Applying Integrated Environmental Assessment to EU Waste Policy

A Scoping Paper for the European Forum on Integrated Environmental Assessment (EFIEA)

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1. Introduction

The purpose of the paper is to identify in what ways integrated environmental assessment (IEA) might be usefully applied to inform the future development of waste policy. In so doing it assesses the current situation in EU waste policy, looking at issues associated with waste generation, existing legislation and initiatives, and the strategic policy questions being raised.

It brings together current thinking on waste management, drawing on the experience of various actors within Member States and at the EU level. In particular, input was sought from a number of institutions known to be working in this area, such as: the European Environment Agency Topic Centre on Waste (EEA/TCW); National Environment Ministries; the European Environment Bureau (EEB); Green Alliance; the Finnish Environment Institute (SYKE); Eunomia Research & Consulting Ltd; Friends of the Earth; Waste Watch; Umweltbundesamt, Berlin; the Center for Energy and Environmental Studies (IVEM, Netherlands); the Wüppertal Institute, KPMG; the National Centre for Business and Sustainability (UK); and of course the European Commission. This list wide-ranging but probably incomplete, as undoubtedly many more individuals and institutions within Member States, Candidate Countries and elsewhere, are working on some aspect of waste policy. Several reports and comments were received, for which the author is grateful, a literature search was undertaken, and interviews were conducted with Otto Linher (European Commission) and Roberto Ferrigno (Policy Director, EEB). Nigel Haigh is also thanked for his useful comments on this paper.

In order to establish whether IEA may have a role to play in developing future EU waste policy, it is first of all necessary to look at the issue in more detail. The paper therefore begins in section two by raising the problems associated with waste generation and disposal. In section three, this is placed within the context of existing EU policy and the limitations of this are highlighted. An overview of current developments is also provided. The discussion on integrated environmental assessment begins in section four, by providing an overview of IEA. Section five presents a summary of current research and looks at the extent to which this approach has already been applied to waste policy. In section six the opportunities for applying IEA to future policy developments is explored, and this is followed by suggestions of what the next steps could be.

The paper is one of four papers recently commissioned under the second phase of the European Forum for Integrated Environmental Assessment (EFIEA).

2. Why is there a need to look at waste policy?

2.1 Waste generation in the EU

The EU generates approximately 1300 million tonnes of waste per year[1]. Construction and demolition make up more than half of this total, with municipal, mining and

[1] EEA (2001), *Environmental Signals*.

waste from other sources contributing about one sixth of the total each. It was estimated that in 1995 waste generation amounted to 3.5 tonnes of solid waste (excluding agricultural waste) per capita, and this figure is set to increase (EEA, 1999). According to the EEA (1999[2]), between 1990 and 1995 total waste generation in the EU and EFTA increased by almost 10%, while economic growth was approximately 6.5%.
Despite limitations in data, the EEA (1999) has predicted that most waste streams would increase over the next decade, so much so that by 2010 the generation of paper and cardboard, glass and plastic waste will increase by between forty to sixty percent compared to 1990 levels. Sewage sludge, electrical and electronic waste and end of life vehicles are other waste streams where substantial increases are expected.

The hazardous content of waste is also a problem as products become more sophisticated and technologically intensive. It is estimated that EEA member countries generate around 36 million tonnes of hazardous waste per year (OECD, 1997[3]). However, any figures are not totally clear due to differences in the definition of hazardous waste in Member States. This situation should be improved by the introduction of the hazardous waste list in the European Waste Catalogue, which establishes common classifications for hazardous waste in the EU, and the new waste statistics Regulation (2150/2002).

At the same time, the negative externalities of existing waste treatment options are being realised (see table 1), and there is a continued desire to divert waste away from landfill. According to the waste hierarchy, landfill is the least preferred waste disposal option, but it still remains the most common form of disposal. Two-thirds of total European municipal waste is landfilled, and the amount continues to increase despite rising levels of recycling and other more preferable options, due to the volume of waste being generated[4].

The enlargement of the EU to include ten new Member States in 2004 adds another dimension to the problem. With anticipated higher levels of economic growth in the new Member States post enlargement, a significant increase in waste generation can be expected. According to EEA estimates, if quantities reach the average amount per capita for the EU, the total amount of municipal waste in these countries will increase by 50 percent from 34 million tonnes in 1995 to 53 million tonnes in 2010[5].

Overall, 'the current situation cannot continue. Waste is now not only a danger to our environment. It is increasingly a threat to human health and our way of life' (European Commission, 1999[6]).

2.2 Decoupling waste and economic growth

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[2] EEA (1999), *Environment on the EU at the turn of the century*.
[3] EEA (1999) *Op cit*
[4] EEA (2002), *Case Studies on waste minimisation practices in Europe*, Topic report 2/2002, Luxembourg
[5] EEA (1999) *Op cit*
[6] European Commission (1999), *EU focus on waste management*, DG Environment, Nuclear Safety and Civil Protection

At the Lisbon European Council in March 1999, it was decided that 3% economic growth per annum was a sustainable level, and that the EU should seek to maintain this. However, there is a question of whether the environment has the carrying capacity to support this level of growth. Waste generation is greatly influenced by how efficiently resources are used in production and by the quantities of goods produced and consumed. There is a strong link between GDP and waste generation. The decoupling of resource use and waste generation from economic growth is clearly required, particularly as less developed countries develop further.

According to the EEA (Environmental Signals, 2002), we are already moving in the right direction towards meeting this objective. It reported that the use of natural resources has remained relatively constant since 1980, at around 51-52 tonnes per capita, whilst at the same time there was growth in GDP. Therefore, there has been a relative decoupling of resource use and waste generation from economic growth already. This view is also supported by the *Zero study*[7], which found that there has been a relative decoupling of economic growth from resource consumption, implying that market conditions already favour resource efficient production to some degree.

However, there is no absolute decline in the volume of the EU's total resource requirements, which implies that the environmental burden related to resource use and therefore waste generation remains constantly high. Consequently the need to focus attention on reducing resource use and waste reduction, and choosing the least environmentally damaging waste treatment options is of great significance.

2.3 The environmental consequences of waste

The environmental consequences of waste range from issues associated with depleting finite natural resources and energy, to the environmental impacts of different waste disposal options (see Table 1). The impacts of waste will also depend on the quantity generated and its characteristics, ie whether it has hazardous components and represents a risk to human health or the environment. It is usually the case that waste with higher environmental impacts per tonne is found in smaller quantities, and is therefore more difficult to separate and collect. Examples include hazardous chemicals, pesticides, solvents and heavy metals[8].

We can also look beyond the direct environmental consequences to considering the wider impacts, for example the climate change implications of different disposal options, or the implications of waste transportation. For example, due to the increasing quantities of waste being generated, the transport of waste represents a significant proportion of total transport. In France, waste accounted for fifteen percent of total weight of freight in 1993 and five percent of the total transport sector energy consumption (Ripert, 1997[9]). Transportation of waste has a number of associated environmental impacts, such as emissions to air of dust, SO_2 and NO_x; the risk of contamination of water, soil and ecosystems from accidental spills; and the risk to human health from accidental spills of hazardous substances.

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[7] Moll, S et al (2003), *Zero study: Resource Use in European Countries, An estimate of materials and waste streams in the Community, including imports and exports using the instrument of material flow analysis*, ETC/WMF.
[8] Steurer (1996), quoted in EEA (1999) *Op cit*.
[9] Quoted in EEA (1999) *Op cit*

Table 1: Selected environmental impacts of waste treatment options[10]

	Landfill	Composting	Incineration	Recycling
Air	Emission of CH_4, CO_2; odours	Emission of CH_4, CO_2; odours	Emission of SO_2, NO_x, HC_l, HF, NMVOC, CO, CO_2, N_2O, dioxins, dibenzofurans, heavy metals (Zn, Pb, Cu, As)	Emission of dust
Water	Leaching of salts, heavy metals, biodegradable and persistent organics to groundwater		Deposition of hazardous substances on surface water	Waste water discharges
Soil	Accumulation of hazardous substances in soil		Landfilling of slags, fly ash and scrap	Landfilling of final residues
Landscape	Soil occupancy; restriction on other land uses	Soil occupancy; restriction on other land uses	Visual intrusion; restriction on other land uses	Visual intrusion
Ecosystems	Contamination and accumulation of toxic substances in the food chain	Contamination and accumulation of toxic substances in the food chain	Contamination and accumulation of toxic substances in the food chain	
Urban areas	Exposure to hazardous substances		Exposure to hazardous substances	Noise

3. Overview of EU waste policy

3.1 Existing waste policy

Before the mid-1970s, waste was largely regarded as a local matter in all Member States, and the EU had no legislation concerned with waste disposal. The adoption of

[10] European Commission (1999), *EU focus on waste management*, DG Environment, Nuclear Safety and Civil Protection

the waste framework Directive in 1975 was in part a response to the introduction by some Member States of legislation intended to provide a national framework for waste policy, and sought to set out a coherent set of measures applicable in all Member States. The framework Directive was followed in the 1970s by Directives on toxic waste, PCB disposal and waste oils. In 1984 a Directive on transfrontier shipment of hazardous waste was adopted. These were all revised or replaced as EU waste policy developed further into a 'second generation' of legislation.

Annex 1, adapted from Haigh (1997[11]), summarises the development of EU waste policy by looking at three distinct periods: 1975-85; 1986-96 and 1997 to the present day. From this it can be seen that there was a tendency in the earlier years to focus on end of pipe solutions to the problems associated with waste, for example setting emission standards for incinerators, and standards for safe disposal of oils. Since the 1990s policy has tended to focus on a more preventative approach, for example via the elimination of harmful substances in products. There has also been a marked increase in the number of policy measures using the principle of producer responsibility, which began in 1996 with the Packaging Directive. It can be seen that much of the policy to date has concentrated on particular waste streams.

In general, EU waste policy is based on four key principles:

(i) Prevention – reduction of waste at source
(ii) Producer responsibility and polluter pays – those who produce waste should pay for their actions
(iii) Precautionary principle – the potential problems should be anticipated
(iv) Proximity principle – waste should be disposed of as near to its source as possible

The first EU waste strategy

The Commission published its first broad Communication on waste, entitled *A Community Strategy for Waste Management*, in September 1989 (SEC(89)934). It built on the waste management elements included in the EU's fourth action programme and outlined five guidelines: prevention, recycling and reuse, optimization of final disposal, regulation of transport and remedial action. Prevention was presented as the primary objective, to be achieved through the development of clean technologies and waste minimization. The other guidelines were envisaged as a hierarchy of next-best options – hence the term **'waste hierarchy'**.

