0	0	0
	(w) Phenol (C6H5OH)	g	0.147611	0.00281435	0	0	0.00004474
	(w) Phosphates (PO4 3-, HPO4--, H2PO4-, H3PO4, as P)	g	8.50032	0	0	0	0.00462575
	(w) Phosphorous Matter (unspecified, as P)	g	0.000610597	0	0	0	0
	(w) Phosphorus (P)	g	0.000357762	0	0	0	0
	(w) Phosphorus Pentoxide (P2O5)	g	0.000433932	0	0	0	0
	(w) Polycyclic Aromatic Hydrocarbons (PAH, unspecified)	g	0.0101569	0	0	0	6.4132E-08
	(w) Potassium (K+)	g	0.380268	0	0	0	0
	(w) Rubidium (Rb+)	g	0.000812559	0	0	0	0
	(w) Salts (unspecified)	g	1312.96	0	0	0	0
	(w) Saponifiable Oils and Fats	g	0.396533	0	0	0	0
	(w) Selenium (Se II, Se IV, Se VI)	g	0.000668199	0	0	0	0
	(w) Silicon Dioxide (SiO2)	g	0.000178969	0	0	0	0
	(w) Silver (Ag+)	g	0.0000488	0	0	0	0
	(w) Sodium (Na+)	g	717.35	0	0	0	1.437015009
	(w) Strontium (Sr II)	g	0.536271	0	0	0	0
	(w) Sulphate (SO4--)	g	1697.89	0	0	0	0.227544639
	(w) Sulphide (S--)	g	0.0262249	0	0	0	4.45061E-07
	(w) Sulphite (SO3--)	g	0.0000271	0	0	0	0
	(w) Sulphurated Matter (unspecified, as S)	g	0.0000026	0	0	0	0.00004092
	(w) Suspended Matter (organic)	g	-0.162154	0	0	0	0.005
	(w) Suspended Matter (unspecified)	g	134.369	0.225148	0	0	0.28208123
	(w) Tars (unspecified)	g	0.00000305	0	0	0	0
	(w) Tetrachloroethylene (C2Cl4)	g	7.51E-10	0	0	0	0
	(w) Tin (Sn++, Sn4+)	g	0.00000248	0	0	0	0
	(w) Titanium (Ti3+, Ti4+)	g	0.002268	0	0	0	0
	(w) TOC (Total Organic Carbon)	g	78.5735	0	0	0	0.001055599

	(w) Toluene (C6H5CH3)	g	0.101595	0	0	0	3.00793E-06
	(w) Tributyl Phosphate ((C4H9)3PO4, TBP)	g	0.000425632	0	0	0	0
	(w) Trichlorethane (1,1,1-CH3CCl3)	g	1.69E-09	0	0	0	0
	(w) Trichloroethylene (CHClCl2)	g	4.66E-08	0	0	0	0
	(w) Triethylene Glycol (C6H14O4)	g	0.0574389	0	0	0	0
	(w) Vanadium (V3+, V5+)	g	0.00251408	0	0	0	0
	(w) VOC (Volatile Organic Compounds)	g	0.0283873	0	0	0	0
	(w) Water (unspecified)	litre	14.2399	0	0	0	0
	(w) Water: Chemically Polluted	litre	2719.8	0	0	0	0.1470492
	(w) Xylene (C6H4(CH3)2)	g	0.0769621	0	0	0	0.000613147
	(w) Zinc (Zn++)	g	1.60038	0	0	0	8.36955E-06
	(wr) Radioactive Substance (unspecified)	kBq	5189.29	0	0	0	0.019710542
	(wr) Radium (Ra224)	kBq	0.00406279	0	0	0	0
	(wr) Radium (Ra226)	kBq	3.12083	0	0	0	0
	(wr) Radium (Ra228)	kBq	0.00812559	0	0	0	0
	(wr) Thorium (Th228)	kBq	0.0162512	0	0	0	0
	_(PE) Electricity	MJ	0	0	0	0	0
	_(PE) Fossil Fuels (fuel energy)	MJ	0	258.92	0	0	0
	_(PM) Total	kg	0	0	0	0	0.05889
	_(PM) Total: Ferrous	kg	0	0	0	0	0
	_(PM) Total: Non Ferrous	kg	0	0	0	0	0
	_(PM) Total: Other	kg	0	0	0	0	0
	_(PM) Total: Plastics	kg	0	0	0	0	0.05889
	_(PP) Total	kg	0	0	0	0	0
	_(PP) Total: Ferrous	kg	0	0	0	0	0
	_(PP) Total: Fluids	kg	0	0	0	0	0
	_(PP) Total: Non Ferrous	kg	0	0	0	0	0
	_(PP) Total: Other	kg	0	0	0	0	0
	_(PP) Total: Plastics	kg	0	0	0	0	0
	_(SE) Electricity	MJ	282.387	0	0	0	0
	_(SE) Waste (fuel energy)	MJ	1164.12	0	0	0	0
	_(SM) ABS	kg	0.933953	0	0	0	0
	_(SM) Aluminium (sheet)	kg	37.5007	0	0	0	0
	_(SM) Copper	kg	4.71593	0	0	0	0
	_(SM) Ferrous (steel plate)	kg	531.345	0	0	0	0
	_(SM) Glass	kg	28.0165	0	0	0	0
	_(SM) Lead	kg	6.25161	0	0	0	0
	_(SM) Other Metals	kg	0.53293	0	0	0	0
	_(SM) Other Plastics	kg	1.50511	0	0	0	0
	_(SM) PA66	kg	1.06193	0	0	0	0
	_(SM) PE	kg	0.550025	0	0	0	0
	_(SM) PP	kg	3.40953	0	0	0	0
	_(SM) PUR	kg	1.25866	0	0	0	0
	_(SM) PVC	kg	1.0558	0	0	0	0
	_(SM) Rubber	kg	3.1	0	0	0	0
	_(SM) Total	kg	622.01	0	0	0	0
	_(SM) Total: Ferrous	kg	531.345	0	0	0	0
	_(SM) Total: Non Ferrous	kg	49.7741	0	0	0	0
	_(SM) Total: Other	kg	31.1165	0	0	0	0
	_(SM) Total: Plastics	kg	9.775	0	0	0	0
	_(SM) Zinc	kg	0.772909	0	0	0	0
	_(SP) ABS Product	kg	0.35	0	0	0	0
	_(SP) Aluminium Product (cast)	kg	14.5992	0	0	0	0
	_(SP) Coolant	kg	3	0	0	0	0
	_(SP) Copper Product (wire)	kg	3.0401	0	0	0	0
	_(SP) Ferrous Product (cast)	kg	96	0	0	0	0
	_(SP) Fluids (unspecified)	kg	3.03282	0	0	0	0

	_(SP) Glass Product	kg	6.9168	0	0	0	0
	_(SP) Lead Product	kg	2.682	0	0	0	0
	_(SP) Lubricant	kg	5.36576	0	0	0	0
	_(SP) Other Materials Product	kg	1.6	0	0	0	0
	_(SP) Other Metals Product	kg	0.286	0	0	0	0
	_(SP) Other Plastics Product	kg	0.55	0	0	0	0
	_(SP) PA66 Product	kg	0.25	0	0	0	0
	_(SP) PE Product	kg	0.25	0	0	0	0
	_(SP) PP Product	kg	1.45	0	0	0	0
	_(SP) PUR Product	kg	0.45	0	0	0	0
	_(SP) PVC Product	kg	0.4	0	0	0	0
	_(SP) Rubber Product (tyre)	kg	18.8	0	0	0	0
	_(SP) Total	kg	159.361	0	0	0	0
	_(SP) Total: Ferrous	kg	96	0	0	0	0
	_(SP) Total: Fluids	kg	11.3986	0	0	0	0
	_(SP) Total: Non Ferrous	kg	20.9453	0	0	0	0
	_(SP) Total: Other	kg	27.3168	0	0	0	0
	_(SP) Total: Plastics	kg	3.7	0	0	0	0
	_(SP) Zinc Product (wire)	kg	0.338	0	0	0	0
	_Recovered Matter: Steel Scrap	kg	17.7173	0	0	0	0
	Recovered Energy	MJ	1322.64	0	0	0	0
	Recovered Matter (total)	kg	77.5424	0.0706949	0	0	0.002384181
	Recovered Matter (unspecified)	kg	57.5608	0.0706949	0	0	0.002384181
	Recovered Matter: Aluminium Scrap	kg	2.23504	0	0	0	0
	Recovered Matter: Carbon Monoxide (CO)	kg	0.406204	0	0	0	0
	Recovered Matter: Iron Scrap	kg	0.00101511	0	0	0	0
	Waste (hazardous)	kg	6.12626	0	0	0	0.005286589
	Waste (incineration)	kg	0.000923096	0	0	0	0.00016509
	Waste (municipal and industrial)	kg	95.1819	0.282892	0	0	0.001752404
	Waste (total)	kg	184.503	2.86773	0	0	0.014717917
	Waste (unspecified)	kg	55.6024	2.57155	0	0	0.002386283
	Waste: Highly Radioactive (class C)	kg	0.0000287	0	0	0	0
	Waste: Intermediate Radioactive (class B)	kg	0.000219564	0	0	0	0
	Waste: Low Radioactive (class A)	kBq	0.00284981	0	0	0	0
	Waste: Mineral (inert)	kg	10.8246	0.0115388	0	0	0.004009491
	Waste: Mining	kg	2.44373	0	0	0	0
	Waste: Non Mineral (inert)	kg	0.457411	0	0	0	0.00013647
	Waste: Non Toxic Chemicals (unspecified)	kg	-0.00480986	0.0000563	0	0	0.00032776
	Waste: Radioactive (unspecified)	kg	0.0000791	0	0	0	0
	Waste: Slags and Ash (unspecified)	kg	16.2838	0.00168861	0	0	0.000786235
	Waste: Treatment	kg	0.136197	0	0	0	0
Reminders:	E Feedstock Energy	MJ	5289.83	8.02089	0	0	3.131862
	E Fuel Energy	MJ	14497.7	281.904	0	0	2.6910273
	E Non Renewable Energy	MJ	19440.3	289.521	0	0	5.758521
	E Renewable Energy	MJ	347.138	0.40371	0	0	0.06437711
	E Total Primary Energy	MJ	19787.5	289.925	0	0	5.822852
	Electricity	MJ elec	7196.38	2.43369	0	0	0.2848727

NB: *Primary: Other* column is omitted for clarity since all flows are 0, i.e. this system makes no contribution in this option.

Table A5 Breakdown of the Current Practice (1997) ELV Disposal and Processing Chain

	Flow	Units	ELV	Transport to Dismantler	Dismantler	Ferrous from Dismantler	Non Ferrous from Dismantler	Plastics from Dismantler	Others from Dismantler	Feeder Site	Shredder	Ferrous	Non Ferrous	Fluff
Inputs:	(r) Barium Sulphate (BaSO4, in ground)	kg	0.00335511	0	0.00045401	0	0	0	0.000329344	0.000685723	0.0017276	0	0.000158428	0
	(r) Bauxite (Al2O3, ore)	kg	0.00595774	0	0.00000883	0	0.000396212	0	0.005479275	0.0000133	0.0000336	0	0.0000265	0
	(r) Bentonite (Al2O3.4SiO2.H2O, in ground)	kg	0.000316938	0	0.0000429	0	0	0	0.000031073	0.0000648	0.000163197	0	0.000015	0
	(r) Chromium (Cr, ore)	kg	0.000000645	0	8.73E-08	0	0	0	6.3356E-08	0.000000132	0.000000332	0	3.05E-08	0
	(r) Clay (in ground)	kg	0.00566451	0	0.000731464	0	0.000262484	0	0.000516096	0.00110478	0.00278337	0	0.000266321	0
	(r) Coal (in ground)	kg	111.573	0.00643928	1.13535	8.8498	3.1456839	0	1.233093	1.95328	5.04179	86.0558	4.14574	0.0061406
	(r) Copper (Cu, ore)	kg	0.00000328	0	0.000000444	0	0	0	3.2183E-07	0.000000671	0.00000169	0	0.000000155	0
	(r) Dolomite (CaCO3.MgCO3, in ground)	kg	0.0197417	0	0	0	0	0	0.0197417	0	0	0	0	0
	(r) Feldspar (ore)	kg	0.0101583	0	0	0	0	0	0.0101583	0	0	0	0	0
	(r) Iron (Fe, ore)	kg	1.5747	0	0.00330038	0	0.632691	0	0.00315059	0.194225	0.564509	0	0.176828	0
	(r) Iron Sulphate (FeSO4, ore)	kg	0.000270441	0	0.0000366	0	0	0	0.000026533	0.0000553	0.000139255	0	0.0000128	0
	(r) Lead (Pb, ore)	kg	0.00000102	0	0.000000139	0	0	0	1.00583E-07	0.000000209	0.000000528	0	4.84E-08	0
	(r) Lignite (in ground)	kg	149.226	0	0.000719646	13.6762	0.3553056	0	0.000522039	0.0222021	0.0643244	132.988	2.11834	0
	(r) Limestone (CaCO3, in ground)	kg	3.23319	0	0.190212	0	0.0852287	0	1.482412039	0.387957	1.01741	0	0.0699712	0
	(r) Manganese (Mn, ore)	kg	0.000000376	0	5.08E-08	0	0	0	3.6924E-08	7.68E-08	0.000000193	0	1.77E-08	0
	(r) Natural Gas (in ground)	kg	62.4323	0.00377585	0.317498	4.92878	1.4535708	0	3.2626954	0.484401	1.24651	47.9276	2.80388	0.0036014
	(r) Nickel (Ni, ore)	kg	0.000000218	0	2.96E-08	0	0	0	2.1488E-08	4.46E-08	0.000000112	0	1.03E-08	0
	(r) Oil (in ground)	kg	46.0937	0.974448	0.5001	2.518	1.6100481	0	1.6697477	0.983592	6.5001	24.4851	5.92301	0.929478
	(r) Pyrite (FeS2, ore)	kg	0.00537749	0	0.000727677	0	0	0	0.000527863	0.00109906	0.00276896	0	0.000253925	0
	(r) Sand (in ground)	kg	0.200815	0	0.000622774	0	0.0795523	0	0.113754803	0.000940618	0.00236978	0	0.00357395	0
	(r) Silver (Ag, ore)	kg	1.63E-08	0	2.2E-09	0	0	0	1.594E-09	3.33E-09	8.38E-09	0	7.68E-10	0
	(r) Sodium Carbonate (Na2CO3, in ground)	kg	1.05631	0	0	0	1.01355	0	0	0	0	0	0.0427657	0
	(r) Sodium Chloride (NaCl, in ground or in sea)	kg	0.095953	0	0.000868117	0	0.005399405	0	0.08453756	0.00131118	0.00330336	0	0.000533365	0
	(r) Uranium (U, ore)	kg	0.0077907	0	0.0000283	0.00058124	0.000070981	0	0.00113644	0.0000439	0.000110925	0.005652	0.00016687	0
	(r) Zinc (Zn, ore)	kg	2.39E-08	0	3.23E-09	0	0	0	2.3406E-09	4.88E-09	1.23E-08	0	1.13E-09	0
	_Catalyser (Demetalization)	kg	0.00202552	0	0	0	0.000216386	0	0.001800002	0	0	0	0.00000913	0
	_Catalyser (Hydrotreating)	kg	0.00281322	0	0	0	0.000300537	0	0.0025	0	0	0	0.0000127	0
	_Catalyser (Unspecified)	kg	0.00000206	0	0	0	0.00000198	0	0	0	0	0	8.34E-08	0
	_Dewaxing aid	kg	0.000100951	0	0	0	0.0000969	0	0	0	0	0	0.00000409	0
	_Furfural	kg	0.000236099	0	0	0	0.000226541	0	0	0	0	0	0.00000956	0
	Adjuvant (unspecified)	kg	-0.000641632	0	0	0	-0.000053	0	-0.000586363	0	0	0	-0.00000224	0
	Amine (unspecified)	kg	-0.00000182	0	0	0	0.00000251	0	-0.00000443	0	0	0	0.000000106	0
	Chlorine (Cl2)	kg	0.0162856	0	0	0	0.00481058	0	0	0	0	0	0.011475	0
	Explosive (unspecified)	kg	0.0000615	0	0.00000827	0	0.000000359	0	6.0027E-06	0.0000125	0.0000315	0	0.0000029	0
	Iron Scrap	kg	0.147583	0	0.000280819	0	0.0482862	0	0.000203711	0.0247265	0.0719506	565.2	0.00213539	0
	Raw Materials (unspecified)	kg	19.0147	0	0.0524478	1.63919	0.25146115	0	0.039813098	0.0902034	0.231622	15.9396	0.770416	0
	Water Used (total)	litre	7291.48	0.188258	76.9692	635.235	81.79118641	0	174.327288	12.1413	43.9841	6177.05	89.6218	0.179844
	Water: Industrial Water	litre	5.76	0	0	0	0	0	5.76	0	0	0	0	0
	Water: Mine Supply	litre	0.0528155	0	0	0	0.0506772	0	0	0	0	0	0.00213828	0
	Water: Public Network	litre	6.77243	0	0	0	0.601072	0	5	0	0	0	1.17136	0
	Water: Unspecified Origin	litre	7196.44	0.188258	5.84659	635.235	81.13908641	0	163.565374	12.1381	32.6565	6177.05	88.4475	0.179844
	Water: Urban Supply Network	litre	82.44	0	71.1205	0	0	0	0	0	11.3195	0	0	0
	Wood (standing)	m3	0.00123433	0	0.00000733	0.000106511	4.22081E-06	0	5.3167E-06	0.0000146	0.0000381	0.00103571	0.0000225	0
Outputs:	(a) Acetaldehyde (CH3CHO)	g	0.0027122	0	0.000367013	0	0	0	0.000266239	0.000554324	0.00139656	0	0.00012807	0
	(a) Acetic Acid (CH3COOH)	g	0.0229162	0	0.003101	0	0	0	0.00224956	0.00468366	0.0117999	0	0.0010821	0
	(a) Acetone (CH3COCH3)	g	0.00263948	0	0.000357172	0	0	0	0.000259093	0.000539461	0.00135911	0	0.000124636	0
	(a) Acetylene (C2H2)	g	0.0751531	0	0.0101697	0	0	0	0.00737725	0.0153599	0.0386976	0	0.00354873	0
	(a) Aldehyde (unspecified)	g	1.42435	0.0359401	0.0159925	0.0507523	0.31255868	0	0.00756785	0.0319175	0.228575	0.493517	0.213235	0.0342907

(a) Alkane (unspecified)	g	0.343738	0	0.0465009	0	0.000161014	0	0.033663386	0.0702335	0.176945	0	0.0162334	0
(a) Alkene (unspecified)	g	0.0761985	0	0.0103107	0	0.00000447	0	0.00747768	0.015573	0.0392345	0	0.00359815	0
(a) Alkyne (unspecified)	g	0.00000547	0	0.000000741	0	0	0	5.3772E-07	0.00000112	0.00000282	0	0.000000258	0
(a) Aluminium (Al)	g	1.64053	0	0.195373	0	0	0	0.14172642	0.295085	0.940173	0	0.0681758	0
(a) Ammonia (NH3)	g	1.67339	0.0179701	0.0119431	0.116714	0.103044419	0	0.005491122	0.0223123	0.13045	1.13493	0.113385	0.0171453
(a) Antimony (Sb)	g	0.000278437	0	0.0000377	0	0	0	0.00002734	0.0000569	0.000143372	0	0.0000131	0
(a) AOX (Adsorbable Organic Halogens)	g	3.11E-10	0	1.63E-13	0	1.414E-10	0	1.1804E-13	2.46E-13	6.2E-13	0	1.68E-10	0
(a) Aromatic Hydrocarbons (unspecified)	g	5.78294	0	0.000355285	0.358513	0.56071666	0	0.000257726	0.00157843	0.00439056	3.48619	1.37093	0
(a) Arsenic (As)	g	0.0030327	0	0.000410382	0	0	0	0.000297694	0.000619829	0.00156159	0	0.000143204	0
(a) Barium (Ba)	g	0.0173098	0	0.00234235	0	0	0	0.00169916	0.00353782	0.00891313	0	0.00081737	0
(a) Benzaldehyde (C6H5CHO)	g	9.88E-10	0	1.34E-10	0	0	0	9.6952E-11	2.02E-10	5.09E-10	0	4.67E-11	0
(a) Benzene (C6H6)	g	0.667203	0	0.0187941	0.0471342	0.00494169	0	0.013632075	0.0288383	0.0728344	0.458334	0.0226936	0
(a) Benzo(a)pyrene (C20H12)	g	0.000233099	0	0.0000315	0	0	0	0.000022901	0.0000476	0.000120026	0	0.000011	0
(a) Berylium (Be)	g	0.000283453	0	0.0000384	0	0	0	0.000027844	0.0000579	0.000145954	0	0.0000134	0
(a) Boron (B)	g	0.137137	0	0.0185573	0	0	0	0.0134617	0.0280283	0.0706142	0	0.00647561	0
(a) Bromium (Br)	g	0.0274162	0	0.00370994	0	0	0	0.00269121	0.00560337	0.0141171	0	0.00129459	0
(a) Butane (n-C4H10)	g	0.142963	0	0.0193456	0	0	0	0.014033621	0.0292191	0.073614	0	0.00675071	0
(a) Butene (1-CH3CH2CHCH2)	g	0.000903878	0	0.000122312	0	0	0	0.000088679	0.000184736	0.000465422	0	0.0000427	0
(a) Cadmium (Cd)	g	0.0295461	0	0.000104005	0.000341906	3.8901E-05	0	0.024939462	0.0001784	0.000457926	0.00332471	0.000160808	0
(a) Calcium (Ca)	g	0.175107	0	0.0236954	0	0	0	0.017189027	0.0357887	0.0901656	0	0.00826856	0
(a) Carbon Dioxide (CO2, biomass)	g	37422.5	0	0	0	0	0	0	0	0	0	15599.6	21822.9
(a) Carbon Dioxide (CO2, fossil)	g	787344	3345.21	4229.45	61088.7	19012.471	0	23373.872	7753.95	33582.2	594029	37737.5	3191.64
(a) Carbon Monoxide (CO)	g	2726.97	18.184	10.7333	227.735	13.103395	0	8.265337	23.819	136.491	2214.5	56.7766	17.3561
(a) Carbon Tetrafluoride (CF4)	g	0.000000794	0	0.000000107	0	0	0	7.7984E-08	0.000000162	0.000000409	0	3.75E-08	0
(a) Chlorides (Cl-)	g	0.000000658	0	0.000000089	0	0	0	6.4567E-08	0.000000134	0.000000339	0	3.11E-08	0
(a) Chlorine (Cl2)	g	0.000000757	0	0.000000103	0	0	0	7.4353E-08	0.000000155	0.00000039	0	3.58E-08	0
(a) Chromium (Cr III, Cr VI)	g	0.00368006	0	0.000497983	0	0	0	0.000361243	0.000752138	0.00189493	0	0.000173772	0
(a) Chromium (Cr)	g	0.100494	0	0	0.0092803	0	0	0	0.0000279	0.0000813	0.090242	0.000862185	0
(a) Cobalt (Co)	g	0.00104114	0	0.000140886	0	0	0	0.000102201	0.00021279	0.000536101	0	0.0000492	0
(a) Copper (Cu)	g	0.301952	0	0.000411171	0.0258872	0	0	0.000298271	0.000672812	0.020406	0.251728	0.00254852	0
(a) Cyanide (CN-)	g	0.000381235	0	0.0000516	0	0	0	0.000037429	0.0000779	0.000196304	0	0.000018	0
(a) Dioxins (unspecified)	g	2.78E-09	0	3.76E-10	0	0	0	2.734E-10	5.68E-10	1.43E-09	0	1.31E-10	0
(a) Ethane (C2H6)	g	1.15164	0	0.155839	0	0	0	0.113047608	0.235374	0.592998	0	0.0543803	0
(a) Ethanol (C2H5OH)	g	0.00525911	0	0.000711658	0	0	0	0.000516245	0.00107487	0.002708	0	0.000248335	0
(a) Ethylbenzene (C8H10)	g	0.000904377	0	0.000122305	0	0.000000895	0	0.000088295	0.000184726	0.000465396	0	0.0000427	0
(a) Ethylene (C2H4)	g	1.62703	0	0.220169	0	0	0	0.15971336	0.332536	0.837786	0	0.0768284	0
(a) Fluorides (F-)	g	0.000164408	0	0.000000867	0	9.85486E-05	0	4.24613E-05	0.00000131	0.0000033	0	0.0000179	0
(a) Fluorine (F2)	g	0.00000321	0	0.000000435	0	0	0	3.1477E-07	0.000000656	0.00000165	0	0.000000152	0
(a) Formaldehyde (CH2O)	g	0.0271156	0	0.00366926	0	0	0	0.00266177	0.00554194	0.0139623	0	0.0012804	0
(a) Halogenated Matter (unspecified)	g	0.000161702	0	2.14E-15	0.0000147	9.22026E-07	0	1.5536E-15	1.99E-08	5.81E-08	0.00014249	0.00000356	0
(a) Halon 1301 (CF3Br)	g	0.00335031	0	0.0000138	0.000273525	8.0701E-05	0	1.00381E-05	0.000025	0.0000647	0.00265976	0.000222741	0
(a) Heptane (C7H16)	g	0.0089183	0	0.00120682	0	0	0	0.000875447	0.00182274	0.00459218	0	0.000421122	0
(a) Hexane (C6H14)	g	0.0178448	0	0.00241474	0	0	0	0.00175171	0.00364714	0.00918856	0	0.000842629	0
(a) Hydrocarbons (except methane)	g	708.6	14.4402	7.34609	31.1243	78.03835	0	51.176748	14.5005	96.2925	302.654	99.2356	13.7911
(a) Hydrocarbons (unspecified)	g	6.2522	0	0.0302202	0	-4.67410814	0	10.9977403	0.0157414	0.0396585	0	-0.157058	0
(a) Hydrogen (H2)	g	0.0872913	0	4.39E-08	0	0	0	0.087291	6.63E-08	0.000000167	0	1.53E-08	0

(a) Hydrogen Chloride (HCl)	g	80.5061	0	0.930162	6.44737	0.32182831	0	3.3535908	1.42208	3.58959	62.6945	1.747	0
(a) Hydrogen Fluoride (HF)	g	8.7224	0	0.033792	0.742424	0.128199945	0	0.024513237	0.0532296	0.134976	7.21936	0.385906	0
(a) Hydrogen Sulphide (H2S)	g	0.226716	0	0.0299167	0	-0.00573563	0	0.025589038	0.0471573	0.119591	0	0.0101975	0
(a) Iodine (I)	g	0.00685333	0	0.000927387	0	0	0	0.000672744	0.0014007	0.00352889	0	0.000323614	0
(a) Iron (Fe)	g	1.39872	0	0.0787894	0	0	0	0.057155046	0.119001	1.11628	0	0.0274938	0
(a) Ketone (unspecified)	g	0.409171	0	0	0	0.392606	0	0	0	0	0	0.0165656	0
(a) Lanthanum (La)	g	0.000454976	0	0.0000616	0	0	0	0.000044692	0.000093	0.000234274	0	0.0000215	0
(a) Lead (Pb)	g	5.21636	0	0.00168178	0.46255	0.126989601	0	0.00121998	0.00345245	0.0730012	4.49785	0.0496132	0
(a) Magnesium (Mg)	g	0.505892	0	0.0684569	0	0	0	0.049659633	0.103395	0.260492	0	0.0238882	0
(a) Manganese (Mn)	g	1.87559	0	0.00047469	0.172907	0.000118437	0	0.000344344	0.00106356	0.00281723	1.68135	0.016512	0
(a) Mercury (Hg)	g	0.0401397	0	0.0000589	0.0013432	8.83471E-05	0	0.024906775	0.0000921	0.000233278	0.0130613	0.000355868	0
(a) Metals (unspecified)	g	19.7819	0	0.00000237	1.72907	0.06580768	0	0.82930664	0.00508317	0.0148245	16.8135	0.324271	0
(a) Methane (CH4)	g	1750.14	0.611838	9.82433	98.9447	10.4238791	0	8.1803188	17.1825	46.6907	962.142	269.434	326.703
(a) Methanol (CH3OH)	g	0.00893465	0	0.00120903	0	0	0	0.000877047	0.00182608	0.0046006	0	0.000421894	0
(a) Molybdenum (Mo)	g	0.000854822	0	0.000115674	0	0	0	0.000083937	0.00017471	0.000440162	0	0.0000404	0
(a) Nickel (Ni)	g	0.161405	0	0.00201111	0.0127482	0.002148572	0	0.00145888	0.00338812	0.00867525	0.123964	0.00701116	0
(a) Nitrogen Oxides (NOx as NO2)	g	2246.4	46.6366	26.0368	141.928	39.926038	0	67.769884	50.282	319.286	1380.11	129.934	44.494
(a) Nitrous Oxide (N2O)	g	37.4375	1.57238	0.722571	1.2396	2.6852912	0	0.9168952	1.43459	10.0896	12.0539	5.22336	1.49927
(a) Organic Matter (unspecified)	g	1.80156	0.0539102	0.0241017	0.0761285	0.14225267	0	0.00756719	0.0480468	0.343292	0.740276	0.31455	0.051436
(a) Particulates (unspecified)	g	899.962	3.78655	16.2876	60.2184	20.596185	0	24.415702	32.9431	117.897	585.566	34.636	3.61501
(a) Pentane (C5H12)	g	0.14382	0	0.0194616	0	0	0	0.01411776	0.0293942	0.0740554	0	0.00679118	0
(a) Phenol (C6H5OH)	g	7.58E-09	0	1.03E-09	0	0	0	7.4453E-10	1.55E-09	3.9E-09	0	3.58E-10	0
(a) Phosphorus (P)	g	0.0127601	0	0.00172669	0	0	0	0.00125257	0.00260794	0.00657041	0	0.000602533	0
(a) Phosphorus Pentoxide (P2O5)	g	0.00000865	0	0.00000117	0	0	0	8.4946E-07	0.00000177	0.00000446	0	0.000000409	0
(a) Polycyclic Aromatic Hydrocarbons (PAH, unspecified)	g	0.0138386	0	0.000113544	0.00118202	0.000056862	0	0.000082323	0.000177012	0.000448153	0.011494	0.000284586	0
(a) Potassium (K)	g	0.174783	0	0.0236514	0	0	0	0.017157147	0.0357224	0.0899984	0	0.00825323	0
(a) Propane (C3H8)	g	0.380765	0	0.0541317	0	0.0417491	0	-0.02350781	0.0817588	0.205982	0	0.020651	0
(a) Propionaldehyde (CH3CH2CHO)	g	2.72E-09	0	3.68E-10	0	0	0	2.6734E-10	5.56E-10	1.4E-09	0	1.28E-10	0
(a) Propylene (CH2CHCH3)	g	0.0837099	0	0.0113276	0	0	0	0.00821723	0.0171088	0.0431036	0	0.00395278	0
(a) Scandium (Sc)	g	0.000154364	0	0.0000209	0	0	0	0.000015133	0.0000315	0.0000795	0	0.00000729	0
(a) Selenium (Se)	g	0.00299099	0	0.000404738	0	0	0	0.000293605	0.000611304	0.00154011	0	0.000141235	0
(a) Silicon (Si)	g	2.16328	0	0.292734	0	0	0	0.21235356	0.442136	1.11391	0	0.10215	0
(a) Sodium (Na)	g	0.100366	0	0.0135814	0	0	0	0.00985215	0.0205129	0.05168	0	0.00473926	0
(a) Strontium (Sr)	g	0.0282501	0	0.00382278	0	0	0	0.00277306	0.00577381	0.0145465	0	0.00133397	0
(a) Sulphur Oxides (SOx as SO2)	g	2704.5	7.07037	15.8081	196.253	102.07462	0	89.509717	26.6489	96.7445	1908.37	255.281	6.74158
(a) Tars (unspecified)	g	0.000210387	0	5.47E-08	0	0.000201481	0	3.9749E-08	8.27E-08	0.000000208	0	0.00000852	0
(a) Thallium (Tl)	g	0.000172454	0	0.0000191	0	0	0	0.000013822	0.0000368	0.000096	0	0.00000667	0
(a) Thorium (Th)	g	0.000291147	0	0.0000394	0	0	0	0.000028551	0.0000595	0.000149917	0	0.0000137	0
(a) Tin (Sn)	g	0.000091	0	0.0000123	0	0	0	8.9284E-06	0.0000186	0.0000469	0	0.0000043	0
(a) Titanium (Ti)	g	0.050581	0	0.00684458	0	0	0	0.00496516	0.0103378	0.026045	0	0.00238843	0
(a) Toluene (C6H5CH3)	g	0.0429596	0	0.00581281	0	0.00000547	0	0.00421433	0.00877948	0.0221189	0	0.00202862	0
(a) Uranium (U)	g	0.000282493	0	0.0000382	0	0	0	0.000027743	0.0000577	0.00014546	0	0.0000133	0
(a) Vanadium (V)	g	0.0535369	0	0.00724351	0	0	0	0.00525452	0.0109424	0.0275688	0	0.00252764	0
(a) VOC (Volatile Organic Compounds)	g	199.885	0	0	0	0	0	2.48832	0	197.397	0	0	0
(a) Water Vapour (H2O)	g	19181.9	0	0	0	0	0	7862.4	0	11319.5	0	0	0
(a) Xylene (C6H4(CH3)2)	g	0.017302	0	0.002341	0	0.00000358	0	0.001696656	0.00353577	0.00890797	0	0.000817048	0
(a) Zinc (Zn)	g	0.526476	0	0.0012933	0.00937799	0.000624664	0	0.000938183	0.00200635	0.418231	0.0911919	0.00281257	0
(a) Zirconium (Zr)	g	0.000216354	0	0.0000293	0	0	0	0.000021286	0.0000442	0.000111404	0	0.0000102	0
(ar) Lead (Pb210)	kBq	0.00659894	0	0.000892962	0	0	0	0.000647771	0.0013487	0.0033979	0	0.000311602	0
(ar) Radioactive Substance (unspecified)	kBq	560233	0	0.00000711	50797.4	3070.886115	0	5.1553E-06	92.8272	270.746	493956	12044.3	0
(ar) Radium (Ra226)	kBq	0.00527964	0	0.000714437	0	0	0	0.000518263	0.00107906	0.00271858	0	0.000249305	0
(ar) Radon (Rn222)	kBq	0.0627421	0	0.00849021	0	0	0	0.00615895	0.0128233	0.0323069	0	0.00296268	0
(s) Aluminium (Al)	g	0.0428287	0	0.00579554	0	0	0	0.00420416	0.0087534	0.0220532	0	0.00202237	0
(s) Arsenic (As)	g	0.0000171	0	0.00000232	0	0	0	1.6747E-06	0.0000035	0.00000881	0	0.000000808	0
(s) Cadmium (Cd)	g	7.74E-09	0	1.05E-09	0	0	0	7.5967E-10	1.58E-09	3.99E-09	0	3.66E-10	0

