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TRANSPORT OF WASTE PRODUCTS

ROUND TABLE

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ECONOMIC RESEARCH CENTRE

REPORT OF THE
HUNDRED AND SIXTEENTH ROUND TABLE
ON TRANSPORT ECONOMICS

held in Paris on 16th-17th December 1999
on the following topic:

TRANSPORT OF WASTE PRODUCTS

EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT

EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT (ECMT)

The European Conference of Ministers of Transport (ECMT) is an inter-governmental organisation established by a Protocol signed in Brussels on 17 October 1953. It is a forum in which Ministers responsible for transport, and more specifically the inland transport sector, can co-operate on policy. Within this forum, Ministers can openly discuss current problems and agree upon joint approaches aimed at improving the utilisation and at ensuring the rational development of European transport systems of international importance.

At present, the ECMT's role primarily consists of:

– helping to create an integrated transport system throughout the enlarged Europe that is economically and technically efficient, meets the highest possible safety and environmental standards and takes full account of the social dimension;

– helping also to build a bridge between the European Union and the rest of the continent at a political level.

The Council of the Conference comprises the Ministers of Transport of 41 full Member countries: Albania, Austria, Azerbaijan, Belarus, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, the Czech Republic, Denmark, Estonia, Federal Republic of Yugoslavia, Finland, France, FYR Macedonia, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Moldova, Netherlands, Norway, Poland, Portugal, Romania, the Russian Federation, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine and the United Kingdom. There are six Associate member countries (Australia, Canada, Japan, New Zealand, Republic of Korea and the United States) and two Observer countries (Armenia and Morocco).

A Committee of Deputies, composed of senior civil servants representing Ministers, prepares proposals for consideration by the Council of Ministers. The Committee is assisted by working groups, each of which has a specific mandate.

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The ECMT's Documentation Service has extensive information available concerning the transport sector. This information is accessible on the ECMT Internet site.

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TRANSPORT OF WASTE IN THE FEDERAL REPUBLIC OF GERMANY

SUMMARY

Frankfurt-am-Main, June 1999

1. LEGAL REQUIREMENTS FOR THE TRANSPORT OF WASTE

1.1. Legal provisions and their consequences for waste management in Germany

1.1.1. Consequences of the Closed Substance Cycle and Waste Management Act

On 3 November 1997, with the entry into force of the Closed Substance Cycle and Waste Management Act (KrW-/AbfG), the Waste Management Act (AbfG) of 1986, which had applied until then, was brought into line with Community law.

Seven regulations were issued in connection with this Law[1], providing for additional regulation. Furthermore, firms transporting and disposing of waste were required to comply with a great many other regulations governing waste management[2].

The Closed Substance Cycle and Waste Management Act (KrW-/AbfG) is based on the principle of closed cycle management. The recognised objective of the Waste Management Act (AbfG), which represented the cornerstone of the provisions for the proper removal of waste, is no longer the principal goal[3].

Nevertheless, the current situation in the German waste management sector would appear to be such that municipal and district authorities throughout the Federal Republic are making every conceivable attempt to transfer waste, often at giveaway prices, to their local publicly-operated incineration plants and disposal sites, and to hinder the transport of waste to neighbouring but, in most cases, more appropriate sites.

The Federal *Länder*, together with their local and regional authorities, vehemently defend the monopoly they have enjoyed until now under the prevailing waste management arrangements. This is due to the fact that the amount of certain types of waste has fallen dramatically since 1993-94 with the result that there is over-capacity in the waste disposal sector (incineration plants, disposal sites).

In the past a great many public waste disposal sites were redeveloped, at considerable cost. In order to cover these costs, many municipalities/districts attempted to designate waste as disposable waste through "creative legislation" so that it could be dumped in their own disposal sites.

The pressure on the municipalities and districts that finance waste disposal sites will become even greater with the implementation, by 2005 at the latest, of the provisions of the TASi (Technical Instructions on Waste from Human Settlements)[4].

The introduction of the Closed Substance Cycle and Waste Management Act (KrW-/AbfG) led to free-market driven competition between the disposal option (a secondary option under the Closed Substance Cycle and Waste Management Act) and the "recycling market", which in various ways complies with the closed cycle concept embodied in the Act.

The "fight for waste" referred to was given a particular impetus by a paper from the LAGA (*Länder* study group on waste) on "The definition and differentiation of waste recycling and waste disposal and of waste and product under the Closed Substance Cycle and Waste Management Act (KrW-/AbfG)[5]". The intention of this much criticised paper was clearly to guarantee that most waste was dumped in disposal sites run by local authorities, the reason, of course, being the cost of privately run (and mostly innovative) recovery facilities.

The sequel to this document, a paper on the distinction between recovery and disposal, drawn up in the meantime by the Federal and *Länder* authorities (*Bund-Länder-Abgrenzungspapier*), was also unfavourably received.

At present, the Federal authorities are working on a statutory regulation, which will classify waste as waste for recovery or waste for disposal and will be binding on all *Länder*.

With the implementation of the Closed Substance Cycle and Waste Management Act in the individual *Länder*, it has emerged quite clearly that the disposal option is considered preferable. This is incompatible both with the Act and with the provisions of Community Law.

Furthermore, there are regular quarrels over the existing obligation to make waste available to parties responsible for waste management: some *Länder* have extended this obligation to industrial waste that requires special supervision and is intended for recovery.

In some places, the Closed Substance Cycle and Waste Management Act uses a great many terms that require interpretation, leading amongst other things to various ways of interpreting the "objective concept of waste". This has significant consequences for the controversial distinction between recovery and disposal and for the obligation to make waste available. The matter has produced great uncertainty amongst those concerned.

The consequence of this situation, of course, is that German courts are inundated with cases. The judgements, which are not usually consistent, are employed as arguments, chosen to suit the intentions of the parties concerned.

1.1.2. Privatisation of waste management

The disposal of domestic refuse, as an exercise in administrative autonomy, has traditionally been the prerogative of German local government.

Since the beginning of the nineties, the Federal Republic of Germany has witnessed an increasing shift towards privatisation in the field of waste disposal, boosted by the introduction of the Closed Substance Cycle and Waste Management Act (KrW-/AbfG) in 1997.

As a result, three possible ways of disposing of domestic refuse are available to the local authorities:

- Subcontracting waste disposal to an outside company, normally after an invitation to tender;
- Privatising the waste disposal sector, so that existing facilities and vehicles are operated by a private concern (usually a private limited company);
- Setting up a Public-Private-Partnership (PPP) between the local authority and a private waste disposal company by founding a joint enterprise.

The experience of the City of Frankfurt am Main[6] provides a good example of the consequences this can have in practice.

In January 1998, one of the largest enterprises[7] in the German waste disposal sector took out a 49 per cent share (75 million DM) in the *Frankfurter Entsorgungs- und Service GmbH* (FES), which is responsible for the disposal of domestic waste in the City of Frankfurt.

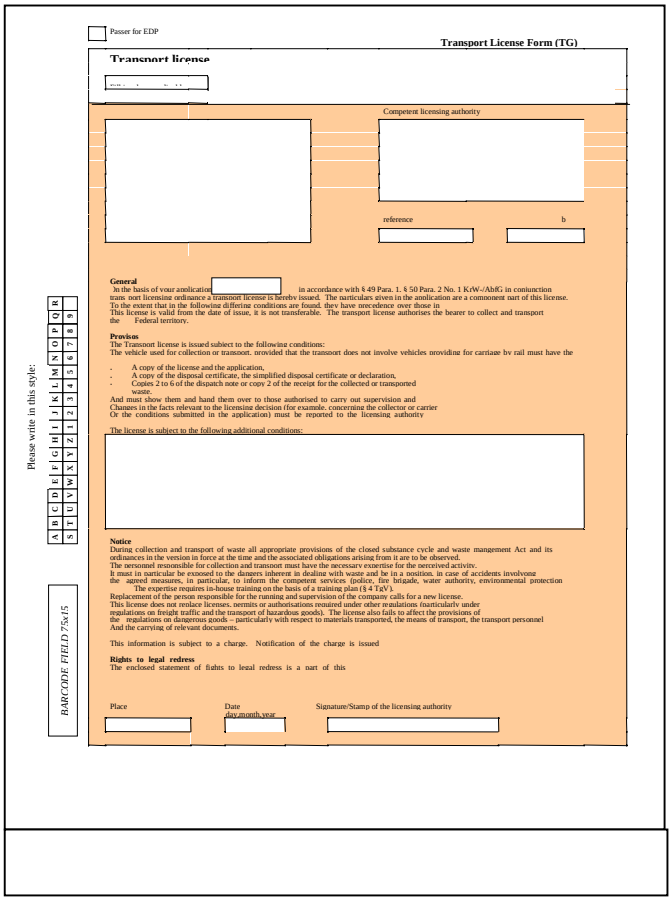
In the financial year 1998, the FES had already shown a turnover of 212 million DM and a profit of 13 million DM.

The enterprise is currently acquiring shares in municipal waste disposal concerns across Germany and in most cases it has a holding of over 50 per cent, especially in the new *Länder*.