The final section of the strategy paper considered waste management in the context of the single market, with particular regard to the movement of waste and the risk that 'in a Community without internal frontiers the flow of waste towards lower-cost disposal plants may become a flood'. Harmonizing disposal standards was seen as a priority but the Commission stated that 'the need to protect the environment may lead to a restriction of movements', favouring waste disposal 'in the nearest suitable centres, making use of the most appropriate technologies to guarantee a high level of protection for

[11] Haigh, N (1997), *Background material for presentation on 'Messages for the future'*, European Parliament's Committee on Environment: Public Hearing *Improving European Waste Management,* 26 November 1997, IEEP.

the environment and public health'. This has become known as the '**proximity principle'**.

The Council welcomed the Commission's strategy[12]. It urged the further development of clean technologies and products and invited the Commission to bring forward a range of proposals. It also reinforced the strategy paper's bias in favour of minimizing movements of waste (the proximity principle), reducing the quantity and toxicity of waste for landfill and developing an 'adequate and integrated network of disposal facilities'.

The priorities in the strategy paper and Resolution were reflected in the strengthened waste framework Directive 91/156, which placed a new obligation on Member States to establish a network of disposal installations with the aim of self-sufficiency in waste disposal.

The waste framework Directive

Directive 91/156 placed general duties on Member States, to take measures to:

- encourage the prevention or reduction of waste production and its harmfulness, particularly through the development of clean technologies, techniques for the final disposal of dangerous substances in waste destined for recovery, and the development and marketing of products designed to have minimal environmental impact by nature of their manufacture, use or final disposal (Article 3.1);
- encourage the recovery of waste, including recycling, reuse or reclamation, and the use of waste as a source of energy (Article 3.1);
- ensure that waste is recovered or disposed of without endangering human health and without using processes or methods which could harm the environment, and in particular without risk to air, soil and plants and animals, without causing a nuisance through noise or odours, and without adversely affecting the countryside or places of special interest. The abandonment, dumping or uncontrolled disposal of waste must be prohibited (Article 4);
- establish an integrated and adequate network of disposal installations, taking account of the best available technology not involving excessive costs. The network is to enable the Community to be self sufficient in waste disposal (Article 5).

The second EU waste strategy

Towards the end of 1995 the Commission signalled the start of a possible change in direction for waste management through a report (COM(95)522, 8.11.95) setting out its approach towards the establishment of 'a comprehensive policy to deal with all waste in the Community'. The Commission's Communication on the review of the Community's strategy for waste management was published in July 1996 (COM(96)399).

Like the previous strategy, this established a hierarchy of priorities for waste management with prevention being the preferred option, followed by increased recovery (material recovery is to be given preference over energy recovery) and then

[12] Council Resolution (OJ C122 18.5.90)

safe disposal. It was stated that the implementation of the hierarchy would be guided by the consideration of the 'best environmental solution' taking into account economic and social costs. The instruments envisaged include regulatory and economic instruments, improved statistics, waste management plans, life-cycle analysis and eco-balances.

In announcing the document, Commissioner Bjerregaard emphasized the important role producer responsibility for products must play in any future waste management strategy, and that waste management concerns should be taken into consideration from the product's design and conception. In support of this the Commission was positioned to take action to:

- promote clean technologies and products and the use of less raw materials in processes and products;
- reduce the generation of hazardous waste by limiting or banning certain heavy metals or dangerous substances in products and processes;
- promote the use of economic instruments able to influence waste prevention without distorting competition; and
- further develop the eco-audit and eco-label schemes

Priority waste streams

As part of its overall strategy, the Commission identified a number of specific waste streams to receive priority attention. The priority waste streams method seeks to bring together government, environmental and industrial interests with the aim of building a consensus before the Commission proposed legislation. Much of current waste policy stems from this programme, such as the end-of-life vehicles Directive, the WEEE Directive and the inclusion of used tyres in the landfill Directive. Outstanding priority waste streams include batteries, household hazardous waste, organic waste and PVC.

3.2 Current developments in EU waste policy

At present, waste policy is mainly being steered by the Sixth Environmental Action Programme[13] (Sixth EAP). This identified natural resources and waste as one of the four environmental priorities of the ten-year Programme:

'better resource efficiency and resource and waste management to bring about more sustainable production and consumption patterns, thereby decoupling the use of resources and the generation of waste from the rate of economic growth and aiming to ensure that the consumption of renewable and non-renewable resources does not exceed the carrying capacity of the environment' (Article 2, paragraph 4).

This aim, as set out in Article 8 of the Decision, is to be pursued through a variety of means, including:

- Ensuring the consumption of resources and their associated impacts do not exceed the carrying capacity of the environment, and breaking the linkages between economic growth and resource use;

[13] Decision 1600/2002/EC, OJ L242, 10.9.2002

- reducing the volume of waste generated through waste prevention initiatives, better resource efficiency and a shift to more sustainable patterns of production and consumption;
- reducing the quantity of waste going to disposal and reducing the volumes of hazardous waste produced; and
- encouraging re-use.

These objectives, in part, are to be pursued in two Thematic Strategies: sustainable management and use of natural resources; and waste recycling (which has recently been expanded to include waste prevention).

The Decision states that the Thematic Strategy on waste recycling should include:
- Measures aimed at ensuring source separation, the collection and recycling of priority waste streams;
- further development of producer responsibility; and
- development and transfer of environmentally sound waste recycling and treatment technology.

The Thematic Strategy on natural resources should include:
- an estimate of materials and waste streams in the EU, including exports and imports;
- a review of the efficiency of policy measures and the impact of subsidies relating to natural resources and waste;
- establishment of goals and targets for resource efficiency and the diminished use of resources;
- promotion of extraction and production methods and techniques to encourage eco-efficiency and the sustainable use of raw materials, energy, water and other resources; and
- development and implementation of a broad range of instruments, including research, technology transfer, market-based and economic instruments, programmes of best practice and indicators of resources efficiency.

Other actions identified in Article 8 include developing and implementing measures on waste prevention and management; and developing or revising waste legislation, including measures in respect of construction and demolition waste, sewage sludge, biodegradable wastes, packaging, batteries and waste shipments. The need for clarification of the definition of waste and non-waste is also identified. These actions are to be developed in the context of Integrated Product Policy (IPP) and the Community's strategy for waste management.

Clearly the development and implementation of the Thematic Strategies represents a great opportunity for using an IEA approach to inform future waste policy developments. These have to be completed by July 2005, and are likely to provide a framework from which specific policies and measures may be proposed. It is expected that the waste recycling strategy in particular will place more focus on addressing shortcomings with existing policy and implementation, than proposing many new measures. The Commission is currently working on developing the first communications[14], following which there be a consultation period. It is hoped that the White Papers will be released ahead of schedule in summer 2004.

Integrated Product Policy (IPP)

The objective of IPP is to reduce the environmental impacts from products throughout their lifecycle, including product design, processes and disposal. A leaked draft of the awaited Commission White Paper indicated that it would look at environmental problems identified in the EU Sustainable Development Strategy (SDS) and Sixth Environmental Action Programme, then focus on specific product groups and what policy instruments may be used to address these specifically.

It is thought that IPP will establish the framework conditions for continuous environmental improvement of all products throughout their life cycle, including non-legislative solutions, legislative solutions, and financial instruments, including taxes and subsidies. The leaked paper also outlined the need for IPP thinking to be integrated into policy areas other than the environment, and the Commission is to encourage individual sectors, via the Cardiff process, to be more explicit about how IPP will be integrated into their work.

Moving away from priority waste streams approach

Identifying where attention should be focused is likely to move away from the existing priority waste stream approach[15]. To some extent, there is a basic framework in place for the most important waste streams, although there are still some gaps. Instead, the logic may shift to looking at materials, regardless of whether these come from packaging or end of life vehicles. Targets for reuse and recycling may therefore be set for paper, plastic etc, rather than looking at these materials from different sources.

3.3 Limitations of existing EU policy

The limitations of existing waste policy have been highlighted by many observers. Those which may be seen as a potential barrier to applying IEA are discussed below, although this is by no means exhaustive. These limitations highlight areas where a more integrated approach may seek to overcome some of the barriers to sustainable waste management, for example through consistent policy messages reinforced by clearer definitions of waste and correct market signals. It also highlights where barriers exist to applying IEA, such as inadequate data.

i. The definition of waste

There are many instances where the definition of waste, and particularly the definition of treatment options, gives rise to uncertainty in implementing EU waste law. For example, when is incineration of waste classed as recovery, and when is it classed as disposal? This has been the issue raised in recent court cases. Although the European Court of Justice (ECJ) has set out criteria for establishing the difference between the

[14] Commission Communication '*Towards a Thematic Strategy on Natural Resources'* expected June 2003; *'Towards a Thematic Strategy on Waste Prevention and Recycling'* expected May 2003.
[15] Interview with Otto Linher, European Commission, 23 April 2003

two, the message remains at best inconsistent and at worst questionable (Boxes 1a and 1b). This alone threatens to undermine the EU waste hierarchy by allowing waste disposal to take place under the guise of recovery. It also, amongst other complications, affects the calculation of recovery and disposal levels and distorts data on recovery targets.

One of the most crucial implications of the difference in definition is in relation to exporting waste, not only within the EU but also to non Member States. Under the Shipment of Waste Regulations, Member States have little control over shipments of waste that are intended for recovery. If an export is for disposal, Member States can question shipments based on the principles of proximity and self-sufficiency. With recovery, however, the proximity principle does not apply.

Box 1a: Recent case law on the definition of waste - Waste or secondary material[16]

Case C-9/00 (*Palin Granit Oy v. Vehmassalon kansanterveystyön kuntayhtymän,* April 2002) concerned the granting of an environmental license by a Finnish municipal board to a company (Palin Granit) to operate a granite quarry, including a management plan for the use of leftover stone as gravel or filling material. Local courts had classified the leftover stone as waste, but this was contested by the company, who insisted that it was a reusable material, and that the area where it was kept was not a landfill but simply a storage area. The ECJ reiterated that there is no decisive test as to whether or not something is waste, and instead looked at a number of indicators. The argument that it has an economic value was not thought to be decisive, and instead the fact that it was a production residue from quarrying and processing stone was regarded as more important. The Court held that, having regard to the principle established in earlier cases that the concept of waste should be interpreted widely in order to limit its inherent risks, then 'the reasoning applicable to by-products should be confined to situations in which the reuse of the goods, materials or raw materials is not a mere possibility but a certainty, without any further processing prior to reuse and as an integral part of the production process' (para.36).

Consequently, the leftover stone is to be classified as waste and treated accordingly. This position was reiterated in the Advocate General's opinion of 10 April 2003 in response to a request from Finland for guidance on the criteria to be used (C-114/01).

[16] Haigh, N (2003) *Manual of Environmental Policy: the EU and Britain*, Chapter 5.3, Maney Publishing, Leeds.

Box 1b: Recent case law on the definition of waste - recovery and disposal[17]

The ECJ delivered two judgements regarding the definition of waste recovery on 13 February 2003. In both judgements, which were brought against Luxembourg and Germany respectively, the Court set three criteria that it says should be used to establish whether an operation is classed as an 'R1' recovery operation, as outlined in the waste framework Directive. Both cases were brought forward in the context of the 1993 waste shipments Regulation, which gives the Member State that is exporting waste greater powers to block exports if it is for disposal rather than recovery.