(s) Calcium (Ca)	g	0.17111	0	0.0231545	0	0	0	0.016796582	0.0349718	0.0881075	0	0.00807982	0
(s) Carbon (C)	g	0.128432	0	0.0173793	0	0	0	0.012607197	0.0262492	0.0661317	0	0.00606455	0
(s) Chromium (Cr III, Cr VI)	g	0.000214218	0	0.000029	0	0	0	0.000020985	0.0000438	0.000110305	0	0.0000101	0
(s) Cobalt (Co)	g	7.85E-09	0	1.06E-09	0	0	0	7.7077E-10	1.6E-09	4.04E-09	0	3.71E-10	0
(s) Copper (Cu)	g	3.93E-08	0	5.32E-09	0	0	0	3.8539E-09	8.03E-09	2.02E-08	0	1.86E-09	0
(s) Iron (Fe)	g	0.0855317	0	0.0115741	0	0	0	0.00839599	0.0174811	0.0440417	0	0.0040388	0
(s) Lead (Pb)	g	0.00000018	0	2.43E-08	0	0	0	1.7655E-08	3.67E-08	9.25E-08	0	8.49E-09	0
(s) Manganese (Mn)	g	0.0017111	0	0.000231545	0	0	0	0.000167961	0.000349718	0.000881075	0	0.0000808	0
(s) Mercury (Hg)	g	1.43E-09	0	1.93E-10	0	0	0	1.4023E-10	2.91E-10	7.34E-10	0	6.73E-11	0
(s) Nickel (Ni)	g	0.000000059	0	7.98E-09	0	0	0	5.7909E-09	1.21E-08	3.04E-08	0	2.79E-09	0
(s) Nitrogen (N)	g	0.000000671	0	9.07E-08	0	0	0	6.5778E-08	0.000000137	0.000000345	0	3.17E-08	0
(s) Oils (unspecified)	g	0.000254084	0	0.0000344	0	0	0	0.000024919	0.0000519	0.000130832	0	0.000012	0
(s) Phosphorus (P)	g	0.0021424	0	0.000289908	0	0	0	0.000210307	0.000437868	0.00110316	0	0.000101164	0
(s) Sulphur (S)	g	0.0256678	0	0.00347335	0	0	0	0.00251959	0.00524603	0.0132168	0	0.00121203	0
(s) Zinc (Zn)	g	0.000643064	0	0.000087	0	0	0	0.000063154	0.000131431	0.000331124	0	0.0000304	0
(w) Acids (H+)	g	0.278294	0	0.000374442	0	0.011363629	0	0.26330453	0.000565546	0.00142483	0	0.00126144	0
(w) Alcohol (unspecified)	g	0.000386531	0	0.0000523	0	0	0	0.000037933	0.000079	0.000199031	0	0.0000183	0
(w) Alkane (unspecified)	g	0.00675427	0	0.000913982	0	0	0	0.000663015	0.00138045	0.00347788	0	0.000318936	0
(w) Alkene (unspecified)	g	0.00062289	0	0.0000843	0	0	0	0.000061137	0.000127307	0.000320737	0	0.0000294	0
(w) Aluminium (Al3+)	g	158.328	0	0.0145017	14.3112	0.5671216	0	0.010519755	0.404367	1.1707	139.163	2.68727	0
(w) Aluminium Hydroxide (Al(OH)3)	g	0.00000676	0	0.000000914	0	0	0	6.6282E-07	0.00000138	0.00000348	0	0.000000319	0
(w) Ammonia (NH4+, NH3, as N)	g	2.17013	0	0.0154149	0.169053	0.022424121	0	0.167543745	0.0245123	0.0622448	1.64388	0.0650525	0
(w) AOX (Adsorbable Organic Halogens)	g	0.003017	0	0.0000123	0.000214912	0.000058804	0	8.8837E-06	0.00012138	0.000346637	0.00208982	0.000164266	0
(w) Aromatic Hydrocarbons (unspecified)	g	0.73139	0	0.00389393	0.0595893	0.01624647	0	0.00282471	0.00665814	0.0170831	0.579449	0.0456456	0
(w) Arsenic (As3+, As5+)	g	0.317688	0	0.0000207	0.0287201	0.001142646	0	1.50233E-05	0.000798141	0.00231551	0.279275	0.0054007	0
(w) Barium (Ba++)	g	14.337	0	0.0168415	1.27482	0.08689436	0	0.012216984	0.0583049	0.15995	12.3964	0.331574	0
(w) Barytes	g	0.606953	0	0.0821324	0	0	0	0.059580039	0.12405	0.31253	0	0.0286603	0
(w) Benzene (C6H6)	g	0.0067579	0	0.000914473	0	2.04E-09	0	0.000663367	0.00138119	0.00347975	0	0.000319108	0
(w) BOD5 (Biochemical Oxygen Demand)	g	90.6861	0.00539102	0.0029598	8.31104	0.043921032	0	0.523289349	0.0394988	0.135191	80.8169	0.802768	0.0051436
(w) Boric Acid (H3BO3)	g	0.00786897	0	0.00106482	0	0	0	0.000772437	0.00160828	0.00405187	0	0.000371573	0
(w) Boron (B III)	g	0.000843714	0	0.000114105	0	0.000000795	0	0.000082386	0.00017234	0.000434191	0	0.0000399	0
(w) Cadmium (Cd++)	g	0.00931986	0	0.00000494	0.000835227	0.00004983	0	4.4445E-06	0.0000278	0.0000781	0.00812178	0.000197832	0
(w) Calcium (Ca++)	g	1.75238	0	0.237122	0	0.000104361	0	0.17196764	0.358142	0.902297	0	0.0827487	0
(w) Carbonates (CO3--, HCO3-, CO2, as C)	g	0.00695755	0	0.00094149	0	0	0	0.000682974	0.001422	0.00358256	0	0.000328535	0
(w) Cesium (Cs++)	g	0.0000482	0	0.00000653	0	0	0	4.7316E-06	0.00000986	0.0000248	0	0.00000228	0
(w) Chlorides (Cl-)	g	2788.93	0	13.2215	243.242	12.66113553	0	15.69452	22.798	58.5608	2365.29	57.4621	0
(w) Chlorinated Matter (unspecified, as Cl)	g	0.362369	0	0.013059	0.0245684	3.08112E-05	0	0.00947324	0.0197251	0.0496956	0.238904	0.00691301	0
(w) Chloroform (CHCl3)	g	0.000000103	0	0.000000014	0	0	0	1.01892E-08	2.12E-08	5.33E-08	0	4.89E-09	0
(w) Chromium (Cr III)	g	0.000449713	0	0.0000609	0	0	0	0.000044188	0.0000919	0.000231565	0	0.0000212	0
(w) Chromium (Cr III, Cr VI)	g	3.69974	0	0.0000416	0.338487	0.00584953	0	0.000117365	0.0047042	0.0136956	3.29146	0.0453883	0
(w) Chromium (Cr VI)	g	8.45E-09	0	1.14E-09	0	0	0	8.2928E-10	1.73E-09	4.35E-09	0	3.99E-10	0
(w) Cobalt (Co I, Co II, Co III)	g	0.0000278	0	0.00000376	0	0	0	2.7239E-06	0.00000568	0.0000143	0	0.00000131	0
(w) COD (Chemical Oxygen Demand)	g	251.051	0.0161517	0.0148828	22.5886	0.030114686	0	5.985582833	0.118585	0.402238	219.653	2.22701	0.0154217
(w) Copper (Cu+, Cu++)	g	0.942094	0	0.0000285	0.0854765	0.00284614	0	0.000238673	0.00195743	0.00569203	0.831176	0.0146779	0
(w) Cyanides (CN-)	g	0.0162565	0	0.00148378	0.000454246	0.0001382	0	0.001076305	0.0022469	0.00566314	0.00441711	0.000776844	0
(w) Dissolved Matter (unspecified)	g	376.604	11.3383	5.77032	16.0747	19.697229	0	12.083591	11.1296	75.0993	156.311	58.2431	10.8563
(w) Dissolved Organic Carbon (DOC)	g	1.05484	0	0.00462134	0.089384	0.01551546	0	0.00335236	0.00731259	0.0185554	0.869173	0.0469219	0
(w) Edetic Acid (C10H16N2O8, EDTA)	g	0.0000134	0	0.00000181	0	0	0	1.3115E-06	0.00000273	0.00000688	0	0.000000631	0
(w) Ethylbenzene (C6H5C2H5)	g	0.00116688	0	0.000157901	0	0	0	0.000114548	0.000238488	0.000600844	0	0.0000551	0
(w) Fluorides (F-)	g	0.045757	0	0.003103	0	0.011799768	0	0.01021433	0.00468667	0.0118075	0	0.00414577	0
(w) Formaldehyde (CH2O)	g	1.31E-09	0	1.78E-10	0	0	0	1.2913E-10	2.68E-10	6.75E-10	0	6.19E-11	0

(w) Halogenous Matter (organic)	g	6.66E-10	0	0	0	6.39E-10	0	0	0	0	0	2.7E-11	0
(w) Hexachloroethane (C2Cl6)	g	1.83E-13	0	2.47E-14	0	0	0	1.7957E-14	3.73E-14	9.4E-14	0	8.62E-15	0
(w) Hydrazine (N2H4)	g	0.00000614	0	0.00000083	0	0	0	6.0229E-07	0.00000125	0.00000316	0	0.00000029	0
(w) Hydrocarbons (unspecified)	g	0.711406	0	0.00000549	0	-0.1570592	0	0.874971595	0.00000829	0.0000209	0	-0.00654123	0
(w) Inorganic Dissolved Matter (unspecified)	g	34.2848	0	0.000102387	0	10.07903912	0	0.006772264	0.000154642	0.000389603	0	24.1983	0
(w) Iodine (I-)	g	0.0048342	0	0.00065416	0	0	0	0.000474541	0.000988022	0.00248921	0	0.000228271	0
(w) Iron (Fe++, Fe3+)	g	309.164	0	0.0161418	28.2805	0.744244741	0	0.012160465	0.181748	0.520413	275.001	4.40808	0
(w) Lead (Pb++, Pb4+)	g	0.948145	0	0.000581212	0.0830343	0.02876644	0	0.000508818	0.00281805	0.00787057	0.807429	0.0171373	0
(w) Lithium Salts (Lithine)	g	0.000000686	0	9.28E-08	0	0	0	6.7291E-08	0.00000014	0.000000353	0	3.24E-08	0
(w) Magnesium (Mg++)	g	0.0820448	0	0.0110989	0	0.0000408	0	0.0080338	0.0167634	0.0422334	0	0.00387469	0
(w) Manganese (Mn II, Mn IV, Mn VII)	g	0.0197943	0	0.00267851	0	0.000000408	0	0.001942895	0.00404554	0.0101923	0	0.000934691	0
(w) Mercury (Hg+, Hg++)	g	0.00837585	0	3.21E-08	0.00077173	0.000004447	0	8.95304E-07	0.00000316	0.00000919	0.00750434	0.0000821	0
(w) Metals (unspecified)	g	25.7321	0	0.0000927	1.83652	0.0003318	0	5.30836288	0.0445616	0.129916	17.8584	0.553866	0
(w) Methane (CH4)	g	0.0180211	0	0.0024386	0	0	0	0.00176897	0.00368319	0.00927938	0	0.000850957	0
(w) Methylene Chloride (CH2Cl2)	g	0.000296644	0	0.0000401	0	0	0	0.000029156	0.0000606	0.000152747	0	0.000014	0
(w) Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	g	0.000453005	0	0.0000613	0	2.04E-08	0	4.44813E-05	0.0000926	0.000233253	0	0.0000214	0
(w) Morpholine (C4H9NO)	g	0.000065	0	0.00000879	0	0	0	0.000006376	0.0000133	0.0000335	0	0.00000307	0
(w) Nickel (Ni++, Ni3+)	g	0.953537	0	0.000114645	0.0864533	0.00289855	0	0.000301121	0.0021034	0.00606614	0.840676	0.0149237	0
(w) Nitrate (NO3-)	g	4.18887	0	0.00221935	0.378539	0.013847581	0	0.003460759	0.0045552	0.0119543	3.68092	0.0933707	0
(w) Nitrite (NO2-)	g	0.00000772	0	0.00000104	0	0	0	7.5765E-07	0.00000158	0.00000397	0	0.000000364	0
(w) Nitrogenous Matter (Kjeldahl, as N)	g	0.00273407	0	0.000369973	0	0	0	0.000268387	0.000558795	0.00140782	0	0.000129103	0
(w) Nitrogenous Matter (unspecified, as N)	g	1.42754	0	0.00368775	0.10306	0.0321712	0	0.2107968	0.00666945	0.0172398	1.00216	0.0517571	0
(w) Oils (unspecified)	g	25.9302	0.146542	0.0822528	1.9555	0.76235578	0	0.49479383	0.179836	1.06632	19.0154	2.0875	0.139771
(w) Organic Dissolved Matter (unspecified)	g	0.0336281	0	0.0000578	0	0.017227846	0	0.014953018	0.0000873	0.000219848	0	0.00108233	0
(w) Oxalic Acid ((COOH)2)	g	0.0000267	0	0.00000361	0	0	0	0.000002623	0.00000546	0.0000138	0	0.00000126	0
(w) Phenol (C6H5OH)	g	0.136173	0	0.000862065	0.00879187	0.00598632	0	0.022486975	0.00143052	0.00365508	0.0854924	0.00746802	0
(w) Phosphates (PO4 3-, HPO4--, H2PO4-, H3PO4, as P)	g	8.45381	0	0.000045	0.771422	-0.0005366	0	0.046823687	0.00955834	0.0278515	7.50134	0.0973127	0
(w) Phosphorous Matter (unspecified, as P)	g	0.000491829	0	0	0	0.0000537	0	0.000435912	0	0	0	0.00000226	0
(w) Phosphorus (P)	g	0.000212714	0	0.0000288	0	0	0	0.000020883	0.0000435	0.00010953	0	0.00001	0
(w) Phosphorus Pentoxide (P2O5)	g	0.000258002	0	0.0000349	0	0	0	0.000025322	0.0000527	0.00013285	0	0.0000122	0
(w) Polycyclic Aromatic Hydrocarbons (PAH, unspecified)	g	0.00958601	0	0.0000965	0.000747309	0.000220095	0	0.000070015	0.000157035	0.000400118	0.00726686	0.000628101	0
(w) Potassium (K+)	g	0.226101	0	0.0305941	0	0.0000204	0	0.022184728	0.0462084	0.116417	0	0.0106768	0
(w) Rubidium (Rb+)	g	0.000483122	0	0.0000654	0	0	0	0.000047416	0.0000987	0.000248767	0	0.0000228	0
(w) Salts (unspecified)	g	1305.98	0	0.0217083	120.155	0	0	0.01574757	1.59053	4.62602	1168.4	11.1706	0
(w) Saponifiable Oils and Fats	g	0.235766	0	0.0319036	0	0	0	0.023143409	0.0481862	0.1214	0	0.0111328	0
(w) Selenium (Se II, Se IV, Se VI)	g	0.000397296	0	0.0000538	0	2.04E-08	0	3.90333E-05	0.0000812	0.000204568	0	0.0000188	0
(w) Silicon Dioxide (SiO2)	g	0.000106409	0	0.0000144	0	0	0	1.04917E-05	0.0000217	0.0000548	0	0.00000502	0
(w) Silver (Ag+)	g	0.000029	0	0.00000392	0	0	0	0.000002845	0.00000592	0.0000149	0	0.00000137	0
(w) Sodium (Na+)	g	20.4272	0	2.67699	0	0.056578851	0	2.526955	4.04325	10.1865	0	0.936952	0
(w) Strontium (Sr II)	g	0.31885	0	0.0431464	0	0.00000144	0	0.031298401	0.0651669	0.164181	0	0.0150561	0
(w) Sulphate (SO4--)	g	1672.08	0	2.1	150.439	6.458791418	0	2.080079	4.95461	13.1909	1462.87	29.9878	0
(w) Sulphide (S--)	g	0.0252214	0	0.000108233	0.00197817	0.000743432	0	0.000950147	0.000190961	0.000492026	0.0192358	0.00152264	0
(w) Sulphite (SO3--)	g	0.0000161	0	0.00000218	0	0	0	1.5839E-06	0.00000329	0.00000829	0	0.00000076	0
(w) Sulphurated Matter (unspecified, as S)	g	0.00000242	0	4.28E-08	0	0.00000227	0	-2.34927E-07	6.46E-08	0.000000163	0	0.000000111	0
(w) Suspended Matter (organic)	g	-0.156523	0	0	0	-0.134107	0	-0.01675733	0	0	0	-0.00565853	0
(w) Suspended Matter (unspecified)	g	128.225	0.00539102	0.360395	10.8998	2.11860448	0	0.42241	0.624025	1.62558	105.99	6.17452	0.0051436
(w) Tars (unspecified)	g	0.00000301	0	7.82E-10	0	0.00000288	0	5.6698E-10	1.18E-09	2.98E-09	0	0.000000122	0
(w) Tetrachloroethylene (C2Cl4)	g	4.46E-10	0	6.04E-11	0	0	0	4.3785E-11	9.12E-11	2.3E-10	0	2.11E-11	0
(w) Tin (Sn++, Sn4+)	g	0.00000148	0	0.0000002	0	0	0	1.4527E-07	0.000000302	0.00000076	0	6.97E-08	0
(w) Titanium (Ti3+, Ti4+)	g	0.00134848	0	0.000182476	0	0	0	0.000132368	0.000275605	0.000694356	0	0.0000637	0
(w) TOC (Total Organic Carbon)	g	77.2777	0	0.109154	6.64274	1.2370753	0	0.515151649	0.194543	0.50192	64.5943	3.48279	0

(w) Toluene (C6H5CH3)	g	0.0968863	0	0.000764297	0.0077173	0.002169631	0	0.000554434	0.00126054	0.00321798	0.0750434	0.00615874	0
(w) Tributyl Phosphate ((C4H9)3PO4, TBP)	g	0.000253067	0	0.0000342	0	0	0	0.000024818	0.0000517	0.000130309	0	0.0000119	0
(w) Trichlorethane (1,1,1-CH3CCl3)	g	1.01E-09	0	1.36E-10	0	0	0	9.8768E-11	2.06E-10	5.18E-10	0	4.75E-11	0
(w) Trichloroethylene (CHClCl2)	g	2.77E-08	0	3.75E-09	0	0	0	2.7139E-09	5.66E-09	1.43E-08	0	1.31E-09	0
(w) Triethylene Glycol (C6H14O4)	g	0.0341513	0	0.00462133	0	0	0	0.00335234	0.00697991	0.0175851	0	0.00161262	0
(w) Vanadium (V3+, V5+)	g	0.0014948	0	0.000202273	0	2.04E-08	0	0.000146724	0.000305507	0.000769689	0	0.0000706	0
(w) VOC (Volatile Organic Compounds)	g	0.0168782	0	0.00228394	0	0	0	0.00165676	0.00344959	0.00869084	0	0.000796986	0
(w) Water (unspecified)	litre	8.12693	0	1.09973	0	0	0	0.79776068	1.661	4.18469	0	0.383753	0
(w) Water: Chemically Polluted	litre	2655.7	0	0.272997	244.218	0.620979506	0	7.61742378	1.40833	3.94381	2374.79	22.8297	0
(w) Xylene (C6H4(CH3)2)	g	0.0457592	0	0.00619209	0	0	0	0.0044918	0.00935234	0.0235622	0	0.00216075	0
(w) Zinc (Zn++)	g	1.59034	0	0.000250339	0.1436	0.0058496	0	0.000617507	0.00422266	0.0121659	1.39638	0.027257	0
(wr) Radioactive Substance (unspecified)	kBq	5155.36	0	6.54E-08	467.434	28.29828954	0	4.7417E-08	0.85656	2.4983	4545.35	110.927	0
(wr) Radium (Ra224)	kBq	0.0024156	0	0.000326877	0	0	0	0.00023712	0.000493705	0.00124383	0	0.000114065	0
(wr) Radium (Ra226)	kBq	1.85554	0	0.251091	0	0	0	0.18214531	0.379239	0.95545	0	0.0876187	0
(wr) Radium (Ra228)	kBq	0.00483122	0	0.000653756	0	0	0	0.000474241	0.000987413	0.00248767	0	0.00022813	0
(wr) Thorium (Th228)	kBq	0.00966246	0	0.00130752	0	0	0	0.000948494	0.00197483	0.00497536	0	0.000456261	0
_(SE) Electricity	MJ	37.6301	0	0	0	0	0	37.6301	0	0	0	0	0
_(SE) Waste (fuel energy)	MJ	0	0	0	0	0	0	0	0	0	0	0	0
_(SM) ABS	kg	0	0	0	0	0	0	0	0	0	0	0	0
_(SM) Aluminium (sheet)	kg	35.4806	0	0	0	10.4806	0	0	0	0	0	25	0
_(SM) Copper	kg	4.56419	0	0	0	1.2642	0	0	0	0	0	3.29999	0
_(SM) Ferrous (steel plate)	kg	528.339	0	0	48.8437	0	0	0	0	0	474.958	4.53782	0
_(SM) Glass	kg	0.666667	0	0	0	0	0	0.666667	0	0	0	0	0
_(SM) Lead	kg	6.1618	0	0	0	5.91234	0	0	0	0	0	0.249466	0
_(SM) Other Metals	kg	0.521146	0	0	0	0.128322	0	0	0	0	0	0.392823	0
_(SM) Other Plastics	kg	0	0	0	0	0	0	0	0	0	0	0	0
_(SM) PA66	kg	0	0	0	0	0	0	0	0	0	0	0	0
_(SM) PE	kg	0	0	0	0	0	0	0	0	0	0	0	0
_(SM) PP	kg	0	0	0	0	0	0	0	0	0	0	0	0
_(SM) PUR	kg	0	0	0	0	0	0	0	0	0	0	0	0
_(SM) PVC	kg	0	0	0	0	0	0	0	0	0	0	0	0
_(SM) Rubber	kg	3.1	0	0	0	0	0	3.1	0	0	0	0	0
_(SM) Total	kg	579.593	0	0	48.8437	17.982305	0	3.766667	0	0	474.958	34.0425	0
_(SM) Total: Ferrous	kg	528.339	0	0	48.8437	0	0	0	0	0	474.958	4.53782	0
_(SM) Total: Non Ferrous	kg	47.4869	0	0	0	17.982305	0	0	0	0	0	29.5047	0
_(SM) Total: Other	kg	3.76667	0	0	0	0	0	3.766667	0	0	0	0	0
_(SM) Total: Plastics	kg	0	0	0	0	0	0	0	0	0	0	0	0
_(SM) Zinc	kg	0.759251	0	0	0	0.196843	0	0	0	0	0	0.562408	0
_(SP) ABS Product	kg	0.3	0	0	0	0	0.3	0	0	0	0	0	0
_(SP) Aluminium Product (cast)	kg	11.781	0	0	0	11.781	0	0	0	0	0	0	0
_(SP) Coolant	kg	3	0	0	0	0	0	3	0	0	0	0	0
_(SP) Copper Product (wire)	kg	2.193	0	0	0	2.193	0	0	0	0	0	0	0
_(SP) Ferrous Product (cast)	kg	73.976	0	0	73.976	0	0	0	0	0	0	0	0
_(SP) Fluids (unspecified)	kg	3.03282	0	0	0	0	0	3.03282	0	0	0	0	0
_(SP) Glass Product	kg	0	0	0	0	0	0	0	0	0	0	0	0
_(SP) Lead Product	kg	1.89	0	0	0	1.89	0	0	0	0	0	0	0
_(SP) Lubricant	kg	3.57718	0	0	0	0	0	3.57718	0	0	0	0	0
_(SP) Other Materials Product	kg	1.6	0	0	0	0	0	1.6	0	0	0	0	0
_(SP) Other Metals Product	kg	0.204	0	0	0	0.204	0	0	0	0	0	0	0
_(SP) Other Plastics Product	kg	0.5	0	0	0	0	0.5	0	0	0	0	0	0
_(SP) PA66 Product	kg	0.2	0	0	0	0	0.2	0	0	0	0	0	0
_(SP) PE Product	kg	0.2	0	0	0	0	0.2	0	0	0	0	0	0
_(SP) PP Product	kg	1.2	0	0	0	0	1.2	0	0	0	0	0	0
_(SP) PUR Product	kg	0.4	0	0	0	0	0.4	0	0	0	0	0	0
_(SP) PVC Product	kg	0.3	0	0	0	0	0.3	0	0	0	0	0	0
_(SP) Rubber Product (tyre)	kg	18.8	0	0	0	0	0	18.8	0	0	0	0	0
_(SP) Total	kg	123.409	0	0	73.976	16.323	3.1	30.01	0	0	0	0	0
_(SP) Total: Ferrous	kg	73.976	0	0	73.976	0	0	0	0	0	0	0	0
_(SP) Total: Fluids	kg	9.61	0	0	0	0	0	9.61	0	0	0	0	0
_(SP) Total: Non Ferrous	kg	16.323	0	0	0	16.323	0	0	0	0	0	0	0
_(SP) Total: Other	kg	20.4	0	0	0	0	0	20.4	0	0	0	0	0
_(SP) Total: Plastics	kg	3.1	0	0	0	0	3.1	0	0	0	0	0	0
_(SP) Zinc Product (wire)	kg	0.255	0	0	0	0.255	0	0	0	0	0	0	0

	_Recovered Matter: Steel Scrap	kg	17.6195	0	0	1.6265	0	0	0	0.0065736	0.019173	15.8161	0.151109	0
	Aluminium Scrap	kg	0	0	0	0	0	0	0	0	0	0	0	0
	Iron Scrap	kg	0	0	0	0	0	0	0	0	565.2	0	0	0
	Recovered Energy	MJ	0	0	0	0	0	0	0	0	0	0	0	0
	Recovered Matter (total)	kg	76.2636	0	0.00223519	6.60855	1.458184792	0	0.01058783	0.106581	0.309521	64.2618	3.50616	0
	Recovered Matter (unspecified)	kg	56.5072	0	0.00221374	4.98206	0.815409862	0	0.0105723	0.113123	0.328613	48.4457	1.80954	0
	Recovered Matter: Aluminium Scrap	kg	2.11464	0	0	0	0.624641	0	0	0	0	0	1.49	0
	Recovered Matter: Carbon Monoxide (CO)	kg	0.398691	0	0	0	0.1024051	0	0	0	0	0	0.296286	0
	Recovered Matter: Iron Scrap	kg	0.000158522	0	0.0000215	0	0	0	0.000015537	0.0000324	0.0000816	0	0.00000749	0
	Waste (hazardous)	kg	0.0458326	0	0.000192081	0	0.000152507	0	0.044393532	0.000290113	0.000730907	0	0.0000735	0
	Waste (incineration)	kg	0.000548843	0	0.0000743	0	0	0	0.000053873	0.000112174	0.000282608	0	0.0000259	0
	Waste (municipal and industrial)	kg	280.254	0	0.000182498	0	0.103953254	0	0.02424121	0.00027564	0.000694443	0	97.8708	182.254
	Waste (total)	kg	374.318	0.00140124	0.625372	0.500184	5.7294466	0	4.9233603	0.968277	2.45455	4.86381	131.347	222.904
	Waste (unspecified)	kg	75.6865	0.00140124	0.208414	0.00197834	2.54365133	0	0.48015381	0.325171	0.829016	0.0192374	31.8261	39.4513
	Waste: Highly Radioactive (class C)	kg	0.0000171	0	0.00000231	0	0	0	1.6747E-06	0.00000349	0.0000088	0	0.000000807	0
	Waste: Intermediate Radioactive (class B)	kg	0.000130546	0	0.0000177	0	0	0	0.000012813	0.0000267	0.0000672	0	0.00000616	0
	Waste: Low Radioactive (class A)	kBq	0.00169441	0	0.000229286	0	0	0	0.000166327	0.000346306	0.000872478	0	0.00008	0
	Waste: Mineral (inert)	kg	8.87018	0	0.362747	0.498206	0.470201	0	0.2928417	0.561229	1.41925	4.84457	0.421127	0
	Waste: Mining	kg	1.45297	0	0.196614	0	0	0	0.14262733	0.29696	0.748156	0	0.068609	0
	Waste: Non Mineral (inert)	kg	0.44134	0	0.0000156	0	0.422405	0	0.001007802	0.0000236	0.0000594	0	0.0178284	0
	Waste: Non Toxic Chemicals (unspecified)	kg	-0.00477342	0	4.85E-08	0	-0.004581741	0	1.17271E-06	7.33E-08	0.000000185	0	-0.000193157	0
	Waste: Oil (hazardous)	kg	2.3	0	0	0	0	0	0	0	0	0	1.1	1.2
	Waste: Radioactive (unspecified)	kg	0.000047	0	0.00000636	0	0	0	4.6105E-06	0.00000961	0.0000242	0	0.00000222	0
	Waste: Slags and Ash (unspecified)	kg	6.72473	0	0.0536945	0	2.19367148	0	4.080648399	0.0810986	0.204319	0	0.111301	0
	Waste: Treatment	kg	0.0809781	0	0.0109579	0	0	0	0.00794903	0.0165505	0.041697	0	0.00382378	0
Rem.:	E Feedstock Energy	MJ	10011.1	8565	10.6901	103.307	26.530381	0	-19.476668	15.5478	39.3479	1004.56	265.621	0
	E Fuel Energy	MJ	9158.91	42.0617	51.8459	686.144	327.22316	0	312.1402	93.9468	412.713	6672.09	520.617	40.1313
	E Non Renewable Energy	MJ	18827.5	8509.24	62.3642	768.415	349.36945	0	290.18609	109.095	450.912	7472.1	775.676	40.1107
	E Renewable Energy	MJ	342.552	97.8214	0.171129	21.0352	4.3605668	0	2.4911899	0.398502	1.14675	204.547	10.5603	0.0205016
	E Total Primary Energy	MJ	19170	8607.06	62.5354	789.451	353.73015	0	292.67778	109.494	452.059	7676.65	786.236	40.1313
	Electricity	MJ elec	7042.27	0.118731	17.3277	623.901	50.333917	0	25.526306	27.1919	69.3911	6066.84	161.53	0.113214