1.2. The transport licence

Under paragraph 49 of the Closed Substance Cycle and Waste Management Act (KrW-/AbfG), waste for disposal may only be collected or transported commercially by the holder of a licence (transport licence) issued by the competent authorities.

Figure 1. **Transport Licence Form**



The licence may only be granted if there are no known facts to cast doubt upon the reliability of the applicant or the persons responsible for the management and supervision of the operation, and if the collector, transporter and third parties commissioned by them have the necessary knowledge and expertise.

Article 49, Section 1, Clause 2 of the Closed Substance Cycle and Waste Management Act states expressly and conclusively that the licensing obligation does not apply:

1. to parties responsible for waste management within the meaning of paragraphs 15 (public-law parties), 17 (associations) and 18 (self-administration authorities in business, industry and trade), as well as third parties commissioned by them;
2. to the collection or transport of excavated earth, roadway rubble or construction rubble, to the extent that such materials do not contain pollutants;
3. to the collection or transport of small amounts of waste, under the responsibility of commercial enterprises, to the extent that the competent authority, upon application or *ex officio*, has exempted such enterprises from the licensing obligation pursuant to sentence 1.

1.3. Licensing and marking waste consignments for national transport

Furthermore, in the Federal Republic of Germany, two parallel statutory regulations govern the marking of waste shipments.

These are paragraph 49 of the Closed Substance Cycle and Waste Management Act (KrW-/AbfG)[8], which entered into force on 6 October 1996 and paragraph 10 of the Waste Transportation Act (AbfVerbrG)[9].

For transport exclusively within Germany, the legal basis is provided by paragraph 49 of the Closed Substance Cycle and Waste Management Act and the related statutory ordinances, particularly the Ordinance on transport licensing (TgV)[10].

First of all, it is necessary to determine whether the waste in question is for disposal[11] or for recovery[12].

If the waste is for disposal, a transport licence is always required.

If it is waste for recovery, then there is an additional requirement, dating from 1 January 1999, to check whether the waste in question is listed in the Ordinance on the designation of waste requiring special supervision[13].

This ordinance, which identifies certain waste in the form of codes, derived from the six-figure "EWC-code"[14] used in Europe, includes codes for waste subject to special supervision in Germany.

If the waste is listed in this regulation, a transport licence is required.

If the waste is not listed, a transport licence is not necessary (see Figure 2).

Display of an "A" plate is only necessary if the waste is for disposal. If the waste is for recovery, no "A" plate is necessary, even if it is waste requiring special supervision, illogical as this may seem[15].

For further information on the requirement to display the plate, see below.

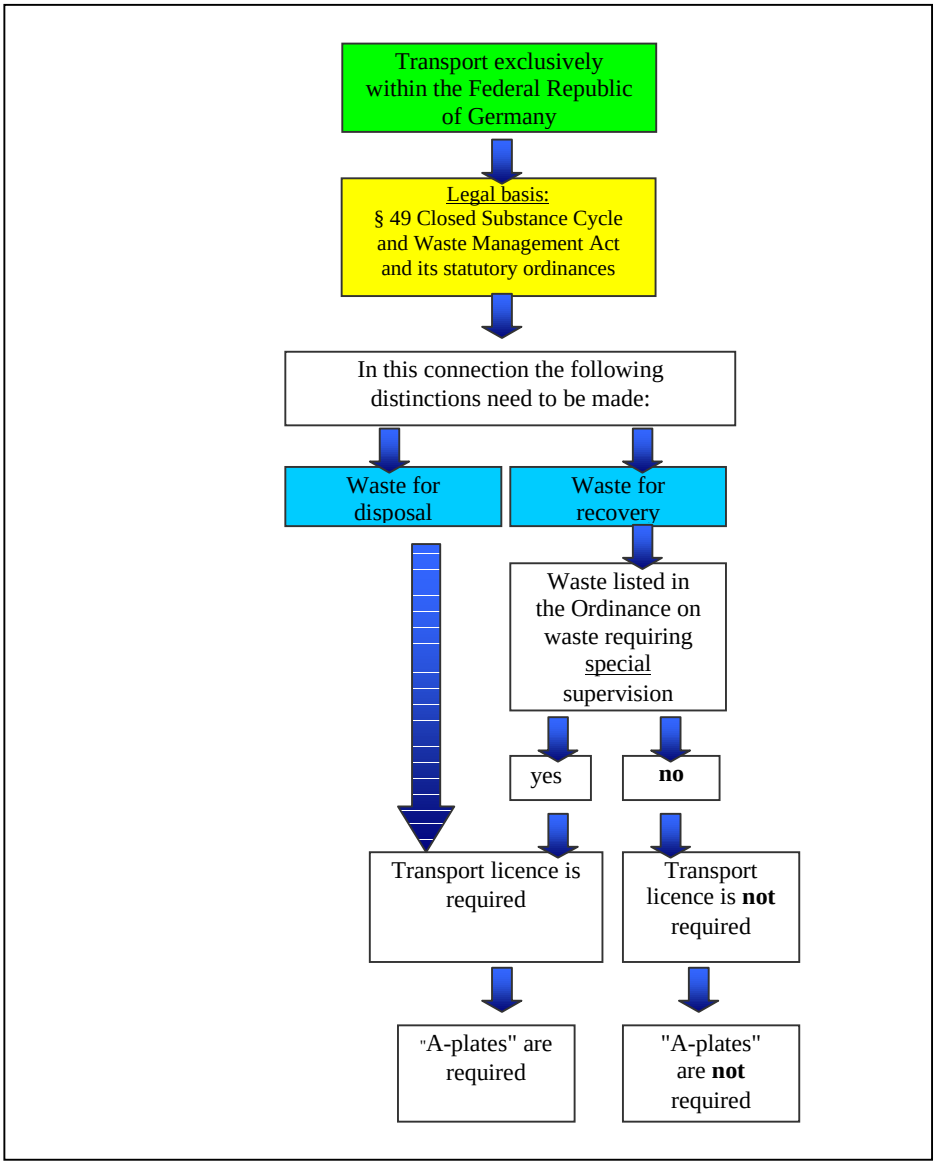


Figure 2: L**icensing procedure for transport of waste inside Germany**

1.3.1. Procedural aspects

Application forms

Certain forms[16] must be used to apply for and obtain the licence. The application is submitted in triplicate. The following documents must be provided with the application.

1. By the applicant (owner of business):
   a) trading licence application,
   b) excerpt from the commercial register,
   c) management reference,
   d) information from the central trade register,

e) proof of third-party vehicle insurance, which must also cover damage to the environment resulting from the process of collection and transportation,
f) if there is to be temporary storage or another activity that does not require the use of a motor vehicle, proof of insurance against harm to third parties through industrial accidents and insurance against damage to the environment resulting from this activity.

2. For the legal representative of the firm's owner, legal persons or associations of persons without legal capacity, those whom the law, statutes or articles of association entitle to represent or run the business:
   a) management reference;
   b) information from the central trade register.

3. For persons responsible for running and supervising the business:
   a) management reference;
   b) information from the central trade register;
   c) proof of specialised knowledge.

Responsibilities

Local responsibility for granting a transport licence falls to the competent authority under Federal *Land* legislation, within whose area of jurisdiction the firm has its head office. Branches that do not come under this jurisdiction need to obtain their own transport authorisation from the authority responsible for them.

In the case of foreign carriers that have no German branch, the authority makes a decision on the application when it is first submitted.

If notification procedure[17] does not provide for a transport licence, the latter will if necessary be granted by the competent authority of the Federal *Land* concerned. For imports, this is the competent authority at the place of reception; for exports, it is the authority at the place where the waste is produced. In cases of transit, the task falls to the competent authority of the *Land* through which the waste transits.

The competent authorities are the regional government councils of the *Länder* in question.

Insurance certification

Where a shipment is to be made by lorry, the applicant must provide proof that he has taken out third-party vehicle insurance, which must also cover damage to the environment[18]. This insurance must cover personal injury for at least 1 million DM and damage to property or inshore waters for 3 million DM.

Corresponding insurance certification is also required for planned shipments of waste by combined road/rail transport or by boat.

The third-party vehicle insurance also covers any risks to the environment (water, including inshore waters, ground, air) posed by the actual transport process, including loading and unloading. A collector and carrier need simply engage in activity of a kind that involves the approved use of vehicles, for insurance against damage to the environment[19] to be required with the third-party vehicle insurance.

Additional employers' liability insurance as well as insurance against damage to the environment is only necessary[20] when an activity not requiring the use of vehicles, in particular unloading and storing[21], is to be carried out[22].

Reliability

Facts that raise doubts about the reliability[23] of the collectors or carriers or the persons responsible for the running and supervision of the business include relevant violations of statutory regulations on waste; in addition, criminal (e.g. fraud) as well as commercial or traffic offences are taken into consideration.

But doubts can also arise simply out of failure to observe the formal dispositions of waste disposal legislation, regardless of the fact that the disposal has been conducted in a perfectly regular way as regards the material itself.