The German case (C228/00) concerned a blocking by German authorities of transfers of waste to Belgium for use in cement kilns as fuel. They believed that the waste should have been defined as disposal and not recovery, as indicated by the notifying party. The German Ministry upheld the position that, according to a number of criteria, the incineration could not be classed as the generation of energy, and therefore had to be disposal. The ECJ continued to disagree with the Ministry, and stated that the criteria it had used did not comply with EU law, and that Germany had infringed provisions in the Regulation by raising unjustified objections to the transfer. Germany argued, however, that in the absence of clear criteria at the EU level, national authorities should be able to lay down their own criteria to distinguish between different operations. The ECJ ruling went against the Ministry decision, and stated that the use of waste as a fuel in cement kilns was indeed **waste recovery** in this instance.

Conversely, in the Luxembourg case (C458/00) the ECJ agreed with the authority's decision to block the export of municipal waste for incineration, agreeing that the treatment was **waste disposal,** despite the fact that there was energy recovery. The Commission had issued proceedings against Luxembourg, as it believed that it was infringing the Regulations by blocking the shipment of the waste, agreeing with the exporter that it was a recovery operation. In its decision, the ECJ found that the Commission's application was unfounded. In this instance it ruled that the 'shipment of waste in order for it to be incinerated in a processing plant designed to dispose of waste cannot be regarded as having the recovery of waste as its principal objective, even if when that waste is incinerated all or part of the heat produced by the combustion is reclaimed' (para 41) and that 'reclamation of the heat generated by the combustion constitutes only a secondary effect of an operation whose principal objective is the disposal of waste, it cannot affect the classification of that operation as a disposal operation'(para 42).

The criteria used by the ECJ were as follows:

- the operation's principal objective must be to allow the use of wastes to produce energy;
- the operation must be able to be considered effectively as 'a means of producing energy', which requires that more energy is produced than consumed and that the surplus energy is put to an effective use as heat or electricity; and
- the majority of the waste must be consumed during the operation, and the majority of energy produced recuperated and used.

[17] Haigh, N (2003) *Op cit*

The criteria used by the ECJ seem to have set the precedent, as they were again used in a judgement delivered on 3 April 2003 (Case C-116/01) against the Netherlands, concerning the issue of recovery and disposal definitions.

In these cases it was recorded that the calorific content of the waste was not a valid consideration. It was also recorded that, in the absence of EU criteria for definitions, a Member State could set its own criteria so long that it was compatible with the waste framework Directive and shipment of waste Regulation. What this means in practice remains unclear, however, considering that both the German and Netherlands criteria were said to infringe EU law.

There are several implications of permitting exports of waste for recovery operations. As waste can be shipped all over Europe with low levels of administrative effort and weak control mechanisms (Ökopol 2002[18]), waste producers may choose this option in preference to more costly and complicated national procedures for dealing with waste. This occurs, as demonstrated by recent case law (see Boxes 1a and 1b), in cases where the process is in fact disposal and not recovery, and should consequently have been subject to tighter controls under that definition. Incineration with recovery is in most cases cheaper than waste incineration. This is partly due to less stringent emission standards being applied to co-incineration plants, and to plants in general in non-EU countries where environmental standards are not as high. Of course, costs can also be less due to the value of the waste as a secondary material, and the substitution of virgin raw materials. There may be opportunities for IEA in helping to determine what the best practicable environmental option would be in any given case. Such an approach would also allow an exploration of questions of scale, which are highly relevant to IEA practice.

The waste incineration Directive (2000/76) covers different kinds of installations. In its general provisions it sets out the principle that "*The co-incineration of waste in plants not primarily intended to incinerate waste should not be allowed to cause higher emissions of polluting substances in that part of the exhaust gas volume resulting from such co-incineration than those permitted for dedicated incineration plants and should therefore be subject to appropriate limitations" (General Provisions 27).* However, there are special provisions for emissions from cement kilns, combustion plants and other industrial sectors co-incinerating waste, as set out in Annex II of the Directive (Ökopol, 2002).

The European Environmental Bureau (EEB), amongst others, is calling for changes in the definition of waste recovery. In a policy statement released in March 2003[19], it states that current EU waste laws are unclear and 'make eco-dumping an acceptable practice'. They propose nine conditions, or *criteria for credible recovery*, which include: the right for Member States to object to exports of waste for recovery; harmonising emission standards for co-incineration operations with incineration operations; minimum standards for efficiency and rate of destruction; a minimum range for calorific value of waste to be set at between 11.5 and 15MJ/kg (otherwise

[18] Sanders K and Lohse J (December 2002), *Towards Credible Recovery,* Okopol GmbH, Hamburg for the European Environmental Bureau
[19] EEB (2003), *Policy Statement on Credible Recovery Operations*

incineration is to be classed as disposal); and not increasing the level of hazardous substances in the product when hazardous waste is used as a recovered fuel.

The EEB argues that if such criteria were to be applied, it would prevent Member States from using incineration to meet recovery targets under several EU Directives, and make trade in waste for incineration within the EU more difficult.

ii. Lack of comprehensive, reliable and comparable data

The ability to predict trends in waste generation, to inform new policy and to assess the effectiveness of existing policy is greatly restricted by the inadequacy of available data. Statistics are usually not comparable across Member States due to differences in definition of different waste streams, differences in how data are collected and aggregated and different reporting periods. Therefore figures that we do have do not reflect a completely clear picture.

This problem has been highlighted in several studies. For example, the EEA report on hazardous waste generation in Member countries (2002[20]) concluded that further improvement was needed to increase the comparability of data between the EEA countries. The study looked at existing data on hazardous waste in order to assess its comparability. The situation it found was that national definitions of hazardous waste were not limited to those defined on the EU Hazardous Waste List (HWL), and that different codes were probably being used for the same waste type. It was acknowledged that the requirement for Member States to implement the HWL will improve this situation, although historical data will remain a problem in tracking trends. Another shortcoming was that the source of hazardous waste is often not recorded. This inhibits the assessment of waste generation paths and hence the development of appropriate policy measures.

The problem of incomparable and inconsistent data was also highlighted by discussions at the 5th EIONET Workshop in June 2002[21], which raised the following issues:

- Overall lack of hard data inhibits analysis of trends, comparisons of Member States and assessment of policy effectiveness.
- There is a need to verify the level of aggregation used for the collection of waste statistics, and whether this is comparable to other countries, and whether it includes the same waste streams.
- Data are often created nationally and are rarely provided to a higher level, which inhibits analysis.

[20] Brodersen, J et al (2002), *Hazardous waste generation in EEA member countries: Comparability of classification systems and quantities*, Topic report 14/2001, European Topic Centre of Waste, EEA, Copenhagen

21 Carlsen R (September, 2002), *Workshop proceedings: 5th EIONET Workshop on Waste and Material Flows*, European Topic Centre on Waste and Material Flows, EEA.

EIONET is the European Environment Information and Observation Network. It is a collaborative network of the European Environment Agency and its Member Countries, connecting National Focal Points in the EU and accession countries, European Topic Centres, National Reference Centres, and Main Component Elements. These organisations jointly provide the information that is used for making decisions for improving the state of environment in Europe and making EU policies more effective. EIONET is both a network of organisations and an electronic network (http://eea.eionet.eu.int).

- There are problems in obtaining data and information on best available technology (BAT) from small and medium sized companies (SMEs)

iii. Implementation in Member States

In the Commission's Third Annual Survey on the implementation and enforcement of EU environmental law[22], it was reported that 20.6% of all open infringements are in relation to waste policy. This includes cases brought against Member States for non-communication, non-conformity and bad application. Of all cases brought for non-conformity, 29.1% were regarding waste policy, which was the largest proportion of all sectors. There was not one Member State that did not have infringement proceedings against it in relation to waste policy. This demonstrates that regardless of how much policy on waste exists, and however it is informed, implementation in Member States is critical.

Most of the implementation difficulties concerned the application of the waste framework Directive to specific installations. However, infringements were also brought regarding the landfill Directive (99/31), hazardous waste Directive (91/689), the batteries and accumulators Directive (91/157 and 93/86), the packaging Directive (94/62), the shipment of waste Regulation (259/93/EEC), the disposal of waste oils Directive (75/439), the disposal of PCBs and PCTs Directive (96/59) and the sewage sludge Directive (86/278).

It is worth noting that the implementation of waste legislation is likely to be one of the hardest areas of the environmental *acquis* for the new Member States after enlargement. What implications this will have for the level of scrutiny that will be given to implementation in existing Member States remains to be seen.

iv. Market failures

Existing EU waste policy steers the way that waste is managed, and often in the wrong direction. For example, despite landfill being the least preferred treatment option of the waste hierarchy, it remains the most common form of treatment throughout the EU. This is in part due to market signals, which make more preferable options, such as incineration with energy recovery, more expensive.

The EEA (1999[23]) found that in nearly all EEA member countries the average treatment prices for landfilling non hazardous waste were far below those for incineration. Consequently, the market mechanism directs waste towards landfill and will continue to do so unless conditions are changed. It was recognised that prices are largely influenced by national rules and regulations, for example the taxation of landfill, or operational requirements which increase the price of disposal or treatment options. The EEA therefore recommended that the EU determine 'an obligatory state of the art for all kinds of waste management activities, leading to the gradual internalisation of external costs', and that there is a gradual substitution of taxes on labour with taxation on energy and raw materials. The latter, it believes, 'is probably

[22] SEC(2002)1041, 1.10.2002
[23] EEA (1999) O*p cit*

the most efficient way of obtaining sound resource management in a free-market economy'.

The EEA (1999) also reports that variations in treatment prices between countries may run counter to the principle of proximity. Furthermore it may affect the competitiveness of recycling industries where operational costs and the costs of disposing of residuals are higher, and as a result may inhibit the growth of the recycling industry in some Member States. On the former point, the EEB (2003)[24] commented that existing laws incentivise the directing of waste towards cheaper, low quality installations in order to avoid the higher costs associated with higher national standards. In particular, the Waste Shipments Regulation does not allow Member States to object to shipments of waste for recovery on the grounds of having higher national environmental standards itself, nor on the availability of more preferable treatment alternatives. The EEB is calling for the Regulation to be amended to allow Member States to object to shipment of waste for recovery if the environmental standards in the receiving installation are lower than in the exporting country, or if recycling options are available.

The waste hierarchy

Two questions can be asked about the waste hierarchy. Firstly, is the hierarchy of options correct; and secondly, is the hierarchical approach working? The first of these questions has been researched in some detail, as discussed in section 5. In relation to the second question, there has been criticism that policy has failed to focus on the most preferred option – prevention. On the contrary, waste generation has continued to increase. There is also recognition that in spite of policy and measures to reduce landfill, it continues to be the most common disposal option in the EU. This is an area where an integrated analytical approach may help to clarify current debates.