Table A6 Breakdown of the 1995 ACORD Plan ELV Disposal and Processing Chain

	Flow	Units	ELV	Transport to Dismantler	Dismantler	Ferrous from Dismantler	Non Ferrous from Dismantler	Plastics from Dismantler	Others from Dismantler	Feeder Site	Shredder	Ferrous	Non Ferrous	Fluff
Inputs:	(r) Barium Sulphate (BaSO4, in ground)	kg	0.00569339	0	0.000460924	0	0	0.000197682	0.001250822	0.00064326	0.00162061	0	0.000430815	0.0010893
	(r) Bauxite (Al2O3, ore)	kg	0.00620735	0	0.00000897	0	0.000351395	0.000004292	0.005497219	0.0000125	0.0000315	0	0.000263421	0.0000381
	(r) Bentonite (Al2O3.4SiO2.H2O, in ground)	kg	0.00053782	0	0.0000435	0	0	0.000018714	0.0001181	0.0000608	0.00015309	0	0.0000407	0.0001029
	(r) Chromium (Cr, ore)	kg	0.00000109	0	8.86E-08	0	0	3.799E-08	2.408E-07	1.24E-07	0.000000312	0	8.28E-08	2.09E-07
	(r) Clay (in ground)	kg	0.0094334	0	0.000742603	0	0.000233245	0.000318433	0.002000706	0.00103636	0.002611	0	0.000734702	0.0017564
	(r) Coal (in ground)	kg	118.676	0.00643928	1.15258	9.74446	2.5328368	0.4953622	3.8636122	1.83232	4.72956	85.1575	6.17694	2.98439
	(r) Copper (Cu, ore)	kg	0.00000557	0	0.000000451	0	0	1.9307E-07	0.000001223	6.29E-07	0.00000159	0	0.000000421	1.07E-06
	(r) Dolomite (CaCO3.MgCO3, in ground)	kg	1.83053	0	0	0	0	0	1.83053	0	0	0	0	0
	(r) Feldspar (ore)	kg	0.294976	0	0	0	0	0	0.294976	0	0	0	0	0
	(r) Iron (Fe, ore)	kg	1.56064	0	0.00335064	0	0.562214	0.005788725	0.01027126	0.182197	0.52955	0	0.246098	0.0211732
	(r) Iron Sulphate (FeSO4, ore)	kg	0.00045892	0	0.0000372	0	0	0.000015918	0.0001008	0.0000519	0.000130631	0	0.0000347	0.0000878
	(r) Lead (Pb, ore)	kg	0.00000174	0	0.000000141	0	0	6.029E-08	3.817E-07	1.96E-07	0.000000495	0	0.000000132	3.33E-07
	(r) Lignite (in ground)	kg	149.54	0	0.000730605	15.0588	0.2668439	0.000313258	0.001982659	0.0208272	0.0603409	131.6	2.2365	0.293727
	(r) Limestone (CaCO3, in ground)	kg	17.8008	0	0.193109	0	0.0757349	0.08323588	2.507180239	0.363932	0.954401	0	7.03157	6.59159
	(r) Manganese (Mn, ore)	kg	6.38E-07	0	5.16E-08	0	0	2.21E-08	1.406E-07	7.2E-08	0.000000181	0	4.82E-08	1.22E-07
	(r) Natural Gas (in ground)	kg	67.8478	0.00377585	0.323	5.42705	1.15666753	0.13160843	7.2259548	0.454403	1.16932	47.4273	3.97895	0.549783
	(r) Nickel (Ni, ore)	kg	3.71E-07	0	0.00000003	0	0	1.2878E-08	8.15E-08	4.19E-08	0.000000106	0	0.000000028	7.09E-08
	(r) Oil (in ground)	kg	46.5652	0.974448	0.499557	2.77256	1.1216896	0.03399512	2.081969	0.922681	6.09756	24.2295	6.81671	1.01449
	(r) Pyrite (FeS2, ore)	kg	0.00912524	0	0.000738758	0	0	0.000316843	0.002004793	0.001031	0.00259748	0	0.000690499	0.001746
	(r) Sand (in ground)	kg	4.65865	0	0.000632257	0	0.0706908	0.000271114	4.569189803	0.00088237	0.00222302	0	0.0128992	0.0018679
	(r) Silver (Ag, ore)	kg	2.76E-08	0	2.24E-09	0	0	9.586E-10	6.06E-09	3.12E-09	7.86E-09	0	2.09E-09	5.28E-09
	(r) Sodium Carbonate (Na2CO3, in ground)	kg	1.4456	0	0	0	0.900645	0	0.383401	0	0	0	0.156807	0.0047513
	(r) Sodium Chloride (NaCl, in ground or in sea)	kg	0.643059	0	0.000881337	0	0.004797693	0.000383416	0.62502766	0.00122998	0.00309879	0	0.00330433	0.0043362
	(r) Uranium (U, ore)	kg	0.00798553	0	0.0000288	0.00064	0.000056501	0.000012375	0.00119705	0.0000411	0.000104056	0.005593	0.000229689	0.000083
	(r) Zinc (Zn, ore)	kg	4.05E-08	0	3.28E-09	0	0	1.406E-09	8.89E-09	4.57E-09	1.15E-08	0	3.06E-09	7.74E-09
	_Catalyser (Demetalization)	kg	0.00202678	0	0	0	0.000192282	0	0.001800002	0	0	0	0.0000335	1.01E-06
	_Catalyser (Hydrotreating)	kg	0.00281497	0	0	0	0.000267059	0	0.0025	0	0	0	0.0000465	1.41E-06
	_Catalyser (Unspecified)	kg	0.00000207	0	0	0	0.00000176	0	0	0	0	0	0.000000306	9.26E-09
	_Dewaxing aid	kg	0.00010151	0	0	0	0.0000861	0	0	0	0	0	0.000015	4.54E-07
	_Furfural	kg	0.00023742	0	0	0	0.000201306	0	0	0	0	0	0.000035	1.06E-06
	Adjuvant (unspecified)	kg	-0.00064194	0	0	0	-0.0000471	0	-0.000586363	0	0	0	-0.0000082	-2.49E-07
	Amine (unspecified)	kg	-0.00000181	0	0	0	0.00000223	0	-0.00000443	0	0	0	0.000000388	1.18E-08
	Chlorine (Cl2)	kg	0.0170782	0	0	0	0.00361284	0	0	0	0	0	0.0133875	0.0000779
	Explosive (unspecified)	kg	0.00010406	0	0.00000839	0	0.000000319	0.000003599	0.00002275	0.0000117	0.0000295	0	0.0000079	0.0000198
	Iron Scrap	kg	0.143416	0	0.000285095	0	0.0429075	0.00012227	0.000773669	0.0231953	0.0674948	559.3	0.00773692	0.0009001
	Raw Materials (unspecified)	kg	19.404	0	0.0532465	1.80491	0.18885302	0.02283068	0.195796368	0.0846173	0.217279	15.7732	0.899033	0.164222
	Water Used (total)	litre	7433.16	0.188258	81.4661	699.453	71.40215176	16.06029	193.7519	11.3894	41.2603	6112.57	131.851	73.7701
	Water: Industrial Water	litre	26.3977	0	0	0	0	0	5.76	0	0	0	19.1981	1.43957
	Water: Mine Supply	litre	0.0531101	0	0	0	0.0450321	0	0	0	0	0	0.00784035	0.0002376
	Water: Public Network	litre	6.74593	0	0	0	0.534117	0	5	0	0	0	1.20899	0.0028177
	Water: Unspecified Origin	litre	7313.79	0.188258	5.93405	699.453	70.82265176	16.05938	182.9857	11.3864	30.6342	6112.57	111.434	72.3224
	Water: Urban Supply Network	litre	86.1485	0	75.5299	0	0	0	0	0	10.6185	0	0	0
	Wood (standing)	m3	0.00127394	0	0.00000744	0.000117278	3.17072E-06	0.00000319	0.00002017	0.0000137	0.0000358	0.0010249	0.0000284	0.0000199
Outputs:	(a) Acetaldehyde (CH3CHO)	g	0.00460242	0	0.000372601	0	0	0.00015992	0.001011139	0.00052	0.00131007	0	0.000348262	0.0008806
	(a) Acetic Acid (CH3COOH)	g	0.0388873	0	0.00314823	0	0	0.001349825	0.00854342	0.00439361	0.0110692	0	0.00294257	0.0074404
	(a) Acetone (CH3COCH3)	g	0.00447902	0	0.000362611	0	0	0.00015557	0.000984027	0.00050605	0.00127494	0	0.000338924	0.000857
	(a) Acetylene (C2H2)	g	0.12753	0	0.0103245	0	0	0.00442687	0.02801795	0.0144087	0.0363011	0	0.00965008	0.0244005
	(a) Aldehyde (unspecified)	g	1.42551	0.0359401	0.0159351	0.0558831	0.266125046	0.00015282	0.01091501	0.0299409	0.214419	0.488366	0.275373	0.0324569

	(a) Alkane (unspecified)	g	0.583232	0	0.047209	0	0.000143078	0.02024201	0.1280434	0.0658841	0.165988	0	0.0441501	0.111573
	(a) Alkene (unspecified)	g	0.129302	0	0.0104678	0	0.00000397	0.004488293	0.02840478	0.0146086	0.0368048	0	0.00978465	0.0247391
	(a) Alkyne (unspecified)	g	0.00000929	0	0.000000752	0	0	3.225E-07	0.000002043	0.00000105	0.00000264	0	0.000000703	1.78E-06
	(a) Aluminium (Al)	g	2.63457	0	0.198348	0	0	0.08504612	0.538262	0.276811	0.88195	0	0.185391	0.468767
	(a) Ammonia (NH3)	g	1.69189	0.0179701	0.0119744	0.128513	0.086286223	0.001780075	0.014556292	0.0209306	0.122372	1.12308	0.137322	0.0271047
	(a) Antimony (Sb)	g	0.00047249	0	0.0000383	0	0	0.000016419	0.0001038	0.0000534	0.000134493	0	0.0000358	0.0000904
	(a) AOX (Adsorbable Organic Halogens)	g	3.18E-10	0	1.65E-13	0	1.192E-10	7.085E-14	4.49E-13	2.31E-13	5.81E-13	0	1.96E-10	1.59E-12
	(a) Aromatic Hydrocarbons (unspecified)	g	5.88365	0	0.000360695	0.394756	0.42111003	0.00015473	0.000978829	0.00148068	0.00411866	3.4498	1.59345	0.0174371
	(a) Arsenic (As)	g	0.00514629	0	0.000416632	0	0	0.00017854	0.001130625	0.00058144	0.00146488	0	0.000389416	0.0009847
	(a) Barium (Ba)	g	0.0293737	0	0.00237802	0	0	0.001019598	0.00645331	0.00331873	0.00836116	0	0.00222268	0.0056201
	(a) Benzaldehyde (C6H5CHO)	g	1.68E-09	0	1.36E-10	0	0	5.82E-11	3.681E-10	1.89E-10	4.77E-10	0	1.27E-10	3.21E-10
	(a) Benzene (C6H6)	g	0.765586	0	0.0190803	0.0518992	0.00371324	0.008181141	0.051777366	0.0270524	0.0683239	0.45355	0.0358487	0.0461601
	(a) Benzo(a)pyrene (C20H12)	g	0.00039555	0	0.000032	0	0	0.000013745	0.0000869	0.0000447	0.000112594	0	0.0000299	0.0000757
	(a) Berylium (Be)	g	0.000481	0	0.0000389	0	0	0.00001669	0.0001057	0.0000543	0.000136916	0	0.0000364	0.000092
	(a) Boron (B)	g	0.232712	0	0.0188399	0	0	0.008078022	0.0511262	0.0262926	0.0662412	0	0.0176092	0.0445254
	(a) Bromium (Br)	g	0.0465234	0	0.00376643	0	0	0.001614907	0.01022106	0.00525637	0.0132428	0	0.00352039	0.0089014
	(a) Butane (n-C4H10)	g	0.242599	0	0.0196402	0	0	0.008421208	0.0532983	0.0274096	0.0690553	0	0.0183573	0.0464169
	(a) Butene (1-CH3CH2CHCH2)	g	0.00153382	0	0.000124175	0	0	0.00005321	0.000336928	0.0001733	0.000436599	0	0.000116063	0.0002935
	(a) Cadmium (Cd)	g	0.0300894	0	0.000105589	0.000376471	2.92009E-05	0.00004526	0.025150555	0.00016735	0.000429568	0.00329	0.000238076	0.0002573
	(a) Calcium (Ca)	g	0.297145	0	0.0240562	0	0	0.010314648	0.065282	0.0335724	0.0845819	0	0.0224847	0.0568534
	(a) Carbon Dioxide (CO2, biomass)	g	6983.59	0	0	0	0	0	0	0	0	0	2901.1	4082.49
	(a) Carbon Dioxide (CO2, fossil)	g	1150000	3345.21	4265.94	67264.4	14948.092	1212.3633	39106.34	7273.76	31502.5	587828	188082	202917
	(a) Carbon Monoxide (CO)	g	3175.52	18.184	10.7444	250.758	10.5135434	1.2146088	17.196144	22.3439	128.039	2191.39	380.578	144.557
	(a) Carbon Tetrafluoride (CF4)	g	0.00000135	0	0.000000109	0	0	4.674E-08	2.963E-07	1.52E-07	0.000000384	0	0.000000102	2.58E-07
	(a) Chlorides (Cl-)	g	0.00000112	0	9.04E-08	0	0	3.875E-08	0.000000245	1.26E-07	0.000000318	0	8.45E-08	2.14E-07
	(a) Chlorine (Cl2)	g	0.00000129	0	0.000000104	0	0	4.465E-08	2.827E-07	1.45E-07	0.000000366	0	9.73E-08	2.46E-07
	(a) Chromium (Cr III, Cr VI)	g	0.00624482	0	0.000505566	0	0	0.000216816	0.001371973	0.00070556	0.00177758	0	0.000472541	0.0011948
	(a) Chromium (Cr)	g	0.100661	0	0	0.0102185	0	0	0	0.0000262	0.0000763	0.0893	0.000846218	0.0001942
	(a) Cobalt (Co)	g	0.00176675	0	0.000143032	0	0	0.00006135	0.00038815	0.00019961	0.000502902	0	0.000133688	0.000338
	(a) Copper (Cu)	g	0.303386	0	0.000417433	0.0285042	0	0.00017885	0.001132799	0.00063115	0.0191423	0.2491	0.00275067	0.0015284
	(a) Cyanide (CN-)	g	0.00064693	0	0.0000524	0	0	0.00002244	0.000142134	0.0000731	0.000184147	0	0.000049	0.0001238
	(a) Dioxins (unspecified)	g	4.72E-09	0	3.82E-10	0	0	1.6377E-10	1.037E-09	5.33E-10	1.34E-09	0	3.57E-10	9.03E-10
	(a) Ethane (C2H6)	g	1.95425	0	0.158212	0	0	0.06783696	0.429344	0.220798	0.556275	0	0.147877	0.373911
	(a) Ethanol (C2H5OH)	g	0.00892436	0	0.000722495	0	0	0.000309783	0.001960655	0.0010083	0.0025403	0	0.000675299	0.0017075
	(a) Ethylbenzene (C8H10)	g	0.00153429	0	0.000124168	0	0.000000795	0.00005321	0.00033653	0.00017329	0.000436575	0	0.000116195	0.0002935
	(a) Ethylene (C2H4)	g	2.76097	0	0.223521	0	0	0.09583991	0.606576	0.311943	0.785904	0	0.20892	0.528261
	(a) Fluorides (F-)	g	0.00019473	0	0.00000088	0	8.61815E-05	4.081E-07	0.00004663	0.00000123	0.0000031	0	0.0000521	4.21E-06
	(a) Fluorine (F2)	g	0.00000545	0	0.000000441	0	0	1.8916E-07	0.000001197	6.16E-07	0.00000155	0	0.000000412	1.04E-06
	(a) Formaldehyde (CH2O)	g	0.0460134	0	0.00372514	0	0	0.001597201	0.01010901	0.00519874	0.0130976	0	0.00348179	0.0088038
	(a) Halogenated Matter (unspecified)	g	0.00016213	0	2.17E-15	0.0000161	6.93023E-07	9.311E-16	5.9E-15	1.87E-08	5.45E-08	0.000141	0.0000039	3.22E-07
	(a) Halon 1301 (CF3Br)	g	0.00343902	0	0.000014	0.000301176	6.06009E-05	0.000006023	0.00003815	0.0000235	0.0000607	0.002632	0.000262655	0.0000402
	(a) Heptane (C7H16)	g	0.0151338	0	0.00122519	0	0	0.000525436	0.003324847	0.00170986	0.0043078	0	0.00114516	0.0028956
	(a) Hexane (C6H14)	g	0.0302814	0	0.00245151	0	0	0.001051041	0.00665273	0.00342129	0.00861954	0	0.00229137	0.0057938
	(a) Hydrocarbons (except methane)	g	782.673	14.4402	7.33679	34.2708	62.309923	0.5000519	112.399518	13.6025	90.3293	299.495	137.402	10.5867
	(a) Hydrocarbons (unspecified)	g	51.579	0	0.0316064	0	-4.157206745	0.024758789	17.0268503	0.0147665	0.0372026	0	35.7928	2.80825
	(a) Hydrogen (H2)	g	0.0872916	0	4.46E-08	0	0	1.9107E-08	0.087291089	6.22E-08	0.000000157	0	4.17E-08	1.05E-07

(a) Hydrogen Chloride (HCl)	g	89.1731	0	0.944327	7.09916	0.22313444	0.404947	5.3818612	1.33401	3.3673	62.04	3.70352	4.67485
(a) Hydrogen Fluoride (HF)	g	8.93095	0	0.0343066	0.817479	0.096316449	0.014712286	0.0930988	0.0499332	0.126618	7.144	0.455787	0.098696
(a) Hydrogen Sulphide (H2S)	g	0.380322	0	0.0303723	0	-0.00509672	0.013034051	0.086309085	0.044237	0.112185	0	0.0275008	0.0717803
(a) Iodine (I)	g	0.0116296	0	0.000941509	0	0	0.000403631	0.002555004	0.00131395	0.00331036	0	0.000880006	0.0022251
(a) Iron (Fe)	g	1.75395	0	0.0799892	0	0	0.03429718	0.2170692	0.111632	1.04715	0	0.074764	0.189043
(a) Ketone (unspecified)	g	0.411454	0	0	0	0.348873	0	0	0	0	0	0.0607407	0.0018404
(a) Lanthanum (La)	g	0.00077206	0	0.0000625	0	0	0.00002683	0.000169651	0.0000872	0.000219766	0	0.0000584	0.0001477
(a) Lead (Pb)	g	5.23032	0	0.00170739	0.509311	0.112802754	0.000732148	0.0046334	0.00323865	0.0684804	4.4509	0.0641995	0.0143151
(a) Magnesium (Mg)	g	0.858465	0	0.0694993	0	0	0.02979949	0.1886026	0.0969921	0.24436	0	0.0649593	0.164252
(a) Manganese (Mn)	g	1.88122	0	0.000481918	0.190387	8.89052E-05	0.000206547	0.001307796	0.0009977	0.00264277	1.6638	0.0165464	0.0047598
(a) Mercury (Hg)	g	0.0404822	0	0.0000598	0.00147899	6.63419E-05	0.0000256	0.025026337	0.0000864	0.000218831	0.012925	0.00042399	0.0001709
(a) Metals (unspecified)	g	19.8263	0	0.0000024	1.90387	0.04903208	6.6532E-06	0.83114534	0.00476838	0.0139065	16.638	0.348276	0.0373146
(a) Methane (CH4)	g	1288.16	0.611838	9.96881	108.947	7.8729204	4.161423	61.4326128	16.1185	43.7992	952.099	54.0899	29.0572
(a) Methanol (CH3OH)	g	0.0151615	0	0.00122744	0	0	0.000526255	0.003330937	0.00171299	0.00431569	0	0.00114726	0.0029009
(a) Molybdenum (Mo)	g	0.00145058	0	0.000117435	0	0	0.00005039	0.000318713	0.00016389	0.000412904	0	0.000109764	0.0002775
(a) Nickel (Ni)	g	0.172272	0	0.00204174	0.014037	0.001613627	0.000875468	0.00554072	0.0031783	0.00813801	0.12267	0.00904998	0.005127
(a) Nitrogen Oxides (NOx as NO2)	g	3423.95	46.6366	26.0441	156.276	30.894456	2.466156	101.22679	47.1681	299.513	1365.7	591.982	756.038
(a) Nitrous Oxide (N2O)	g	37.7851	1.57238	0.72042	1.36491	2.1277476	0.016223222	1.620796	1.34575	9.46478	11.9281	6.30417	1.31985
(a) Organic Matter (unspecified)	g	1.8062	0.0539102	0.0240172	0.0838246	0.10800654	0.000289799	0.01343659	0.0450714	0.322032	0.732548	0.375354	0.0477105
(a) Particulates (unspecified)	g	2362.68	3.78655	16.5041	66.3061	16.9349987	6.437276	238.586782	30.903	110.596	579.453	652.032	641.137
(a) Pentane (C5H12)	g	0.244053	0	0.019758	0	0	0.008471696	0.0536178	0.0275739	0.0694693	0	0.0184673	0.0466952
(a) Phenol (C6H5OH)	g	1.29E-08	0	1.04E-09	0	0	4.466E-10	2.828E-09	1.45E-09	3.66E-09	0	9.73E-10	2.46E-09
(a) Phosphorus (P)	g	0.0216531	0	0.00175299	0	0	0.000751591	0.00475713	0.00244644	0.00616352	0	0.00163847	0.0041429
(a) Phosphorus Pentoxide (P2O5)	g	0.0000147	0	0.00000119	0	0	5.098E-07	0.000003222	0.00000166	0.00000418	0	0.00000111	2.81E-06
(a) Polycyclic Aromatic Hydrocarbons (PAH, unspecified)	g	0.0144536	0	0.000115273	0.00130151	0.000042733	0.00004948	0.000312777	0.00016605	0.0004204	0.011374	0.000373218	0.0002981
(a) Potassium (K)	g	0.296594	0	0.0240116	0	0	0.010295519	0.065161	0.0335102	0.084425	0	0.022443	0.056748
(a) Propane (C3H8)	g	0.659801	0	0.054956	0	0.0370986	0.02356367	0.0863594	0.0766957	0.193226	0	0.0578251	0.130076
(a) Propionaldehyde (CH3CH2CHO)	g	4.61E-09	0	3.74E-10	0	0	1.6017E-10	1.014E-09	5.21E-10	1.31E-09	0	3.49E-10	8.83E-10
(a) Propylene (CH2CHCH3)	g	0.14205	0	0.0115001	0	0	0.004930906	0.03120803	0.0160493	0.0404343	0	0.0107488	0.0271787
(a) Scandium (Sc)	g	0.00026195	0	0.0000212	0	0	0.00000909	0.0000575	0.0000296	0.0000746	0	0.0000198	0.0000501
(a) Selenium (Se)	g	0.00507551	0	0.000410902	0	0	0.00017621	0.001115075	0.00057345	0.00144474	0	0.00038406	0.0009711
(a) Silicon (Si)	g	3.67095	0	0.297192	0	0	0.12742765	0.806497	0.414756	1.04493	0	0.277778	0.70237
(a) Sodium (Na)	g	0.170314	0	0.0137882	0	0	0.005912014	0.03741745	0.0192426	0.0484795	0	0.0128875	0.0325865
(a) Sodium Sulphate (Na2SO4)	g	0.00326409	0	0	0	0	0	0.00326409	0	0	0	0	0
(a) Strontium (Sr)	g	0.0479386	0	0.003881	0	0	0.001664063	0.01053197	0.00541625	0.0136456	0	0.00362747	0.0091722
(a) Sulphur Oxides (SOx as SO2)	g	3012.66	7.07037	15.9897	216.093	74.51283	5.56852	131.29573	24.9986	90.7533	1888.45	499.962	57.9715
(a) Tars (unspecified)	g	0.00021184	0	5.56E-08	0	0.000179038	2.388E-08	1.504E-07	7.76E-08	0.000000195	0	0.0000312	1.08E-06
(a) Thallium (Tl)	g	0.00026896	0	0.0000194	0	0	0.000008323	0.0000526	0.0000346	0.00009	0	0.0000181	0.0000459
(a) Thorium (Th)	g	0.00049406	0	0.00004	0	0	0.000017139	0.0001085	0.0000558	0.000140633	0	0.0000374	0.0000945
(a) Tin (Sn)	g	0.00015441	0	0.0000125	0	0	0.000005358	0.00003395	0.0000174	0.000044	0	0.0000117	0.0000295
(a) Titanium (Ti)	g	0.0858325	0	0.00694881	0	0	0.002979455	0.01885716	0.00969763	0.0244321	0	0.00649488	0.0164225
(a) Toluene (C6H5CH3)	g	0.0728973	0	0.00590133	0	0.00000486	0.002530333	0.01601223	0.00823579	0.0207491	0	0.00551667	0.013947
(a) Uranium (U)	g	0.00047937	0	0.0000388	0	0	0.000016644	0.0001053	0.0000542	0.000136452	0	0.0000363	0.0000917
(a) Vanadium (V)	g	0.0908426	0	0.00735382	0	0	0.003153121	0.01995622	0.0102647	0.0258615	0	0.00687343	0.0173797
(a) VOC (Volatile Organic Compounds)	g	187.661	0	0	0	0	0	2.48832	0	185.172	0	0	0
(a) Water Vapour (H2O)	g	46651.3	0	0	0	0	0	7862.4	0	10618.5	0	26205.4	1965.02
(a) Xylene (C6H4(CH3)2)	g	0.0293589	0	0.00237665	0	0.00000318	0.001019219	0.006448046	0.00331681	0.00835632	0	0.00222195	0.0056169
(a) Zinc (Zn)	g	0.507818	0	0.001313	0.0103261	0.000469139	0.00056314	0.003563113	0.0018821	0.392331	0.09024	0.0038207	0.0033095
(a) Zirconium (Zr)	g	0.00036714	0	0.0000297	0	0	0.000012747	0.0000807	0.0000415	0.000104505	0	0.0000278	0.0000702
(ar) Lead (Pb210)	kBq	0.011198	0	0.000906561	0	0	0.000388549	0.002460161	0.00126518	0.00318748	0	0.00084734	0.0021425
(ar) Radioactive Substance (unspecified)	kBq	561671	0	0.00000722	55932.8	2306.316522	0.000003096	0.00001961	87.0786	253.979	488800	13177.8	1112.93
(ar) Radium (Ra226)	kBq	0.0089592	0	0.000725316	0	0	0.000311035	0.001968313	0.00101224	0.00255022	0	0.000677936	0.0017142
(ar) Radon (Rn222)	kBq	0.106469	0	0.0086195	0	0	0.003695804	0.02339095	0.0120292	0.0303063	0	0.00805644	0.020371
(s) Aluminium (Al)	g	0.0726774	0	0.0058838	0	0	0.00252281	0.01596706	0.00821133	0.0206875	0	0.00549944	0.0139055
(s) Arsenic (As)	g	0.000029	0	0.00000235	0	0	1.0082E-06	0.00000637	0.00000328	0.00000827	0	0.0000022	5.56E-06
(s) Cadmium (Cd)	g	1.31E-08	0	1.06E-09	0	0	4.56E-10	2.883E-09	1.48E-09	3.74E-09	0	9.94E-10	2.51E-09

(s) Calcium (Ca)	g	0.290363	0	0.0235071	0	0	0.010079203	0.0637918	0.0328061	0.0826512	0	0.0219715	0.0555557
(s) Carbon (C)	g	0.21794	0	0.017644	0	0	0.007565252	0.0478809	0.0246236	0.0620364	0	0.0164914	0.041699
(s) Chromium (Cr III, Cr VI)	g	0.00036351	0	0.0000294	0	0	0.000012614	0.0000798	0.0000411	0.000103474	0	0.0000275	0.0000696
(s) Cobalt (Co)	g	1.33E-08	0	1.08E-09	0	0	4.619E-10	2.924E-09	1.51E-09	3.79E-09	0	1.01E-09	2.55E-09
(s) Copper (Cu)	g	6.67E-08	0	5.4E-09	0	0	2.316E-09	1.462E-08	7.54E-09	0.000000019	0	5.05E-09	1.28E-08
(s) Iron (Fe)	g	0.145142	0	0.0117503	0	0	0.005038219	0.03188719	0.0163986	0.0413143	0	0.0109827	0.0277702
(s) Lead (Pb)	g	3.05E-07	0	2.47E-08	0	0	1.0584E-08	0.000000067	3.45E-08	8.68E-08	0	2.31E-08	5.83E-08
(s) Manganese (Mn)	g	0.00290363	0	0.000235071	0	0	0.00010082	0.000637918	0.00032806	0.000826512	0	0.000219715	0.0005556
(s) Mercury (Hg)	g	2.42E-09	0	1.96E-10	0	0	8.398E-11	5.32E-10	2.73E-10	6.89E-10	0	1.83E-10	4.63E-10
(s) Nickel (Ni)	g	0.0000001	0	8.11E-09	0	0	3.471E-09	2.204E-08	1.13E-08	2.85E-08	0	7.58E-09	1.92E-08
(s) Nitrogen (N)	g	0.00000114	0	9.21E-08	0	0	3.949E-08	2.502E-07	1.29E-07	0.000000324	0	8.61E-08	2.18E-07
(s) Oils (unspecified)	g	0.00043116	0	0.0000349	0	0	0.000014958	0.0000947	0.0000487	0.00012273	0	0.0000326	0.0000825
(s) Phosphorus (P)	g	0.00363551	0	0.000294322	0	0	0.00012615	0.000798711	0.00041075	0.00103484	0	0.000275096	0.0006956
(s) Sulphur (S)	g	0.0435565	0	0.00352624	0	0	0.001512003	0.00956924	0.00492116	0.0123983	0	0.00329589	0.0083338
(s) Zinc (Zn)	g	0.00109124	0	0.0000883	0	0	0.00003786	0.000239771	0.00012329	0.000310619	0	0.0000826	0.0002088
(w) Acids (H+)	g	0.549423	0	0.000380144	0	0.010031625	0.000264361	0.51167215	0.00053052	0.00133659	0	0.0216514	0.003557
(w) Alcohol (unspecified)	g	0.00065592	0	0.0000531	0	0	0.00002279	0.000144093	0.0000741	0.000186706	0	0.0000496	0.0001255
(w) Alkane (unspecified)	g	0.0114615	0	0.0009279	0	0	0.000397784	0.002518065	0.00129496	0.00326251	0	0.000867285	0.002193
(w) Alkene (unspecified)	g	0.001057	0	0.0000856	0	0	0.0000367	0.000232213	0.00011942	0.000300874	0	0.00008	0.0002022
(w) Aluminium (Al3+)	g	158.673	0	0.0147225	15.758	0.4259317	0.006312624	0.039952855	0.379325	1.0982	137.71	2.89679	0.343514
(w) Aluminium Hydroxide (Al(OH)3)	g	0.0000115	0	0.000000928	0	0	3.983E-07	0.000002517	0.0000013	0.00000326	0	0.000000867	2.19E-06
(w) Ammonia (NH4+, NH3, as N)	g	2.25772	0	0.0156496	0.186144	0.017346594	0.006746478	0.19904317	0.0229944	0.0583901	1.62672	0.0836184	0.0410612
(w) AOX (Adsorbable Organic Halogens)	g	0.00306918	0	0.0000125	0.000236639	4.41927E-05	0.000005358	3.39053E-05	0.00011386	0.000325171	0.002068	0.000194627	0.000035
(w) Aromatic Hydrocarbons (unspecified)	g	0.755053	0	0.00395322	0.0656134	0.01220161	0.001695012	0.01072797	0.00624582	0.0160252	0.5734	0.0543378	0.0108532
(w) Arsenic (As3+, As5+)	g	0.318337	0	0.000021	0.0316235	0.000858178	0.000008995	5.69913E-05	0.00074871	0.00217211	0.27636	0.00581791	0.0006692
(w) Barium (Ba++)	g	14.4541	0	0.017098	1.4037	0.06526049	0.007331155	0.046399213	0.0546942	0.150045	12.267	0.374029	0.0684981
(w) Barytes	g	1.02996	0	0.0833831	0	0	0.03575244	0.2262789	0.116368	0.293176	0	0.0779361	0.197064
(w) Benzene (C6H6)	g	0.0114677	0	0.000928399	0	1.81E-09	0.000398099	0.002519417	0.00129566	0.00326426	0	0.000867752	0.0021941
(w) BOD5 (Biochemical Oxygen Demand)	g	90.8389	0.00539102	0.00295971	9.15124	0.037471748	0.000348802	0.52749112	0.0370527	0.126819	79.9733	0.796752	0.180128
(w) Boric Acid (H3BO3)	g	0.0133531	0	0.00108104	0	0	0.000463498	0.002933647	0.00150868	0.00380094	0	0.00101042	0.0025549
(w) Boron (B III)	g	0.00143139	0	0.000115842	0	0.000000707	0.00004969	0.000313977	0.00016167	0.000407303	0	0.000108398	0.0002738
(w) Cadmium (Cd++)	g	0.00936426	0	0.00000501	0.000919664	0.000037415	0.000002151	0.000014513	0.0000261	0.0000732	0.008037	0.000219123	0.0000301
(w) Calcium (Ca++)	g	11.9532	0	0.240733	0	0.0000927	0.10321976	0.6532393	0.335963	0.846419	0	3.95512	5.81838
(w) Carbonates (CO3--, HCO3-, CO2, as C)	g	0.0118065	0	0.000955827	0	0	0.000409842	0.002593854	0.00133394	0.0033607	0	0.000893388	0.002259
(w) Cesium (Cs++)	g	0.0000818	0	0.00000662	0	0	0.000002838	0.00001799	0.00000925	0.0000233	0	0.00000619	0.0000157
(w) Chlorides (Cl-)	g	4194.15	0	13.4229	267.832	9.505952915	5.756264	69.03227	21.3862	54.9343	2340.6	456.078	955.602
(w) Chlorinated Matter (unspecified, as Cl)	g	0.430093	0	0.0132579	0.0270521	2.31099E-05	0.005684627	0.03597834	0.0185036	0.0466181	0.23641	0.0147178	0.0318479
(w) Chloroform (CHCl3)	g	1.76E-07	0	1.42E-08	0	0	6.099E-09	3.86E-08	1.98E-08	0.00000005	0	1.33E-08	3.36E-08
(w) Chromium (Cr III)	g	0.00076313	0	0.0000618	0	0	0.00002649	0.000167701	0.0000862	0.000217225	0	0.0000577	0.000146
(w) Chromium (Cr III, Cr VI)	g	3.70616	0	0.0000422	0.372706	0.00439468	0.000018116	0.0002018	0.00441288	0.0128475	3.2571	0.0471532	0.007279
(w) Chromium (Cr VI)	g	1.43E-08	0	1.16E-09	0	0	4.973E-10	3.152E-09	1.62E-09	4.08E-09	0	1.08E-09	2.74E-09
(w) Cobalt (Co I, Co II, Co III)	g	0.0000471	0	0.00000382	0	0	1.6353E-06	0.00001035	0.00000532	0.0000134	0	0.00000357	9.02E-06
(w) COD (Chemical Oxygen Demand)	g	251.513	0.0161517	0.0149739	24.8722	0.01961779	0.003864501	6.0147981	0.111241	0.377328	217.36	2.21673	0.506416
(w) Copper (Cu+, Cu++)	g	0.943848	0	0.000029	0.0941176	0.00214116	0.000012432	0.000296591	0.00183621	0.00533954	0.8225	0.0156718	0.0019033
(w) Cyanides (CN-)	g	0.0239217	0	0.00150637	0.000500168	0.0001103	0.00064616	0.004087835	0.00210776	0.00531244	0.004371	0.00170748	0.0035721
(w) Dissolved Matter (unspecified)	g	378.133	11.3383	5.76262	17.6998	14.48939	0.3428676	14.6366	10.4403	70.4485	154.679	66.9582	11.3375
(w) Dissolved Organic Carbon (DOC)	g	1.08279	0	0.00469172	0.0984202	0.01165284	0.002011686	0.01273204	0.00685974	0.0174063	0.8601	0.0557082	0.0132103
(w) Edetic Acid (C10H16N2O8, EDTA)	g	0.0000227	0	0.00000183	0	0	7.865E-07	0.00000498	0.00000256	0.00000645	0	0.00000171	4.34E-06
(w) Ethylbenzene (C6H5C2H5)	g	0.00198011	0	0.000160305	0	0	0.00006876	0.000435025	0.00022372	0.000563635	0	0.000149833	0.0003789
(w) Fluorides (F-)	g	0.066775	0	0.00315025	0	0.010219312	0.001401732	0.01696911	0.00439643	0.0110763	0	0.0116375	0.0079243
(w) Formaldehyde (CH2O)	g	2.23E-09	0	1.8E-10	0	0	7.731E-11	4.89E-10	2.52E-10	6.34E-10	0	1.68E-10	4.26E-10