Area of validity

The transport licence is valid across the Federal Republic[24]. The authority cannot restrict an appropriate application to certain districts, except to ensure that licensing requirements are met.

The applicant can nevertheless apply for a licence that imposes restrictions with respect to:

- the district in which collection will take place;
- the area containing the waste to be transported (waste quota); and
- the period of validity (limited term).

Of course, this has an effect on the amount of the licensing or administrative charges. Even where there is such a limitation, the requirements in terms, *inter alia*, of specialised know-how remain unaffected.

Content and transferability of the transport licence

Paragraph 8 (1) of the Ordinance on transport licensing regulates the content and the area of validity of the licence. Furthermore, it clearly indicates that the transport licence, because its requirements[25] are to be met by a particular individual, is not transferable.

It is also stipulated that the form issued by the federal authorities must be used. The transport licence is normally granted for an unlimited period, but here too collectors and carriers may apply for a licence that is valid for a limited term, which affects the amount of the licensing and administrative charges.

Conditions

A transport licence may be subject to conditions[26], bearing in mind that it is required for the purpose of safeguarding the general good, and more especially ensuring that certain requirements are met. Most competent authorities require the applicant to inform them of any change in his circumstances that may be relevant to their ability to fulfil the requirements of the licence[27].

The conditions guarantee permanent insurance cover and participation in ongoing training courses, confirmed by the regular submission of certificates.

According to paragraph 49 of the Closed Substance Cycle and Waste Management Act, the licencee is not exempted from obtaining authorisation in areas governed by other regulations. This is particularly true for licences, permits and authorisation issued under the Freight Traffic Act or for the transport of dangerous goods. They are not required for the issue of transport licences under waste management law.

Charges

When charges are determined, the following should be taken into account:

- the administrative charge for carrying out official duties, if it is not a separate charge, and
- the significance, the economic value or other purpose served by the official duties for the person who has to pay the charge.

The licence charge is a proportional sum of around 500 DM. It is derived from the average administrative charge for carrying out official duties, multiplied by a given factor.

The charge for a transport licence, valid across the Federal Republic for an indefinite period and for all kinds of waste, is 10 000 DM.

Where the transport licence is modified or where the scope of an existing licence is extended, 350 DM is normally charged.

1.3.2. Waste disposal firms

It is also possible to become an accredited waste disposal firm.

One of the objects of the Closed Substance Cycle and Waste Management Act (KrW-/AbfG) is to simplify administration. The Ordinance on Waste Disposal Firms (EfbV) should be seen in this light, since it brings about deregulation by transferring responsibility to the economic sector concerned. There is a consequent transfer of control measures whereby the authorities delegate responsibility for checks and supervision to the private sector.

An accredited waste disposal firm enjoys the following advantages:

- The firm does not need a transport licence[28];
- The firm does not need a licence for brokerage[29];
- A producer of waste requiring special supervision does not need to have proof of disposal confirmed beforehand if he uses an accredited waste disposal firm[30];
- The firm may take away and recycle old cars, if authorised to do so[31].

An important advantage conferred by official recognition is that the firm offers a certified guarantee of "safe disposal" to other businesses, above all the waste producer. This is regarded as giving a competitive advantage (in that it confers a seal of quality) to a waste disposal firm. The waste disposal firm that enjoys official recognition is thus able to dissociate itself from any "black sheep" in the sector.

There is no legal obligation to have such accreditation, it depends entirely on the wishes of the firm. Nevertheless, when drawing up middle- and long-term corporate economic plans, every individual firm must consider whether it might be a good idea to become an accredited waste disposal

company. In particular, it should be pointed out here that invitations to tender increasingly demand bids from accredited firms.

In addition, a firm must keep a daily log, in which the most important indications of the origin and whereabouts of waste are entered.

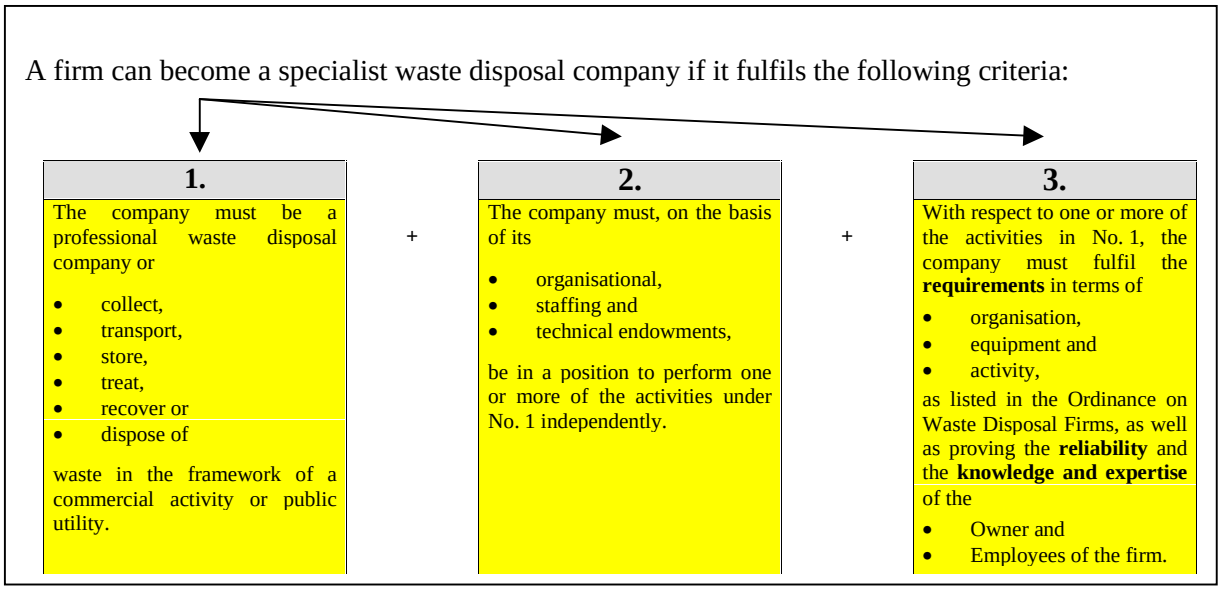


Figure 3: **Criteria to be met by a waste disposal company**

Furthermore, depending on the firm concerned, it is necessary to prove that various types of insurance have been taken out, such as insurance against damage to the environment and employer's liability insurance.

Waste disposal firms are only dispensed from the requirement to have a transport licence where the company's accreditation is granted for specific activities. This is evident, for example, where the activity for which the company is accredited is "collection and transport". The company would not be covered for "storage" of waste.

Where the accreditation of a firm of carriers or brokers extends only to particular types of waste, the waiving of the licence requirement under paragraph 51 of the Closed Substance Cycle and Waste Management Act is only applicable to those kinds of waste.

1.4. Licensing and marking waste shipments for transboundary waste transport

The modalities for granting a transport licence have already been explained in section 1.3.; they are likewise applicable in this area.

The legal basis for transboundary waste transport is paragraph 10 of the Waste Transportation Act. If waste is transported across a frontier, checks are required, as has been explained, to determine whether it is waste for disposal [32] or waste for recovery[33]. If it is waste for disposal, a transport licence is always required.

If it is waste for recovery, additional checks have been required since 1st January 1999, to see whether the waste in question is listed in the "Ordinance on the designation of waste requiring special supervision[34]". This ordinance, which lists certain wastes in the form of codes derived from the six-figure "EWC-code"[35] used in Europe, includes codes for waste materials that are subject to special supervision in Germany.

If the waste is listed in this ordinance, a transport licence is likewise required. If the waste is not listed, a transport licence is not required (see Figure 4). It is always necessary to display the "A" plate, which is not always required for transport exclusively within Germany. In this respect, therefore, there is no difference between waste for recovery and waste for disposal.

It must be pointed out that, even in the case of waste on the "Green List", there may be a transport-licensing requirement. Shipments of waste must nevertheless display the "A" plate, even if no transport licence is necessary[36].

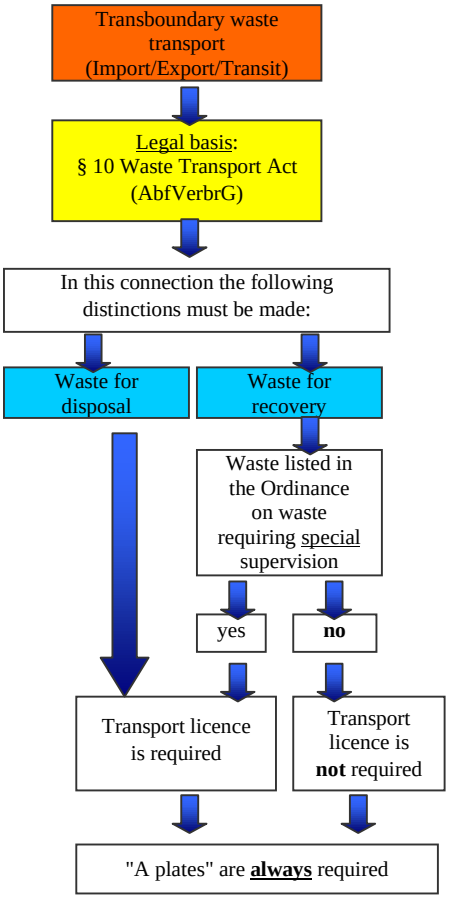


Figure 4. **Licensing procedure for transboundary transport of waste**

At present, there is no obligation to mark waste shipments under EU regulations. Hence the obligation only exists within the area in which the Waste Transport Act applies, and the "A" plates should therefore be removed when a consignment crosses the frontier from Germany to other EU States.