4. Overview of Integrated Environmental Assessment

In essence, Integrated Environmental Assessment (IEA) is an approach that brings together different disciplines to allow a more holistic assessment of environmental issues. Several definitions exist, amongst which is that used by the European Environment Agency (EEA):

'*The interdisciplinary process of identification, analysis and appraisal of all relevant natural and human processes and their interactions which determine both the current and future state of environmental quality, and resources, on appropriate spatial and temporal scales, thus facilitating the framing and implementation of policies and strategies'* (NERI, 1997[25]).

This is further elaborated on by Luiten (1998), who outlines the main 'steps towards improving the environment' as:

(i) Data collection, including monitoring, scientific research or modelling processes;

24 EEB (2003) O*p cit*
[25] NERI (1997) *Integrated Environmental Assessment on Eutrophication, A Pilot Study*, Technical Report No 207, Ministry of Environment and Energy, National Environmental Research Institute

(ii) Statistical analysis of the gathered data in order to identify trends, differences, etc.
(iii) Assessment of the information to deliver conclusions about developments, priorities etc.
(iv) Reporting of the results, including justification;
(v) Supporting the political approval and guiding the implementation of results.

According to Luiten, IEA could be considered one of these steps, but has relations with each of the other steps. In a broader sense, therefore, IEA 'has to deal with the whole process from data collection up to and including implementation'. The involvement of the relevant scientific disciplines, information technology and the interests of society must also be considered in each of the five steps, as illustrated in Table 2.

Table 2: Elements of IEA[a]

	Public/politics	**Information technology**	**Science**
Data collection	Selection of DPSIR indicators	Data warehouse, GIS, geographical and sector aggregation.	Monitoring, specific modelling, experts opinion, local studies
Statistical analysis	Sensitivity	Uncertainty	Credibility
Modelling	Scenarios Strategic environmental assessment	Structured knowledge, hardware, software	Integrated environmental modelling, local models
Reporting	Public participation, launching reports	Communication, EIONET/Internet	Documentation
Decision making and implementati on	Green accounting	Multi-criteria analysis	Cost-benefit analysis, environmental efficiency

[a] The cells are not to be considered as stand-alone; there are many interactions between the items. Each cell indicates one or more specific aspects, but this has to be in coordination with other items. For example, the selection of indicators should make it possible to carry out cost-benefit analysis. For an appropriate IEA all items must be presented in a well-balanced manner

Source: Luiten, 1998[26]

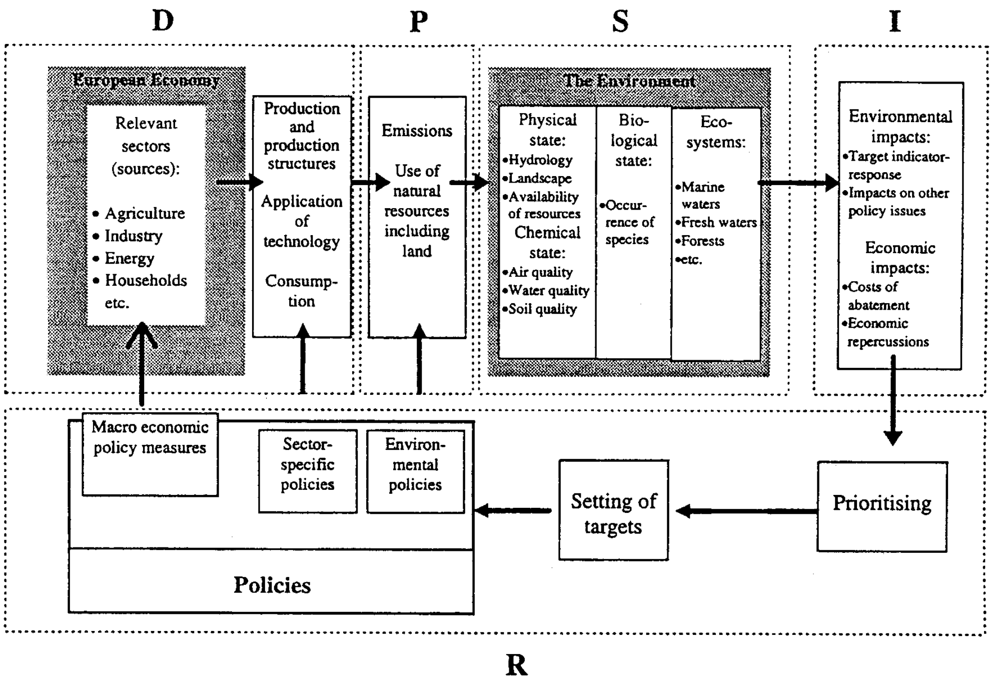
The EEA has adopted a framework for IEA showing the chain of linkages from driving forces in society right the way through to desirable response. This approach,

[26] op cit

termed DPSIR, has been used in assessments of the Europe's environment, for the production of its State of the Environment reports. These reports contribute to the preparation of policy at the EU level.

The DPSIR approach looks at the chain of events from driving forces [D], to pressure on the environment [P], to the state of the environment itself [S], the impact on people and nature [I] and the desirable response [R] (Luiten, 1998[27]; Wieringa, 1999[28]). Although more detailed explanations are available elsewhere, Figure 1 helps to illustrate the different stages in the EEA approach.

Figure 1: Integrated Environmental Assessment in a DPSIR Framework



Source: NERI (1997), reproduced in Luiten (1999)[29]

Applying IEA is not straightforward, however. Haigh (1998[30]) highlights the importance of the political process in decision-making, regardless of scientific evidence, and the different situations in Member States, both politically and culturally. According to Haigh, '*any attempt to play down the human equation will doom IEA to irrelevance'*. The complexity of bringing together academics and scientists from different disciplines, and politicians from different Member States with their own political cultures and local conditions also needs to be considered.

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[27] Luiten (1998) *Op cit*

[28]Wieringa, K (1999), 'Towards integrated environmental assessment support for European Community's environmental action programme process', *International Journal of Environment and Pollution, Vol 11, No.4 1999*

[29] Luiten (1999), *Op cit*

[30] Haigh, N (1998), 'Roundtable 4: Challenges and opportunities for IEA – science-policy interactions from a policy perspective', *Environmental Modelling and Assessment 3* (1998) 135-142, Baltzer Science Publishers BV

Additionally, there is the question of whether this will become even more complex when the EU expands to include 25 Member States in 2004.

Though beyond the scope of this paper, it is worthwhile noting that further literature exists on the theory of IEA, including how it should be defined, how it can work in practice, critiques of methodology, the need for quality guidelines and the inherent problems of applying scientific evidence to policy debates (see for example Rotmans, 1998[31] and Ravetz, 1999[32]). There is also an ongoing debate about whether IEA should be defined more broadly to explicitly include economic and social considerations, and if so whether the IEA term should be altered accordingly.

5. To what extent has IEA already been applied to EU waste policy?

To some extent, researchers have been looking at the integrated environmental assessment of waste policy for some time. However, this has generally been in the form of other approaches such as life cycle analysis, cost-benefit analysis, environmental accounting, environmental impact assessment, etc, rather than being defined as IEA as such. In particular, a lot of work has focused on looking at the environmental impact of the different treatment and disposal options, and life cycle analyses of different products. Below is a selection of the different studies that have been undertaken. These demonstrate how research has looked at different aspects of the bigger picture.

5.1 Focusing on waste streams or specific materials

Since the 1990s the EU has taken a waste stream approach to identifying where the focus on policy development needs to be. The aim of this approach was to bring together relevant interest groups to participate in the decision-making process prior to proposals being adopted. These priority wastes included batteries, end-of-life vehicles, waste electrical and electronic equipment, organic waste, packaging waste and household hazardous waste. It has been indicated that in the future the Commission will instead possibly look at material-specific waste sources, and not waste streams. A lot if literature exists on specific waste streams in particular, not least from the Commission itself. The two approaches are demonstrated below.

Waste streams

Many studies exist on those waste streams that have been the focus of policy attention in recent years. For example, a recent study looked at waste from construction and demolition[33]. An interesting aspect of this particular study was that it was conducted in a local context. The study goes through the life cycle of mineral resources in the north west of England, beginning with the quarries in the region. At each stage of the life cycle the impacts on society are considered, using mass balance analysis and other modelling tools to identify and assess impacts associated with different activities.

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[31] Rotmans, Jan (1998) 'Methods for IA: The challenges and opportunities ahead', *Environmental Modelling and Assessment 3* (1998) 155-179, Baltzer Science Publishers BV

[32] Razetz, JR (1999), 'Developing principles of good practice in integrated environmental assessment', *International Journal of Environment and Pollution*, Vol 11, No 3, 1999, Inderscience Enterprises Ltd.

[33] National Centre for Business and Sustainability (2003) *Rocks to Rubble: Building a Sustainable Region*, 4sight Project

The analysis revealed that waste arose at every stage in the life cycle of construction materials, including 'excessive exploitation' of resources, inefficiencies in energy use, impacts on the road transport system, and poor final management of waste. This, the authors commented, has a negative impact on the region's economy, the environment and health, and threatens to undermine its commitment to sustainable development. The main concerns identified by the study were inefficiency, pollution and waste generation. It found that for every tonne of construction material used in the northwest, approximately 115kg of CO2 is produced, and approximately 13 million tonnes of building materials are discarded from building sites in the region, placing additional pressure on landfill capacity. Following this analysis, the authors recommended a number of solutions to the problems, such as converting waste streams into resources via the increased use of aggregates.

The EEA (2002)[34] demonstrated how an integrated approach could be applied to the management of biodegradable municipal waste (BMW) in Europe. The report looks at different national strategies set up by Member States to divert biodegradable waste away from landfill, as required by Directive 1999/31. At that time, reliance on landfill for the treatment of BMW ranged from 5% in Denmark to over 80% in the UK and Ireland.
The waste stream of BMW was broken down into four phases:

(i) production
(ii) presentation (preparation for collection), collection, transfer and movement
(iii) treatment
(iv) end-use/final destination (beneficial use or disposal)

The report outlined that in developing national strategies it was necessary to look at each of these phases, and measures vary accordingly. For example, in phase one, strategies relating to production might include public education programmes and waste reduction initiatives, whereas in phase three, initiatives may include bans or restrictions on the type of waste that can go to landfill.

Denmark is a good case to consider as it was found to have the lowest reliance on landfill for BMW. Incineration with energy recovery is the main treatment route for BMW, accounting for 54.3% of this waste. Most plants in Denmark have been upgraded to combined heat and power generation, which is in line with energy policy, as incineration with energy recovery is important for district heating schemes. There has also been an increase in participation in home composting schemes, and there are high separate collection rates for municipal waste. This is encouraged by separate collection schemes, for example for garden waste, food waste and paper.