(w) Halogenous Matter (organic)	g	6.7E-10	0	0	0	5.68E-10	0	0	0	0	0	9.89E-11	3E-12
(w) Hexachloroethane (C2Cl6)	g	3.1E-13	0	2.51E-14	0	0	1.0755E-14	6.81E-14	3.5E-14	8.82E-14	0	2.34E-14	5.93E-14
(w) Hydrazine (N2H4)	g	0.0000104	0	0.000000843	0	0	3.616E-07	0.000002287	0.00000118	0.00000296	0	0.000000788	1.99E-06
(w) Hydrocarbons (unspecified)	g	0.714161	0	0.00000557	0	-0.1395719	0.000339993	0.87498276	0.00000778	0.0000196	0	-0.0218719	0.0002492
(w) Inorganic Dissolved Matter (unspecified)	g	36.0196	0	0.000103946	0	7.560415275	0.000269594	0.052673174	0.00014507	0.000365476	0	28.2395	0.166082
(w) Iodine (I-)	g	0.00820331	0	0.000664121	0	0	0.000284783	0.001802241	0.00092684	0.00233506	0	0.000620738	0.0015696
(w) Iron (Fe++, Fe3+)	g	309.863	0	0.0163876	31.1395	0.558957528	0.007026579	0.044923419	0.170493	0.488185	272.13	4.66496	0.642698
(w) Lead (Pb++, Pb4+)	g	0.954704	0	0.000590063	0.0914286	0.02509191	0.000253057	0.001688468	0.00264354	0.00738316	0.799	0.0222869	0.0043383
(w) Lithium Salts (Lithine)	g	0.00000116	0	9.42E-08	0	0	4.042E-08	2.557E-07	1.31E-07	0.000000331	0	8.81E-08	2.23E-07
(w) Magnesium (Mg++)	g	0.139207	0	0.0112679	0	0.0000362	0.004831356	0.0305604	0.0157252	0.0396179	0	0.0105381	0.0266302
(w) Manganese (Mn II, Mn IV, Mn VII)	g	0.0335894	0	0.0027193	0	0.000000362	0.001165961	0.007379265	0.00379501	0.00956109	0	0.00254173	0.0064267
(w) Mercury (Hg+, Hg++)	g	0.00839048	0	3.26E-08	0.000849748	3.3555E-06	1.3967E-08	9.604E-07	0.00000296	0.00000862	0.007426	0.0000825	0.0000163
(w) Metals (unspecified)	g	25.8505	0	0.0000941	2.02218	-0.0222089	0.000377992	5.37269742	0.041802	0.12187	17.672	0.599928	0.0417786
(w) Methane (CH4)	g	0.0305807	0	0.00247574	0	0	0.001061517	0.00671849	0.0034551	0.00870473	0	0.00231401	0.0058511
(w) Methylene Chloride (CH2Cl2)	g	0.00050338	0	0.0000408	0	0	0.000017453	0.0001106	0.0000569	0.000143287	0	0.0000381	0.0000963
(w) Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	g	0.00076871	0	0.0000622	0	1.81E-08	0.00002669	0.000168895	0.0000868	0.000218808	0	0.0000582	0.0001471
(w) Morpholine (C4H9NO)	g	0.00011026	0	0.00000893	0	0	0.000003823	0.00002422	0.0000125	0.0000314	0	0.00000834	0.0000211
(w) Nickel (Ni++, Ni3+)	g	0.955757	0	0.000116391	0.0951933	0.00218052	0.00004989	0.00053381	0.00197315	0.00569048	0.8319	0.0159885	0.0021312
(w) Nitrate (NO3-)	g	4.21224	0	0.00225314	0.416807	0.00894006	0.000989758	0.008073739	0.00427311	0.011214	3.6425	0.103468	0.0137171
(w) Nitrite (NO2-)	g	0.0000131	0	0.00000106	0	0	4.544E-07	0.000002881	0.00000148	0.00000373	0	0.000000991	0.0000025
(w) Nitrogenous Matter (Kjeldahl, as N)	g	0.00463954	0	0.000375607	0	0	0.00016117	0.001019294	0.00052419	0.00132064	0	0.00035107	0.0008877
(w) Nitrogenous Matter (unspecified, as N)	g	1.45111	0	0.00374391	0.113479	0.026266	0.00161654	0.21828159	0.00625643	0.0161721	0.9917	0.0622219	0.0113769
(w) Oils (unspecified)	g	26.2286	0.146542	0.0822787	2.15319	0.57086866	0.009766867	0.65263961	0.1687	1.00028	18.8169	2.42229	0.205198
(w) Organic Dissolved Matter (unspecified)	g	0.0441544	0	0.0000587	0	0.0152747	0.000059	0.015070281	0.0000819	0.000206233	0	0.0124072	0.0009966
(w) Oxalic Acid ((COOH)2)	g	0.0000453	0	0.00000367	0	0	1.5727E-06	0.00000996	0.00000512	0.0000129	0	0.00000343	8.67E-06
(w) Phenol (C6H5OH)	g	0.14142	0	0.000875193	0.00968067	0.00496112	0.000376295	0.024236655	0.00134193	0.00342872	0.0846	0.00959157	0.0023282
(w) Phosphates (PO4 3-, HPO4--, H2PO4-, H3PO4, as P)	g	8.46806	0	0.0000457	0.849408	-0.00198283	0.000042101	0.0469151	0.00896641	0.0261267	7.42303	0.0990722	0.0164307
(w) Phosphorous Matter (unspecified, as P)	g	0.00049214	0	0	0	0.0000477	0	0.000435912	0	0	0	0.0000083	2.52E-07
(w) Phosphorus (P)	g	0.00036096	0	0.0000292	0	0	0.000012539	0.0000793	0.0000408	0.000102747	0	0.0000273	0.0000691
(w) Phosphorus Pentoxide (P2O5)	g	0.00043781	0	0.0000354	0	0	0.000015197	0.0000962	0.0000495	0.000124623	0	0.0000331	0.0000838
(w) Polycyclic Aromatic Hydrocarbons (PAH, unspecified)	g	0.0101305	0	0.000098	0.000822857	0.000165297	0.00004205	0.000265861	0.00014731	0.00037534	0.007191	0.000772208	0.0002507
(w) Potassium (K+)	g	0.38367	0	0.03106	0	0.0000181	0.013317704	0.08427976	0.0433468	0.109207	0	0.0290342	0.0734061
(w) Rubidium (Rb+)	g	0.00081983	0	0.0000664	0	0	0.00002842	0.000180105	0.0000926	0.000233362	0	0.000062	0.0001569
(w) Salts (unspecified)	g	1307.97	0	0.0220389	132.303	0	0.009449662	0.0598075	1.49203	4.33955	1156.2	10.9769	2.56696
(w) Saponifiable Oils and Fats	g	0.400078	0	0.0323894	0	0	0.013887701	0.0878962	0.0452021	0.113882	0	0.0302736	0.0765479
(w) Selenium (Se II, Se IV, Se VI)	g	0.00067418	0	0.0000546	0	1.81E-08	0.00002339	0.000148147	0.0000762	0.000191899	0	0.000051	0.000129
(w) Silicon Dioxide (SiO2)	g	0.00018057	0	0.0000146	0	0	0.000006267	0.0000397	0.0000204	0.0000514	0	0.0000137	0.0000345
(w) Silver (Ag+)	g	0.0000492	0	0.00000398	0	0	0.000001708	0.00001081	0.00000556	0.000014	0	0.00000372	9.41E-06
(w) Sodium (Na+)	g	762.733	0	2.71776	0	0.050232791	1.1653005	11.704548	3.79286	9.55567	0	215.937	517.809
(w) Strontium (Sr II)	g	0.541066	0	0.0438034	0	0.00000128	0.018781752	0.118869882	0.0611313	0.154013	0	0.0409422	0.103523
(w) Sulphate (SO4--)	g	1689.94	0	2.13198	165.647	4.8581997	0.9141349	9.90395	4.64778	12.374	1447.6	33.5522	8.30597
(w) Sulphide (S--)	g	0.0259021	0	0.000109881	0.00217815	0.000586065	0.00004776	0.001169821	0.00017914	0.000461556	0.019035	0.00182228	0.0003124
(w) Sulphite (SO3--)	g	0.0000273	0	0.00000221	0	0	9.489E-07	0.00000601	0.00000309	0.00000778	0	0.00000207	5.23E-06
(w) Sulphurated Matter (unspecified, as S)	g	0.00000265	0	4.34E-08	0	0.00000202	1.8582E-08	-1.481E-07	6.06E-08	0.000000153	0	0.000000392	1.13E-07
(w) Suspended Matter (organic)	g	-0.156356	0	0	0	-0.119169	0.000281334	-0.01675733	0	0	0	-0.0207479	0.0000363
(w) Suspended Matter (unspecified)	g	135.414	0.00539102	0.365838	12.0017	1.591817748	0.15720456	2.4935801	0.585381	1.52491	104.883	8.68531	3.11955
(w) Tars (unspecified)	g	0.00000303	0	7.94E-10	0	0.00000256	3.409E-10	2.152E-09	1.11E-09	2.79E-09	0	0.000000446	1.54E-08
(w) Tetrachloroethylene (C2Cl4)	g	7.57E-10	0	6.13E-11	0	0	2.63E-11	1.664E-10	8.56E-11	2.16E-10	0	5.73E-11	1.45E-10
(w) Tin (Sn++, Sn4+)	g	0.0000025	0	0.000000203	0	0	8.694E-08	0.000000551	2.83E-07	0.000000713	0	0.0000019	4.79E-07
(w) Titanium (Ti3+, Ti4+)	g	0.00228828	0	0.000185254	0	0	0.00007939	0.000502729	0.00025854	0.000651356	0	0.000173153	0.0004378
(w) TOC (Total Organic Carbon)	g	78.153	0	0.110816	7.31429	0.9363137	0.04751482	0.7366934	0.182495	0.470837	63.92	4.01364	0.42036

(w) Toluene (C6H5CH3)	g	0.101299	0	0.000775936	0.00849748	0.001629456	0.000332541	0.002105674	0.00118248	0.00301869	0.07426	0.00746652	0.0020305
(w) Tributyl Phosphate ((C4H9)3PO4, TBP)	g	0.00042944	0	0.0000348	0	0	0.000014917	0.0000943	0.0000485	0.000122239	0	0.0000325	0.0000822
(w) Trichlorethane (1,1,1-CH3CCl3)	g	1.71E-09	0	1.38E-10	0	0	5.93E-11	3.749E-10	1.93E-10	4.86E-10	0	1.29E-10	3.27E-10
(w) Trichloroethylene (CHClCl2)	g	4.7E-08	0	3.8E-09	0	0	1.6308E-09	1.032E-08	5.31E-09	1.34E-08	0	3.55E-09	8.99E-09
(w) Triethylene Glycol (C6H14O4)	g	0.0579525	0	0.0046917	0	0	0.002011671	0.01273199	0.00654766	0.0164961	0	0.00438522	0.0110882
(w) Vanadium (V3+, V5+)	g	0.00253656	0	0.000205353	0	1.81E-08	0.00008806	0.000557263	0.00028659	0.000722024	0	0.000191942	0.0004853
(w) VOC (Volatile Organic Compounds)	g	0.0286411	0	0.00231872	0	0	0.00099426	0.00629237	0.00323596	0.00815264	0	0.00216725	0.00548
(w) Water (unspecified)	litre	15.348	0	1.11648	0	0	0.478715	3.029816	1.55813	3.92554	0	1.69038	3.54894
(w) Water: Chemically Polluted	litre	2708.64	0	0.277154	268.908	0.549822828	13.52263	8.268187	1.32111	3.69958	2350	22.9372	39.1534
(w) Xylene (C6H4(CH3)2)	g	0.0776502	0	0.00628639	0	0	0.002695427	0.0170595	0.00877317	0.022103	0	0.00587573	0.014857
(w) Zinc (Zn++)	g	1.59435	0	0.000254151	0.158118	0.00440049	0.00010889	0.001125609	0.00396116	0.0114125	1.3818	0.0294705	0.0037004
(wr) Radioactive Substance (unspecified)	kBq	5168.6	0	6.64E-08	514.689	21.25270159	2.852E-08	0.00000018	0.803515	2.34359	4497.9	121.373	10.2418
(wr) Radium (Ra224)	kBq	0.00409912	0	0.000331855	0	0	0.00014221	0.000900564	0.00046313	0.00116681	0	0.000310177	0.0007843
(wr) Radium (Ra226)	kBq	3.14873	0	0.254914	0	0	0.1093003	0.691768	0.355754	0.896281	0	0.238262	0.602454
(wr) Radium (Ra228)	kBq	0.00819825	0	0.000663712	0	0	0.000284688	0.001801131	0.00092627	0.00233362	0	0.000620355	0.0015686
(wr) Thorium (Th228)	kBq	0.0163965	0	0.00132743	0	0	0.000569077	0.003602274	0.00185253	0.00466725	0	0.00124071	0.0031372
_(SE) Electricity	MJ	223.931	0	0	0	0	0	37.6301	0	0	0	74.4526	111.849
_(SE) Waste (fuel energy)	MJ	1423.04	0	0	0	0	0	0	0	0	0	579.967	843.074
_(SM) ABS	kg	0.939472	0	0	0	0	0.285926	0	0	0	0	0	0.653546
_(SM) Aluminium (sheet)	kg	37.2075	0	0	0	7.87111	0	0	0	0	0	29.1667	0.169736
_(SM) Copper	kg	4.67593	0	0	0	0.755938	0	0	0	0	0	3.89999	0.019998
_(SM) Ferrous (steel plate)	kg	529.258	0	0	53.7815	0	0	0	0	0	470	4.45378	1.02231
_(SM) Glass	kg	19.3585	0	0	0	0	0	19.3585	0	0	0	0	0
_(SM) Lead	kg	6.19617	0	0	0	5.25375	0	0	0	0	0	0.914708	0.0277156
_(SM) Other Metals	kg	0.53293	0	0	0	0.0746364	0	0	0	0	0	0.458294	0
_(SM) Other Plastics	kg	1.51409	0	0	0	0	0.450135	0	0	0	0	0	1.06396
_(SM) PA66	kg	1.0694	0	0	0	0	0.18438	0	0	0	0	0	0.885022
_(SM) PE	kg	0.553138	0	0	0	0	0.18438	0	0	0	0	0	0.368759
_(SM) PP	kg	3.42946	0	0	0	0	1.0694	0	0	0	0	0	2.36006
_(SM) PUR	kg	1.26624	0	0	0	0	0.367619	0	0	0	0	0	0.898625
_(SM) PVC	kg	1.06201	0	0	0	0	0.326773	0	0	0	0	0	0.735239
_(SM) Rubber	kg	3.1	0	0	0	0	0	3.1	0	0	0	0	0
_(SM) Total	kg	610.935	0	0	53.7815	14.0855914	2.868613	22.4585	0	0	470	39.5362	8.20496
_(SM) Total: Ferrous	kg	529.258	0	0	53.7815	0	0	0	0	0	470	4.45378	1.02231
_(SM) Total: Non Ferrous	kg	49.3855	0	0	0	14.0855914	0	0	0	0	0	35.0824	0.21745
_(SM) Total: Other	kg	22.4585	0	0	0	0	0	22.4585	0	0	0	0	0
_(SM) Total: Plastics	kg	9.83382	0	0	0	0	2.868613	0	0	0	0	0	6.9652
_(SM) Zinc	kg	0.772909	0	0	0	0.130157	0	0	0	0	0	0.642752	0
_(SP) ABS Product	kg	0.35	0	0	0	0	0.35	0	0	0	0	0	0
_(SP) Aluminium Product (cast)	kg	14.5992	0	0	0	14.5992	0	0	0	0	0	0	0
_(SP) Coolant	kg	3	0	0	0	0	0	3	0	0	0	0	0
_(SP) Copper Product (wire)	kg	3.0401	0	0	0	3.0401	0	0	0	0	0	0	0
_(SP) Ferrous Product (cast)	kg	96	0	0	96	0	0	0	0	0	0	0	0
_(SP) Fluids (unspecified)	kg	3.03282	0	0	0	0	0	3.03282	0	0	0	0	0
_(SP) Glass Product	kg	6.90813	0	0	0	0	0	6.90813	0	0	0	0	0
_(SP) Lead Product	kg	2.682	0	0	0	2.682	0	0	0	0	0	0	0
_(SP) Lubricant	kg	3.57718	0	0	0	0	0	3.57718	0	0	0	0	0
_(SP) Other Materials Product	kg	1.6	0	0	0	0	0	1.6	0	0	0	0	0
_(SP) Other Metals Product	kg	0.286	0	0	0	0.286	0	0	0	0	0	0	0
_(SP) Other Plastics Product	kg	0.55	0	0	0	0	0.55	0	0	0	0	0	0
_(SP) PA66 Product	kg	0.25	0	0	0	0	0.25	0	0	0	0	0	0
_(SP) PE Product	kg	0.25	0	0	0	0	0.25	0	0	0	0	0	0
_(SP) PP Product	kg	1.45	0	0	0	0	1.45	0	0	0	0	0	0
_(SP) PUR Product	kg	0.45	0	0	0	0	0.45	0	0	0	0	0	0
_(SP) PVC Product	kg	0.4	0	0	0	0	0.4	0	0	0	0	0	0
_(SP) Rubber Product (tyre)	kg	18.8	0	0	0	0	0	18.8	0	0	0	0	0

	_(SP) Total	kg	157.563	0	0	96	20.9453	3.7	36.91813	0	0	0	0	0
	_(SP) Total: Ferrous	kg	96	0	0	96	0	0	0	0	0	0	0	0
	_(SP) Total: Fluids	kg	9.61	0	0	0	0	0	9.61	0	0	0	0	0
	_(SP) Total: Non Ferrous	kg	20.9453	0	0	0	20.9453	0	0	0	0	0	0	0
	_(SP) Total: Other	kg	27.3081	0	0	0	0	0	27.30813	0	0	0	0	0
	_(SP) Total: Plastics	kg	3.7	0	0	0	0	3.7	0	0	0	0	0	0
	_(SP) Zinc Product (wire)	kg	0.338	0	0	0	0.338	0	0	0	0	0	0	0
	_Recovered Matter: Steel Scrap	kg	17.6484	0	0	1.79092	0	0	0	0.00616651	0.0179857	15.651	0.148311	0.0340428
	Aluminium Scrap	kg	0.0659544	0	0	0	0	0	0	0	0	0	0	0.0659544
	Iron Scrap	kg	0.54469	0	0	0	0	0	0	0	559.3	0	0	0.54469
	Recovered Energy	MJ	1609.34	0	0	0	0	0	0	0	0	0	654.42	954.922
	Recovered Matter (total)	kg	77.3219	0	0.00226923	7.27664	1.124300979	0.192041	0.0152642	0.0999811	0.290353	63.591	4.09613	0.633952
	Recovered Matter (unspecified)	kg	57.3503	0	0.00224745	5.48571	0.644638013	0.1918077	0.0152051	0.106117	0.308263	47.94	2.07254	0.5838
	Recovered Matter: Aluminium Scrap	kg	2.21757	0	0	0	0.469118	0	0	0	0	0	1.73833	0.0101163
	Recovered Matter: Carbon Monoxide (CO)	kg	0.406204	0	0	0	0.0662697	0	0	0	0	0	0.339934	0
	Recovered Matter: Iron Scrap	kg	0.00102196	0	0.0000218	0	0	0.000233195	0.0000591	0.0000304	0.0000766	0	0.0000204	0.0005806
	Waste (hazardous)	kg	6.67597	0	0.000195006	0	0.000135519	0.00008366	0.044801711	0.00027215	0.000685643	0	1.98431	4.64549
	Waste (incineration)	kg	0.00093135	0	0.0000754	0	0	0.0000323	0.000204612	0.00010523	0.000265107	0	0.0000705	0.0001782
	Waste (municipal and industrial)	kg	32.1908	0	0.000185277	0	0.081681167	0.4295441	0.02608623	0.00025857	0.000651438	0	9.80594	21.8465
	Waste (total)	kg	85.7696	0.00140124	0.634883	0.55075	4.6837319	0.7030227	7.3441675	0.908314	2.30255	4.81304	32.938	30.8898
	Waste (unspecified)	kg	14.138	0.00140124	0.211576	0.00217834	1.87690893	0.09202494	1.98631731	0.305034	0.777677	0.0190366	6.52455	2.34126
	Waste: Highly Radioactive (class C)	kg	0.000029	0	0.00000235	0	0	0.000001007	0.00000637	0.00000328	0.00000826	0	0.00000219	5.55E-06
	Waste: Intermediate Radioactive (class B)	kg	0.00022153	0	0.0000179	0	0	0.000007693	0.0000487	0.000025	0.0000631	0	0.0000168	0.0000424
	Waste: Low Radioactive (class A)	kBq	0.00287529	0	0.000232777	0	0	0.00009978	0.000631694	0.00032486	0.000818447	0	0.000217571	0.0005501
	Waste: Mineral (inert)	kg	10.8146	0	0.368271	0.548571	0.40441057	0.15792034	1.07947603	0.526473	1.33136	4.794	0.719645	0.884421
	Waste: Mining	kg	2.46559	0	0.199608	0	0	0.08558656	0.541683	0.27857	0.701825	0	0.186569	0.471746
	Waste: Non Mineral (inert)	kg	0.450312	0	0.0000159	0	0.375352	0.000006801	0.007431306	0.0000221	0.0000558	0	0.0653844	0.0020438
	Waste: Non Toxic Chemicals (unspecified)	kg	-0.00476508	0	4.93E-08	0	-0.004071381	9.01895E-06	1.2712E-06	6.88E-08	0.000000173	0	-0.000704514	2.26E-07
	Waste: Radioactive (unspecified)	kg	0.0000798	0	0.00000646	0	0	0.000002767	0.00001757	0.00000901	0.0000227	0	0.00000604	0.0000153
	Waste: Slags and Ash (unspecified)	kg	21.4707	0	0.0545122	0	1.949310861	0.02337901	4.19971916	0.0760763	0.191666	0	13.8292	1.14688
	Waste: Treatment	kg	0.137414	0	0.0111248	0	0	0.004769999	0.03018953	0.0155255	0.0391148	0	0.010398	0.0262918
Rem.:	E Feedstock Energy	MJ	4004.24	8565	10.8852	113.75	8.63186	4.469116	2.8943	14.585	36.9112	994.071	-2094.55	-3652.41
	E Fuel Energy	MJ	15653.7	42.0617	52.2849	755.509	262.89257	14.621952	562.4489	88.1289	387.155	6602.44	3087.07	3799.1
	E Non Renewable Energy	MJ	19312.7	8509.24	62.9959	846.098	268.14947	19.018088	561.6807	102.339	422.988	7394.1	980.269	145.784
	E Renewable Energy	MJ	345.284	97.8214	0.173554	23.1617	3.35507288	0.07271612	3.675097	0.373824	1.07573	202.412	12.2526	0.910494
	E Total Primary Energy	MJ	19657.9	8607.06	63.1695	869.259	271.50446	19.090872	565.35615	102.713	424.064	7596.51	992.521	146.694
	Electricity	MJ elec	7170.93	0.118731	17.5906	686.974	38.687223	8.229476	65.72782	25.508	65.0939	6003.51	201.567	57.922

Table A7 Breakdown of the Draft EC ELV Directive 11034/971 ELV Disposal and Processing Chain

	Flow	Units	ELV	Transport to Dismantler	Dismantler	Ferrous from Dismantler	Non Ferrous from Dismantler	Plastics from Dismantler	Others from Dismantler	Feeder Site	Shredder	Ferrous	Non Ferrous	Fluff
Inputs:	(r) Barium Sulphate (BaSO4, in ground)	kg	0.00564294	0	0.00046362	0	0	0.000197682	0.001289432	0.0006269	0.0015794	0	0.00012207	0.00136388
	(r) Bauxite (Al2O3, ore)	kg	0.00608554	0	0.00000902	0	0.000351395	0.000004292	0.005573518	0.0000122	0.0000307	0	0.0000768	0.0000276
	(r) Bentonite (Al2O3.4SiO2.H2O, in ground)	kg	0.000533056	0	0.0000438	0	0	0.000018714	0.0001218	0.0000592	0.000149197	0	0.0000115	0.00012884
	(r) Chromium (Cr, ore)	kg	0.00000108	0	8.91E-08	0	0	3.799E-08	2.478E-07	0.000000121	0.000000304	0	2.35E-08	2.62E-07
	(r) Clay (in ground)	kg	0.00935064	0	0.000746947	0	0.000233245	0.000318433	0.002058966	0.00101001	0.0025446	0	0.00024097	0.00219745
	(r) Coal (in ground)	kg	118.825	0.00643928	1.1593	9.74446	2.5328368	0.4953622	4.5135917	1.78572	4.60929	85.8426	4.71402	3.42174
	(r) Copper (Cu, ore)	kg	0.00000552	0	0.000000453	0	0	1.9307E-07	0.000001261	0.000000613	0.00000154	0	0.000000119	0.00000133
	(r) Dolomite (CaCO3.MgCO3, in ground)	kg	2.0885	0	0	0	0	0	2.0885	0	0	0	0	0
	(r) Feldspar (ore)	kg	0.426902	0	0	0	0	0	0.426902	0	0	0	0	0
	(r) Iron (Fe, ore)	kg	1.51834	0	0.00337024	0	0.562214	0.005788725	0.01074059	0.177564	0.516083	0	0.222461	0.0201156
	(r) Iron Sulphate (FeSO4, ore)	kg	0.000454854	0	0.0000374	0	0	0.000015918	0.0001039	0.0000505	0.000127309	0	0.00000984	0.00010994
	(r) Lead (Pb, ore)	kg	0.00000172	0	0.000000142	0	0	6.029E-08	3.937E-07	0.000000191	0.000000482	0	3.73E-08	4.16E-07
	(r) Lignite (in ground)	kg	150.132	0	0.000734879	15.0588	0.2668439	0.000313258	0.002043869	0.0202976	0.0588065	132.659	2.06347	0.00216187
	(r) Limestone (CaCO3, in ground)	kg	15.7654	0	0.194238	0	0.0757349	0.08323588	5.812042539	0.354677	0.930131	0	0.0655269	8.24986
	(r) Manganese (Mn, ore)	kg	0.000000632	0	5.19E-08	0	0	2.21E-08	1.446E-07	7.02E-08	0.000000177	0	1.37E-08	1.53E-07
	(r) Natural Gas (in ground)	kg	69.6583	0.00377585	0.325139	5.42705	1.15666753	0.13160843	8.6844201	0.442847	1.13958	47.8089	3.1796	1.35871
	(r) Nickel (Ni, ore)	kg	0.000000367	0	3.02E-08	0	0	1.2878E-08	0.000000084	4.08E-08	0.000000103	0	7.95E-09	8.88E-08
	(r) Oil (in ground)	kg	47.1135	0.974448	0.49852	2.77256	1.1216896	0.03399512	2.225605	0.899217	5.9425	24.4245	6.52213	1.6983
	(r) Pyrite (FeS2, ore)	kg	0.00904436	0	0.00074308	0	0	0.000316843	0.002066673	0.00100478	0.00253143	0	0.000195651	0.00218599
	(r) Sand (in ground)	kg	6.13213	0	0.000635956	0	0.0706908	0.000271114	6.042035703	0.000859929	0.00216649	0	0.013594	0.00187133
	(r) Silver (Ag, ore)	kg	2.74E-08	0	2.25E-09	0	0	9.586E-10	6.25E-09	3.04E-09	7.66E-09	0	5.92E-10	6.61E-09
	(r) Sodium Carbonate (Na2CO3, in ground)	kg	1.45559	0	0	0	0.900645	0	0.383882	0	0	0	0.171063	0
	(r) Sodium Chloride (NaCl, in ground or in sea)	kg	0.907628	0	0.000886493	0	0.004797693	0.000383416	0.892186889	0.0011987	0.00301999	0	0.00114765	0.00400738
	(r) Uranium (U, ore)	kg	0.00801187	0	0.0000289	0.00064	0.000056501	0.000012375	0.00123138	0.0000401	0.00010141	0.005638	0.00017807	0.0000852
	(r) Zinc (Zn, ore)	kg	4.01E-08	0	3.3E-09	0	0	1.406E-09	9.17E-09	4.46E-09	1.12E-08	0	8.68E-10	9.7E-09
	_Catalyser (Demetalization)	kg	0.00251587	0	0	0	0.000192282	0	0.002287063	0	0	0	0.0000365	0
	_Catalyser (Hydrotreating)	kg	0.00349426	0	0	0	0.000267059	0	0.00317647	0	0	0	0.0000507	0
	_Catalyser (Unspecified)	kg	0.00000209	0	0	0	0.00000176	0	0	0	0	0	0.000000333	0
	_Dewaxing aid	kg	0.000102422	0	0	0	0.0000861	0	0	0	0	0	0.0000163	0
	_Furfural	kg	0.00023954	0	0	0	0.000201306	0	0	0	0	0	0.0000382	0
	Adjuvant (unspecified)	kg	-0.0008011	0	0	0	-0.0000471	0	-0.000745026	0	0	0	-0.00000895	0
	Amine (unspecified)	kg	-0.00000298	0	0	0	0.00000223	0	-0.00000563	0	0	0	0.000000423	0
	Chlorine (Cl2)	kg	0.0172128	0	0	0	0.00361284	0	0	0	0	0	0.0136	0
	Explosive (unspecified)	kg	0.000103143	0	0.00000844	0	0.000000319	0.000003599	0.00002345	0.0000114	0.0000288	0	0.00000228	0.0000248
	Iron Scrap	kg	0.141567	0	0.000286763	0	0.0429075	0.00012227	0.000797551	0.0226054	0.0657784	563.8	0.00822508	0.0008436
	Raw Materials (unspecified)	kg	19.4971	0	0.053558	1.80491	0.18885302	0.02283068	0.223200359	0.0824655	0.211753	15.9001	0.851913	0.157557
	Water Used (total)	litre	7457.32	0.188258	83.207	699.453	71.40215176	16.06029	220.9872	11.0998	40.211	6161.75	91.7896	61.1726
	Water: Industrial Water	litre	18.96	0	0	0	0	0	18.96	0	0	0	0	0
	Water: Mine Supply	litre	0.0535852	0	0	0	0.0450321	0	0	0	0	0	0.00855311	0
	Water: Public Network	litre	7.8715	0	0	0	0.534117	0	6.35294	0	0	0	0.984447	0
	Water: Unspecified Origin	litre	7342.82	0.188258	5.96799	699.453	70.82265176	16.05938	195.6678	11.0969	29.8551	6161.75	90.7959	61.1662
	Water: Urban Supply Network	litre	87.5853	0	77.2368	0	0	0	0	0	10.3485	0	0	0
	Wood (standing)	m3	0.00127746	0	0.00000749	0.000117278	3.17072E-06	0.00000319	0.00002077	0.0000133	0.0000349	0.00103315	0.0000222	0.000022
Outputs:	(a) Acetaldehyde (CH3CHO)	g	0.00456163	0	0.000374781	0	0	0.00015992	0.001042351	0.000506773	0.00127676	0	0.0000987	0.00110253
	(a) Acetic Acid (CH3COOH)	g	0.0385426	0	0.00316664	0	0	0.001349825	0.00880714	0.00428188	0.0107877	0	0.000833767	0.00931563
	(a) Acetone (CH3COCH3)	g	0.00443932	0	0.000364732	0	0	0.00015557	0.001014402	0.000493185	0.00124252	0	0.000096	0.00107297
	(a) Acetylene (C2H2)	g	0.1264	0	0.0103849	0	0	0.00442687	0.02888275	0.0140423	0.035378	0	0.00273432	0.0305504
	(a) Aldehyde (unspecified)	g	1.44609	0.0359401	0.0158821	0.0558831	0.266125046	0.00015282	0.02027019	0.0291795	0.208967	0.492295	0.266947	0.0544499