For further information on the vehicle marking requirement, see below.

1.5. Vehicle marking requirement

A statutory ruling on vehicle marking was introduced so that waste consignments, because of the potential danger they presented in road traffic, might be made more easily recognisable. To counter any possible circumvention of the regulations, all waste consignments subject to licensing also had to observe the vehicle-marking requirement.

The extension of the vehicle-marking requirement to all waste is intended to encourage stringent control of this kind of transport, as part of the measures taken by the competent authorities of the *Land* under the supervisory responsibility of the Federal Office for Freight Transport (BAG), and to intensify the fight against false declarations.

According to paragraph 49 (6) of the Closed Substance Cycle and Waste Management Act, vehicles transporting waste on the public highways must be fitted with two white, rectangular, reflective warning plates measuring 40 centimetres across by at least 30 centimetres high; the warning plates must display the letter "A" in black. The height of the letter must be 20 centimetres and the line thickness 2 centimetres (see Figure 5).

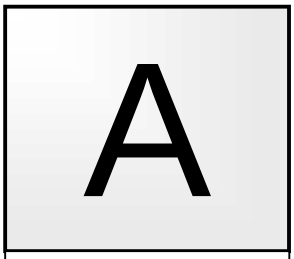


Figure 5: **The "A plate" for marking shipments of waste transported inside Germany**

During transport, the warning panels are to be fixed at the front and rear of the vehicle, at right angles to the axle and no higher than 1.5 metres above road level so that they are clearly visible. If the waste is transported in an articulated lorry, the second panel must be fixed to the back of the trailer. When the lorry is unladen the "A" plates must not be covered.

The *Bundesverband Güterkraftverkehr Logistik und Entsorgung (BGL)*, based in Frankfurt, drew the European Commission's attention to the need for a Europe-wide regulation, when the association learned that some EU States were contemplating a vehicle-marking requirement for waste shipments, comparable to that of the Federal Republic of Germany. This led to projects involving the use of different letters for the sign. If the aforementioned projects had been adopted as planned, carriers

transporting waste shipments would, for example, have had to display an "A" sign in Germany, a sign marked "D/A" ("Déchets/Afval") beyond the Belgian border and an orange coloured panel bearing the legend "Déchets" when crossing over to France.

The BGL is of the opinion that a harmonized system of marking waste shipments is desirable. However, the BGL suggests using a symbol for this purpose rather than a letter.

The European Commission has welcomed the suggestion and wants to try it out together with changes in the content of the EU Regulation on Waste Transport.

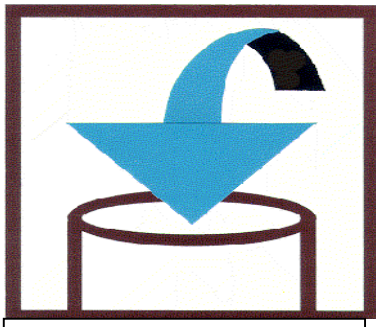


Figure 6:
The symbol for marking waste shipments suggested by BGL for the European Union

2. DESCRIPTION OF CURRENT SITUATION AND EFFECTS ON WASTE MANAGEMENT IN GERMANY

2.1. Waste transport within the Federal Republic of Germany

2.1.1. Distribution by sector of German enterprises working in waste management

A breakdown of the industrial waste produced in the Federal Republic of Germany reveals that the amounts of waste comparable to domestic refuse (Figure 7[37]) consist largely of:

- plastics (18 per cent)
- wood (13 per cent)
- paper and cardboard (11 per cent).

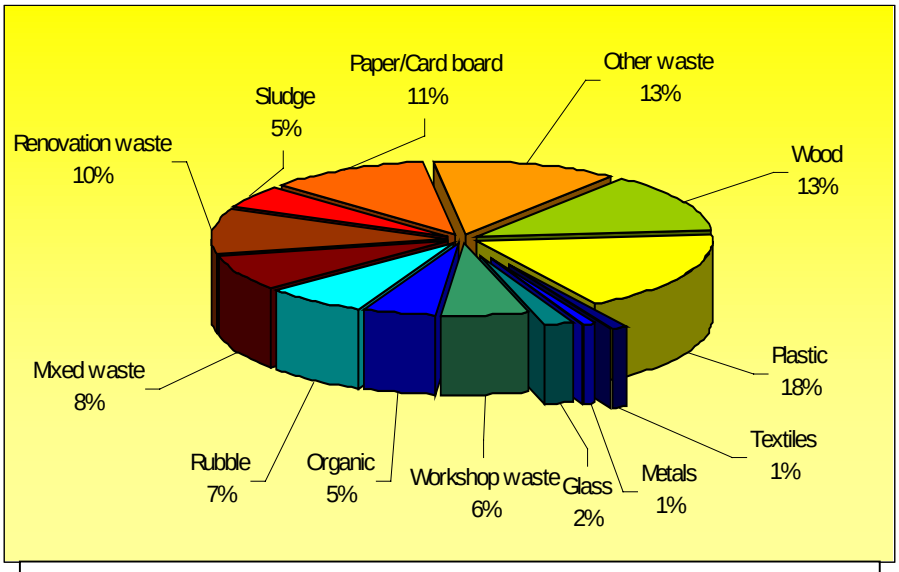


Figure 7. **Breakdown of domestic-type industrial waste produced in the Federal Republic of Germany, 1993**

The waste management sector consists of very many different market segments. If we consider the corresponding distribution (see Figure 8[38]), it is immediately apparent that the "waste collection and transport" segment with 15 312 enterprises (corresponding to 65 per cent) is the largest for the sector.

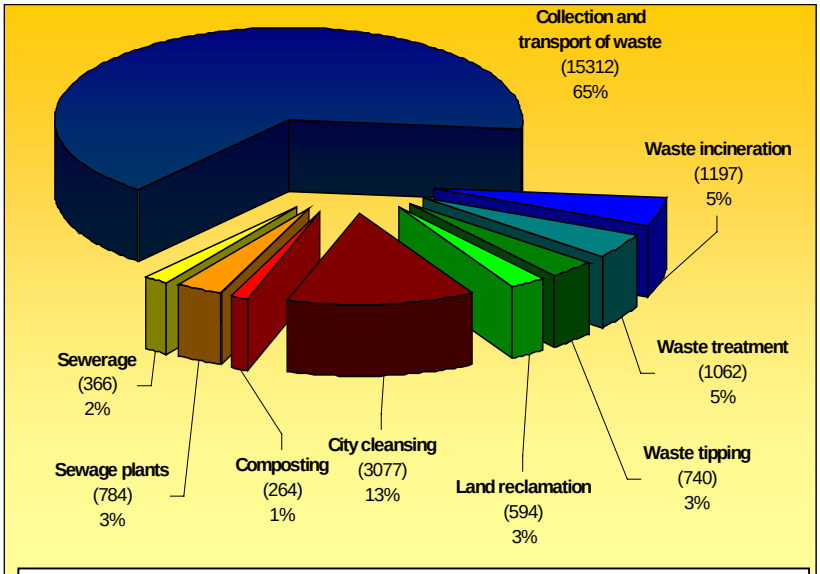


Figure 8. **Distribution of German waste disposal firms by sector (Values in brackets: total number); Situation 1996.**

The second largest segment is "city cleaning" with 3 077 enterprises (corresponding to 13 per cent). Transport also makes a significant contribution to this segment.