This level of success has been achieved through a mix of policy measures across each of the four phases. For example, municipalities are legally obliged to collect 40-55% of newspapers and magazines for recycling, establish collection systems for food waste from canteens and restaurants that generate more than 100kg of food per week, and there are reduced fees for municipal waste collection from households that carry

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[34] Crowe, M et al (Jan 2002) *Biodegradable municipal waste management in Europe, Part I: Strategies and instruments*, Topic report 15/2001, EEA European Topic Centre on Waste, Luxembourg.

out home composting. There are taxes on landfill and incineration, differentiated between those plants with energy recovery and those without. The aim is to encourage recycling, and consequently this is not taxed, and nor is composting and anaerobic digestion. In 1997 a ban on landfilling any waste that would be suitable for incineration was introduced. This has been very successful in diverting biodegradable waste away from landfill.

The Danish example also highlights the importance of local considerations in defining a waste strategy. What is appropriate in one Member State cannot be equally applied in another, and therefore there is a limit to what can be prescribed at the EU level. In this instance, Denmark has succeeded in diverting BMW away from landfill very successfully, but this has mainly been achieved by the expansion of incineration with energy recovery. Although this is a viable option, and more preferable to disposal, such a move could arguably not be adopted in other countries, for example the UK, where there is much opposition to incineration and expansion would be politically unpopular. This represents, therefore, an example of Haigh's 'human equation' (see above).

Priority materials

Several studies have looked at the environmental impacts of different materials through their entire life cycle. One material of concern, and where the EU may in the future focus attention, is PVC. DG Environment commissioned a report to assess the waste management costs of diverting PVC waste away from incineration, in particular towards recycling, and the associated environmental costs and benefits[35]. The study covered the EU-15 and six Candidate Countries for the period 2000 to 2020. Over this time frame post-consumer PVC waste is anticipated to increase from 3.6 to 6.4 million tonnes per annum, whilst recycling remains low at 3% of arisings. This low rate is due to high separation and processing costs. At the time of the study 82% of PVC waste went to landfill, and 15% was incinerated.

Due to restrictions on landfill the amount of PVC going to incineration was expected to increase to 45% of arisings over the time period being reviewed, with 9% being mechanically recycled, and 50% still going to landfill. The study looked at three scenarios based on different diversion rates of landfill to recycling, incineration to recycling, and incineration to landfill:

- Scenario 1: Recycling increases to 15%, decrease in landfill and incineration
- Scenario 2: Recycling increases to 22%, decrease in landfill and incineration
- Scenario3: Recycling unchanged, incineration decreases to 30% (from BAU forecast of 45%), increase in landfill.

The researchers firstly considered the financial costs associated with incineration, recycling, landfill and sorting. As part of this they looked at what they termed the 'incinerator subsidy'. This cost accounts for the higher costs associated with incinerating PVC (as the chlorine content of PVC places a high demand on alkaline reagents in air pollution control systems at incinerators, so much so that each unit of

[35] Brown et al (2000) *Economic Evaluation of PVC Waste Management: A report produced for the European Commission DG Environment,* AEA Technology

PVC requires the same amount of reagents as up to 70 units of MSW), which is presently distributed between other materials being incinerated.

The initial results showed that scenarios one and two were dependent on the net recycling costs charged to waste producers as a disposal fee for recycling: when the revenue from the sale of recyclate is low, the disposal fee increases and vice versa. Also, a major component of the recycling cost was for collection and segregation. Unit costs were found to be lowest in scenario one, where recycling is focussed mainly on easier to process products, and highest in scenario two where there are higher rates of recycling and for a range of applications. In scenario three there were net savings in costs to be achieved when diverting PVC from incineration to landfill. If this study alone were to influence policy, a change would be needed to allow PVC disposal in landfill in some Member States.

The researchers then went on to assess, as far as possible, the external costs associated with each scenario. The analysis specifically focused on air pollution effects and the impact on climate change and human health. Due to uncertainties, best estimates and lower and upper costs were calculated based on different assumptions for valuations of externalities. From this analysis it was concluded that:

- In all cases diverting PVC from incineration resulted in environmental improvements;
- Environmental benefits were sufficient to outweigh the financial costs in scenario one, even when the avoided 'incinerator subsidy' is excluded;
- In scenario two, environmental benefits only exceed costs when the high valuation of externalities is used; and
- Scenario three shows a net cost saving in financial and environmental terms.

However, it was acknowledged that not all externalities were included in the analysis, and if more were to be included this may affect the results. Nevertheless, it was concluded that there would be benefits of diverting PVC disposal away from incineration, particularly to recycling.

Another study assessed different recovery options for plastics. The Öko-Institute (2000[36]) prepared a literature review on behalf of the EEB looking at LCA studies on the different disposal options for plastics used in packaging. This came in response to claims from industry that the waste hierarchy was obsolete and that materials needed to be looked at on a case-by-case basis. The study confirmed that although results from studies reviewed differed greatly, the waste hierarchy for this material should run in the following order of preference: Mechanical and monomer recycling; feedstock recycling and mono-incineration; waste incineration with energy recovery; landfill. It did mention, however, that divergences in this hierarchy occur in certain instances, such as if mechanical recycling is restricted to low quality mechanical recycling, or where incineration plants have very high waste to energy ratios. From this analysis the following policy recommendations were made: Incineration should only be favoured over landfill where high energy recovery ratios could be achieved; recovery plants should fulfil BAT standards (Best Available Technology required under the IPPC Directive, see Annex 1), or comply with a specific audit scheme;

[36] Volrad Wollny and Martin Schmeid (2000), *Assessment of plastic recovery options, The Öko-Institut e.V.,* EEB

increasing targets for recycling of plastics should be set; and measures to reduce hazardous substances should be introduced.

It is worth noting that the examples above, though looking at specific materials or waste streams, have tended to concentrate on the environmental performance of these materials when they become waste. In an integrated approach the whole life cycle would need to be considered.

5.2 Waste treatment options and the waste hierarchy

Many studies to date have looked at the relative merits of different waste treatment options, and have used different research techniques, such as cost-benefit analysis, economic evaluation and life-cycle analysis.

A report for Friends of the Earth, UK Waste and Waste Watch, on the economics of different waste management options for municipal waste, used a cost-benefit analysis approach to prove the hypothesis that: '*although the financial costs of recycling are greater than that for other methods of dealing with waste, to the extent that one is able to incorporate the environmental costs and benefits associated with all methods, the overall economic analysis will show that when one accounts for all the costs and benefits, the net result shows recycling to be the best option in respect of materials recovered from the household waste stream'*[37]

The study analysed different cost analyses undertaken in the UK for the waste disposal options of landfill, kerbside recycling, composting, and incineration, and sought to shed light upon the usefulness of valuation approaches in the context of waste management.

The study provided an overview of existing studies where economic values have been assigned to disposal options. For example, the UK Government's Draft Waste Strategy[38] (1999) contained figures (see table 4) based on the total resource costs (excluding landfill tax), collection, transfer and transportation to the recovery or disposal site, gate fees, operational and capital costs (which have been annualised for conversion to cost per tonne).

Table 4: Costs of different waste management options

Treatment	**Cost range (£/t)**
Recycling (kerbside collection)	55-145
Composting (kerbside collection)	70-120
Incineration	45-100
Landfill (excluding tax)	45-65

Source: DETR 1999

[37] Dr Elisabeth Broome, Prashant Vaze and Dr Dominic Hogg, *Beyond the Bin: The Economics of Waste Management Options, A final report to Friends of the Earth, UK Waste and Waste Watch*, Ecotec Research and Consulting Ltd.

[38] DETR (1999), *A Way with Waste: A Draft Waste Strategy for England and Wales,* London

However, the cost estimates had a wide range due to the uncertainty over present and future costs, and the differences in applying the options to different regions, for example urban versus rural. The researchers found that figures presented in this table and elsewhere did not tend to look at the financial costs of the different recycling options and therefore tried to obtain more detailed costs. They also went one step further by aiming to incorporate the environmental costs and benefits, and in so doing reviewed existing literature on the externalities of waste management. An example is set out in Box 2.

Box 2: Coopers and Lybrand/CSERGE (1997)[39]

The study looked at 12 EU Member States for the base year of 1990, and addressed the following factors for deeming external costs:

- Composition of waste stream;
- Size of the disposal site or facility;
- Physical characteristics of the disposal site;
- Age of the disposal site, or facility;
- Spatial location of the disposal site; and
- Level of pollution abatement in a facility.

The study included recycling and broke this down into seven different materials. It concluded that, except for plastic film, recycling generates positive externalities which are very large in comparison to the externalities associated with landfilling and incineration (based on the assumptions made in the study). One criticism of the study, however, was that it did not consider certain issues, such as the environmental costs associated with different municipal solid waste options, toxic air pollutants from incineration or landfill, and disamenity impacts and leachate.

The DETR (1999) updated the study's results, which can be seen in table 5.

Table 5: External costs and benefits of different waste management options

Waste Management Option	**External Cost Estimate, £ per tonne of waste, 1999 prices**
Landfill	- 3
Incineration (displacing electricity from coal-fired stations)	+ 17
Incineration (displacing average mix electricity generation)	- 10
Recycling	+ 161
- Ferrous metals	+ 297
- Non-ferrous metals	+ 929
- Glass	+ 196
- Paper	+ 69
- Plastic film	- 17
- Rigid plastic	+ 48
- Textiles	+ 66

Source: Adapted from Coopers and Lybrand et al (1997) in DETR (1999)

[39] Coppers and Lybrand/CSERGE (1997), *Cost Benefit Analysis of the Different Municipal Waste Management Systems: Objectives and Instruments for the Year 2000,*Luxembourg: Office fir the Official Publications of the European Communities, as summarised in Broome et al, *Op cit*

The study concluded that the hypothesis (that recycling is the best option) could not be proven conclusively: '*There are a number of persuasive arguments that one can present for recycling. There are fewer for other treatment options (other than they make the job of 'dealing with waste' disarmingly simple). There are more for waste minimisation (and energy efficiency)'.*

Perhaps more important was the study's overall message about the use of studies quantifying costs and benefits in determining waste policy: *'…however strongly one believes the quantification of private and external costs and benefits should be an ultimate arbiter of whether or not something may or may not be a good idea, one is likely to have to accept the fact that studies attempting to do this will be less than conclusive'.* It highlighted the limitations of life cycle analysis as a tool upon which to base waste management decisions, and the problems with using cost-benefit analysis when there is so much scientific uncertainty involved in any valuations. Economic valuations, whether they incorporate externalities or otherwise, are also based on existing market structures.

Questions were also raised regarding the use of such methods for decision making in the context of such uncertainty, and it was noted that '*valuation exercises can raise as many questions as they solve'.* This issue of uncertainty is one to which IEA might usefully be applied.