	(a) Alkane (unspecified)	g	0.578047	0	0.0474852	0	0.000143078	0.02024201	0.1319793	0.0642087	0.161766	0	0.0125299	0.139692
	(a) Alkene (unspecified)	g	0.128155	0	0.010529	0	0.00000397	0.004488293	0.02928106	0.0142371	0.0358688	0	0.00277301	0.0309742
	(a) Alkyne (unspecified)	g	0.00000921	0	0.000000756	0	0	3.225E-07	0.000002103	0.00000102	0.00000258	0	0.000000199	0.00000223
	(a) Aluminium (Al)	g	2.60817	0	0.199508	0	0	0.08504612	0.554877	0.269771	0.859522	0	0.0525298	0.586913
	(a) Ammonia (NH3)	g	1.70625	0.0179701	0.0119714	0.128513	0.086286223	0.001780075	0.017362599	0.0203983	0.11926	1.13212	0.131541	0.0390476
	(a) Antimony (Sb)	g	0.000468301	0	0.0000385	0	0	0.000016419	0.000107	0.000052	0.000131073	0	0.0000101	0.00011319
	(a) AOX (Adsorbable Organic Halogens)	g	3.1E-10	0	1.66E-13	0	1.192E-10	7.085E-14	4.62E-13	2.25E-13	5.67E-13	0	1.88E-10	4.89E-13
	(a) Aromatic Hydrocarbons (unspecified)	g	5.91451	0	0.000362805	0.394756	0.42111003	0.00015473	0.001009043	0.00144303	0.00401393	3.47756	1.61304	0.0010673
	(a) Arsenic (As)	g	0.00510068	0	0.000419069	0	0	0.00017854	0.001165525	0.000566658	0.00142763	0	0.00011034	0.00123282
	(a) Barium (Ba)	g	0.0291133	0	0.00239193	0	0	0.001019598	0.00665251	0.00323433	0.00814853	0	0.000629789	0.0070366
	(a) Benzaldehyde (C6H5CHO)	g	1.66E-09	0	1.37E-10	0	0	5.82E-11	3.801E-10	1.85E-10	4.65E-10	0	3.6E-11	4.02E-10
	(a) Benzene (C6H6)	g	0.765606	0	0.019192	0.0518992	0.00371324	0.008181141	0.053375246	0.0263644	0.0665864	0.457199	0.0226367	0.0564589
	(a) Benzo(a)pyrene (C20H12)	g	0.000392048	0	0.0000322	0	0	0.000013745	0.0000896	0.0000436	0.00010973	0	0.00000848	0.0000948
	(a) Berylium (Be)	g	0.000476737	0	0.0000392	0	0	0.00001669	0.000109	0.000053	0.000133434	0	0.0000103	0.00011523
	(a) Boron (B)	g	0.23065	0	0.0189501	0	0	0.008078022	0.0527044	0.025624	0.0645567	0	0.0049895	0.0557474
	(a) Bromium (Br)	g	0.0461111	0	0.00378846	0	0	0.001614907	0.01053657	0.0051227	0.012906	0	0.000997491	0.0111449
	(a) Butane (n-C4H10)	g	0.240449	0	0.0197551	0	0	0.008421208	0.0549435	0.0267125	0.0672992	0	0.00520146	0.0581157
	(a) Butene (1-CH3CH2CHCH2)	g	0.00152023	0	0.000124901	0	0	0.00005321	0.00034733	0.000168889	0.000425496	0	0.0000329	0.00036743
	(a) Cadmium (Cd)	g	0.0870715	0	0.000106206	0.000376471	2.92009E-05	0.00004526	0.082139399	0.000163096	0.000418644	0.00331647	0.000164361	0.00031244
	(a) Calcium (Ca)	g	0.294512	0	0.0241969	0	0	0.010314648	0.0672971	0.0327187	0.0824309	0	0.00637098	0.0711826
	(a) Carbon Dioxide (CO2, biomass)	g	26210.4	0	0	0	0	0	0	0	0	0	23648.4	2562.01
	(a) Carbon Dioxide (CO2, fossil)	g	1090000	3345.21	4277.33	67264.4	14948.092	1212.3633	76651.88	7088.79	30701.4	592558	42022.1	245558
	(a) Carbon Monoxide (CO)	g	2875.07	18.184	10.7332	250.758	10.5135434	1.2146088	21.232284	21.7757	124.782	2209.02	51.6228	155.236
	(a) Carbon Tetrafluoride (CF4)	g	0.00000134	0	0.00000011	0	0	4.674E-08	3.053E-07	0.000000148	0.000000374	0	2.89E-08	3.23E-07
	(a) Chlorides (Cl-)	g	0.00000111	0	9.09E-08	0	0	3.875E-08	0.000000253	0.000000123	0.00000031	0	2.39E-08	2.67E-07
	(a) Chlorine (Cl2)	g	0.00000127	0	0.000000105	0	0	4.465E-08	2.907E-07	0.000000142	0.000000357	0	2.76E-08	3.08E-07
	(a) Chromium (Cr III, Cr VI)	g	0.00618947	0	0.000508524	0	0	0.000216816	0.001414323	0.000687617	0.00173237	0	0.000133893	0.00149598
	(a) Chromium (Cr)	g	0.101055	0	0	0.0102185	0	0	0	0.0000255	0.0000744	0.0900185	0.000718487	0
	(a) Cobalt (Co)	g	0.00175109	0	0.000143869	0	0	0.00006135	0.000400131	0.000194537	0.000490113	0	0.0000379	0.00042323
	(a) Copper (Cu)	g	0.303996	0	0.000419875	0.0285042	0	0.00017885	0.001167766	0.000615097	0.0186555	0.251104	0.00211475	0.00123519
	(a) Cyanide (CN-)	g	0.000641196	0	0.0000527	0	0	0.00002244	0.000146521	0.0000712	0.000179465	0	0.0000139	0.00015498
	(a) Dioxins (unspecified)	g	4.68E-09	0	3.84E-10	0	0	1.6377E-10	1.069E-09	5.2E-10	1.31E-09	0	1.01E-10	1.13E-09
	(a) Ethane (C2H6)	g	1.93693	0	0.159137	0	0	0.06783696	0.442597	0.215183	0.542128	0	0.0419004	0.468151
	(a) Ethanol (C2H5OH)	g	0.00884526	0	0.000726722	0	0	0.000309783	0.002021175	0.000982661	0.0024757	0	0.000191344	0.00213787
	(a) Ethylbenzene (C8H10)	g	0.0015206	0	0.000124894	0	0.000000795	0.00005321	0.000346829	0.00016888	0.000425473	0	0.000033	0.00036741
	(a) Ethylene (C2H4)	g	2.7365	0	0.224829	0	0	0.09583991	0.6253	0.30401	0.765918	0	0.0591968	0.661402
	(a) Fluorides (F-)	g	0.00019826	0	0.000000886	0	8.61815E-05	4.081E-07	0.00007175	0.0000012	0.00000302	0	0.0000322	0.00000268
	(a) Fluorine (F2)	g	0.0000054	0	0.000000444	0	0	1.8916E-07	0.000001234	0.0000006	0.00000151	0	0.000000117	0.00000131
	(a) Formaldehyde (CH2O)	g	0.0456056	0	0.00374693	0	0	0.001597201	0.01042105	0.00506653	0.0127645	0	0.000986554	0.0110227
	(a) Halogenated Matter (unspecified)	g	0.000162775	0	2.18E-15	0.0000161	6.93023E-07	9.311E-16	6.08E-15	1.82E-08	5.31E-08	0.00014213	0.00000374	6.43E-15
	(a) Halon 1301 (CF3Br)	g	0.00345104	0	0.0000141	0.000301176	6.06009E-05	0.000006023	0.00003935	0.0000229	0.0000591	0.00265318	0.000253046	0.0000416
	(a) Heptane (C7H16)	g	0.0149996	0	0.00123236	0	0	0.000525436	0.003427477	0.00166638	0.00419825	0	0.000324477	0.00362536
	(a) Hexane (C6H14)	g	0.030013	0	0.00246585	0	0	0.001051041	0.00685809	0.00333428	0.00840034	0	0.000649251	0.00725404
	(a) Hydrocarbons (except methane)	g	815.405	14.4402	7.32089	34.2708	62.309923	0.5000519	145.039778	13.2566	88.0322	301.905	116.007	32.3231
	(a) Hydrocarbons (unspecified)	g	40.0942	0	0.0321434	0	-4.157206745	0.024758789	44.794629	0.014391	0.0362565	0	-0.744735	0.0939756
	(a) Hydrogen (H2)	g	0.0872915	0	4.49E-08	0	0	1.9107E-08	0.087291093	6.07E-08	0.000000153	0	1.18E-08	1.32E-07

	(a) Hydrogen Chloride (HCl)	g	93.8797	0	0.949851	7.09916	0.22313444	0.404947	11.2398807	1.30009	3.28167	62.5392	1.72616	5.1157
	(a) Hydrogen Fluoride (HF)	g	8.96229	0	0.0345073	0.817479	0.096316449	0.014712286	0.0959725	0.0486634	0.123398	7.20148	0.428241	0.10152
	(a) Hydrogen Sulphide (H2S)	g	0.376758	0	0.0305499	0	-0.00509672	0.013034051	0.08885301	0.043112	0.109332	0	0.00707566	0.0898982
	(a) Iodine (I)	g	0.0115266	0	0.000947017	0	0	0.000403631	0.002633864	0.00128054	0.00322617	0	0.000249347	0.00278594
	(a) Iron (Fe)	g	1.72571	0	0.0804571	0	0	0.03429718	0.2237692	0.108793	1.02053	0	0.0211841	0.236689
	(a) Ketone (unspecified)	g	0.415135	0	0	0	0.348873	0	0	0	0	0	0.0662626	0
	(a) Lanthanum (La)	g	0.000765221	0	0.0000629	0	0	0.00002683	0.000174886	0.000085	0.000214178	0	0.0000166	0.00018495
	(a) Lead (Pb)	g	5.24948	0	0.00171738	0.509311	0.112802754	0.000732148	0.00477643	0.00315629	0.066739	4.48671	0.0584844	0.0050522
	(a) Magnesium (Mg)	g	0.850856	0	0.0699059	0	0	0.02979949	0.1944236	0.0945255	0.238146	0	0.018406	0.205649
	(a) Manganese (Mn)	g	1.88852	0	0.000484738	0.190387	8.89052E-05	0.000206547	0.001348164	0.000972329	0.00257556	1.67719	0.013849	0.001426
	(a) Mercury (Hg)	g	0.0975151	0	0.0000602	0.00147899	6.63419E-05	0.0000256	0.082011246	0.0000842	0.000213266	0.013029	0.000369341	0.00017696
	(a) Metals (unspecified)	g	21.613	0	0.00000242	1.90387	0.04903208	6.6532E-06	2.542548835	0.00464712	0.0135528	16.7719	0.327463	0.000025
	(a) Methane (CH4)	g	1655.01	0.611838	10.0246	108.947	7.8729204	4.161423	75.1605328	15.7086	42.6854	959.759	391.63	38.4495
	(a) Methanol (CH3OH)	g	0.0150271	0	0.00123462	0	0	0.000526255	0.003433757	0.00166943	0.00420594	0	0.000325072	0.00363201
	(a) Molybdenum (Mo)	g	0.00143772	0	0.000118122	0	0	0.00005039	0.00032855	0.000159723	0.000402403	0	0.0000311	0.00034749
	(a) Nickel (Ni)	g	0.17262	0	0.00205368	0.014037	0.001613627	0.000875468	0.00571175	0.00309747	0.00793106	0.123657	0.00760179	0.00604153
	(a) Nitrogen Oxides (NOx as NO2)	g	3194.38	46.6366	26.0073	156.276	30.894456	2.466156	157.22845	45.9686	291.897	1376.69	128.254	932.058
	(a) Nitrous Oxide (N2O)	g	38.8954	1.57238	0.718248	1.36491	2.1277476	0.016223222	2.407607	1.31152	9.22409	12.024	5.61486	2.51372
	(a) Organic Matter (unspecified)	g	1.82142	0.0539102	0.0239385	0.0838246	0.10800654	0.000289799	0.01817664	0.0439252	0.313843	0.738442	0.35502	0.0820403
	(a) Particulates (unspecified)	g	1957.98	3.78655	16.5852	66.3061	16.9349987	6.437276	289.715917	30.1171	107.784	584.116	36.5787	799.614
	(a) Pentane (C5H12)	g	0.24189	0	0.0198736	0	0	0.008471696	0.0552729	0.0268727	0.0677027	0	0.00523265	0.0584641
	(a) Phenol (C6H5OH)	g	1.28E-08	0	1.05E-09	0	0	4.466E-10	2.918E-09	1.42E-09	3.57E-09	0	2.76E-10	3.08E-09
	(a) Phosphorus (P)	g	0.0214612	0	0.00176324	0	0	0.000751591	0.00490397	0.00238422	0.00600678	0	0.000464256	0.0051871
	(a) Phosphorus Pentoxide (P2O5)	g	0.0000146	0	0.0000012	0	0	5.098E-07	0.000003322	0.00000162	0.00000407	0	0.000000315	0.00000352
	(a) Polycyclic Aromatic Hydrocarbons (PAH, unspecified)	g	0.0144925	0	0.000115948	0.00130151	0.000042733	0.00004948	0.000322433	0.000161827	0.000409709	0.0114655	0.000282231	0.0003411
	(a) Potassium (K)	g	0.293966	0	0.0241521	0	0	0.010295519	0.0671723	0.032658	0.0822781	0	0.00635916	0.0710506
	(a) Propane (C3H8)	g	0.63719	0	0.0552775	0	0.0370986	0.02356367	0.073977	0.0747453	0.188312	0	0.0216007	0.162615
	(a) Propionaldehyde (CH3CH2CHO)	g	4.57E-09	0	3.76E-10	0	0	1.6017E-10	1.045E-09	5.08E-10	1.28E-09	0	9.89E-11	1.11E-09
	(a) Propylene (CH2CHCH3)	g	0.140791	0	0.0115673	0	0	0.004930906	0.03217133	0.0156411	0.039406	0	0.00304564	0.0340288
	(a) Scandium (Sc)	g	0.000259624	0	0.0000213	0	0	0.00000909	0.0000593	0.0000288	0.0000727	0	0.00000562	0.0000628
	(a) Selenium (Se)	g	0.00503053	0	0.000413305	0	0	0.00017621	0.001149495	0.000558865	0.001408	0	0.000108822	0.00121586
	(a) Silicon (Si)	g	3.63841	0	0.29893	0	0	0.12742765	0.831392	0.404208	1.01836	0	0.0787074	0.879393
	(a) Sodium (Na)	g	0.168804	0	0.0138689	0	0	0.005912014	0.03857245	0.0187533	0.0472467	0	0.00365163	0.0407995
	(a) Sodium Sulphate (Na2SO4)	g	0.00326819	0	0	0	0	0	0.00326819	0	0	0	0	0
	(a) Strontium (Sr)	g	0.0475137	0	0.0039037	0	0	0.001664063	0.01085707	0.00527852	0.0132986	0	0.00102783	0.0114839
	(a) Sulphur Oxides (SOx as SO2)	g	2902.85	7.07037	16.0545	216.093	74.51283	5.56852	219.03094	24.3629	88.4454	1903.64	296.926	51.1436
	(a) Tars (unspecified)	g	0.000213724	0	5.59E-08	0	0.000179038	2.388E-08	1.554E-07	7.56E-08	0.00000019	0	0.000034	1.64E-07
	(a) Thallium (Tl)	g	0.000266092	0	0.0000195	0	0	0.000008323	0.0000542	0.0000337	0.0000877	0	0.00000514	0.0000574
	(a) Thorium (Th)	g	0.000489679	0	0.0000402	0	0	0.000017139	0.0001119	0.0000544	0.000137056	0	0.0000106	0.00011835
	(a) Tin (Sn)	g	0.000153044	0	0.0000126	0	0	0.000005358	0.00003495	0.000017	0.0000428	0	0.00000331	0.000037
	(a) Titanium (Ti)	g	0.0850718	0	0.00698945	0	0	0.002979455	0.01943926	0.00945102	0.0238108	0	0.0018403	0.0205616
	(a) Toluene (C6H5CH3)	g	0.0722507	0	0.00593585	0	0.00000486	0.002530333	0.016506	0.00802635	0.0202215	0	0.00156381	0.0174621
	(a) Uranium (U)	g	0.000475123	0	0.000039	0	0	0.000016644	0.0001086	0.0000528	0.000132982	0	0.0000103	0.00011484
	(a) Vanadium (V)	g	0.0900374	0	0.00739683	0	0	0.003153121	0.02057222	0.0100037	0.0252039	0	0.00194756	0.02176
	(a) VOC (Volatile Organic Compounds)	g	188.654	0	0	0	0	0	8.19072	0	180.463	0	0	0
	(a) Water Vapour (H2O)	g	36228.9	0	0	0	0	0	25880.4	0	10348.5	0	0	0
	(a) Xylene (C6H4(CH3)2)	g	0.0290983	0	0.00239055	0	0.00000318	0.001019219	0.006646706	0.00323246	0.00814381	0	0.000630028	0.00703252
	(a) Zinc (Zn)	g	0.498231	0	0.00132068	0.0103261	0.000469139	0.00056314	0.003673103	0.00183424	0.382354	0.0909661	0.00283972	0.00388517
	(a) Zirconium (Zr)	g	0.000363884	0	0.0000299	0	0	0.000012747	0.0000832	0.0000404	0.000101848	0	0.00000787	0.0000879
	(ar) Lead (Pb210)	kBq	0.0110987	0	0.000911864	0	0	0.000388549	0.002536101	0.00123301	0.00310642	0	0.000240091	0.00268252
	(ar) Radioactive Substance (unspecified)	kBq	563919	0	0.00000726	55932.8	2306.316522	0.000003096	0.00002021	84.8642	247.521	492733	12614.3	0.0000214
	(ar) Radium (Ra226)	kBq	0.0088798	0	0.000729559	0	0	0.000311035	0.002029073	0.000986498	0.00248537	0	0.000192091	0.00214622
	(ar) Radon (Rn222)	kBq	0.105526	0	0.00866992	0	0	0.003695804	0.02411295	0.0117233	0.0295356	0	0.00228276	0.0255052
	(s) Aluminium (Al)	g	0.0720333	0	0.00591821	0	0	0.00252281	0.01645986	0.00800251	0.0201614	0	0.00155825	0.0174102
	(s) Arsenic (As)	g	0.0000288	0	0.00000236	0	0	1.0082E-06	0.00000657	0.0000032	0.00000805	0	0.000000623	0.00000696
	(s) Cadmium (Cd)	g	0.000000013	0	1.07E-09	0	0	4.56E-10	2.973E-09	1.45E-09	3.64E-09	0	2.82E-10	3.15E-09

(s) Calcium (Ca)	g	0.287789	0	0.0236446	0	0	0.010079203	0.0657609	0.0319718	0.0805493	0	0.00622555	0.0695577
(s) Carbon (C)	g	0.216009	0	0.0177472	0	0	0.007565252	0.0493589	0.0239974	0.0604588	0	0.00467277	0.0522087
(s) Chromium (Cr III, Cr VI)	g	0.000360292	0	0.0000296	0	0	0.000012614	0.0000823	0.00004	0.000100842	0	0.00000779	0.0000871
(s) Cobalt (Co)	g	1.32E-08	0	1.08E-09	0	0	4.619E-10	3.014E-09	1.47E-09	3.7E-09	0	2.86E-10	3.19E-09
(s) Copper (Cu)	g	6.61E-08	0	5.43E-09	0	0	2.316E-09	1.512E-08	7.34E-09	1.85E-08	0	1.43E-09	1.6E-08
(s) Iron (Fe)	g	0.143855	0	0.0118191	0	0	0.005038219	0.03287149	0.0159815	0.0402636	0	0.00311192	0.0347693
(s) Lead (Pb)	g	0.000000302	0	2.48E-08	0	0	1.0584E-08	6.91E-08	3.36E-08	8.46E-08	0	6.54E-09	7.3E-08
(s) Manganese (Mn)	g	0.00287789	0	0.000236446	0	0	0.00010082	0.000657609	0.000319718	0.000805493	0	0.0000623	0.00069558
(s) Mercury (Hg)	g	2.4E-09	0	1.97E-10	0	0	8.398E-11	5.48E-10	2.66E-10	6.71E-10	0	5.19E-11	5.8E-10
(s) Nickel (Ni)	g	9.92E-08	0	8.15E-09	0	0	3.471E-09	2.264E-08	0.000000011	2.78E-08	0	2.15E-09	2.4E-08
(s) Nitrogen (N)	g	0.00000113	0	9.27E-08	0	0	3.949E-08	2.572E-07	0.000000125	0.000000316	0	2.44E-08	2.73E-07
(s) Oils (unspecified)	g	0.000427342	0	0.0000351	0	0	0.000014958	0.0000976	0.0000475	0.000119609	0	0.00000924	0.00010329
(s) Phosphorus (P)	g	0.00360329	0	0.000296044	0	0	0.00012615	0.000823366	0.000400306	0.00100852	0	0.0000779	0.0008709
(s) Sulphur (S)	g	0.0431705	0	0.00354686	0	0	0.001512003	0.00986463	0.00479601	0.012083	0	0.000933879	0.0104342
(s) Zinc (Zn)	g	0.00108157	0	0.0000889	0	0	0.00003786	0.000247171	0.000120156	0.000302719	0	0.0000234	0.00026141
(w) Acids (H+)	g	0.659674	0	0.000382368	0	0.010031625	0.000264361	0.64242691	0.000517031	0.0013026	0	0.00275265	0.00199663
(w) Alcohol (unspecified)	g	0.000650104	0	0.0000534	0	0	0.00002279	0.000148542	0.0000722	0.000181958	0	0.0000141	0.00015713
(w) Alkane (unspecified)	g	0.01136	0	0.000933328	0	0	0.000397784	0.002595795	0.00126203	0.00317954	0	0.000245742	0.00274567
(w) Alkene (unspecified)	g	0.00104764	0	0.0000861	0	0	0.0000367	0.000239381	0.000116387	0.000293223	0	0.0000227	0.00025321
(w) Aluminium (Al3+)	g	159.263	0	0.0148086	15.758	0.4259317	0.006312624	0.041186143	0.369679	1.07028	138.818	2.71499	0.0435641
(w) Aluminium Hydroxide (Al(OH)3)	g	0.0000114	0	0.000000933	0	0	3.983E-07	0.000002597	0.00000126	0.00000318	0	0.000000246	0.00000275
(w) Ammonia (NH4+, NH3, as N)	g	2.26389	0	0.0157412	0.186144	0.017346594	0.006746478	0.20256208	0.0224096	0.0569052	1.63981	0.0698284	0.0463926
(w) AOX (Adsorbable Organic Halogens)	g	0.00306902	0	0.0000126	0.000236639	4.41927E-05	0.000005358	3.48932E-05	0.000110967	0.000316902	0.00208464	0.000185892	0.000037
(w) Aromatic Hydrocarbons (unspecified)	g	0.757548	0	0.00397635	0.0656134	0.01220161	0.001695012	0.01105912	0.00608699	0.0156176	0.578013	0.0515872	0.0116976
(w) Arsenic (As3+, As5+)	g	0.319522	0	0.0000211	0.0316235	0.000858178	0.000008995	5.86889E-05	0.000729674	0.00211688	0.278584	0.00545901	0.0000621
(w) Barium (Ba++)	g	14.506	0	0.017198	1.4037	0.06526049	0.007331155	0.047831389	0.0533033	0.146229	12.3657	0.348867	0.0505931
(w) Barytes	g	1.02083	0	0.0838708	0	0	0.03575244	0.2332639	0.113409	0.28572	0	0.0220829	0.246731
(w) Benzene (C6H6)	g	0.0113661	0	0.00093383	0	1.81E-09	0.000398099	0.002597187	0.00126271	0.00318125	0	0.000245875	0.00274714
(w) BOD5 (Biochemical Oxygen Demand)	g	91.3132	0.00539102	0.00295511	9.15124	0.037471748	0.000348802	0.64761245	0.0361105	0.123594	80.6167	0.681702	0.0100509
(w) Boric Acid (H3BO3)	g	0.0132348	0	0.00108736	0	0	0.000463498	0.003024197	0.00147031	0.00370428	0	0.000286299	0.0031988
(w) Boron (B III)	g	0.00141863	0	0.00011652	0	0.000000707	0.00004969	0.000323589	0.000157556	0.000396945	0	0.0000308	0.00034278
(w) Cadmium (Cd++)	g	0.00939912	0	0.00000504	0.000919664	0.000037415	0.000002151	0.000015147	0.0000254	0.0000714	0.00810166	0.000206465	0.0000148
(w) Calcium (Ca++)	g	6.24137	0	0.242141	0	0.0000927	0.10321976	0.6733922	0.327419	0.824895	0	0.0637726	4.00644
(w) Carbonates (CO3--, HCO3-, CO2, as C)	g	0.0117019	0	0.000961418	0	0	0.000409842	0.002673924	0.00130001	0.00327523	0	0.000253138	0.0028283
(w) Cesium (Cs++)	g	0.0000811	0	0.00000666	0	0	0.000002838	0.00001849	0.00000901	0.0000227	0	0.00000175	0.0000196
(w) Chlorides (Cl-)	g	4122.72	0	13.5014	267.832	9.505952915	5.756264	83.37081	20.8424	53.5373	2359.43	58.2361	1250.7
(w) Chlorinated Matter (unspecified, as Cl)	g	0.429693	0	0.0133354	0.0270521	2.31099E-05	0.005684627	0.03708884	0.018033	0.0454326	0.238312	0.0055004	0.0392303
(w) Chloroform (CHCl3)	g	0.000000174	0	1.43E-08	0	0	6.099E-09	3.98E-08	1.93E-08	4.87E-08	0	3.77E-09	4.21E-08
(w) Chromium (Cr III)	g	0.00075637	0	0.0000621	0	0	0.00002649	0.000172876	0.000084	0.000211701	0	0.0000164	0.00018281
(w) Chromium (Cr III, Cr VI)	g	3.72037	0	0.0000425	0.372706	0.00439468	0.000018116	0.000229	0.00430066	0.0125208	3.28331	0.042724	0.000125
(w) Chromium (Cr VI)	g	1.42E-08	0	1.17E-09	0	0	4.973E-10	3.252E-09	1.58E-09	3.98E-09	0	3.07E-10	3.43E-09
(w) Cobalt (Co I, Co II, Co III)	g	0.0000467	0	0.00000384	0	0	1.6353E-06	0.00001067	0.00000519	0.0000131	0	0.00000101	0.0000113
(w) COD (Chemical Oxygen Demand)	g	252.814	0.0161517	0.0149958	24.8722	0.01961779	0.003864501	6.3621123	0.108412	0.367733	219.109	1.89199	0.0486642
(w) Copper (Cu+, Cu++)	g	0.947456	0	0.0000292	0.0941176	0.00214116	0.000012432	0.000357976	0.00178951	0.00520375	0.829118	0.0146008	0.0000858
(w) Cyanides (CN-)	g	0.0237786	0	0.00151518	0.000500168	0.0001103	0.00064616	0.004214003	0.00205416	0.00517734	0.00440617	0.000696848	0.00445814
(w) Dissolved Matter (unspecified)	g	387.319	11.3383	5.74993	17.6998	14.48939	0.3428676	19.31023	10.1748	68.657	155.924	64.2588	19.3739
(w) Dissolved Organic Carbon (DOC)	g	1.0865	0	0.00471916	0.0984202	0.01165284	0.002011686	0.01312505	0.0066853	0.0169637	0.86702	0.0520202	0.0138828
(w) Edetic Acid (C10H16N2O8, EDTA)	g	0.0000225	0	0.00000185	0	0	7.865E-07	0.00000513	0.0000025	0.00000629	0	0.000000486	0.00000543
(w) Ethylbenzene (C6H5C2H5)	g	0.00196256	0	0.000161243	0	0	0.00006876	0.000448453	0.00021803	0.000549302	0	0.0000425	0.00047435
(w) Fluorides (F-)	g	0.0670534	0	0.00316868	0	0.010219312	0.001401732	0.02200019	0.00428463	0.0107946	0	0.00574302	0.00944112
(w) Formaldehyde (CH2O)	g	2.21E-09	0	1.81E-10	0	0	7.731E-11	5.05E-10	2.45E-10	6.18E-10	0	4.77E-11	5.33E-10