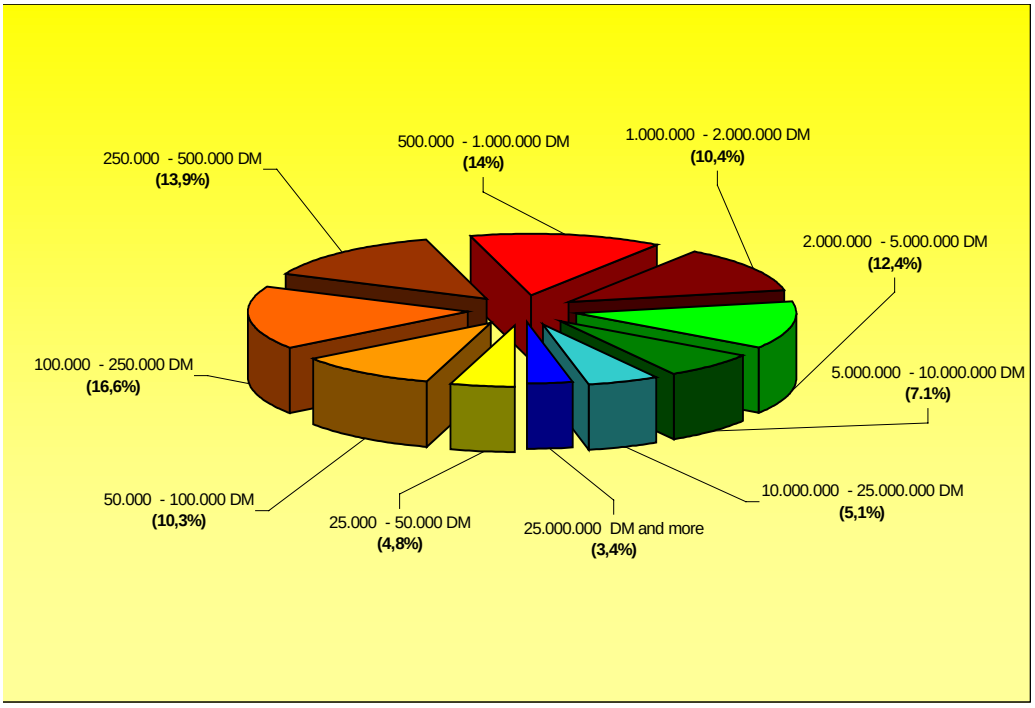
The reason for the low level of turnover in the other market segments (such as sewerage, composting, incineration and tipping of waste) must be that the maintenance of disposal sites and incineration plants are typically the preserve of local authorities for the period under review.

In particular, the segments for treatment and for incineration of waste have recently been taken over by privately-managed concerns.

2.1.2. Turnover levels in German waste management

The waste management market in Germany has been claimed by small- and medium-sized enterprises, although greater concentration and internationalisation may be noted in the form of takeovers, mergers and joint ventures (see Figure 9[39]).

Figure 9. **Distribution of German waste management firms according to size**



Notes: The figures represent turnover. Figures in brackets: relative size of sector as percentage of the whole; situation in 1996.

The largest group, making up 16.9 per cent, consists of enterprises with an annual turnover of 100 000 to 250 000 DM. The smallest category, amounting to 3.4 per cent, is made up of enterprises with an annual turnover of more than 25 000 000 DM.

The number of waste disposal firms in the Federal Republic of Germany more than tripled in the ten years between 1986 and 1996 (see Figure 10[40]).

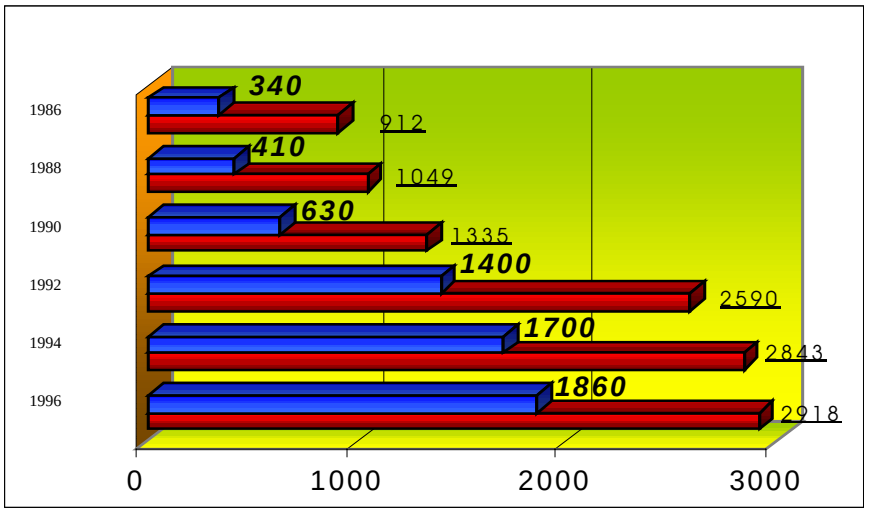


Figure 10: **Juxtaposition: Number of enterprises and turnover thereof. Upper line: Turnover in tens of thousands of DM, taking account of VAT**

In this connection it is also worth noting that the number of waste disposal facilities doubled in the two years from 1990 to 1992.

The reasons for this are, of course, reunification as well as the issuing of the Ordinance on packaging and the introduction of the Dual System in Germany.

Moreover, if the turnover figures and the total number of firms are set side by side, the interesting fact emerges that turnover increased fivefold within the same period of time.

The distribution or concentration of different waste disposal facilities have a particular effect on the waste management sector and also on transport services, which is why it is necessary to shed further light on these facilities.

2.1.3. Waste disposal sites

In 1996, there were 562 waste disposal sites, including 13 sites for special waste and four underground sites. Figure 11[41] shows that there is a clear concentration of sites in the South (Bavaria and Baden-Württemberg) and in the East (Saxony).

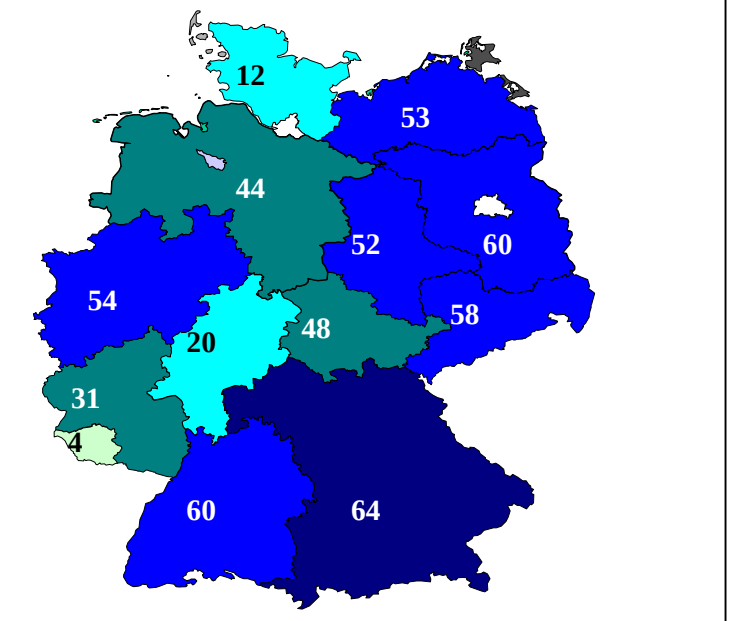


Figure 11: **Distribution of disposal sites in Germany (1996)**

In 1986, domestic refuse sites were a dumping ground for predominantly untreated waste from human settlements (domestic refuse, bulky refuse, industrial waste comparable to domestic refuse), but also for building waste, excavated earth, sewage sludge, ashes, slag and shredded waste.

Under the provisions of the Technical Instructions on Waste from Human Settlements (TASi)[42], the dumping of organic waste in its original form will no longer be allowed as from 1st June 2005 at the latest.

The TASi regulates the conditions under which it will be possible to dump waste on disposal sites. The TASi provides for two classes of disposal site, i.e. Class I and Class II sites, each of which has different allocation ratings. There are important differences between the classes of site with respect to the phenol parameter (≤ 0.2 mg/l or ≤ 50 mg/l) and the aluminium N values (≤ 4 mg/l or ≤ 200 mg/l). In addition, the ignition loss of the organic matter portion should not exceed 5 per cent. With the present state of the art, these values can only be achieved through a process of thermal treatment (incineration).

2.1.4. Disposal site charges

A comparison of charges in individual *Länder* (see Table 1[43]) reveals considerable differences in charge structures.

Baden Württemberg	158- 390 DM
Bavaria	250- 548 DM
Berlin	48- 180 DM
Brandenburg	48- 180 DM
Hamburg	100- 175 DM
Hanseatic City of Bremen	100- 291 DM
Hesse	145- 425 DM
Mecklenburg-W. Pomerania	80- 207 DM
Lower Saxony	100- 291 DM
North Rhine-Westphalia	53- 350 DM
Rhineland - Palatinate	135- 300 DM
Saarland	135- 300 DM
Saxony	80- 200 DM
Saxony-Anhalt	35- 150 DM
Schleswig-Holstein	100- 175 DM
Thuringia	86- 205 DM

Table 1:
Comparative tipping charges; DM per tonne

This is shown particularly clearly in Figure 12, in which the charges are represented in the form of a graph.