In the waste hierarchy, recycling is deemed to be preferable to incineration (with energy recovery or without) and landfill. Although recycling may have several benefits over landfill (such as reduced volume to land, reuse of resources, etc) research has shown that it has environmental impacts of its own: plants processing scrapped cars, for example, produce large amounts of shredder waste contaminated with oil and heavy metals and smelting of the metals give rise to emissions of heavy metals, dioxins etc. from secondary steel works and aluminium smelters (EEA, 1999); in most cases the recycled product is of a lower quality than the virgin material; even high quality recycled materials represent a net loss of resources because the energy used for initial production is lost and some material is always lost during collection and treatment; and there are often higher transport distances for waste for recycling than disposal (Ripert, 1997).

Once recycling has taken place there is also the dilemma of what should happen to the residual waste (materials remaining after recycling). In a recent report focusing on recycling in the UK[40], a life-cycle assessment of several residual waste options was carried out. Again, the limitations of using a life cycle analysis (LCA) approach are highlighted, and it was stressed that there is a need for such analyses to be considered amongst a range of different techniques available for comparing different options. In particular, the following shortcomings are highlighted:

- The difficulty in assessing the issue of time;
- A tendency to view the world as static;
- The lack of location-dependent impact assessment;

[40] RCRN (2002) *Maximising Recycling Rates: Tackling Residuals*, Research for the Community Recycling Network

- There are a number of different approaches to impact assessment which weight emissions differently to one another;
- Data used in the process have different ages and origin, leading to potential bias in the analysis.

Nevertheless, the analysis looked at several potential waste treatment scenarios for residuals. The performance of the different options was examined at per tonne of waste processed in relation to various criteria: global warming potential of the gases released; human toxicity analysis; acidification; eutrophication; ozone depletion; smog; and resource depletion. The assessment concluded that all options have some environmental impacts, and that different options are better in relation to certain criteria and over different time scales. For example, in relation to climate change, landfill performs better than incineration where the time horizon is longer (modelled up to 500 years), as time affects the relative global warming potential of the different gases, and there are different residence times in the atmosphere. However, in the short term methane is more powerful than carbon dioxide, so landfill performs less well. Alternatively, if we are more interested in focusing on reducing acidification, the best performers were found to be co-incineration options, because of the displacement effect for fossil fuels. Although the research was unable to conclude what the best option for dealing with residual waste in the UK would be, it did find that sending untreated residual waste to landfill or a ‘UK-standard mass-burn grate’ incinerators are the worst options available.

The above reports have in common that they start from the premise that recycling is a preferable treatment option. However, there is still not even a consensus that recycling is preferable to other treatment options lower down the waste hierarchy.

Recent studies in both Denmark[41] and Sweden[42] have challenged the benefits of sorting and recycling waste versus incineration with energy recovery. In the Danish study, researchers argued that it would be better for them to burn paper collected for recycling. It argued that as a carbon neutral activity it would benefit the environment, and even reduce CO_2 emissions by replacing the need to burn coal. Financially it was found to be better too, as the market price for paper is lower than that for coal. According to Swedish researchers, any advantages of sorting household waste are more than offset by the high costs involved. Instead it is recommended that all household and packaging waste, organic or otherwise, should be incinerated and the heat recovered for district heating and electricity supply.

In direct response to the arguments presented in the Swedish research, officials from Sweden’s Environmental Protection Agency have recently put forward a counter-argument[43]. In letters printed in the Swedish press, the research was criticised as showing ‘a lack of both holistic thinking and substantiated environmental

[41] IMV (Danish Environmental Assessment Institute) (2002), quoted in Edie News Summary, 13 December 2002
[42] Chalmers Institute of Technology, Stockholm municipality and Greater Stockholm Electricity, quoted in *Europen*, Issue 19, February 2003
[43] Björn Södermark, Deputy Director of the Enforcement and Implementation Department at the Swedish EPA, quoted in ENDS Daily, 23 April 2003

arguments'[44]. The Swedish EPA argued that that too much emphasis on incineration could deter efforts to focus on waste reduction, and the public was encouraged to continue separating waste for recycling. The environmental benefits of recycling over incineration were highlighted, including the gain of recovering and recycling material, compared with burning it (although recognising that the environmental gain of recovering is judged in Sweden to be greatest for metals and plastics and but less apparent for food waste and cardboard based on renewable raw materials); reduced energy needs of not using virgin materials, resulting in reduced emissions; and most importantly by motivating producers to develop more resource-efficient and non-polluting products.

The letter also makes reference to the fact that recycling is often more expensive than incineration as the market does not place adequate economic value on environmental gains. Therefore the market reduces the incentive to recycle, and it is difficult for recycling to compete. However, it insists that once the socio-economic gains are taken into consideration, this levels the playing field. It also draws attention to the shortage of incineration capacity, and recommends that capacity be reserved for those materials that cannot be recycled.

Thus it can be seen that, even in the most forward-looking states in environmental terms, the current waste hierarchy is intensely controversial, and would benefit from better analysis using integrated assessment techniques.

5.3 Policy and practice

In trying to establish why some areas perform better than others in managing waste, numerous studies have looked at best practice, and the potential for applying this elsewhere. Such reports offer valuable insights into the strengths and weaknesses of existing policy and practice at the EU level, at the Member State level, locally or elsewhere.

Whilst such information may perhaps not be a component of an IEA as such, it instead represents examples of where analysis has informed certain choices. This experience can help inform the future decision-making process, of which IEA is one element.

Such examples include the EEA's report, *Case studies on waste minimisation practices in Europe* (2002)[45], the Eurocities Conference report (1999)[46] which contains examples of where Member States have used very different approaches and a mix of measures, and recent work by the Green Alliance, C*reative policy packages for waste*[47] (2002), which looked at waste strategies of seven countries and states in the EU and US.

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[44] Svenska Dagbladet (2003) *Source separation of refuse − for a better environment, now and in the future!*, Swedish EPA, April 2003
[45] Henrik Jacobsen and Merete Kristoffersen (2002), *Case studies on waste minimisation practices in Europe,* EEA European Topic Centre on Waste, Luxembourg
[46] *Proceedings of the European Conference on Waste Management Planning*, 7 June 1999, DG Environment and Eurocities
[47] Hill, J et al (2002), C*reative policy packages for waste,* Green Alliance, London.

5.4 Predicting future trends

A technical report on waste management[48], which was commissioned by DG Environment as one of a series supporting the main report: *European Environmental Priorities: an Integrated Economic and Environmental Assessment*, looked at scenarios for the future based on projections of waste data for specific streams, and waste generation data. Four scenarios were applied to the data to project different waste trends in 2010: Baseline (BL-1993); Baseline (BL-2010); Technology Driven (TD-2010a and TD-2010b) and Accelerated Policies (AP-2010). The scenarios looked at the marginal costs of five disposal options (landfill, incineration, incineration with energy recovery, recycling and composting) for all EU Member States. The cost estimates presented included all impacts associated with emissions to air and the risk to health from the treatment of municipal solid waste (MSW), and considered the avoided costs of virgin material as a result of recycling, the avoided costs of virgin material as a result of prevention, and the avoided costs of waste treatment/disposal as a result of prevention. No distinction was made for variations in the cost of techniques between Member States, nor was any distinction made between rural and urban areas.

Conclusions from this work included:

- The accelerated policy scenario, which included initiatives such as a virgin materials tax on paper and plastics, resulted in prevention of overall waste by 3% in 2010;
- Compared to MSW figures in BL-1993, there is still an increase of nearly 13% in waste arisings for the accelerated policy scenario, thus illustrating the basic need to address rising waste arisings;
- The shift in MSW treatment/disposal methods from landfill to more desirable options is successful in a cost effective way in the accelerated policy scenario. Compared to BL-1993, landfill decreases and incineration without energy recovery vanished; and
- Shifting to incineration with, rather than without energy recovery, is considered to be cost effective, especially when considering the climate change benefits.

The analysis was used to present recommendations for future policy options. These were based on policy measures used in the scenarios, and included a virgin materials tax to encourage reduction at source, product taxes to reflect the cost of disposal, recycling credits, increased landfill taxes and variable domestic collection fees.

It was recognised, however, that more work needs to be undertaken to identify other impacts and costs that were beyond the scope of this particular study. For example, the costs associated with impacts on water and soil were not explored, but are of importance is we are to take a more integrated approach.

5.5 Sustainable production and consumption

More recently, policy thinking has started to take on a more holistic approach, based on the premise that 'it is the total of environmental impacts associated with the entire life cycle of raw materials which has to be considered' (the *Zero Study*, 2003). The

[48] C Sedee, J Jantzen, BJ de Hann, DW Pearce (May 2000), Technical Report on waste Management, RIVM, EFTEC, NTUA and IIASA in association with TME and TNO.

development of the Thematic Strategy on natural resources involves looking at the whole issue of resource use, right through its life cycle. A study recently commissioned by DG Environment, the 'zero study[49]', will feed into the development of the Thematic Strategy. The purpose of the study was to present information on the materials and waste streams in the EU using the method of material flow accounting. The material flow analyses (MFA) presented provided information on the volume, structure and interlinkages of European resource and material flows, both for the EU-15 and for the Candidate Countries, looking specifically at the resource flow of fossil fuels, metals and industrial materials, construction minerals and biomass. From this, a number of conclusions were made, including:

- There has been a relative decoupling of economic growth from resource consumption, implying that market conditions already favour resource efficient production to some degree. However, there is no absolute decline in the volume of the EU's total resource requirements, which implies that the environmental burden related to resource use remains constantly high.
- Resource use varies between Member States: The total material requirement (TMR –measures the physical basis of an economy in terms of primary materials) in the EU is on average fifty tonnes per capita, and ranges between approximately 32t/capita in Italy to almost 100t/capita in Finland.
- In Candidate Countries, direct materials productivity will have to rise by a factor of five to reach that of the EU.
- The EU is increasingly importing more of its resources, which is resulting in a shift in the environmental burden associated with resource use to other regions. Resource use is consequently becoming more of an issue of international burden sharing.
- The growth in infrastructures and urban development, particularly as the Candidate Countries strive towards greater economic growth to meet EU levels, will affect future waste generation and the capacity for renewable supply and resource generation.
- It is currently not scientifically possible to assess which environmental impacts of resource use are of greater importance, nor to determine the various specific impacts of major resource flows which may or may not become more significant in the short or longer term. Therefore, political judgement will be required for setting priorities.

The authors point out that the information presented in the study highlights some general characteristics of the material flow system, but that more in-depth analysis needs to be undertaken on more specific causal relationships and impacts. Therefore, a precautionary approach should be taken, based on the rationale that a volume reduction in resource use *ceteris paribus* also leads to a reduction of potential environmental impacts.

Thus there are clearly moves towards more integrated analysis, and it is recognised that more research is needed to support the development of a new policy framework.