	(w) Halogenous Matter (organic)	g	6.76E-10	0	0	0	5.68E-10	0	0	0	0	0	1.08E-10	0
	(w) Hexachloroethane (C2Cl6)	g	3.07E-13	0	2.52E-14	0	0	1.0755E-14	7.02E-14	3.41E-14	8.59E-14	0	6.64E-15	7.42E-14
	(w) Hydrazine (N2H4)	g	0.0000103	0	0.000000848	0	0	3.616E-07	0.000002357	0.00000115	0.00000289	0	0.000000223	0.00000249
	(w) Hydrocarbons (unspecified)	g	0.71653	0	0.00000561	0	-0.1395719	0.000339993	0.88133454	0.00000758	0.0000191	0	-0.0264119	0.00080772
	(w) Inorganic Dissolved Matter (unspecified)	g	36.318	0	0.000104554	0	7.560415275	0.000269594	0.084270269	0.000141377	0.000356182	0	28.6715	0.00095255
	(w) Iodine (I-)	g	0.00813061	0	0.000668006	0	0	0.000284783	0.001857871	0.000903267	0.00227568	0	0.000175884	0.00196514
	(w) Iron (Fe++, Fe3+)	g	311.076	0	0.0164835	31.1395	0.558957528	0.007026579	0.046423209	0.166157	0.47577	274.319	4.29761	0.0484912
	(w) Lead (Pb++, Pb4+)	g	0.957245	0	0.000593515	0.0914286	0.02509191	0.000253057	0.001761498	0.00257631	0.00719541	0.805429	0.0205232	0.0023934
	(w) Lithium Salts (Lithine)	g	0.00000115	0	9.48E-08	0	0	4.042E-08	2.637E-07	0.000000128	0.000000323	0	0.000000025	2.79E-07
	(w) Magnesium (Mg++)	g	0.137969	0	0.0113338	0	0.0000362	0.004831356	0.03149956	0.0153253	0.0386104	0	0.00299103	0.0333417
	(w) Manganese (Mn II, Mn IV, Mn VII)	g	0.0332917	0	0.00273521	0	0.000000362	0.001165961	0.007606998	0.0036985	0.00931795	0	0.00072024	0.00804644
	(w) Mercury (Hg+, Hg++)	g	0.00842352	0	3.28E-08	0.000849748	3.3555E-06	1.3967E-08	1.1992E-06	0.00000289	0.0000084	0.00748575	0.000072	9.64E-08
	(w) Metals (unspecified)	g	25.9577	0	0.0000946	2.02218	-0.0222089	0.000377992	5.4053248	0.0407389	0.118771	17.8142	0.577001	0.00123412
	(w) Methane (CH4)	g	0.0303096	0	0.00249022	0	0	0.001061517	0.00692587	0.00336724	0.00848337	0	0.000655668	0.00732574
	(w) Methylene Chloride (CH2Cl2)	g	0.000498923	0	0.000041	0	0	0.000017453	0.000114	0.0000554	0.000139644	0	0.0000108	0.00012059
	(w) Molybdenum (Mo II, Mo III, Mo IV, Mo V, Mo VI)	g	0.000761895	0	0.0000626	0	1.81E-08	0.00002669	0.000174106	0.0000846	0.000213244	0	0.0000165	0.00018415
	(w) Morpholine (C4H9NO)	g	0.000109278	0	0.00000898	0	0	0.000003823	0.00002492	0.0000121	0.0000306	0	0.00000236	0.0000264
	(w) Nickel (Ni++, Ni3+)	g	0.959398	0	0.000117072	0.0951933	0.00218052	0.00004989	0.000602545	0.00192297	0.00554577	0.838593	0.0148478	0.0003444
	(w) Nitrate (NO3-)	g	4.22874	0	0.00226632	0.416807	0.00894006	0.000989758	0.009381236	0.00416444	0.0109288	3.67181	0.0967316	0.006723
	(w) Nitrite (NO2-)	g	0.000013	0	0.00000107	0	0	4.544E-07	0.000002961	0.00000144	0.00000363	0	0.000000281	0.00000314
	(w) Nitrogenous Matter (Kjeldahl, as N)	g	0.00459842	0	0.000377804	0	0	0.00016117	0.001050757	0.00051086	0.00128705	0	0.0000995	0.00111142
	(w) Nitrogenous Matter (unspecified, as N)	g	1.5028	0	0.00376581	0.113479	0.026266	0.00161654	0.2657784	0.00609732	0.0157609	0.999679	0.0592561	0.0111046
	(w) Oils (unspecified)	g	26.4438	0.146542	0.0821646	2.15319	0.57086866	0.009766867	0.72441587	0.16441	0.974844	18.9683	2.35637	0.292932
	(w) Organic Dissolved Matter (unspecified)	g	0.0439811	0	0.000059	0	0.0152747	0.000059	0.024753945	0.0000798	0.000200988	0	0.00330104	0.00025269
	(w) Oxalic Acid ((COOH)2)	g	0.0000449	0	0.00000369	0	0	1.5727E-06	0.00001027	0.00000499	0.0000126	0	0.000000972	0.0000109
	(w) Phenol (C6H5OH)	g	0.147611	0	0.000880312	0.00968067	0.00496112	0.000376295	0.030350439	0.00130781	0.00334153	0.0852807	0.00884069	0.00259202
	(w) Phosphates (PO4 3-, HPO4--, H2PO4-, H3PO4, as P)	g	8.50032	0	0.000046	0.849408	-0.00198283	0.000042101	0.0469189	0.00873839	0.0254623	7.48276	0.0887455	0.00018805
	(w) Phosphorous Matter (unspecified, as P)	g	0.000610597	0	0	0	0.0000477	0	0.000553865	0	0	0	0.00000906	0
	(w) Phosphorus (P)	g	0.000357762	0	0.0000294	0	0	0.000012539	0.0000818	0.0000397	0.000100134	0	0.00000774	0.0000865
	(w) Phosphorus Pentoxide (P2O5)	g	0.000433932	0	0.0000357	0	0	0.000015197	0.0000992	0.0000482	0.000121453	0	0.00000939	0.00010488
	(w) Polycyclic Aromatic Hydrocarbons (PAH, unspecified)	g	0.0101569	0	0.0000985	0.000822857	0.000165297	0.00004205	0.000274067	0.000143564	0.000365795	0.00724886	0.000706025	0.00028987
	(w) Potassium (K+)	g	0.380268	0	0.0312417	0	0.0000181	0.013317704	0.0868792	0.0422445	0.10643	0	0.00822928	0.0919069
	(w) Rubidium (Rb+)	g	0.000812559	0	0.0000668	0	0	0.00002842	0.000185665	0.0000903	0.000227427	0	0.0000176	0.00019639
	(w) Salts (unspecified)	g	1312.96	0	0.0221678	132.303	0	0.009449662	0.0616536	1.45409	4.22919	1165.5	9.30836	0.0652132
	(w) Saponifiable Oils and Fats	g	0.396533	0	0.0325789	0	0	0.013887701	0.0906093	0.0440526	0.110986	0	0.00857792	0.0958407
	(w) Selenium (Se II, Se IV, Se VI)	g	0.000668199	0	0.0000549	0	1.81E-08	0.00002339	0.000152717	0.0000742	0.000187019	0	0.0000145	0.0001615
	(w) Silicon Dioxide (SiO2)	g	0.000178969	0	0.0000147	0	0	0.000006267	0.0000409	0.0000199	0.0000501	0	0.00000387	0.0000433
	(w) Silver (Ag+)	g	0.0000488	0	0.00000401	0	0	0.000001708	0.00001114	0.00000542	0.0000136	0	0.00000105	0.0000118
	(w) Sodium (Na+)	g	717.35	0	2.73366	0	0.050232791	1.1653005	13.788834	3.6964	9.31266	0	0.729791	685.873
	(w) Strontium (Sr II)	g	0.536271	0	0.0440596	0	0.00000128	0.018781752	0.122539014	0.0595767	0.150097	0	0.011601	0.129615
	(w) Sulphate (SO4--)	g	1697.89	0	2.14445	165.647	4.8581997	0.9141349	11.848831	4.52959	12.0593	1459.25	30.326	6.3177
	(w) Sulphide (S--)	g	0.0262249	0	0.000110524	0.00217815	0.000586065	0.00004776	0.001414886	0.00017458	0.000449819	0.0191882	0.00174822	0.00032669
	(w) Sulphite (SO3--)	g	0.0000271	0	0.00000223	0	0	9.489E-07	0.00000619	0.00000301	0.00000758	0	0.000000586	0.00000655
	(w) Sulphurated Matter (unspecified, as S)	g	0.0000026	0	4.37E-08	0	0.00000202	1.8582E-08	-2.154E-07	5.91E-08	0.000000149	0	0.000000395	1.29E-07
	(w) Suspended Matter (organic)	g	-0.162154	0	0	0	-0.119169	0.000281334	-0.02129166	0	0	0	-0.0226341	0.00065936
	(w) Suspended Matter (unspecified)	g	134.369	0.00539102	0.367956	12.0017	1.591817748	0.15720456	3.168381	0.570494	1.48614	105.727	6.9089	2.384
	(w) Tars (unspecified)	g	0.00000305	0	7.99E-10	0	0.00000256	3.409E-10	2.222E-09	1.08E-09	2.72E-09	0	0.000000486	2.35E-09
	(w) Tetrachloroethylene (C2Cl4)	g	7.51E-10	0	6.17E-11	0	0	2.63E-11	1.714E-10	8.34E-11	2.1E-10	0	1.62E-11	1.81E-10
	(w) Tin (Sn++, Sn4+)	g	0.00000248	0	0.000000204	0	0	8.694E-08	0.000000568	0.000000276	0.000000695	0	5.37E-08	0.0000006
	(w) Titanium (Ti3+, Ti4+)	g	0.002268	0	0.000186338	0	0	0.00007939	0.000518248	0.000251963	0.000634792	0	0.0000491	0.00054817
	(w) TOC (Total Organic Carbon)	g	78.5735	0	0.111464	7.31429	0.9363137	0.04751482	0.8639444	0.177854	0.458864	64.4343	3.90102	0.327905

(w) Toluene (C6H5CH3)	g	0.101595	0	0.000780475	0.00849748	0.001629456	0.000332541	0.002170674	0.00115241	0.00294193	0.0748575	0.00693639	0.002296
(w) Tributyl Phosphate ((C4H9)3PO4, TBP)	g	0.000425632	0	0.000035	0	0	0.000014917	0.0000972	0.0000473	0.00011913	0	0.00000921	0.00010287
(w) Trichlorethane (1,1,1-CH3CCl3)	g	1.69E-09	0	1.39E-10	0	0	5.93E-11	3.869E-10	1.88E-10	4.74E-10	0	3.66E-11	4.09E-10
(w) Trichloroethylene (CHClCl2)	g	4.66E-08	0	3.83E-09	0	0	1.6308E-09	1.064E-08	5.17E-09	0.000000013	0	1.01E-09	1.13E-08
(w) Triethylene Glycol (C6H14O4)	g	0.0574389	0	0.00471914	0	0	0.002011671	0.013125	0.00638115	0.0160766	0	0.00124254	0.0138828
(w) Vanadium (V3+, V5+)	g	0.00251408	0	0.000206554	0	1.81E-08	0.00008806	0.000574463	0.000279299	0.000703662	0	0.0000544	0.00060764
(w) VOC (Volatile Organic Compounds)	g	0.0283873	0	0.00233228	0	0	0.00099426	0.0064866	0.00315367	0.00794531	0	0.000614082	0.00686111
(w) Water (unspecified)	litre	14.2399	0	1.12301	0	0	0.478715	3.123336	1.51851	3.82571	0	0.295684	3.8749
(w) Water: Chemically Polluted	litre	2719.8	0	0.278775	268.908	0.549822828	13.52263	9.506846	1.28752	3.6055	2368.91	19.1075	34.1296
(w) Xylene (C6H4(CH3)2)	g	0.0769621	0	0.00632316	0	0	0.002695427	0.0175861	0.00855007	0.0215409	0	0.00166487	0.0186015
(w) Zinc (Zn++)	g	1.60038	0	0.000255638	0.158118	0.00440049	0.00010889	0.001264852	0.00386043	0.0111223	1.39292	0.0275805	0.00075204
(wr) Radioactive Substance (unspecified)	kBq	5189.29	0	6.68E-08	514.689	21.25270159	2.852E-08	0.000000186	0.783082	2.28399	4534.09	116.189	1.97E-07
(wr) Radium (Ra224)	kBq	0.00406279	0	0.000333796	0	0	0.00014221	0.000928363	0.000451354	0.00113713	0	0.0000879	0.00098196
(wr) Radium (Ra226)	kBq	3.12083	0	0.256405	0	0	0.1093003	0.713122	0.346707	0.873489	0	0.0675108	0.754294
(wr) Radium (Ra228)	kBq	0.00812559	0	0.000667594	0	0	0.000284688	0.001856731	0.000902709	0.00227427	0	0.000175775	0.00196393
(wr) Thorium (Th228)	kBq	0.0162512	0	0.00133519	0	0	0.000569077	0.003713464	0.00180542	0.00454856	0	0.000351552	0.00392787
_(SE) Electricity	MJ	282.387	0	0	0	0	0	123.866	0	0	0	0	158.521
_(SE) Waste (fuel energy)	MJ	1164.12	0	0	0	0	0	0	0	0	0	0	1164.12
_(SM) ABS	kg	0.933953	0	0	0	0	0.285926	0	0	0	0	0	0.648027
_(SM) Aluminium (sheet)	kg	37.5007	0	0	0	7.87111	0	0	0	0	0	29.6296	0
_(SM) Copper	kg	4.71593	0	0	0	0.755938	0	0	0	0	0	3.95999	0
_(SM) Ferrous (steel plate)	kg	531.345	0	0	53.7815	0	0	0	0	0	473.782	3.78151	0
_(SM) Glass	kg	28.0165	0	0	0	0	0	28.0165	0	0	0	0	0
_(SM) Lead	kg	6.25161	0	0	0	5.25375	0	0	0	0	0	0.997863	0
_(SM) Other Metals	kg	0.53293	0	0	0	0.0746364	0	0	0	0	0	0.458294	0
_(SM) Other Plastics	kg	1.50511	0	0	0	0	0.450135	0	0	0	0	0	1.05497
_(SM) PA66	kg	1.06193	0	0	0	0	0.18438	0	0	0	0	0	0.877548
_(SM) PE	kg	0.550025	0	0	0	0	0.18438	0	0	0	0	0	0.365645
_(SM) PP	kg	3.40953	0	0	0	0	1.0694	0	0	0	0	0	2.34013
_(SM) PUR	kg	1.25866	0	0	0	0	0.367619	0	0	0	0	0	0.891037
_(SM) PVC	kg	1.0558	0	0	0	0	0.326773	0	0	0	0	0	0.72903
_(SM) Rubber	kg	3.1	0	0	0	0	0	3.1	0	0	0	0	0
_(SM) Total	kg	622.01	0	0	53.7815	14.0855914	2.868613	31.1165	0	0	473.782	39.47	6.90639
_(SM) Total: Ferrous	kg	531.345	0	0	53.7815	0	0	0	0	0	473.782	3.78151	0
_(SM) Total: Non Ferrous	kg	49.7741	0	0	0	14.0855914	0	0	0	0	0	35.6885	0
_(SM) Total: Other	kg	31.1165	0	0	0	0	0	31.1165	0	0	0	0	0
_(SM) Total: Plastics	kg	9.775	0	0	0	0	2.868613	0	0	0	0	0	6.90639
_(SM) Zinc	kg	0.772909	0	0	0	0.130157	0	0	0	0	0	0.642752	0
_(SP) ABS Product	kg	0.35	0	0	0	0	0.35	0	0	0	0	0	0
_(SP) Aluminium Product (cast)	kg	14.5992	0	0	0	14.5992	0	0	0	0	0	0	0
_(SP) Coolant	kg	3	0	0	0	0	0	3	0	0	0	0	0
_(SP) Copper Product (wire)	kg	3.0401	0	0	0	3.0401	0	0	0	0	0	0	0
_(SP) Ferrous Product (cast)	kg	96	0	0	96	0	0	0	0	0	0	0	0
_(SP) Fluids (unspecified)	kg	3.03282	0	0	0	0	0	3.03282	0	0	0	0	0
_(SP) Glass Product	kg	6.9168	0	0	0	0	0	6.9168	0	0	0	0	0
_(SP) Lead Product	kg	2.682	0	0	0	2.682	0	0	0	0	0	0	0
_(SP) Lubricant	kg	5.36576	0	0	0	0	0	5.36576	0	0	0	0	0
_(SP) Other Materials Product	kg	1.6	0	0	0	0	0	1.6	0	0	0	0	0
_(SP) Other Metals Product	kg	0.286	0	0	0	0.286	0	0	0	0	0	0	0
_(SP) Other Plastics Product	kg	0.55	0	0	0	0	0.55	0	0	0	0	0	0
_(SP) PA66 Product	kg	0.25	0	0	0	0	0.25	0	0	0	0	0	0
_(SP) PE Product	kg	0.25	0	0	0	0	0.25	0	0	0	0	0	0
_(SP) PP Product	kg	1.45	0	0	0	0	1.45	0	0	0	0	0	0
_(SP) PUR Product	kg	0.45	0	0	0	0	0.45	0	0	0	0	0	0
_(SP) PVC Product	kg	0.4	0	0	0	0	0.4	0	0	0	0	0	0
_(SP) Rubber Product (tyre)	kg	18.8	0	0	0	0	0	18.8	0	0	0	0	0

	_(SP) Total	kg	159.361	0	0	96	20.9453	3.7	38.71538	0	0	0	0	0
	_(SP) Total: Ferrous	kg	96	0	0	96	0	0	0	0	0	0	0	0
	_(SP) Total: Fluids	kg	11.3986	0	0	0	0	0	11.39858	0	0	0	0	0
	_(SP) Total: Non Ferrous	kg	20.9453	0	0	0	20.9453	0	0	0	0	0	0	0
	_(SP) Total: Other	kg	27.3168	0	0	0	0	0	27.3168	0	0	0	0	0
	_(SP) Total: Plastics	kg	3.7	0	0	0	0	3.7	0	0	0	0	0	0
	_(SP) Zinc Product (wire)	kg	0.338	0	0	0	0.338	0	0	0	0	0	0	0
	_Recovered Matter: Steel Scrap	kg	17.7173	0	0	1.79092	0	0	0	0.0060097	0.0175283	15.7769	0.125924	0
	Iron Scrap	kg	0	0	0	0	0	0	0	0	563.8	0	0	0
	Recovered Energy	MJ	1322.64	0	0	0	0	0	0	0	0	0	0	1322.64
	Recovered Matter (total)	kg	77.5424	0	0.0022825	7.27664	1.124300979	0.192041	0.02885804	0.0974386	0.28297	64.1026	3.96926	0.466008
	Recovered Matter (unspecified)	kg	57.5608	0	0.0022606	5.48571	0.644638013	0.1918077	0.02879714	0.103419	0.300423	48.3257	2.01265	0.465419
	Recovered Matter: Aluminium Scrap	kg	2.23504	0	0	0	0.469118	0	0	0	0	0	1.76593	0
	Recovered Matter: Carbon Monoxide (CO)	kg	0.406204	0	0	0	0.0662697	0	0	0	0	0	0.339934	0
	Recovered Matter: Iron Scrap	kg	0.00101511	0	0.0000219	0	0	0.000233195	0.0000609	0.0000296	0.0000746	0	0.00000577	0.00058908
	Waste (hazardous)	kg	6.12626	0	0.000196147	0	0.000135519	0.00008366	0.044746292	0.000265226	0.000668207	0	0.0000774	6.08009
	Waste (incineration)	kg	0.000923096	0	0.0000758	0	0	0.0000323	0.000210928	0.000102551	0.000258365	0	0.00002	0.00022311
	Waste (municipal and industrial)	kg	95.1819	0	0.000186361	0	0.081681167	0.4295441	0.07706233	0.000251995	0.000634871	0	78.6631	15.9294
	Waste (total)	kg	184.503	0.00140124	0.638591	0.55075	4.6837319	0.7030227	17.7314982	0.885215	2.24399	4.85176	126.792	25.4216
	Waste (unspecified)	kg	55.6024	0.00140124	0.212808	0.00217834	1.87690893	0.09202494	3.01378381	0.297276	0.7579	0.0191898	47.199	2.12992
	Waste: Highly Radioactive (class C)	kg	0.0000287	0	0.00000236	0	0	0.000001007	0.00000657	0.00000319	0.00000805	0	0.000000622	0.00000695
	Waste: Intermediate Radioactive (class B)	kg	0.000219564	0	0.000018	0	0	0.000007693	0.0000502	0.0000244	0.0000615	0	0.00000475	0.0000531
	Waste: Low Radioactive (class A)	kBq	0.00284981	0	0.000234139	0	0	0.00009978	0.000651193	0.000316599	0.000797634	0	0.0000616	0.00068879
	Waste: Mineral (inert)	kg	10.8246	0	0.370426	0.548571	0.40441057	0.15792034	1.13565894	0.513085	1.29751	4.83257	0.474604	1.08988
	Waste: Mining	kg	2.44373	0	0.200776	0	0	0.08558656	0.558403	0.271486	0.683977	0	0.0528637	0.590643
	Waste: Non Mineral (inert)	kg	0.457411	0	0.000016	0	0.375352	0.000006801	0.010601202	0.0000216	0.0000543	0	0.0712961	0.0000634
	Waste: Non Toxic Chemicals (unspecified)	kg	-0.00480986	0	4.96E-08	0	-0.004071381	9.01895E-06	4.0789E-06	0.000000067	0.000000169	0	-0.000773109	0.0000212
	Waste: Radioactive (unspecified)	kg	0.0000791	0	0.0000065	0	0	0.000002767	0.00001807	0.00000878	0.0000221	0	0.00000171	0.0000191
	Waste: Slags and Ash (unspecified)	kg	16.2838	0	0.0548311	0	1.949310861	0.02337901	13.44931137	0.0741417	0.186791	0	0.384681	0.161341
	Waste: Treatment	kg	0.136197	0	0.0111898	0	0	0.004769999	0.03112143	0.0151307	0.0381201	0	0.00294625	0.0329183
Rem:	E Feedstock Energy	MJ	5289.83	8565	10.9612	113.75	8.63186	4.469116	-394.3214	14.2141	35.9725	1002.07	300.276	-4371.19
	E Fuel Energy	MJ	14497.7	42.0617	52.4204	755.509	262.89257	14.621952	1070.8827	85.8877	377.309	6655.56	593.983	4586.54
	E Non Renewable Energy	MJ	19440.3	8509.24	63.2065	846.098	268.14947	19.018088	671.8983	99.7367	412.231	7453.59	882.373	214.805
	E Renewable Energy	MJ	347.138	97.8214	0.174482	23.1617	3.35507288	0.07271612	4.679556	0.364317	1.04838	204.04	11.8819	0.538123
	E Total Primary Energy	MJ	19787.5	8607.06	63.381	869.259	271.50446	19.090872	676.57925	100.101	413.28	7657.63	894.255	215.343
	Electricity	MJ elec	7196.38	0.118731	17.693	686.974	38.687223	8.229476	81.05373	24.8593	63.4385	6051.81	169.691	53.8196

Appendix B: Composition and mass of the generic ELV used in the study

Table B1 Composition and Mass of the Generic ELV used in the Study

Category	Material	Mass (kg)
Ferrous	Ferrous	727.4
Non Ferrous	Aluminium	56.1
	Copper	11.7
	Lead	10.3
	Zinc	1.3
	Other Metals	1.1
Plastics	Acrylonitrile Butadiene Styrene	8.6
	Polypropylene	36.1
	Polyethylene	6.0
	Polyamide 66	6.7
	Polyvinyl Chloride	10.0
	Polyurethane	11.7
	Other Plastics	14.0
Other	Rubber	41.8
	Glass	34.6
	Other Materials	48.9
Fluids	Coolant	6.0
	Lubricant	6.9
	Other Fluids (exc. Fuel)	3.9
	TOTAL	1043.1

Appendix C: Background information

C1 Introduction

Each option has the same format with respect to hierarchy, which consists of the following elements:

- The ELV disposal and processing chain;
- Production of materials and manufacture of products from primary (virgin) extraction;
- Derivation of fuel energy from ELV waste and generation of electricity.

The ELV disposal and processing chain (Appendix C, C2) results in the disposal of one ELV and the production of secondary materials, products, fuel energy (derived from waste from the ELV) and generated electricity (again, derived from waste from the ELV). In several cases, the amounts of each of these outputs varies between the options, depending on the level of recycling and recovery targets set within each.

In order to balance these outputs, and using the system boundaries expansion methodology discussed in Chapter 2, primary material and product systems (Appendix C, C3), and energy from fossil fuels and electricity generated using the fuel mix of the national grid (Appendix C, C4), are added. The contribution of each of these systems depends on the magnitude of the differences arising in the outputs of the ELV disposal chain.

Below is further explanation of each of these elements using the current practice (1997) option as an example, with a discussion of modelling differences arising from consideration of the 1995 ACORD plan and draft EC Directive 11034/971 in Sections C5 and C6.

C2 The ELV Disposal and Processing Chain

Modelling of the ELV disposal and processing chain for each option is broadly the same, except for adjustments to take account of the handling of fluff. In each case, there is an input of one ELV, with a composition as defined in Appendix B. Below is a description of the system for the current practice (1997) option. Differences arising for the other two options are highlighted further on in section C5 and C6.

The ELV system comprises the following elements, each of which is discussed in more detail below:

- Transport to dismantlers;
- Dismantlers;
- Transport and processing of removed materials and parts (e.g. ferrous, copper, glass)
- Scrapyards/feeder sites;
- Shredder;
- Ferrous transport and processing (from shredder);
- Non Ferrous transport and processing (from shredder);
- Fluff disposal to landfill.

Transport to Dismantlers

The transport characteristics for the vehicle towing the ELV, such as maximum load, fuel (assumed to be diesel) consumption and distance travelled (Appendix D) are specified here. The environmental inputs and outputs associated with fuel use (in a transport application) are also calculated here, including precombustion processes (extraction, piping, refining, electricity use, transport to delivery stations) and combustion in the engine.

Dismantlers

This details the energy and consumable requirements of the dismantling activity, such as use of oxy-propane equipment, electricity and fuel. The changing composition of the ELV due to the dismantling process is documented, according to removal rates for each option (Appendix D). Material that is removed from the ELV undergoes further transport and processing, which is modelled in the appropriate system dealing with the transport and subsequent processing e.g. ferrous, aluminium, polyethylene.

The dismantling stage also includes on-site mechanical and jib flattening or shearing (using diesel driven mobile equipment) where appropriate.

Transport and processing of removed materials and parts

Each material type is considered in a separate sub-system. The sub-systems for metals divide the material into ‘recovered’ and ‘reused’. No further processing of reused material (i.e. secondary product (SP)) is considered. Recovered material (i.e. secondary material (SM)) is assumed to be transported and processed into a form for further use, e.g. resmelting of metals.

Any plastic currently recovered from the ELV is assumed to be reused as reusable product only.

Rubber is treated as tyre and non-tyre rubber. Tyres are the only form of rubber removed at the dismantler. These are subsequently divided into four categories, *viz*:

- Reuse;
- Retreading;
- Incineration (with energy recovery);
- Other applications.

The proportion of tyres entering each of these routes is based on data provided by the BRMA and MVDA. Incineration of the tyres (with energy recovery) is assumed to take place at Elm Energy in Wolverhampton.

Glass and other materials are recovered as material only. Coolant, lubricant and other fluids are also recovered.

More detailed assumptions are provided in Appendix D.

Scrapyards/feeder sites

This considers the transport of ELV shells to the scrapyard (feeder site) and the subsequent crushing of the ELV, which may be by mechanical flattening (or flattening with the jib of a crane), baling or shearing. The proportion of ELVs that are crushed at a separate scrapyard is taken into account, as some ELVs are crushed at the dismantler whereas others are transported to the shredder in an uncrushed form.

Shredder

This deals with transport of crushed ELV shells from the dismantler and scrapyard, transport of uncrushed ELVs direct to the shredder, on-site transport and the shredding operation itself.

The processed ELV[15] forms three material outputs known as the ferrous, NFM and fluff fractions. Quantities of each arising from the shredder depend on the composition of the dismantled ELV.

Ferrous transport and processing

This deals with the transport of ferrous scrap from the shredder to a smelter, both within the UK and overseas, as well as the environmental inputs and outputs associated with the reprocessing of the material. Typical markets for UK ferrous scrap comprise Canada, USA, India and the Far East. For the purposes of this study, half of the ferrous scrap produced is assumed to be exported to Turkey, based on information provided by the industry.

Non ferrous transport and processing

The non ferrous fraction is transported to and processed in a heavy media separation plant (HMSP). Recovered metal is subsequently transported and resmelted into secondary material (SM). The location of the necessary plant to reprocess the recovered non ferrous metal has been based on industry responses. With the exception of aluminium, all non ferrous metals are assumed to be transported and reprocessed in the Far East. For aluminium, it is assumed that one third goes to the Far East, one third to North America and one third, to Europe.

The remainder of the NFM fraction from the HMSP is termed NFM waste which is landfilled.

Fluff to landfill

Fluff processing after shredding depends on the option. In 1997, fluff was typically landfilled.

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[15] Shredder infeed consists of other goods as well as ELVs, such as ‘white goods’ (refrigerators, washing machines, etc) and light iron amongst others. These goods (and their subsequent output to the ferrous, NFM fraction and fluff) are outside the system boundaries of this study.

C3 Production of materials and manufacture of products from primary (virgin) extraction

These systems comprise the production of materials from a primary source, and further processing to produce manufactured products. Each material and product modelled in the ELV disposal and processing chain has an equivalent primary material or product.

Where an option e.g. 1997 Current Practice, produces less material and/or product from ELV disposal and processing (in comparison with another option), the primary systems are used to 'top up' material and product levels in the deficient option, so that all modelled scenarios produce the same output (in mass terms for each material and product). The assumption is that if the material or product cannot be made from a secondary source, it must come from a primary source in order to satisfy demand.

Electricity use is based on a European average fuel mix, the rationale being that production of new materials and products would come from anywhere in Europe.

C4 Derivation of fuel energy from ELV waste and generation of electricity

A cement kiln and blast furnace within the ELV disposal and processing chain can derive energy from waste from the ELV (in the 1995 ACORD plan and draft EC[16] ELV Directive 11034/971 options). Where the energy derived from the waste in one option is less than the energy produced in an alternative option, energy is assumed to derive from combustion of coal and natural gas, each contributing half of the required amount in megajoules (MJ). This is used to supplement fuel energy derived from the waste such that total derived fuel energy is the same in all options.

Similarly, all options produce electricity due to the combustion of tyres at Elm Energy. The 1995 ACORD plan and draft EC ELV Directive 11034/971 options yield additional generated electricity through combustion of a mass of fluff (the amount varying depending on the option considered) in a MSW incinerator with energy recovery. Where there is a shortfall in the electricity generated, provision of electricity is assumed to derive from the UK fuel mix for 1996 supplying the grid. Consequently all scenarios are equal in generated electricity terms.

C5 The 1995 ACORD plan

The 1995 ACORD plan (ACORD; 1995) sets a recovery target of 82%. Some of this additional material recovery (when compared to current practices in 1997) is derived from activities at the dismantler. However, in order to meet the greater material recovery targets of the plan, recovery of plastics is assumed to take place through the further processing of fluff. It is assumed that this would be undertaken by separate facilities that would take fluff from several shredders (much like HMSP take the NFM fraction from different shredders at present). These facilities would sort the fluff and remove some plastics. Although such facilities did not exist at the time of the study, it was the opinion of parts of the industry that the technology was already possible and only the economics of such a process prevented it being commissioned. Assumptions regarding the process parameters are based on information provided by industry, and

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[16] Plus the 1996 draft of the ELV Directive, for reference.

detailed in Appendix D. All recovered plastics undergo reprocessing into a useful secondary material.

Any material that is not recovered or reused (i.e. the remainder of the fluff and NFM waste) is assumed to be combusted. This study considers three combustion alternatives, a third of the waste going to each (as a default option):

- Blast furnace;
- Cement kiln;
- MSW incinerator.

Average distances for the transport of waste were based on the distribution of shredders, and the above facilities in the UK (see Appendix D).

We have assumed that use of fluff in the blast furnace and cement kiln yields fuel energy. The net heat value of the fluff is highly dependent on the infeed material through the shredder. This is, in turn, dependent on how much and what has been removed at the dismantling stage. Literature sources have quoted a range of 12.6 - 27.0 MJ/kg (CCPCT; 1996) and 11-18 MJ/kg (SAE; 1997). We have adopted a figure of 13.7 MJ/kg for this option.

The MSW incinerator is assumed to generate electricity for the UK national grid, from the combustion of the fluff. The lower heat value of the fluff for this application is the same as for the blast furnace and cement kiln. The conversion from fuel energy to electrical energy is assumed to be 25%.

Some differences exist between the three combustion alternatives, namely;

- The blast furnace and MSW incinerator systems include the disposal of waste ash to landfill, and therefore take account of the associated transport and disposal implications. There is no waste ash from combustion in a cement kiln.
- In order to be suitable as a cement kiln fuel, the fluff fraction must undergo further processing after the shredding stage (Poll, 1996). This processing is likely to require further shredding, screening, magnetic and eddy current separation. Such a process would lead to some further metal recovery and generation of a fine (small size) fraction. Any recovered metal produced by this additional process step is transported and resmelted. The fine fraction is assumed to be landfilled. The removal of inerts is also assumed to increase the net heat value of the fluff from 13.7 MJ/kg to 17.4 MJ/kg.

C6 The draft EC ELV Directive 11034/971

The draft version of the ELV Directive requires a minimum of 85% material recovery and reuse plus a minimum 10% energy recovery for 2015[17] (EC; 1997). We have used the 85% and 10% levels, with the additional 5% remaining going to landfill.
We assume that fluff is processed using technology highlighted above for the 1995 ACORD plan. All additional recovery (when compared to the 1995 ACORD plan) is assumed to be material recovery.

Draft 11034/971 of the ELV Directive stipulates a percentage of material for energy recovery and a percentage to landfill. We have assumed that this distinction is made on the basis of the composition and properties of the waste. Thus, the fluff is divided into plastic of a suitable quality for material recovery and plastic available for energy recovery. Remaining inert material is landfilled. All NFM waste is assumed to go to landfill.