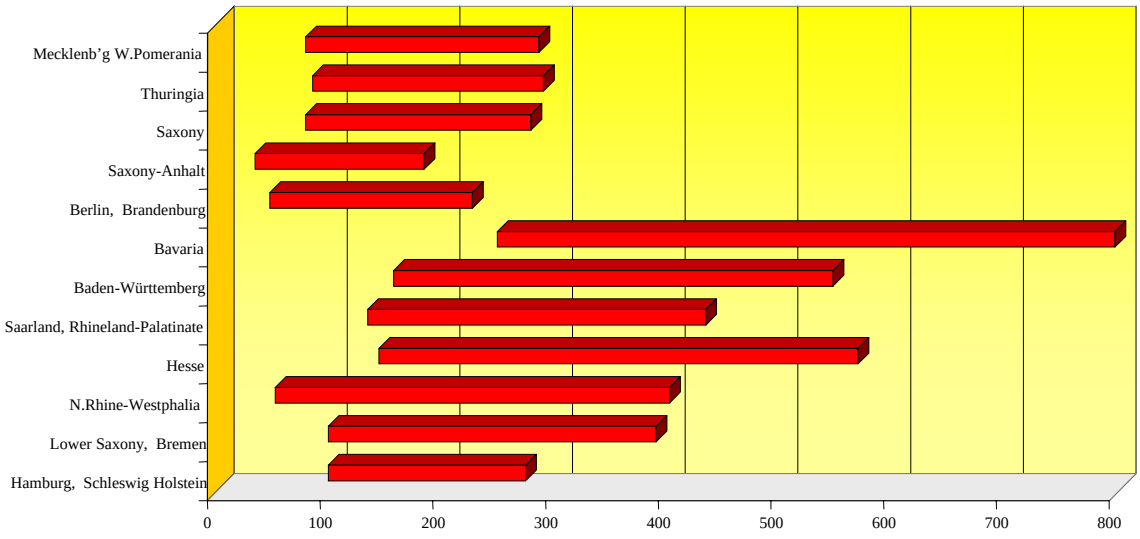


Figure 12: **Comparison of tipping charges**

Disposal sites in the new *Länder* would in many cases appear to offer much better value than those in the old *Länder*.

The reason for this is to be found in the strict requirements for disposal sites in the old *Länder*[44] (Baden Württemberg, Bavaria, Berlin, Hamburg, Hanseatic City of Bremen, Hesse, Lower Saxony,

North Rhine Westphalia, Rhineland-Palatinate, Saarland and Schleswig Holstein). The same standards are not found, or only to a very limited extent, in facilities in the new *Länder* (Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt and Thuringia), which were, of course, able to maintain low costs under the transitional regulations.

2.1.5. Domestic refuse incineration plants

In 1996, there were 51 incineration plants for domestic refuse (waste from human settlements) in operation. These facilities burned around 11 000 000 tonnes of waste. Nearly all facilities produced energy either by yielding electricity or creating heat that was made available for heating buildings.

As shown in Figure 13[45], the majority of incineration plants for domestic refuse are located in the area of the old *Länder*, more especially in Bavaria and North Rhine-Westphalia.

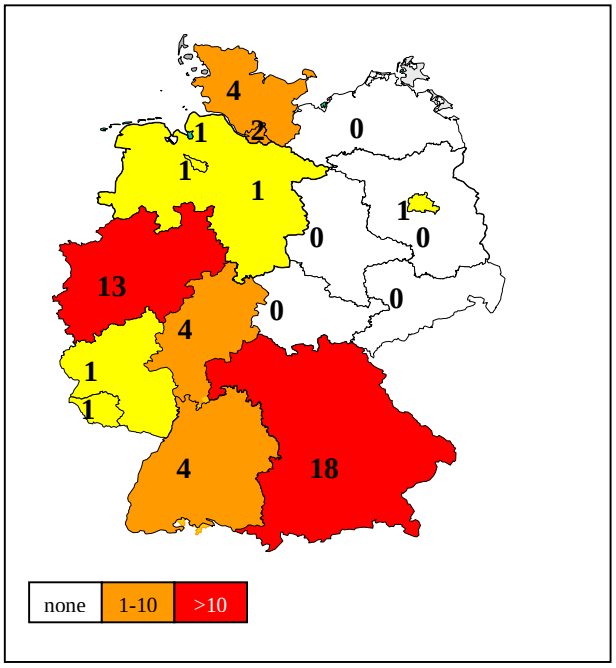


Figure 13: **Distribution of domestic waste incineration facilities in Germany (1996)**

A ruthless price war is being waged precisely in the area where incineration plants for domestic refuse are located. As a result, many of the incineration plant operators have had difficulty in finding sufficient waste to keep their facilities running. A great many facilities have been operating at 20 per cent of their capacity.

Consequently, the cost of incinerating domestic refuse has sunk to a fraction of what it was. The consequence of these plummeting prices is that waste, which had previously been dumped in inexpensive sites, is being burned in incineration plants for domestic refuse at knock-down prices. This was how the expression "the quest for garbage" came to be coined.

The use of domestic refuse incineration plants will very probably increase with the requirements of the Technical Instructions on Waste from Human Settlements[46], with the result that the transport of waste to these facilities will also increase. Moreover, incineration is called for in the "Council Directive on the incineration of waste".

2.1.6. Special waste incineration plants

The 32 special waste incineration plants operating in Germany in 1996 had a total incineration capacity of around 1 100 000 tonnes per year.

It is clear from Figure 14[47] that there is a massive concentration of special waste incineration in North Rhine-Westphalia. In the new *Länder*, with the exception of Berlin and Brandenburg, there are no special waste incineration plants accessible to the public. The four facilities in the new *Länder*, shown in Figure 14, were to be assigned to private operators.

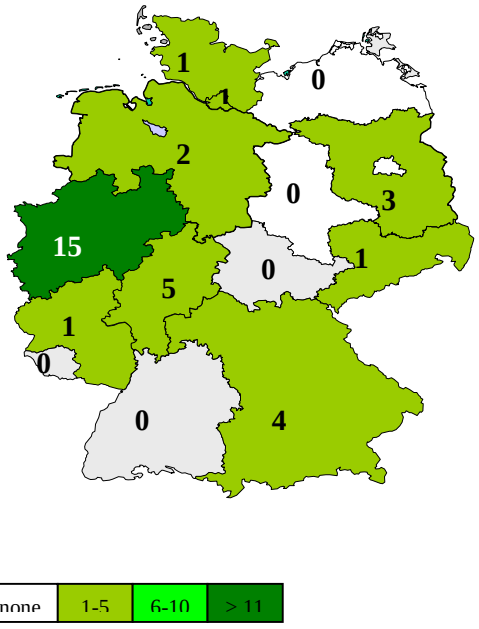


Figure 14: **Distribution of special waste incineration facilities in Germany (1996)**

2.2. Transboundary waste transport

Transboundary waste shipments are in principle subject to a licensing (notification[48]) requirement. In such cases it must be recognised that, under German law, waste for disposal must be managed inside the country as a matter of priority.

Unfortunately, information is only available for the years 1994-96. A comparison of the shipments transported shows that in 1996 significantly less waste was imported than was exported (see Figure 15).

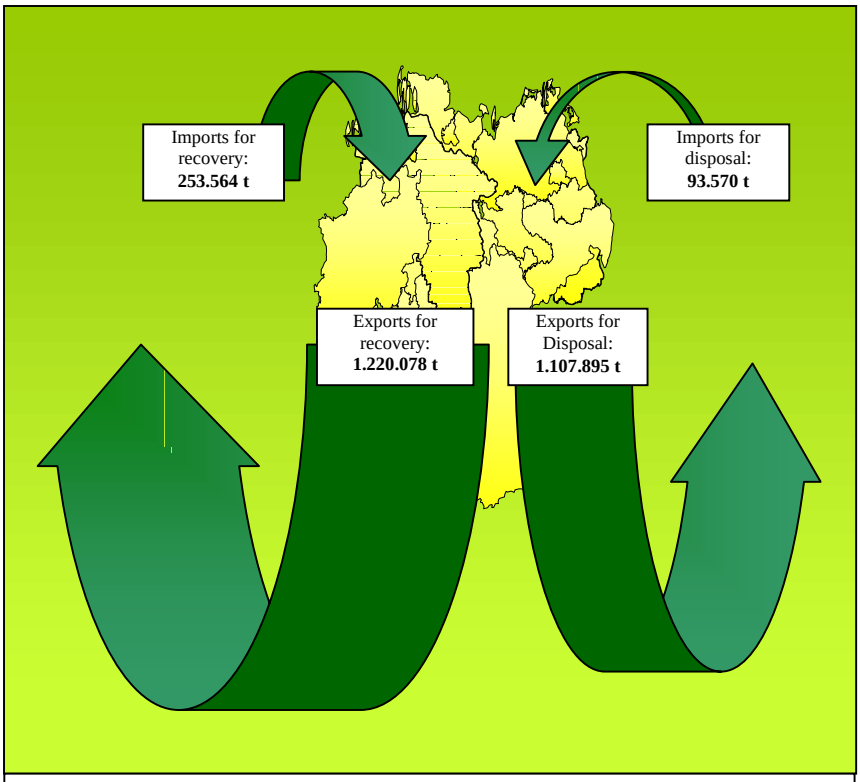


Figure 15: **Imported and exported waste, 1996**

Of the exported waste, 91 per cent was recycled and only 9 per cent disposed of (cf. Table 2[49] and Figure 15[50]). Moreover, of the imported waste, only 73 per cent was recycled.

Of the exported waste, 77 per cent went to states in the European Union, predominantly to Belgium, France, Italy and the Netherlands.

The exact amounts imported can be seen from Table 2[51] and Figure 17[52]. Information on the tonnage can be obtained from Table 2[53] and Figure 18[54]. Shipments to "non-EU states" consisted predominantly of waste on the "Green List"[55].