[49] Moll et al (2003) *Op cit*

6. Exploring the opportunities for IEA in waste policy

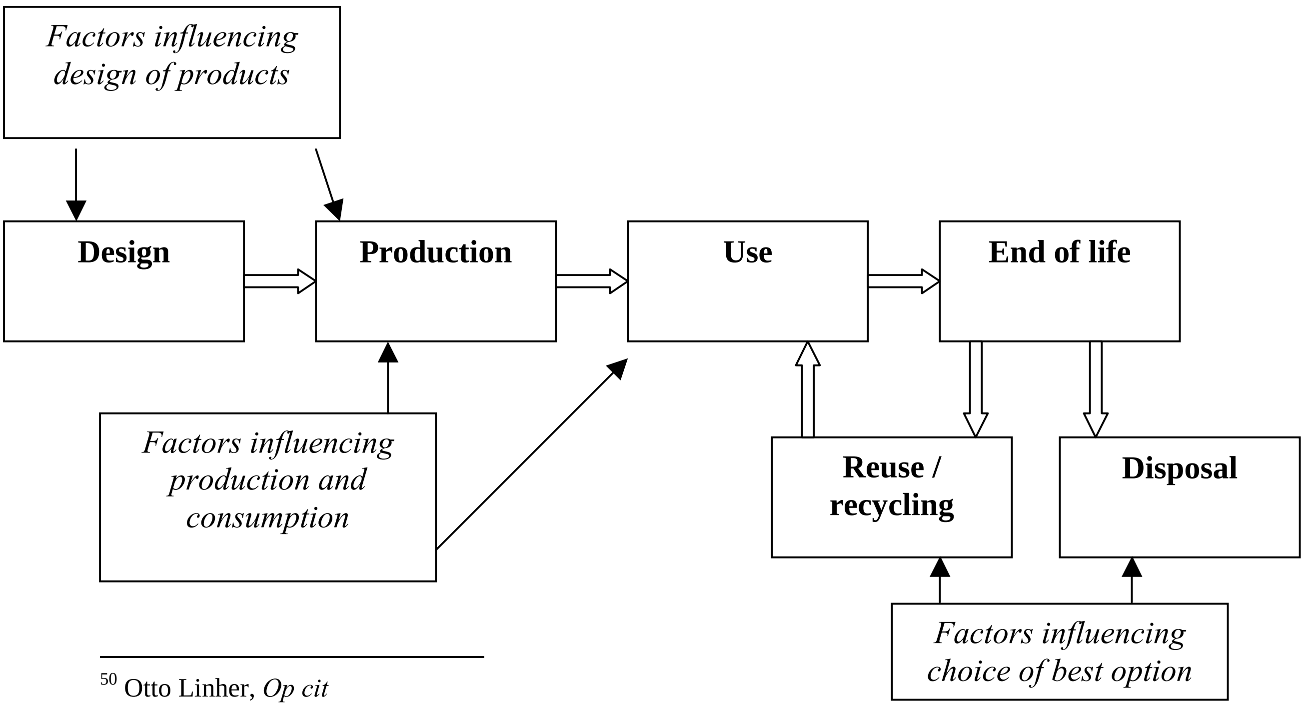
Integrated environmental assessment clearly represents an opportunity to look at the issue of waste in a more holistic manner than appears to have been done before. According to a representative from the Commission[50], the main advantage of IEA is that it can help to make the issues and trade offs of policy options transparent. It can also help to identify areas where it is possible to get real environmental benefits at a low cost. It was commented, however, that there should also be caution: by looking at the whole picture you sometimes may not concentrate on the specifics, and there are issues associated with quantification. Therefore even though policy decisions could be better informed, there will still be a degree of uncertainty.

In order to take an integrated approach towards waste policy, the whole life cycle of waste needs to be considered, beginning with the design and production of goods, right through to final disposal.

As the EEA (1999) states, '*The challenge of increasing waste quantities cannot be solved in a sustainable way by efficient waste management and recycling alone. There is an urgent need for integration of waste management into a strategy for sustainable development, where waste prevention, reduction of resource depletion and energy consumption and minimisation of emissions at the source is given high priority. Waste must be analysed and handled as an integrated part of total material flow through the society.'*

Integrated environmental assessment therefore needs to reflect the different stages associated with waste generation, and to understand the factors influencing these stages, as highlighted in figure 2.

Figure 2: Understanding stages in waste generation



50 Otto Linher, *Op cit*

There are also a number of different levels where IEA could be applied to waste policy, as demonstrated in Figure 3. This illustrates the potential approaches to IEA and in part reflects the research that has been done to date.

From this it can be seen that there are a number of different approaches that could make up the overall IEA approach. For example, life cycle analyses of products or scientific research into the environmental aspects of different waste disposal options, to name but two possible approaches, each has a valid input to contribute to understanding the bigger picture. Research could also be broken down to different scales. For example, an IEA of waste could be carried out for a local administrative region, or a Member State, for the EU or globally. Looking at the issue of waste as a whole would arguably be far too complex, and so breaking it down into more manageable, digestible parts is perhaps the best way forward. Scoping the appropriate course and approach would, however, in itself show some of the strengths of the IEA approach.

What is important, however, is that this is done in a coordinated manner underneath the 'umbrella' of an overall integrated approach. It is also important that the correct people are involved in any assessment, regardless of whether this is for one particular waste stream or one specific region, and that this includes relevant social/political sensitivities (the 'human equation'). The whole rationale of IEA is that it needs to be an interdisciplinary process of identification, analysis and appraisal of all relevant natural and human processes and their interactions, and this could apply regardless of scale or scope. EFIEA is well placed to tackle these challenges.

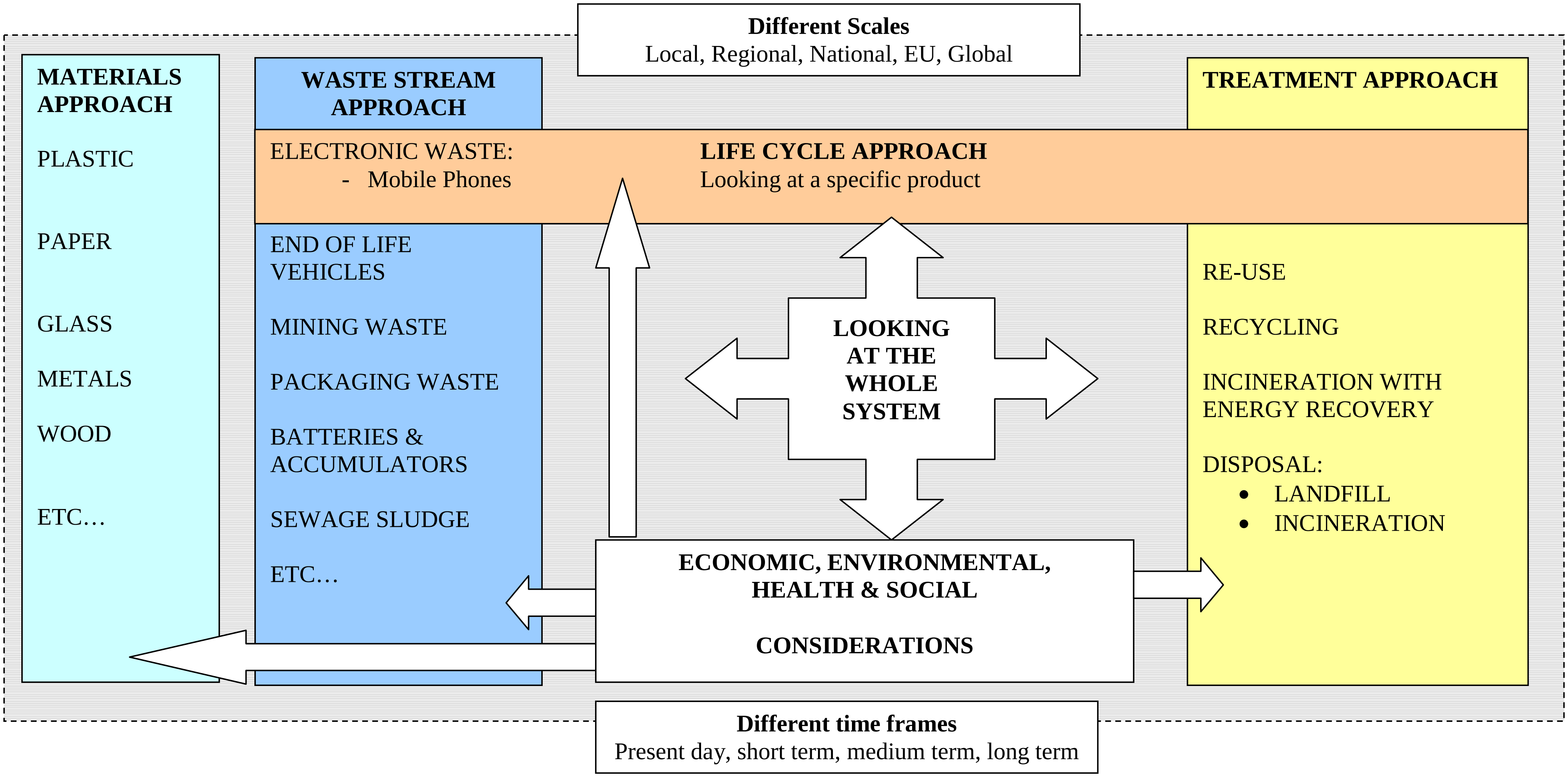
What are the barriers to IEA?

After looking at the limitations of existing policy and the information reviewed on what assessments have been carried out to date on waste policy, the barriers to adopting an integrated approach include, but are not restricted to:

- The lack of comprehensive and comparable data;
- Scientific uncertainty regarding environmental effects and modelling techniques;
- Difficulty in assigning monetary values to the environment and health;
- Market failures in reflecting negative externalities; and
- Knowledge of the actors who need to be involved in IEA.

These challenges emphasise some of the potential strengths and distinctive features of the IEA approach, as promoted by EFIEA.

Figure 3: Potential Approaches to IEA in Waste Policy



7. Next Steps

Before an IEA framework could be developed, there are a number of questions that need answering, and these are by no means in themselves easy to solve. It is suggested that, should a workshop on IEA in waste policy be arranged, the following would provide some guidance for the discussion:

Structural considerations / How would IEA work in reality?

- How can / should the EU put in place an overarching IEA system for waste policy?
- Should the focus of such as system be on the whole issue, or should it be broken down into digestible parts, for example waste streams, life cycle analysis, etc?
- How can the EU coordinate all inputs into the overall IEA process: the research community; public participation, etc?
- At what stage should the defining of sustainable waste policy be set by Member States to reflect different national circumstances? How far does the EU need to go to protect the Internal Market and EU environment?
- How can the research community better influence, inform and meet the needs of policy makers?
- What barriers need to be overcome before a truly integrated approach could be developed?

Issue specific considerations:

- What is the best treatment option for waste from different waste streams?
- How can policy address material flow, and tackle waste as an ‘upstream’ issue?
- Where should the focus be – reducing hazardous substances, reducing resource use, limiting the environmental effects of treatment options, etc?