The combustion of tyres removed at the dismantler comprises part of the energy recovery target for the ELV.

Removal of inert material from waste for combustion increases the assumed lower heat value to 21.7 MJ/kg for this option, in comparison with equivalent figures for the 1995ACORD plan (13.7 MJ/kg and 17.4 MJ/kg).

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[17] The 1996 version of the draft ELV Directive stipulated a minimum of 90% material recovery and reuse with a minimum additional 5% energy recovery (EC; 1996).

All additional recovery (above that achieved by the 1995 ACORD plan) is assumed to be material recovery. The fluff fraction is divided into plastics that can be materially recovered, material of a sufficient net heat value for energy recovery, and inert material for landfilling. NFM waste is landfilled.

The combustion of tyres removed at the dismantler contributes to meeting the energy recovery target.

Shredder derived material that is combusted for energy recovery is assumed to have a lower heat value of 21.7 MJ/kg.

Appendix D: Assumptions used in the study

D1 Introduction

Below is a summary of major assumptions.

- All systems are in a steady state.
- Current fuel mix and process technologies are appropriate for extrapolation to 2015.
- The composition and weight of the ELV is as given in Appendix A.
- Vehicles registered in 1996 will become ELVs in 2015, i.e. no age structure is considered for the ELV due to insurance write offs and MOT failures.
- ‘Other metals’ is represented by brass.
- ‘Other plastics’ comprises polycarbonates (60%), polyethylene terephthalate (20%), polystyrene (10%) and polybutadiene (10%).
- ‘Other materials’ comprises composites (55%), lacquer, bitumen and wax (20.4%), wood (12.3%) and fabrics, fibre and felt (12.3%).
- An allowance is made for loss of rubber due to wear in the calculation of the mass of rubber in the ELV (0.6 kg from three tyres), based on BRMA data.
- Other fluids are oil based, e.g. clutch and brake fluid.
- Fuel is not considered in the composition of the ELV.

D2 1997 Current Practice Option

ELV – Transport to Dismantlers

Most ELVs are driven to dismantlers (the incentive being that the dismantler will pay less money for the ELV if he has to collect it). Those that are collected tend to be insurance write offs. Collections can be any distance, but generally the dismantler will only go far if the ELV is financially worth it. We have used the following:

- An average return distance of 40 miles;
- Dismantlers tend to use 7.5 tonne (gross vehicle weight) trucks that carry one vehicle;
- The truck uses diesel;
- Fuel consumption is 15-20 miles per gallon (mpg) (we assume 17 mpg);
- We assume that only 10% of ELVs arriving at the dismantlers have to be towed by the dismantler. Vehicles driven to the dismantler (or towed by another private vehicle) are outside the system boundaries of the study.

ELV – Dismantlers

This system deals with the actions of vehicle dismantlers. The default situation assumes 100% dismantling, although indications are that itinerant collectors may make up to 20% of the dismantling stage. Their affect would be to change the composition of the dismantled ELV.

The following dismantling rates have been applied, based on data supplied by members of ACORD;

Table D1 Recycling Rates used in the Study for the Current Practice (1997) Option

Material	Dismantler (kg)	Post Dismantler (kg)	Total Recycling (%)
Ferrous	132.1	566.2	96
Aluminium	23.1	27.4	90
Copper	4.3	6.2	90
Lead	9.0	0.3	90
Zinc	0.5	0.7	90
Other Metals	0.4	0.6	90
ABS	0.3	0.0	3
PP	1.2	0.0	3
PE	0.2	0.0	3
PA66	0.2	0.0	3
PVC	0.3	0.0	3
PUR	0.4	0.0	3
Other Plastics	0.5	0.0	3
Rubber	19.2*	0.0	46*
Glass	0.5	0.0	1
Other Materials	1.6	0.0	3
Lubricant	4.6	0.0	67
Coolant	3.0**	0.0	50
Other Fluids	3.9	0.0	100

Virtually all rubber removed from an ELV by the dismantler consists of tyres (of which there are assumed to be five). Two of the five are reused (MVDA). The three tyres remaining are reused or recovered according to statistics provided in a report for the Tyre Industry/Government Used Tyre Working Group (reported to DTI). The tyres are retreaded, recycled and used in other applications, such as boat fenders. Additional recovery (as energy recovery at Elm Energy in Wolverhampton) is excluded from the Dismantler column of the above table (which has the effect of taking total recovery (material and energy) at the dismantlers from 46% to 57%.

** Remainder of coolant disposed to wastewater (50%).

The net loss of material and products at the dismantling stage using the figures above is 20.4% (compared to an MVDA figure of 21.4%).

Electricity is used for air chisels, cutting equipment, and mechanical flattening, etc. This figure is varies according to the dismantler, and most electricity use is for heating and lighting (which is outside the system boundaries of this study). We assume that only 25% of electricity is used in applications concerning the dismantling of an ELV.

The same approach as above is adopted for water use, which is used for steam cleaning, etc.

An oxygen cylinder is replaced every two weeks, and a propane cylinder every six months. Quantities of gas in each cylinder obtained from BOC. Manufacture of the gas cylinders and transport to and from the dismantlers of full and empty cylinders is not considered (as oxygen used is less than 0.1% of ELV mass).

Cleaning of reusable products, i.e. secondary products (SP), prior to reuse is not considered as quantity of cleaning material used is negligible (less than 0.1% of ELV weight).

Secondary products are used once.

10% of ELVs are crushed at the dismantler using either an electrically driven mechanical flattener or a diesel driven mobile shear. We assume a ratio of 4:1 respectively as the scale of operation for mobile shearing is low, and usually restricted to those dismantlers in remote locations where the economics of bulking up loads for transport are more favourable, given the distance to a suitable shredder. No allowance is made for fuel used by mobile shear operators.

ELV – Removal and processing of material from the dismantlers

50% of recovered ferrous is smelted in the UK, with the other 50% exported overseas. Transport to the UK smelter (and the port for exports) is by diesel truck carrying a 22 tonne load, covering a 40 mile journey at 6 mpg. The trucks return empty 50% of the time.

Exported ferrous goes by ship to Turkey (8200 km, one way only as we assume the ship returns with another cargo).

Recovered aluminium is exported to Europe, the Far East and North America (in equal amounts by mass).

Aluminium transported to Europe goes in bulkers carrying 22 tonne loads, travelling 350 miles at 6 mpg. They return to the UK loaded.

Aluminium destined for the Far East or North America travels 40 miles to a UK port in lorries of the same specification as above, except that 50% of the time, they return unloaded. Shipping distance to the Far East and North America taken as 21 500 km and 6 100 km respectively.

Lead recovered at the dismantler is mainly from batteries that are sent to a UK smelter for processing.

All copper, zinc and other metals are exported to the Far East using transport assumptions provided above (for the Far East only).

Tyres that are sent from the dismantler for retreading travel in diesel lorries carrying 20 tonne loads, covering 80 miles. Retreading involves the removal of old rubber from the tyre, which is used in other applications (e.g. underlay). The mass of new rubber applied to the tyre is based on BRMA data.

Tyres that are sent to the Elm Energy incinerator plant in Wolverhampton are transported in lorries with the same characteristics as above.

Glass is transported 100 miles (in lorries with the same characteristics as above) to a cullet processor.

Used oil is collected in a 3 500 gallon tanker (NAWDC News; 1993) which is assumed to be 75% full. Lubricant density taken as 0.89 kg/l. Annual transport distance is 40 000 miles (NAWDC News, as above) with a fuel consumption of 9 mpg. Recycling of used oil is interpreted as conversion to base oil.

Coolant is drained and is at 20% strength in water. Half is recovered following MVDA recommendations. These state that the coolant solution is held in a tank, where it can be made up to a particular solution strength and given or sold to customers on site. In this way, it is ‘reused’.

Fuel is not considered in the reference composition of the ELV.

ELV – Scrapyards/feeder sites

The default scenario considers that 10% of ELVs are crushed at the dismantlers, 80% crushed at an appropriate dedicated site, with the remainder going to the shredder unflattened. This division is based on discussion with members of the industry.

The uncrushed ELVs are transported on diesel lorries carrying 7 tonne loads, travelling 10 miles doing 10 mpg. They are assumed to return empty 75% of the time.

Four fifths of the process (be it shearing, flattening or baling) is electrically driven, with the remainder being diesel driven. Diesel use during jib flattening with a crane is assumed to be negligible.

An allowance has been made for wear and tear on blades (based on information provided by the industry).

ELV – Shredder

- Transport of crushed ELVs from the dismantler and scrapyard has the following characteristics:
- Distance from the dismantler to the shredder is 25 miles;
- Distance from the scrapyard to the shredder is 20 miles;
- A truck carrying uncrushed ELVs carries a 7 000 kg load;
- A truck carrying crushed ELVs carries a 17 500 kg load (this is based on a load of 20 tonnes for mechanically flattened ELVs and 15 tonnes for crane flattened ELVs, each of which is estimated (by the industry) to contribute 40% each to ELV processing.
- Fuel consumption of a truck with a 7 000 kg load is 10 mpg;
- Fuel consumption of a truck with a 17 500 kg load is 6 mpg;
- Trucks return to the dismantlers empty 50% of the time;
- Trucks return to the scrapyard empty 75% of the time.

Consumables used by the shredder (such as water, electricity, on-site use of diesel, etc) are based on confidential site data obtained from the industry. Most shredders in the UK are ‘dry’. These shredders still use some water to reduce the risk of explosion, almost all of which evaporates.

Atmospheric emissions are based on literature values (AEA Technology; 1996).

The composition of each fraction produced by the shredder is as follows. Ultimately, the shredder output composition is heavily dependent on the infeed composition. Literature data are primarily concerned with a typical shredder infeed, i.e. ELVs mixed with white goods and light iron.

Table D2 Assumed Percentage Composition of the Fractions arising from the Shredder as a result of the Dismantled Generic ELV Infeed for the 1997 Current Practice Option

Material	Ferrous Fraction	Non Ferrous Fraction	Fluff Fraction
Ferrous	94.2	0.9	4.9
Aluminium	1.2	81.8	17.0
Copper	9.5	74.3	16.2
Lead	0.0	23.1	76.9
Zinc	0.0	87.5	12.5
Other Metals	0.0	85.7	14.3
Plastics	0.0	21.5-31.5	68.5-78.5
Rubber	3.4	90.0	6.6
Glass	0.0	41.6	58.4
Other Materials	4.7	39.7	55.6
Lubricant	0.0	47.8	52.2

Maximum recovery for ferrous and non ferrous metals is 96% and 90% respectively, in line with data provided by CARE.

Ferrous composition is 99.2% ferrous and 0.8% impurities, in line with data provided by the industry.

Plastics in the NFM fraction total 22%, compared to an industry figure of 20%. Ferrous in the NFM fraction totals 5%, in agreement with the industry figure. Non ferrous metals total 30%, compared to the industry figure of 35%.

ELV – Ferrous transport and processing

Assumptions for processing of the ferrous scrap are assumed to be the same as provided in the *Removal and processing of material* section above.

ELV – Non Ferrous Fraction transport and processing

The NFM fraction is assumed to go to an HMSP. Transport characteristics to the HMSP are as follows:

- Distance to HMSP is 45 miles;
- Fuel consumption is 6 mpg;
- Maximum load is 22 tonnes;
- The return journey is empty 40% of the time.

Consumable values are based on confidential site data.

100% of metals are extracted from the NFM fraction. These are processed assuming the same transport and processing scenarios as in the *Removal and processing of material* section above.

Lead from the HMSP is exported to the Far East and has the same transport characteristics as the other non ferrous metals in the *Removal and processing of material* section above.

NFM waste is transported in 20 tonne loads (using diesel lorries travelling 40 miles, doing 6 mpg) to landfill. All return journeys are empty.

ELV - Fluff fraction to landfill

Treated in the same way as the NFM waste in the *Non ferrous fraction transport and processing* section above.

D3 The 1995 ACORD Plan

With the exception of the following case, assumptions used in modelling this option are the same as the 1997 Current Practice option:

ELV - Dismantlers

Recovery rates for this option always match or improve on the recovery rates of the 1997 Current Practice option.

Removal rates are based on the 1995 ACORD Implementation Plan (ACORD; 1995), modified where applicable due to the above assumption. 19% of the ELV is reused, all of which occurs at the dismantling stage, together with an additional 6% material recovery. The following interpretation is used;

- 4% of plastics are reused, and 4% recovered.
- Rates of recovery for rubber, other materials and fluids are the same as the 1997 Current Practice option.
- 15% of glass is made available for flat glass production, and 42% for other applications.

Table D3 summarises the recycling targets as set by ACORD.

Table D3 Recycling Rates used in the Study for the 1995 ACORD Plan*

Material Category	Dismantler (kg)	Post Dismantler (kg)	Total Recycling (%)
Ferrous	160	560.1	99
Aluminium	23.1	31.9	98
Copper	4.3	7.2	98
Lead	9.0	1.1	98
Zinc	0.5	0.8	98
Other Metals	0.4	0.7	98
ABS	0.7	0.8	17
PP	2.9	3.2	17
PE	0.5	0.5	17
PA66	0.5	1.2	17
PVC	0.8	0.9	17
PUR	0.9	1.1	17
Other Plastics	1.1	1.3	17
Rubber	19.2**	0.0	46
Glass	19.7	0.0	57
Other Material	1.6	0.0	3
Lubricant	4.6	0.0	67
Coolant	3.0	0.0	50
Other Fluids	3.9	0.0	100

* Recovery of some materials are greater than stipulated in the ACORD Plan (notably rubber and fluids) due to changes in practices in the intervening time between publication of the plan and practices in 1997. This is explored further below.

** Actual recovery at the dismantlers is 24 kg, the difference being that which goes to energy recovery.

Products and material removed from the ELV for reuse and recovery respectively at the dismantling stage are in accordance with ACORD figures, except where this is contrary to the assumption that levels of recovery are at least equivalent to rates achieved in the 1997 Current Practice option. Due to this amendment, actual reuse and recycling for the ACORD plan increases from 82% to 83.5% (due mainly to greater recovery of rubber and fluids in the 1997 Current Practice option). This approach was discussed with ACORD and agreed since it was decided that the plan should be considered in the context of more recent dismantling practices, rather than those that were present at the time the plan was being formulated.

ELV – Shredder

The composition of each fraction produced by the shredder is as follows:

Table D4 Assumed Percentage Composition of the Fractions arising from the Shredder as a result of the Dismantled Generic ELV Infeed of the 1995 ACORD Plan

Material	Ferrous Fraction	Non Ferrous Fraction	Fluff Fraction
Ferrous	97.8	0.9	1.3
Aluminium	1.2	95.5	3.3
Copper	9.5	87.8	2.7
Lead	0.0	84.6	15.4
Zinc	0.0	100.0	0.0
Other Metals	0.0	100.0	0.0
Plastics	0.0	21.0-31.6	68.4-79.0
Rubber	3.4	89.9	6.7
Glass	0.0	41.6	58.4
Other Materials	4.9	39.5	55.6
Lubricant	0.0	47.8	52.2

ELV – Fluff transport and processing

Due to the increased material recovery targets of the 1995 ACORD plan (and the higher targets for the draft EC Directive) it was necessary to consider the method of material recovery. Some would come from the dismantling activity. However dismantlers are only likely to remove what is economic for them to do so. After discussion with the industry, it has been assumed that some material recovery of plastics is derived from a dedicated facility that would take fluff and remove plastics. An indication of the process has been provided but cannot be stated due to confidentiality. Although such a plant does not exist at present, it was felt that it is technically feasible now (although not economically feasible). The plant is assumed to use 10% of the energy requirements of a shredder.

The transport characteristics to the facility are as follows:

- Distance to the facility from the shredder is 30 miles;
- Lorries are diesel and do 6 mpg;
- Maximum load is 20 tonnes;
- No return empty journeys.

Those constituents of the fluff that remain after recovery of some plastics, are combusted, with an equal portion (in mass and composition) going to a blast furnace, cement kiln and MSW incinerator.

Transport distances between shredders and blast furnaces, cement kilns and MSW incinerators were calculated assuming that the waste would travel to the nearest combustion facility (regardless of capacity), using major roads. Average transport distances (one way) were as follows:

- Blast Furnace: 103 miles;
- Cement Kiln: 32 miles;
- MSW incinerator: 86 miles.

Diesel trucks are assumed to make a return journey (return empty), taking a 20 tonne maximum load, doing 6 mpg.

In the blast furnace and cement kiln, combustion of the fluff releases fuel energy. In the MSW incinerator system this is used to generate electricity for the UK national grid. All three combustion systems use aggregated incineration data as data relating to combustion of fluff in blast furnaces, cement kilns and MSW incinerators are scarce at the time of writing. It is unlikely that such data would reflect a fluff comprised solely of ELVs. Composition of the fluff is crucial for the net heat value, which in turn, has important implications for fuel energy and electricity generated, not to mention the nature of wastes generated and atmospheric emissions.

The net heat value of the fluff in the blast furnace is 13.7 MJ/kg, based on industry data.

In accordance with the literature (Anon.), the cement kiln step has an additional processing stage prior to introduction into the cement kiln. This is necessary in order to remove further metals, PVC and inerts in order to make the fluff more suitable for cement kiln requirements. This process takes place at the same facility that recovers plastics from the fluff. Energy requirements are assumed to be the same (again) as the plastics sorting facility. No other consumables or emissions to atmosphere are considered, except those concerned with energy requirements.

Metals removed due to this processing undergo the same recovery process as listed in the *Non ferrous fraction transport and processing* section.

Removed inerts are transported to landfill by diesel fuelled truck travelling 40 miles at 6 mpg, carrying a 20 tonne load. The truck returns empty.

Due to the further processing of the fluff (and, in particular, the removal of inerts) it is assumed that the net heat value of the fluff entering the cement kiln is elevated to 17.4 MJ/kg.

The conversion of fuel energy to electrical energy in the MSW incinerator is assumed to be 25% giving a rate of electricity production of 3.4 MJ elec/kg.

Fluff burnt in the cement kiln produces no waste product, becoming part of the cement. Waste slags and ash generated by the blast furnace and MSW incinerator systems, are assumed to be transported to landfill in 20 tonne (maximum load) diesel fuelled lorries travelling 45 miles (with an empty return journey).

ELV - Non Ferrous Fraction Transport and Processing

The same assumptions apply to the NFM waste as stated in the *Fluff Transport and Processing* section above.

D4 Draft EC ELV Directive 11034/971

Table D5 illustrates the interpretation of the draft EC ELV Directive 11034/971 used in this study.

Table D5 Recycling Rates used in the Study for the Draft EC ELV Directive 11034/971*

Material Category	Dismantler (kg)	Post Dismantler (kg)	Total Recycling (%)
Ferrous	160.0	563.8	99.5
Aluminium	23.1	32.4	99
Copper	4.3	7.3	99
Lead	9.0	1.2	99
Zinc	0.5	0.8	99
Other Metals	0.4	0.7	99
ABS	0.7	0.8 (6.7)	17 (95)
PP	2.9	3.2 (28.1)	17 (95)
PE	0.5	0.5 (4.7)	17 (95)
PA66	0.5	1.2 (4.7)	17 (95)
PVC	0.8	0.9 (7.8)	17 (95)
PUR	0.9	1.1 (9.1)	17 (95)
Other Plastics	1.1	1.3 (10.9)	17 (95)
Rubber	35.0 (15.8)	0.0	47 (85)
Glass	26.2	0.0	76
Other Material	1.6	0.0 (16.6)**	3 (42)
Lubricant	6.9	0.0	100
Coolant	3.0	0.0	50
Other Fluids	3.9	0.0	100

* Additionally, material removed for energy recovery is shown in parenthesis, together with the effect on overall recovery targets (recycling plus energy recovery) in the Total Recycling column (in parenthesis).

** The other material which is removed for combustion consists of composites.

Using the split given in Table D5, we achieve the recycling and energy recovery targets for the draft EC ELV Directive 11034/971 as follows:

Removed at dismantling stage:	284.3 kg	
Removed at the shredder (ferrous):	563.8 kg	
Removed at the HMSP (non ferrous):	45.8 kg	
Removed at the plastics recovery plant (fluff):	97.0 kg	
TOTAL:	990.9 kg	(95% of ELV weight)
Of which material for energy recovery	104.4 kg	(10% of ELV weight)

ELV - Shredder

The assumed split of the shredder infeed is as follows:

Table D6 Assumed Percentage Composition of the Fractions arising from the Shredder as a result of the Dismantled Generic ELV Infeed for the Draft EC ELV Directive 11034/971

Material	Ferrous Fraction	Non Ferrous Fraction	Fluff Fraction
Ferrous	98.6	0.8	0.6
Aluminium	1.2	97.0	1.8
Copper	9.5	89.1	1.4
Lead	0.0	92.3	7.7
Zinc	0.0	100.0	0.0
Other Metals	0.0	100.0	0.0
Plastics	0.0	4.8-5.7	94.3-95.2
Rubber	8.8	85.3	5.9
Glass	0.0	41.7	58.3
Other Materials	4.9	60.2	34.9

ELV – Fluff Transport and Processing

The net heat value of the combustible waste from the plastic recovery facility is 21.7 MJ/kg. As the waste is already separated from inerts and metals (and the PVC is removed), we assume that it is suitable for use in the cement kiln without further processing. Therefore, the lower heat value of the waste going to the cement kiln is the same.

D5 Primary Material and Product Systems

Within the DEAM database, some industrial process data are aggregated without the environmental inputs and outputs of electricity generation for the national grid. This allows the user to 'refine' the system by adding an appropriate electricity generation model for the country or region being studied. Data from car manufacturers indicated that parts are made all over Europe, so a European average electricity generation model was applied to these systems.

Plastic products are assumed to undergo a thermoforming process.

Ferrous and aluminium products are cast. Copper and zinc products are wire. The environmental inputs and outputs of the production of lead and other metal products is represented by the production of the metal.

Glass product manufacture is represented by manufacture of flat glass.

Transport of primary materials and products is not considered.

D6 Primary Fossil Fuel/Electricity Systems

Fossil fuel energy is assumed to come from coal and natural gas (North Sea) in equal amounts (in terms of MJ of energy delivered).

Electricity is assumed to be generated using the fuel mix for the UK in 1996 (default situation).

D7 Draft EC ELV Directive (1996)

At the time this work was started, the 1996 draft of the Directive was the most recent available and was modelled. However during the study, a more recent draft was produced in 1997 (11034/971) which was subsequently used to represent the Directive given its contemporary nature (compared to the 1996 version of the Directive, which was of historical significance only). Below are the assumptions that were used for the 1996 version of the Directive.

Given the high rates of ferrous and non ferrous metal recovery already achieved, it is assumed that additional material recovery from the ELV will primarily come from additional recovery of plastics, rubber and glass. This requires that the economics are favourably disposed to this activity. Table D7 illustrates the interpretation of the draft EC ELV Directive (1996) used in this study.

Table D7 Recycling Rates used in the Study for the Draft EC ELV Directive (1996)*

Material Category	Dismantler (kg)	Post Dismantler (kg)	Total Recycling (%)
Ferrous	160.0	563.8	99.5
Aluminium	23.1	32.4	99
Copper	4.3	7.3	99
Lead	9.0	1.2	99
Zinc	0.5	0.8	99
Other Metals	0.4	0.7	99
ABS	1.3	5.2 (1.7)	75 (95)
PP	5.1	22.0 (7.1)	75 (95)
PE	0.7	3.9 (1.1)	75 (95)
PA66	0.5	3.3 (2.6)	75 (95)
PVC	1.5	5.4 (2.1)	75 (95)
PUR	1.6	7.1 (2.4)	75 (95)
Other Plastics	2.0	8.4 (2.9)	75 (95)
Rubber	35.0 (15.8)	0.0	47 (85)
Glass	26.2	0.0	76
Other Material	1.6	0.0 (16.5)**	3 (42)
Lubricant	6.9	0.0	100
Coolant	3.0	0.0	50
Other Fluids	3.9	0.0	100

* Additionally, material removed for energy recovery is shown in parenthesis, together with the effect on overall recovery targets (recycling plus energy recovery) in the Total Recycling column (in parenthesis).

** The other material which is removed for combustion consists of composites.

Using the split given in Table D7, we achieve the targets for recycling and energy recovery as specified in the draft EC ELV Directive (1996) as follows:

Removed at dismantling stage: 289.6 kg
Removed at the shredder (ferrous): 563.8 kg
Removed at the HMSP (non ferrous): 45.8 kg
Removed at the plastics recovery plant (fluff): 91.7 kg
TOTAL: 990.9 kg (95% of ELV weight)
Of which material for energy recovery 52.2 kg (5% of ELV weight)

Unlike the 1995 ACORD plan, in which all unrecycled material is combusted, the draft Directive stipulates a proportion of the ELV from which energy recovery can be obtained (5%) and a proportion which can be landfilled (5%). Material that is not recycled is divided on the basis of its net heat value in order to determine that material which goes to energy recovery and that material which goes to landfill. As the facility already exists to remove plastics (as discussed in the ACORD plan section), the same plant is used to remove plastics for material recovery (where possible), and for energy recovery.

ELV - Shredder

The assumed split of the shredder infeed is as follows:

Table D8 Assumed Percentage Composition of the Fractions arising from the Shredder as a result of the Dismantled Generic ELV Infeed in the Draft EC ELV Directive 1996

Material	Ferrous Fraction	Non Ferrous Fraction	Fluff Fraction
Ferrous	98.6	0.8	0.6
Aluminium	1.2	97.0	1.8
Copper	9.5	89.1	1.4
Lead	0.0	92.3	7.7
Zinc	0.0	100.0	0.0
Other Metals	0.0	100.0	0.0
Plastics	0.0	4.8-6.1	93.9-95.2
Rubber	8.8	85.3	5.9
Glass	0.0	41.7	58.3
Other Materials	4.9	60.2	34.9

ELV – Fluff Transport and Processing

The net heat value of the combustible waste from the plastic recovery facility is the same as for the draft EC ELV Proposal 11034/971, as it consists of plastics.
ELV - Non Ferrous Fraction Transport and Processing

All NFM waste goes to landfill (i.e. it comprises part of the 5% of material from the ELV which is landfilled). Transport characteristics are the same as provided in the *Non Ferrous Fraction Transport and Processing* section of the Current Practice (1997) option.

Appendix E: Background information on life cycle impact assessment methodologies

E1 Greenhouse Effect

Introduction

The Earth absorbs radiation from the sun, mainly at the surface. This energy is then redistributed by the atmosphere and ocean and re-radiated to space at longer wavelengths. Some of the thermal radiation is absorbed by (greenhouse) gases in the atmosphere, principally water vapour, but also carbon dioxide, methane, chlorofluorocarbons (CFCs), ozone and other greenhouse gases. The absorbed energy is re-radiated in all directions, downwards as well as upwards such that the radiation that is eventually lost to space is from higher, colder levels in the atmosphere. The result is that the surface loses less heat to space than it would do in the absence of the greenhouse gases and consequently stays warmer. This phenomenon, which acts rather like a blanket around the Earth, is known as the Greenhouse Effect.

The Greenhouse Effect is a normal phenomenon. However, what is important is the Greenhouse Effect due to anthropogenic emissions. The resulting potential increase in temperature can alter atmospheric and oceanic temperatures, which can potentially lead to alteration of circulation and weather patterns. A rise in sea level is also predicted due to thermal expansion of the oceans and melting of polar ice sheets.

Methodology

Source: International Panel on Climate Change (IPCC), *The 1994 Report of the Scientific Assessment Working Group of IPCC*; 1995.

World Meteorological Organisation (WMO), *Scientific Assessment of Ozone Depletion: 1998*, Report n° 44 (Global Ozone Research and Monitoring Project).

Indices used: IPCC Greenhouse effect (direct, 100 years)

The potential direct effects on global warming (the Greenhouse Effect) of the emission of 38 greenhouse gases are considered.

Index Calculation

The overall result of emission of these gases on the Greenhouse Effect (E) is calculated as follows:

$$E = \sum_i GWP_i \cdot m_i$$

Where:
m_i is the mass of the gas i released (in kg),
GWP_i is its Global Warming Potential (GWP).

The Greenhouse Effect is expressed in mass equivalents of carbon dioxide (CO_2).

The GWP of a gas *i* can be defined as the ratio between the cumulative radiative forcing at present and a future time horizon (in this case, 100 years) as a result of the release of a unit mass of greenhouse gas *i* now, and an equal emission of the standard gas, carbon dioxide. The calculation of the GWP is based on understanding the fate of the emitted gas and the radiative effect associated with the amount remaining in the atmosphere.

Table E1 Global Warming Potentials used in the Study

Flows	Coefficient GWP_i
(a) Carbon Dioxide (CO_2, fossil)	1
(a) Methane (CH_4)	21
(a) Nitrous Oxide (N_2O)	310
(a) CFC 11 ($CFCl_3$)	4600
(a) CFC 12 (CCl_2F_2)	10600
(a) CFC 13 (CF_3Cl)	14000
(a) CFC 113 ($CFCl_2CFCl_2$)	6000
(a) CFC 114 (CF_2ClCF_2Cl)	9800
(a) CFC 115 (CF_3CF_2Cl)	10300
(a) HCFC 22 (CHF_2Cl)	1900
(a) HCFC 123 ($CHCl_2CF_3$)	120
(a) HCFC 124 ($CHClFCF_3$)	620
(a) HCFC 141b ($CFCl_2CH_3$)	700
(a) HCFC 142b (CF_2ClCH_3)	2300
(a) HCFC 225ca ($C_3HF_5Cl_2$)	180
(a) HCFC 225cb ($C_3HF_5Cl_2$)	620
(a) Carbon Tetrachloride (CCl_4)	1400
(a) Methyl Chloroform (CH_3CCl_3, HC-140a)	140
(a) Halon 1301 (CF_3Br)	6900
(a) HFC 23 (CHF_3)	14800
(a) HFC 32 (CH_2F_2)	880
(a) HCFC 43-10 mee	1700
(a) HFC 125 (CF_3CHF_2)	3800
(a) HFC 134 ($C_2H_2F_4$)	1200
(a) HFC 134a (CF_3CH_2F)	1600
(a) HFC 152a (CHF_2CH_3)	190
(a) HFC 143 ($C_2H_3F_3$)	370
(a) HFC 143a (CF_3CH_3)	5400
(a) HFC 227ea ($CF_3CF_2CHF_2$)	3800

Flows	Coefficient GWP$_i$
(a) HFC 236fa ($CF_3CF_2CH_2F$)	9400
(a) HFC 245ca ($CF_3CF_2CH_3$)	720
(a) Chloroform ($CHCl_3$, HC-20)	5
(a) Methylene Chloride (CH_2Cl_2, HC-130)	10
(a) Sulphur Hexafluoride (SF_6)	22200
(a) Carbon Tetrafluoride (CF_4)	5700
(a) Hexafluoroethane (C_2F_6, FC116)	11400
(a) Perfluorocyclo-butane (c-C_4F_8)	11200
(a) Perfluorohexane (C_6F_{14})	9000
(a) HCFC 21 ($CHC_{l2}F$)	210
(a) HFC 41 (CH_3F)	140
(a) HFC 161 (CH_3CH_2F)	10
(a) Methyl Chloride (CH_3Cl)	16
(a) Bromomethane (CH_3Br)	5
(a) Methylene Bromide (CH_2Br_2)	1
(a) Halon 1201 (CHF_2Br)	470
(a) Halon 1211 (CF_2ClBr)	1300
(a) Perfluoropropane (C_3F_8)	8600
(a) Perfluorobutane (C_4F_{10})	8600
(a) Perfluoropentane (C_5F_{12})	8900
(a) HFE 125 (CF_3OCHF_2)	15300
(a) HFE 134 (CHF_2OCHF_2)	6900
(a) HFE 143a (CH_3OCF_3)	970
(a) HCFE 235da2 ($C_3H_2ClF_5O$)	340
(a) HFE 245fa2 ($C_3H_3F_5O$)	570
(a) HFE 254cb ($C_3H_4F_4O$)	25
(a) HFE 7100 ($C_4F_9OCH_3$)	390
(a) HFE 7200 ($C_4F_9OC_2H_5$)	55
(a) HFC 152 (CH_2FCH_2F)	43
(a) HFC 236cb ($CH_2FCF_2CF_3$)	1400
(a) HFC 236ea (CHF_2CHFCF_3)	1000
(a) HFC 365mfc ($C_4H_5F_5$)	910

Limitations of the Index

The need to gain a measure of future commitment to global warming due to current emissions of greenhouse gases (for policy setting and decision making) resulted in the development of GWPs.

This evaluation technique has limitations, which are as follows:

In order to define a GWP, the fate of the greenhouse gas in the atmosphere must be known. Generally, this information is not well known. As a result of the uncertainty outlined above, the typical variability of quoted figures is 35% relative to the carbon dioxide reference. The level of variability becomes greater as further time horizons are considered. This is because background concentrations of certain atmospheric constituents must be considered in order to calculate GWPs and predictions of levels at further time horizons are open to greater uncertainty.