The majority of German waste management firms still see their area of operation (source of customers) in the "surrounding area", or within a radius of about 50 km from their business premises. This is clear from Figure 16[56].

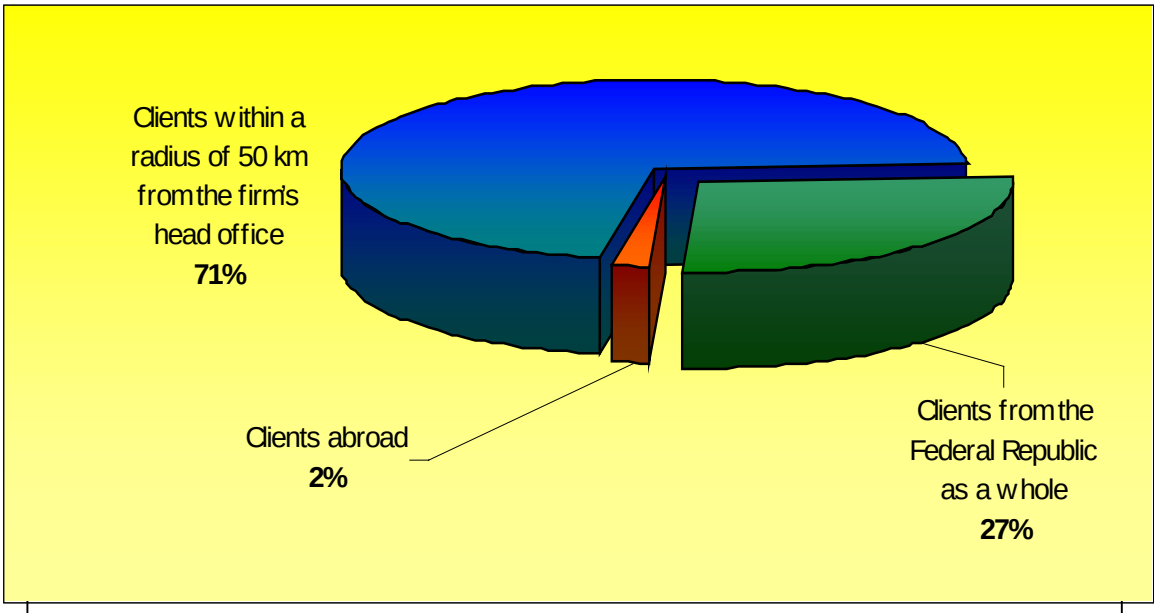


Figure 16. **Distribution of clients of German waste management companies, 1996**

	Exports (t) 1994	*Exports (t) 1995*	*Exports (t) 1996*	*Imports (t) 1994*	*Imports (t) 1995*	*Imports (t) 1996*
Albania	-	-	-	452	-	-
Australia	-	-	-	-	122	34
Austria	3 542	8 192	6 480	24 825	44 223	37 132
Belarus	-	1 812	-	-	10	-
Belgium	157 385	216 195	185 151	7 572	23 663	13 011
Brazil	105	-	-	-	-	32
Bulgaria	9 866	-	138	-	-	11
Canada	121	1 256	216			2 037
China	-	496	924	-	-	-
Croatia	5 970	8 284	19 598	-	-	-
Czech Republic	4 198	108 460	94 086	654	2 229	1 252
Denmark	36 654	50 710	55 697	677	831	9 563
Egypt	-	-	-	-	-	56
Estonia	-	-	1945	-	3	20
Finland	1 423	565	2 722	3	537	527
France	122 243	247 897	209 241	3 487	17 755	15 922
Great Britain	37 404	34 498	41 701	1 166	1 376	3 902
Greece	-	-	-	20	700	65
Hungary	8 185	44 089	49221	-	2 079	2 080
India	-	3 361	1 216	0 03	0 14	0 87
Ireland	-	-	-	1 064	657	675
Israel	-	35	39	-	80	154
Italy	24	2 484	112 791	1192	7 472	12 486
Japan	-	-	-	3	403	431
Jordania	-	-	-	-	-	103
Kazakstan	-	676	584	-	-	-
South Korea	-	-	193	-	-	24
Lithuania	-	935	-	-	-	-
Luxemburg	-	22 694	58 222	2 482	42 815	42 137
Malaysia	-	-	309	-	-	-
Mexico	-	-	440	-	-	-
Netherlands	90 224	167 253	175 938	8 199	47 061	105 104
New Zealand	-	-	-	-	-	17
Norway	2 963	12 564	13 728	130	905	214
Pakistan	-	-	-	-	30	-
Poland	2 861	18 831	14 699	40	1 144	1 317
Portugal	-	1 212	610	-	-	36
Russian Federation	-	-	-	-	5	883
Sweden	-	37 393	42 710	397	827	1 114
Switzerland	19 542	29 745	25 014	46 248	81 333	90 847
Slovakian Republic	1 246	22 907	27 972	-	-	40
Slowenien	-	1 459	-	180	685	766
South Africa	-	-	-	-	1 085	1 443
Spain	23 374	31 995	44 008	6	-	-
Ukraine	-	110	243	-	55	1 592
USA	542	23 144	34149	1 301	2 850	2 106
Total amount	**527 782**	**1 099 543**	**1 220 078**	**100 098**	**280 936**	**347 134**
Of which recovered	280 706	938 642	1 107 895	43 427	211 744	253 564
Of which disposed of	274 076	160 901	112 183	56 671	69 192	93 570
Of which waste from human settlements	8 203	32 369	28 943	39	169	1 065
Of which dangerous waste under Basel Convention	336 445	740 272	821 718	71 080	241 053	253 553

Table 2: **Import and export situation in Germany (1994-1996)**

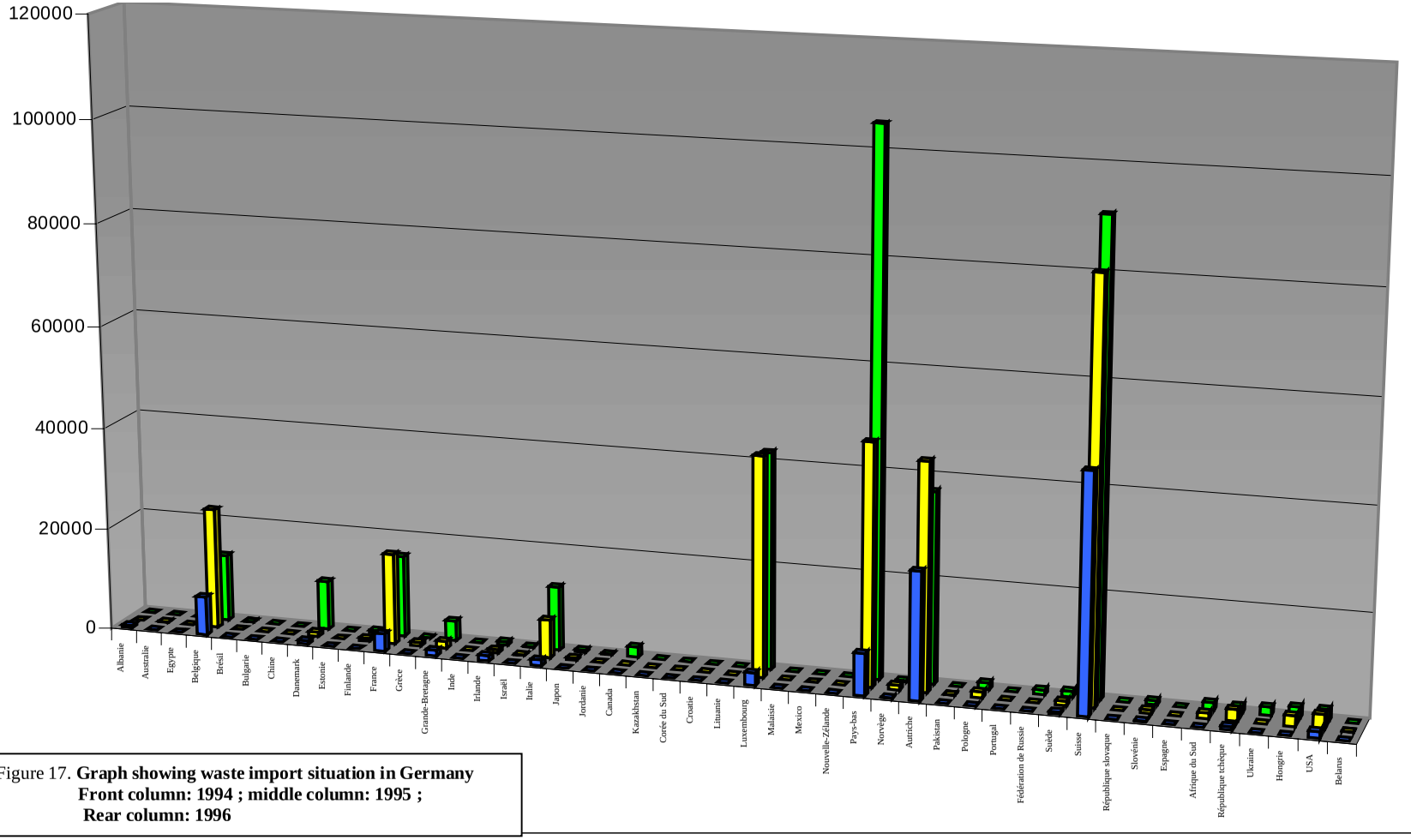


Figure 17. **Graph showing waste import situation in Germany**
Front column: 1994 ; middle column: 1995 ;
Rear column: 1996