The actors

Identifying the appropriate actors is extremely important. Although we can take an educated guess about the groups that should be involved in any discussions, in reality a comprehensive list of all actors is not known. Taking the regulatory authorities as an example, the way that waste disposal is administered in different Member States varies. Even within a Member State the situation is not always entirely transparent. For example, in the UK waste collection and disposal is the responsibility of Waste Collection Authorities (WCA) and Waste Disposal Authorities (WDA) respectively. However, the WDA do not undertake waste disposal themselves, but contract this out to the private sector, which is a very disjointed sector comprising numerous operators, some of which are not legitimate. Whilst the WCA and WDA are easy to identify, as these are County Councils and District Councils, identifying private sector actors would not be so easy.

However, the broad categories of potential actors should include:

- Policy makers at the EU, Member State and Candidate Country level;

- The research community, involving researchers from various disciplines;
- Competent authorities in Member States and Candidate Countries;
- Non Governmental Organisations (NGOs);
- Industry groups; and
- Members of the public

8. Conclusions

The issue of sustainable waste management is now more than ever an issue of great concern. This is starting to be addressed at both the EU and Member State level, but much remains to be done if current levels of resource consumption and waste generation are to be placed on a more sustainable footing.

This paper has provided an overview of the current situation regarding the application of IEA to waste policy, and the challenges which lie ahead for policy makers. Although it is by no means all-inclusive, it demonstrates that whilst much research has been undertaken in this field, there are many opportunities for the application of IEA to waste policy, and at a variety of levels.

To look at the whole system at once would arguably be too complex a task, and the best approach would perhaps be to continue looking at smaller parts of the system, for example priority waste streams/materials or specific disposal options. However, this should be within an overall integrated framework. This overall 'bigger picture' needs to be coordinated at the EU level, ensuring that all stakeholders are brought together to provide a more holistic assessment of waste. Also, and critically, there is a need to address the shortcomings of existing policy, for example data limitations and problems with definitions, in order to remove the barriers to a more integrated approach.

IEA presents a major opportunity to bring existing information together in a new context to contribute to the development of strategic thinking on waste policy. It must be remembered, however, that IEA will not provide all the solutions: it represents one important input into policy making. The interactions of scientific debate, the political process itself, and the individual characteristics of Member States will continue to determine how future waste policy will be defined. According to Haigh (1998)[51] '*…we should not delude ourselves that it [IEA] will always be easy…IEA must be framed with as much understanding as its proponents can manage of all the many complexities of policy making. They must be prepared to admit that any IEA is likely to be incomplete. The effort to be comprehensive is laudable, the claim that IEA will provide a complete solution would be misleading'*.

Nevertheless, IEA can *'help to identify areas where we are really trying to get environmental benefits…and it can help make issues and the trade-offs of policy options more transparent'*[52].

[51] Haigh (1998), *Op cit*
[52] Otto Linher, *Op cit*

Annex 1: The Development of EU Waste Policy Since 1975

Strategies	**Phase I 1975-85**	**Phase II 1986-96**	**Phase III 1997 -**	**Purpose**[53]
Waste Strategies		EU 1st waste strategy – September 1989, SEC(89)934; Council Resolution May 1990 (OJ C122, 18.5.1990)	EU 2nd waste strategy – July 1996, COM(96)399; Council Resolution February 1997 (OJ C76, 11.3.97)	The first EU strategy outlined five guidelines: prevention, recycling and reuse, optimisation of final disposal, regulation of transport and remedial action. Prevention was presented as the primary objective, to be achieved through the development of clean technologies and waste minimization. Other guidelines were envisaged as a hierarchy of next-best options. The 1996 Strategy confirmed the principles of prevention, producer responsibility, precaution and proximity, and set out the preferred hierarchy of waste management options. It also stressed the need for reduced movements of waste and improved waste transport regulation, and the need for new and better waste management tools, such as: regulatory and economic instruments; reliable and comparable statistics on waste; waste management plans; and proper enforcement of legislation. Priority waste streams were defined.
The Sixth Environmental Action Programme			2001-2010	The Sixth EAP is considered one of the major driving forces for waste policy at present, specifically the Thematic strategies on natural resources and waste recycling. See section 3.2 for more details.
Legislation	**Phase I 1975-85**	**Phase II 1986-96**	**Phase III 1997 -**	**Purpose**
Framework Directive	Directive 75/442	Directive 91/156		In all Member States waste disposal was regarded as a local or regional problem until the early 1970s. Several Member States then introduced or proposed legislation to provide some kind of national framework for dealing with it and the Directive accordingly seeks to set out a coherent set of measures applicable in all Member States. The Directive was entirely revised in 1991.
Waste Oils	Directive 75/439	Directive 87/101		*End of pipe* – safe disposal of waste oils and priority of recovery.
PCBs and PCTs	Directive 76/403	Directive 96/59		*End of pipe* – controls for environmentally safe disposal. Directive 96/59 sets out a system of control for the elimination of PCBs within the framework of Directive 75/442. It requires steps to be taken to identify PCBs, to dispose of them by a

[53] Haigh, N (2003) Manual of Environmental Policy: the EU and Britain, Chapter 5.3, Maney Publishing, Leeds.

Legislation	Phase I 1975-85	Phase II 1986-96	Phase III 1997 -	Purpose
				specified deadline, and to decontaminate or dispose of contaminated equipment. NB. Separate Directives 76/769 and 85/467 restrict the sale and use of PCBs.
Hazardous waste	Directive 78/319	Directive 91/689, as amended by Directive 94/31/EC		*End of pipe* - Strict requirements for operations involving hazardous waste.
Transfrontier shipment	Directive 84/631	Regulation 259/93 (repealed 84/631, 85/469, 86/279, 87/112).	Amending Regulations: 120/97, 2408/98, 1420/1999 and Regulation 1547/1999 (repealed Decision 94/575)	*End of pipe* – notifications procedure; avoiding shipments for disposal; principles of proximity and self sufficiency. Regulation 259/93 establishes systems to monitor and control the shipment of waste within, into and out of the Community. It replaced a number of earlier Directives concerned with the shipment of hazardous waste, and now applies to all waste.
Packaging	Directive 85/339 (beverage containers)	Directive 94/96	Under revision COM(2001)729	*End of pipe* – targets for recovery and recycling AND *Prevention* – reduction of waste in design stage
Sewage sludge		Directive 86/278	Proposal expected for a new Directive addressing the issues more widely, extending regulatory controls to all domestic and industrial sludge and establishing tough harmonising requirements on contaminants.	*End of pipe* – measures for preventing harmful effects when used in agriculture.
Batteries and accumulators		Directive 91/157	Proposal expected for its revision	*Prevention* - To reduce heavy metal content of batteries and accumulators, ensure separate collection, inform consumers and prohibiting marketing of certain batteries.
Incinerators		Directive 89/369 (municipal) Directive 89/429 (municipal) Directive 94/67 (hazardous)	Directive 2000/76 (repealed earlier Directives)	*End of pipe* – Sets emission limit values and operation requirements. The aim is to prevent or limit negative effects on the environment and risks to human health from incineration and co-incineration of waste.
Ecolabel		Regulation 880/92	Regulation 1980/2000	*Prevention* of waste generation and use of hazardous substances. It is a voluntary award scheme for the award of eco-labels to products and services which have the potential to reduce negative environmental impacts, as compared with other products of the same product group. One objective concerns the efficient use of resources.
EMAS		Regulation 1836/93	Regulation 761/2001	*Prevention* of waste generation and use of hazardous substances as part of an overall

				environmental management system.
Landfill			Directive 1999/31	*End of pipe* - aims to tackle emissions of methane by limiting the amount of biodegradable waste going to landfill. Sets standards for proper licensing, monitoring and aftercare of new and existing landfill sites. AND *Prevention* - encouraging the prevention, recycling and recovery of waste by limiting its final disposal through landfill. By requiring that charges are levied by operators to reflect the continuing costs of landfill, including clean up and aftercare, it seeks to make other, apparently more expensive, methods of waste disposal more attractive to waste producers.
Legislation	**Phase I 1975-85**	**Phase II 1986-96**	**Phase III 1997 -**	**Purpose**
End of life vehicles (ELVs)			Directive 2000/53	*End of pipe and Prevention* - Seeks to reduce the amount of waste, and therefore the adverse environmental effects, resulting from the disposal of vehicles. It aims to improve the environmental performance of all the operators involved at each stage of a vehicle's life, but, in particular, those involved in the treatment of ELVs. There are requirements for restrictions on the use of hazardous substances, and certain substances will be banned.
Ozone depleting substances			Regulation 2037/2000	*End of pipe and Prevention* - Articles regarding the safe disposal of ozone depleting substances from waste refrigerators, and phasing out of certain ODS in production.
Port reception facilities for ship generated waste and cargo residues.			Directive 2000/59	*Prevention* - Aims to reduce the amount of pollution caused to seas and coastlines of member states by waste and cargo residues discharged into the sea by shipping. This is to be done by improving the availability of reception facilities at community ports in order to meet the needs of ships without causing undue delay.
Integrated Pollution Prevention and Control (IPPC)		Directive 1996/61		*Prevention and end of pipe* - The waste management industry is one of the categories covered by IPPC. Facilities are subject to authorisation through permitting, which set certain requirements, including avoidance of waste and safe recovery or disposal. It requires that Best Available Technology (BAT) is applied, which includes the use of low waste technology, the use of less hazardous substances, the furthering of recovery and recycling, the consumption of raw materials and energy,

				and energy efficiency.
Waste statistics			Regulation 2150/2002	To establish a framework for the production of community statistics on the generation, recovery and disposal of waste. Designed to complement reporting under several Directives, and ensure the effective provision of statistics. It provides details of data collection procedures and timeframes for reporting by Member States.
Waste electrical and electronic equipment (WEEE) and the Restriction of hazardous substances (ROHS)			Directive 2003/96 and Directive 2003/95	*End of pipe and prevention* - Seeks to prevent WEEE and increase the rates of reuse, recycling and recovery of waste. It also aims to improve the environmental performance of producers, distributors and consumers involved in the life cycle of electrical and electronic equipment (EEE). The ROHS Directive focuses on the restriction on the use of hazardous substances in EEE to facilitate safer disposal.
Future developments				
Composting / Biodegradable waste			Proposal expected 2003/4	*Prevention* - To provide guidance in diverting this stream away from landfill.
Mining waste			Proposal expected 2003	
Construction waste			Proposal expected	
Integrated product policy			Green Paper COM(2001)68, White paper expected in 2003	A *life-cycle approach* to the impact of products from design and production to their use and disposal. The main priority of IPP is to internalise the environmental costs of products through the use of market forces. To achieve this it is anticipated that the focus would be on eco-design and manufacturing of products, information dissemination, and incentives to increase demand for greener products.
Classification of waste-to-energy process			Proposal expected	
Environmental standards for end user equipment (EUE)			Proposal expected	
Measures from the Thematic Strategies on natural resources and waste recycling			Thematic strategies to be developed by July 2005. Specific measures may be proposed after this.	