GWPs assume that the gas under consideration is uniformly distributed in the atmosphere. Consequently, aerosols, which are typically unevenly distributed but may be radiatively important, are not included.

Indirect effects, (i.e. where the emission of one greenhouse gas can lead to the formation of another greenhouse gas), are not considered (with the exception of methane) due to insufficient knowledge of atmospheric processes. An indirect component (which encompasses changes in tropospheric ozone levels and stratospheric water vapour) is considered in the calculation of the GWP for methane only.

Air Acidification

Introduction

During the Industrial Revolution, atmospheric pollution affected human health, as observed in London with its 'pea soup' fogs. Particulates and sulphur oxides were the main culprits. As a result, measures were taken to decrease the level of pollution in these populated areas by increasing the height of chimneys, for example.

In the early seventies, lake acidification was observed in Scandinavia, Canada and the United States. The pollutants causing the Scandinavian problem seemed to come from Eastern Europe. As a result, the Long-Range Transboundary Air Pollution Convention was approved in Europe (1979) which became known as the Geneva Convention. In the following year, the United States adopted the Acid Precipitation Act.

A further consequence of acidification is forest decline. This deterioration occurs mainly in coniferous trees. The proportion of trees that lost between 10% and 20% of their foliage was 33% in Germany, 15% in Luxembourg, 40% in the Netherlands, 26% in Switzerland and 25% in France (1985 statistics).

Acidification also affects:

- Soil (the addition of basic materials may be required to compensate for acidification);
- Buildings (local affect damaging most building materials);
- Human health (local effect when high concentrations of sulphur oxides are reached).

Sources

The two primary acidifying species are compounds of sulphur and nitrogen. The principal sources of these compounds are outlined below:

Table E2 Principal Sources of Sulphur Oxides and Nitrogen Oxides

Source	SOx	NOx
Natural	Volcano (6-60 Mt/year) Amino acid decomposition (40-100 Mt/year)	Organism metabolism (14 Mt)
Human	Combustion (65 Mt/year)	Fossil fuel combustion (21 Mt) Biomass combustion (12 Mt) Urea (NH_3) emissions by animals (25 Mt)

Other compounds (hydrogen chloride, hydrogen bromide, etc) released from man made sources also contribute to acidification.

Acidifying compounds may be present in a gaseous state, dissolved in water or fixed on solid particles. They reach ecosystems through dissolution in rain or wet deposition (for which the expression *acid rain* is inappropriate).

The following reactions table illustrates how the main mechanisms transforming NO_2 and SO_2 into acids may be simplified:

Sulphur oxides:

$SO_2 + \frac{1}{2} O_2 \rightarrow SO_3$ (Sulphurous anhydride - photochemical reaction in gaseous phase, catalysed by iron and manganese)

$SO_2 + H_2O \rightarrow H_2SO_3$ (Sulphurous acid - reaction catalysed by iron and manganese and occurring in droplets)

$H_2SO_3 + (H_2O_2 \text{ and } O_3) \rightarrow H_2SO_4$ (Sulphurous acid is unstable and rapidly transforms into sulphuric acid)

$SO_2 + NO_2 + H_2O \rightarrow H_2SO_4 + NO$

Nitrogen oxides:

$NO + O_3 \rightarrow NO_2 + O_2$ (photochemical reaction in gaseous phase)

$NO_2 + OH \rightarrow HNO_3$ (Nitric acid - gaseous - dry deposition)

HNO_3 (g) → HNO3 (aq.) (From gaseous to aqueous phase in droplets - wet deposition)

In terrestrial ecosystems, acidification (H^+ supply) diminishes soil buffer capacity by reacting first with carbonate ($CaCO_3$) and then silicate ($CaAl_2Si_2O_8$). H^+ ions may then interact with the cations which are linked to clay (this process depends on the cation exchange capacity of the soil) and finally leads to the liberation of aluminium (Al^{3+}) and iron (Fe^{3+}) which are toxic.

Acidification reaches water directly or indirectly via the soil. When the buffer capacity becomes too low, pH declines leading to biological damage and to the releases of toxic elements previously contained in humus. Acidification also has direct consequences on the ecosystem (for example, organisms cannot assimilate calcium when the pH falls below 6).

Methodology

Source: Centre for Environmental Science (CML); *Environmental Life Cycle Assessment of Products - Guide and Background*; October 1992; Leiden University, The Netherlands.

Blau S and Seneviratne S; *Acidification and Eutrophication in Life Cycle Assessments (LCAs)*, 1995, Swiss Federal Institute of Technology (ETH), Zurich, Switzerland.

The inventory data assigned to the CML Air Acidification characterisation method are the 10 acidifying compounds that are potentially transformed into acid compounds through reactions with atmospheric elements. Although ammonia is a base, its emissions to atmosphere are included as they may be potentially oxidised and release H^+.

Index Calculation

Atmospheric Acidification index (A) is calculated as follows:

$$A = \sum_i AP_i \cdot m_i$$

Where:
m_i is the mass of the compound *i* (in g),
AP_i is the Acidification Potential of the compound.

The Acidification Index is expressed in mass equivalents of H^+.

Table E3 Acidification Indices used in the Study

Flows	Coefficient AP_i
(a) Sulphur Oxides (SOx as SO_2)	32
(a) Nitrogen Oxides (NOx as NO_2)	46
(a) Ammonia (NH_3)	17
(a) Hydrogen Chloride (HCl)	36.5
(a) Hydrogen Fluoride (HF)	20
(a) Chromic Acid (H_2CrO_4)	29.5
(a) Sulphuric Acid (H_2SO_4)	24.5
(a) Hydrogen Bromide (HBr)	81
(a) Hydrogen Cyanide (HCN)	27
(a) Hydrogen Sulphide (H_2S)	17

Limitations of the index

The method is limited because the extent of acidification depends on the following local factors:

The acidifying compounds may reach a terrestrial or an aquatic ecosystem where the impacts on each ecosystem are distinct. The implicit hypothesis behind this method is that ecological damage is independent of the type of ecosystem affected.

Impact depends on the type of soil, e.g. thin soils on granite or sandstone low in carbonate have a poor buffer capacity and are more fragile when facing acidification.

Certain vegetation species are more fragile than others to acidification, e.g. coniferous trees are more greatly affected than deciduous trees.

Stratospheric Ozone Depletion

Introduction

The ozone layer is present in the stratosphere and acts as a filter absorbing harmful short wave ultraviolet light whilst allowing longer wavelengths to pass through.

Since the late 1970s, a thinning of layers within the ozone layer over the Antarctic has been observed during the Spring, which could amount to up to 80-98% removal (the so called ‘ozone hole’).

This ‘hole’ over the Antarctic is created due to the unique chemistry present over the Poles. During the winter, a cyclonic vortex forms over the Antarctic, within which temperatures reduce to very low levels (less than $-80^{o}C$), allowing the formation of polar stratospheric clouds (PSCs).

Most chlorine and bromine (from CFCs and other sources) in the atmosphere is bound in reservoir compounds (consisting of nitrates and hydroxyl groups) which render them inert and unable to affect ozone. However, in the presence of the PSCs, complex reactions occur which release active chlorine and bromine from these reservoir compounds. The addition of ultraviolet light during the Spring sets up catalytic reactions involving the chlorine and bromine, which result in ozone depletion. As the vortex breaks down, this ozone depleted air mixes into the rest of the stratosphere. These reactions occur, to a lesser extent, in the Arctic.

A decline in the ozone layer allows more harmful short wave radiation to reach the Earth’s surface, potentially causing changes to ecosystems as different flora and fauna have varying abilities to cope with it. There may also be adverse affects to agricultural productivity. Affects on man can include increased skin cancer rates (particularly the fatal melanoma type) and eye cataracts, as well as suppression of the immune system.

Another potential problem is the uncertain affect on the climate.

Methodology

Source:	World Meteorological Organisation (WMO); *Scientific Assessment of Ozone Depletion*, 1991. World Meteorological Organisation (WMO); *Scientific Assessment of Ozone Depletion: 1998*; Report n°44 (Global Ozone Research and Monitoring Project)

The direct effect on stratospheric ozone depletion of the emission of 22 ozone depleting gases is considered.

Index Calculation

The overall result of emission of these gases on stratospheric ozone depletion (OD) is calculated as follows:

$$\mathrm{OD} = \sum_{i} \mathrm{ODP}_i \cdot m_i$$

Where:
m_i is the mass of the gas *i* released (in kg);
ODP_i is its Ozone Depletion Potential (ODP).

Ozone depletion is expressed in mass equivalents of CFC 11.

The ODP of a gas *i* is defined as the ratio between ozone breakdown in the equilibrium state due to annual emissions (in kg/yr) of a quantity of gas *i* released into the atmosphere, and the breakdown of stratospheric ozone in the equilibrium state due to an equal quantity of CFC 11, which is used as a reference.

Table E4 Ozone Depletion Potentials used in the Study

Flows	Coefficient
(a) Methyl Chloroform (CH_3CCl_3, HC-140a)	0.11
(a) HCFC 225cb ($C_3HF_5Cl_2$)	0.017
(a) HCFC 225ca ($C_3HF_5Cl_2$)	0.017
(a) HCFC 22 (CHF_2Cl)	0.034
(a) HCFC 142b (CF_2ClCH_3)	0.043
(a) HCFC 141b ($CFCl_2CH_3$)	0.086
(a) HCFC 124 ($CHClFCF_3$)	0.026
(a) HCFC 123 ($CHCl_2CF_3$)	0.012
(a) Halon 2402 (CF_2ClBr)	7
(a) Halon 2401 (CHF_2CF_2Br)	0.25
(a) Halon 2311 ($CF_3CHBrCl$)	0.14
(a) Halon 1301 (CF_3Br)	12
(a) Halon 1211 (CF_2ClBr)	5.1
(a) Halon 1202 (CF_2Br_2)	1.25
(a) Halon 1201 (CHF_2Br)	1.4
(a) CFC 12 (CCl_2F_2)	0.82
(a) CFC 115 (CF_3CF_2Cl)	0.4
(a) CFC 114 (CF_2ClCF_2Cl)	0.85
(a) CFC 113 ($CFCl_2CFCl_2$)	0.9
(a) CFC 11 ($CFCl_3$)	1
(a) Carbon Tetrachloride (CCl_4)	1.2
(a) Bromomethane (CH_3Br)	0.37

Limitations of the Index

The method is limited by the following factors:

- ODPs upon which this assessment method is based, are subject to considerable uncertainty and regular modification. Consequently both the lower and upper values in the range of uncertainty are available for assessment purposes (we use the upper values in this study).
- Greenhouse gases can affect the level of ozone directly through chemical reactions or indirectly by contributing to global warming. At present, the influence of this factor is not incorporated due to the complex nature of the reactions involved.
- Concentrations of trace gases such as nitrogen oxides affect atmospheric levels of the hydroxyl radical (OH) which, in turn, affects the atmospheric lifetime of hydrogenated compounds that can impact on ozone depletion. This process can influence future ozone depletion rates and therefore they must be assigned an assumed level, which may vary with time.
- ODPs are defined at steady state, and therefore do not represent transient affects. In reality, shorter lived chlorinated and brominated compounds will reach a steady state ability to destroy ozone before longer lived compounds.
- ODPs are based on annually averaged global changes in ozone, which do not take into account heterogeneous chemical reactions (i.e. which involve a change in state) which occur specifically at the Poles. Consequently ODP derived concentrations tend to understate damage to ozone caused by the presence of chlorine and bromine in the atmosphere through the emission of ozone depleting gases.

Non Renewable Resource Depletion

Resource depletion can be defined as the decreasing availability of natural resources. The resources considered in this impact are fossil and mineral resources, excluding biotic resources and associated impacts such as species extinction and loss of biodiversity. This index addresses the depletion of various resources rather than the impacts caused by their extraction from the environment (e.g., methane emissions from coal mining).

Some schools of thought believe that resource depletion should not be considered an environmental impact. For these schools of thought:

- Market price mechanisms are believed to take care of the scarcity issue, price being a measure of the level of depletion of a resource or its scarcity and its societal value.
- There are still growing known reserves of fossil fuels.
- Major potential for cleaner energy substitutes such as solar energy have not been fully explored yet.

However a counter argument may be that:

- Prices are influenced by many more factors such as the existence of non-perfect markets (monopolies, subsidies, etc.).
- Other energy substitutes such as solar energy will probably be a long term and partial solution.
- The continued use of resources may lead to a shift to poorer or less favourably sited reserves thus resulting in greater emissions.

Whatever stance one might take, the resource depletion issue is at the heart of the sustainability debate and is important enough to attempt to provide a measure of scarcity using indicators. The assessment of the relative importance of the resource depletion index compared to other impact scores is left to the end-user.

Definition of Availability

Natural resource depletion does not consider availability within the economy, but rather within the ‘natural environment’. Economic stock, such as aluminium from aluminium cans or steel from used car bodies, is excluded from this impact. Therefore, the availability is not measured within the whole economy, but only at the boundary economy/environment. Furthermore, availability is concerned with the primary extraction medium (e.g., iron ore available from the earth’s crust) and not within the entire geosphere (which would include iron available in water bodies, atmosphere, plants, landfills, etc.).

Resource vs. Reserve

The notion of reserve of a resource should also be determined. Geologists, mining engineers and others operating in the mineral field have used various terms to describe and classify mineral resources. Known resources can be classified from two standpoints:

- purely geological or physical/chemical characteristics - such as grade, tonnage, thickness and depth - of the material in place, and
- profitability analyses, based on costs of extracting and marketing the material in a given economy at a given time.

The former constitutes important objective scientific information relating to the resource and a relatively unchanging foundation upon which the latter economic delineation can be made. Depending on the selectivity chosen for the economic criterion, different types of reserve have been defined, including economic reserve, marginal reserve, ultimately extractable reserves and ultimate reserve/resource base (in increasing order in terms of quantity).

There is no clear rational for selecting one type of reserve or another for use in impact assessment. Any definition including economics has some embedded uncertainties. For example, it is not in the interest of resource-extracting companies to have too large an economic reserve because this would lower their market value. On the other hand, ultimate reserve (also termed resource base, obtained by multiplying the average concentrations of chemical elements in the earth's crust by the mass of the crust) also leads to uncertainties since clearly not all of the resource is available for use.

Data sources

For mineral resources, the reserve chosen for this index is the reserve base as defined by the US Bureau of Mines *viz*: *part of an identified resource that meets specified minimum physical and chemical criteria related to current mining and production practices, including those for grade, quality thickness, and depth. The reserve base encompasses those parts of the resources that have a reasonable potential for becoming economically available within planning horizons beyond those that assume proven technology and current economics. It includes those resources that are currently economic (reserve), marginally economic (marginal reserves) and currently sub-economic*. By including economic and sub-economic considerations, the reserve base falls between the two extremes of economic reserve and ultimate reserve/resource base.

For fossil fuels (including uranium), the reserve chosen is based on information supplied by the World Energy Council (WEC). In order to being consistent with the reserve base used by the US Bureau of Mines, the reserve chosen for fossil fuels has been defined as the addition of the WEC's *proved amount in place* (tonnage in place that has been both carefully measured and has also been assessed as exploitable under present and expected local economic conditions with existing available technology) and *estimated additional reserves recoverable* (quantity of the estimated additional amount in place which might become recoverable within foreseeable economic and technological limits).

The most important aspect of this impact assessment index is the availability of a relative scale allowing comparisons between resources, rather than an estimation of the exact size of what is considered available for use. This reflects the comparative, as opposed to the predictive, nature of Impact Assessment performed within an LCA. In this case, Impact Assessment aims at assessing the relative potential impacts of different alternatives (i.e., natural resource depletion index of A vs. B) rather than assessing the actual impacts of a system on the environment (as would be done in traditional risk assessment).

Jeroen B. Guinee, *A proposal for the definition of resource equivalency factors for use in product Life-Cycle Assessment in development of a methodology for the environmental life -cycle assessment of products (thesis)*, CML, Leiden, Netherlands, 1995.

Summary Document on FEFCO LCA Projects. Prepared by Ecobilan for the Federation Europeenne du Carton Ondule. December 1994, Paris, France.

CML, *Environmental Life Cycle Assessment of Products - Background*, October 1992, Leiden, Netherlands.

United States Department of the Interior. Bureau of Mines, *Mineral Commodity Summary*, 1994.

Index Calculation

Non renewable resource indices (R) are calculated as follows:

$$\mathbf{R = \sum F_i . m_i}$$

where, for the non renewable resource i

m_i is the mass of the compound(in kg),
F_i is the resource's weighting factor (or equivalency factor).

In this case, the inverse of remaining years of use is used as a weighting factor.

$$\mathbf{F_i = 1 / y_i}$$

The Depletion of Non Renewable Resource Index is expressed in kg/yr.

The number of remaining years of use is defined as the reserves divided by the total worldwide production (i.e., extraction). It represents the number of years for which current reserves will suffice at the present production (extraction) level. However, this index does not correctly account for the size of the reserve i.e. two resources with the same number of years will have the same indices irrespective of whether there are 1 kg or 1000000 Mt reserves.

Note on Uncertainty

Beyond the uncertainties associated with the inventory quantities, the sources of uncertainty in this index are:

- Selection of the calculation method for the equivalency factors: diverse methods, other than the one described in this section, could have been applied, by changing the power of the various components.
- Selection of the type of reserve used in the calculation: other types of reserve could have been considered.
- Data quality issue: The quantities of both reserves and production for each natural resource are uncertain.
- Sensitivity analysis could be used to explore the influence of modelling uncertainties (i.e., by adjusting values and analysing the difference in terms of end-results).
- As far as data are concerned, there is, however, no indication of ranges in the reserve estimates provided by the different sources consulted.

Eutrophication of Water

Eutrophication is defined as the enrichment of marine or lake waters with mineral salts when it refers to a natural process or, as the enrichment in nutritive elements of waters when referring to human intervention. Eutrophication is primarily a natural process as mineral salts brought by erosion increase lake biomass; hence biomass sedimentation and erosion leads to the filling of the lake. Human activities have dramatically accelerated eutrophication by releasing phosphorus compounds (fertilisers, detergents, etc), nitrogen compounds (fertilisers) and organic matter (urban and industrial effluents) into the water.

Terrestrial and aquatic eutrophication

Terrestrial eutrophication increases plant growth and primary production. In European countries, the limiting agent is mainly nitrogen. As plant growth is not linked to nitrogen in the same way for all plants, nitrogen supply leads to a shift in the ecosystem composition.

With regard to the aquatic environment, eutrophication occurs mainly in lakes although rivers and coastal marine waters may also be affected.

Four steps may be distinguished:

1. Accumulation of nutritive elements (nitrogen, phosphorus, organic matter).

2. Proliferation of phytoplankton and algae in the epilimnion layer (upper and warmest layer that is formed during summer). The water becomes green and appears dirty. Algal decomposition on the shore of the lakes emits unpleasant smells.

3. Algae die and decompose in the hypolimnion layer (deepest and coldest layer) consuming oxygen. A shift in the ecosystem composition occurs (disappearance of salmonids – trout and char, and appearance of cyprinides).

4. Onset of anaerobic decomposition when the oxygen reserve is completely depleted. Decomposition by bacteria liberates hydrogen sulphide and ammonia. The reducing conditions lead to the emission of phosphorus that was previously locked in the sediment, thus enhancing the process. Finally, all forms of life disappear.

This eutrophication process is enhanced in the summer as the suns radiation is at a maximum and the epilimniom and hypolimnion layers are clearly separated.

Source:	Centre of Environmental Science (CML), *Environmental life cycle assessment of products. Guide and Backgrounds*, October 1992, Leiden University, The Netherlands.
Indices:	CML-Eutrophication (water)

As oxygen depletion is an intermediary step towards the final consequences of eutrophication (ecosystem shift and depletion), the elements oxidised chemically or biologically when released into the environment are also considered when examining eutrophication. This explains why the CML eutrophication index includes Chemical Oxygen Demand (COD).

The Eutrophication (water) index is an amended version of an index produced by CML. It has been introduced by Ecobilan as the CML oxygen depletion index does not seem to be an adequate index for terrestrial nutrification. The Eutrophication (water) index is restricted to water eutrophication. The flows included are the emissions of nutritive compounds in water and COD.

Index Calculation

Eutrophication (water) index (E) is calculated as follows:

$$E = \sum NP_i \, . \, m_i$$

where, for the nutritive compound i:

m_i is the mass of the compound(in g),
NP_i is the Nutrification Potential of the compound.

The Eutrophication index is expressed in gram of phosphate.

Eutrophication is assessed through oxygen depletion. The Nutrification Potential of the compound i is based on its potential contribution to the formation of the Redfield algae biomass (C106H263O110N16P). This contribution is translated into oxygen depletion taking into account the quantity of oxygen consumed when algae decomposes. The COD is already expressed as a quantity of consumed oxygen.

Critical Volumes (Air and Water)

Critical volumes are an attempt to encompass toxicological aspects of a system.

Source	S. Ahbe, A. Braunschweig & R. Müller-Wenk, Swiss Federal Office of Environment, Forests and Landscape (BUWAL). *Ecobalance of Packaging Materials - State of 1990*, Environmental Series 132, Berne, Switzerland, 1991.
Indices	CVCH-Water, CVCH-Air

They are calculated for two separate categories of releases: air emissions and water emissions, by dividing each relevant flow from the inventory (X) by a limit value given by local regulations:

Critical volume = X / Limit value

Critical volumes for each flow are then aggregated for all air emissions and for all water emissions, yielding two figures - a critical volume for air and one for water. Critical volumes for air emissions are aggregated and expressed in units of m^3. Critical volumes for water emissions are also aggregated and expressed as litres. No attempt should be made to combine them. This technique is a weighting procedure, and should not be interpreted as the volume of air or water that is polluted.

Swiss critical volumes apply solely to Switzerland and rely on current regulations in this country.

Limitations

The method is limited by the following factors:

- Critical volumes are defined from a particular set of regulations, *viz*. the Swiss limits for chemicals under consideration. These regulations may differ from one country to another or as political issues vary.
- They do not express solely toxicological concerns (e.g. malodorous products may be very heavily weighted because of unfavourable public opinion, whereas they may not constitute real threats but only an inconvenience). Thresholds can also be derived from state of the art measurement techniques and can thus be reduced as techniques improve whereas there is no shift in the toxicological status.
- Flows may not be taken into account because they have no regulatory constraints.

Swiss Ecopoints Method

Ecopoints are calculated by multiplying the flows obtained in the inventory by ecofactors (where such factors exist), and by totalling to provide a score. The Ecopoints method is applied to selected articles belonging to the main types of flows between the environment and the studied system

Source	S. Ahbe, A. Braunschweig & R. Müller-Wenk, Swiss Federal Office of Environment, Forests and Landscape (BUWAL). *Methodology of Ecobalance based on Ecological Optimisation,* Environment Series 133, Berne, Switzerland, 1991.
Indices:	Ecopoints-Total

Ecofactors (E) are derived from two figures:

- the total yearly emission or consumption of the flow in Switzerland (F),
- the maximum acceptable yearly flow for Switzerland (Fk, critical flow).

$$\mathbf{E = (1 / Fk) . (F / Fk) . 10^{12}}$$

An ecofactor thus increases as the critical flow decreases and as the yearly flow reaches the critical flow. The ecopoint score (S) is thus obtained:

$$\mathbf{S = X . E}$$

where X is the flow in the inventory. Swiss ecopoints apply to Switzerland and rely on value based judgements (maximum acceptable flows).

Limitations

The method is limited by the following factors:

- Ecopoints are defined for the Swiss situation (F, annual Swiss flow) and for Swiss political choices (Fk, maximum acceptable annual flows for Switzerland). They are valid only for this country and could change radically if calculated with the same parameters for another country.
- F is an objective figure, although it can be difficult to estimate, whereas Fk depends on regulations and thus on a political estimate of what should be the desirable goal to reach in terms of flow.
- Ecofactors are missing for a number of items such as methane or hydrogen fluoride, either because they are not considered as presenting a problem at the Swiss level or because there is a scarcity of data.

Environmental Priority Strategies (EPS) Method

This assessment technique multiplies emissions and extractions by an Environmental Load Index so that they can be valued in terms of a common Environmental Load Unit (ELU). The value of the Environmental Load Index takes into account biodiversity, human health, production, resources and aesthetic values.

A willingness to pay for damages is assigned to the above categories, based on an estimated average societal value, stemming from the Swedish Parliament. The index may result from the sum of beneficial as well as adverse impacts, based on scientific knowledge where possible, e.g. the greenhouse effect may increase drowning due to a sea level rise whilst possibly decreasing the occurrence of cardiovascular diseases.

Source Swedish Environmental Research Institute (IVL), *EPS- Default Valuation of Environmental Impacts from Emission and Use of Resources*, 1996.

Limitations

The method is limited by the following factors:

- Valuation can be highly variable (e.g. depletion is rated much higher than human health).
- Effects that are still under debate are used to derive causality chains, such as a rise in sea-level or a reduction of human life expectation due to a rise in the greenhouse effect.
- Not all emissions are classified. When faced with a low value for water releases, it is unclear whether this is due to low water releases or to a lack of classification factors that do exist but have not been taken into account.

Appendix F: Assumptions used for indicators of performance

Sources of data for indicators of performance

The following section describes the indicators of performance used to put the main results of the study into context. Results for the processing and disposal of one ELV under the 1997 Current Practice option have been used for illustrative purposes below.

Data for the calculation of indicators of performance have come from a wide variety of sources. Please note that the calculated indicators should not be considered as absolute values but rather as a means to help the reader to better grasp the relative importance of the results.

Indicators of performances for main air emissions contributing to greenhouse effect and air acidification

Carbon dioxide (CO_2)

Mass of CO_2 emitted (in tonnes) due to the disposal and processing of one ELV has been put into context by calculating the area of a temperate forest required to take up the equivalent amount of CO_2 using photosynthesis in one year.

Assuming that the carbon sequestration potential of one hectare of forest is 8 tonnes per year (source: confidential) and considering that molecular masses of CO_2 and C are respectively 44 and 12, the equivalent amount of CO_2 absorbed by one hectare of forest is 8 tonnes *44/12 = 29 tonnes CO_2/ha/year.

As an illustration, the 1.13 tonnes of CO_2 emitted for the 1997 Current Practice option is equivalent to 1.13/29 = 0.039 ha of forest that will absorb the same quantity of CO_2 in one year.

Total carbon dioxide equivalent (total CO_2 equivalent)

This calculation has been similarly applied to the global warming potential, expressed as a CO_2 equivalent, i.e. including the contribution of CO_2 and other greenhouse gases emitted due to the processing and disposal of an ELV multiplied by a weighting coefficient.

As an illustration, the 1.20 tonnes of CO_2 equivalent for the 1997 Current Practice option is equivalent to 1.20/29 = 0.041 ha of forest that will absorb the same quantity of CO_2 in one year.

Methane (CH_4)

The mass of CH_4 emitted due to the processing and disposal of one ELV has been put into context by calculating the number of cattle emitting an equivalent amount of CH_4 per day.

The MAFF publication *UK Food and Farming in Figures* (1997) indicates that there were $11.9 * 10^6$ cattle and calves in the UK in 1996. The DETR publication *Digest of Environmental Statistics No 20* (1998) provides the estimated emissions of methane from agriculture (Table 1.3): $9.4 * 10^5$ tonnes of methane emitted in 1996. As a result, the daily discharge of CH_4 is $9.4 * 10^5 / (11.9 * 10^6 * 365$ days$)= 0.000216$ tonnes/day i.e. 216 g CH_4 emitted per day and per animal.

As an illustration, the 2098 g of CH_4 emitted for the 1997 Current Practice option is equivalent to the amount of methane emitted by 2098/216 = 10 cattle per day.

Nitrogen oxides (NOx)

The mass of NOx emitted due to the processing and disposal of one ELV has been put into context by calculating the number of miles driven in a car emitting an equivalent amount of NOx..

According to the DEAM database, the amount of NOx emitted during the production of 1 litre of petrol and subsequent combustion in a car engine is 6.88 g. This data is derived from a European car manufacturer and represents the average emissions from a generic car. Assuming that a car has an average fuel consumption of 35 miles per gallon (mpg) and considering that there is 4.546 litres in a gallon, a car will emit 6.88 g / 35 mpg* 4.546 litres/gal = 0.894 g NOx per mile.

As an illustration, the 3179 g of NOx emitted for the 1997 Current Practice option is equivalent to the amount of NOx emitted by a car travelling 3179/0.894 = 3558 miles.

Sulphur oxides (SOx)

The mass of SOx emitted due to the processing and disposal of one ELV has been put into context by calculating the number of miles driven in a car emitting an equivalent amount of SOx.

According to the DEAM database, the amount of SOx emitted during the production of 1 litre of petrol and its subsequent combustion in a car engine is 3.35 g. This data is derived from a European car manufacturer and represents the average emissions from a generic car. Assuming that a car has an average fuel consumption of 35 miles per gallon (mpg) and considering that there is 4.546 litres in a gallon, a car will emit 3.35 g / 35 mpg* 4.546 litres/gal = 0.435 g SOx emitted per mile.

As an illustration, the 4257g of SOx emitted for the 1997 Current Practice option is equivalent to the amount of SOx emitted by a car travelling 4257/0.435 = 9784 miles.
Indicators of performances for non renewable resource consumption

Oil consumption

The mass of oil consumed in the processing and disposal of one ELV has been put into context by calculating the number of miles driven in a car that requires the same amount of oil consumption (through combustion of petrol).

According to the DEAM database, the amount of oil consumed during the production of 1 litre of petrol is 0.813 kg. Assuming that a car has an average fuel consumption of 35 miles per gallon (mpg) and considering that there is 4.546 litres in a gallon, a car will consume 0.813 kg / 35 mpg* 4.546 litres/gal = 0.106 kg of oil per mile.

As an illustration, the 72 kg of oil consumed for the 1997 Current Practice option is equivalent to the amount of oil consumed indirectly by a car that travels 72/0.106 = 680 miles.

Natural gas consumption

The mass of natural gas consumed due to the processing and disposal of one ELV has been put into context by calculating the equivalent natural gas consumption per day and per person in the UK. By natural gas consumption, we are referring to the total natural gas consumption for all industrial/domestic activities in the UK normalised to UK population and not to the natural gas consumption used only for heating purposes of houses.

The DETR publication entitled *Digest of Environmental Statistics No 20* (1998) provides an estimated total amount of gas consumed in 1996 in the UK as primary energy: 82.4 million tonnes of oil equivalent (Mtoe), as well as the total population of the UK in 1996: 58 801 000 persons. Considering that the average net heat value of natural gas is 51 MJ/kg (source: BUWAL/DEAM database) and that 1 Mtoe = 4.18 10^{10} MJ (source: *Key World Energy Statistics*, IEA), the average daily amount of gas consumed per person is 82.4 * 4.18 10^{10} MJ / (58801000 person* 51 MJ/kg * 365 day) = 3.14 kg of natural gas per day per person.

As an illustration, the 109 kg of natural gas consumed for the Current Practice option is equivalent to the daily consumption of natural gas in the UK normalised of 109/3.14 = 35 persons.

Indicators of performances for water emissions contributing to eutrophication

COD (chemical oxygen demand)

It is difficult to find a reference parameter for COD releases as the concentration of COD authorised largely depends on local conditions where COD is released. The COD concentration is usually defined in a trade effluent discharge consent (contract between an industrial operator and a waste water treatment plant operator) when the effluents are released into a sewer. Otherwise it is defined in a contract between an industrial operator and the Environment Agency (e.g. a wastewater discharge consent) if the effluents are released directly into a river. Local parameters considered are volume, rate of flow and quality of river or effluents in sewer.

The COD due to the processing and disposal of one ELV has been put into context by calculating the volume of water needed to dilute this amount of COD in order to reach the average concentration of effluents entering a sewer.

A typical COD concentration of effluents entering a sewer ranges from 200-1000 mg/l (source: industry experience).

As an illustration, the 270 g of COD released in water for the 1997 Current Practice option is equivalent to a volume of 270 g / 0.750 g/l = 360 litres of water entering a sewer with a consented COD of 750 mg/l.

Phosphates

Phosphates released due to the processing and disposal of one ELV has been put into context by calculating the volume of water needed to dilute this amount of phosphates in order to reach the average concentration of orthophosphates in UK rivers.

The DETR publication *Digest of Environmental Statistics No 20* (1998) provides the estimated orthophosphates concentration of water in the UK: 0.59 mg/litres (expressed as P) in 1996 (Table 3.11).

As an illustration, the 9.5 g of phosphates (expressed as P) released in the 1997 Current Practice option is equivalent to a volume of 9 500 mg/ 0.59 mg/l= 16 100 litres of water with an average UK phosphate concentration.