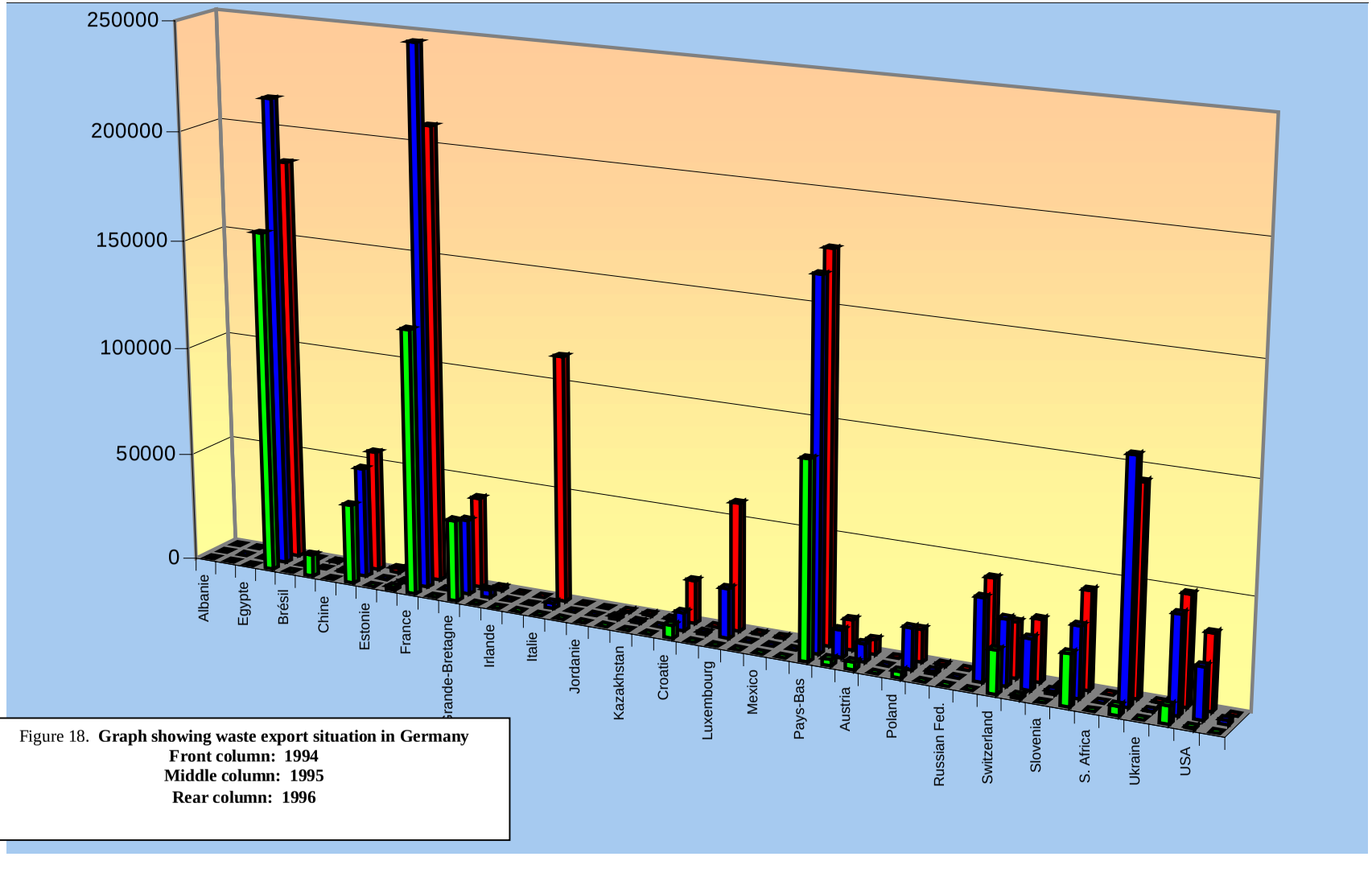


Figure 18. **Graph showing waste export situation in Germany**
Front column: 1994
Middle column: 1995
Rear column: 1996

This is evidently a consequence of the Freight Traffic Act (GüKG), in force until 30 June 1998, which provided for different national licensing requirements for local traffic (within 50 km from the site of the business premises) and long-distance traffic (outside the 50 km radius). Since then, the Freight Traffic Act has been revised and no longer distinguishes between local and long-distance traffic.

Another reason for the German preference for the surrounding area or the market already conquered could well be the unavoidable complexity and length of the licensing process ("notification process") for transboundary waste shipments.

3. OUTLOOK

3.1. Establishing legal norms in the field of waste management

The German waste management sector will soon have to face some important innovations, some of which will have a considerable impact:

3.1.1. Possible adoption of European "Council Directive on the incineration of waste"[57]:

This directive combines previous directives on waste incineration with Directive 94/67/EC on the incineration of hazardous waste. In particular, the new directive will regulate co-incineration of wastes and the use made of the heat produced.

3.1.2. Amendment of the Technical Instructions on Waste from Human Settlements (TASi):

Under the Technical Instructions on Waste from Human Settlements, it will only be possible to dump inert materials on waste disposal sites as from the year 2005. With the present state of the art, this requirement can only be met through incineration of waste.

3.1.3. Possible adoption of the "Regulation on IT devices"[58]:

At present around 110 000 tonnes of used devices from the fields of information and communications technology are accumulated every year in the Federal Republic of Germany. These have mainly been used for business purposes in industry, trade and services. Old IT devices are to be taken back free of charge by the manufacturers, as part of their product responsibility under the Closed Substance Cycle and Waste Management Act, and recycled or disposed of in an environmentally sound way.

The EC Directives on waste[59] currently in force require Member States to take the necessary steps in all relevant sectors to ensure that waste is recycled or disposed of in an environmentally sound way, until such time as a harmonized system for designated types of waste comes about or is introduced as a result of a concrete proposal by the Commission[60].

The rulings referred to under points 3.1.1 and 3.1.2 will certainly not change the amount of waste, though "disposal methods" are provided for as a matter of urgency. It is to be assumed that, as a result of market demand, waste will be transported over long distances.

Landfill operators will be faced with a drastic fall in the quantity of waste from human settlements, which could possibly result in increased charges.

It remains to be noted that the EU urgently needs to introduce directives that precisely define the concept of waste. There is also a pressing need for clarification of the unexplained legal terms "waste for recovery" and "waste for disposal" in the European provisions.

3.2. Developments in the waste transport field

Owing to changes made to the German Freight Traffic Act (GüKG) in the area of commercial road haulage on 1st July 1998, exact comparative figures cannot be recorded, especially as no statistics are kept on the transport of waste in particular. The abolition of the distinction between local freight traffic and long-distance freight traffic means that official statistics for local and long-distance traffic are no longer recorded separately[61]. Since for this reason no clear information is available, the ifo (Institute for Economic Research)[62] was called upon for help in obtaining prognoses on traffic developments for 1999.

In 1998, the quantities carried by road hauliers fell very slightly by around 11.5 million tonnes (- 0.3 per cent) to 3.83 billion tonnes. This was essentially due to the ongoing recession in the building trade and to a notable interruption in steel production in the second half of 1998[63].

For 1999, the ifo Institute expects road haulage levels to increase by 21.4 million tonnes to 3.85 billion tonnes (+ 0.6 per cent), despite a decline in the buoyancy of the economy as a whole, owing to the expectation that the recession in the building sector will end. Because these increases will mainly affect short-distance transport and, according to the estimates of the ifo Institute, there will be a falling off - for the first time in many years - of the growth in international traffic, transport of waste will increase correspondingly by + 0.7 per cent to 471.2 billion tonne-kilometres.

As regards the details, the ifo Institute expects the situation for 1999 to develop as follows:

Table 3. **Distribution of Traffic Sectors**

Traffic sectors	Amount of freight traffic					Transport performance				
	In *millions* of tonnes			% change		In *billions* of t-km			% change	
	1997	1998	1999	1998/97	1999/98	1997	1998	1999	1998/97	1999/98
Freight sector as a whole	3843.2	3831.7	3853.1	- 0.3	0.6	452.2	467.8	471.2	3.4	0.7
Of which:										
Road haulage:	3204.4	3196.3	3227.4	- 0.3	1.0	303.7	314.8	319.0	3.7	1.4
National firms	2975.0	2952.8	2975.1	- 0.7	0.8	223.2	228.6	229.7	2.4	0.5
- industrial traffic	1540.8	1493.3	1502.4	- 3.1	0.6	151.3	157.8	159.0	4.3	0.8
- company transport	1434.2	1459.4	1472.7	1.8	0.9	71.8	70.8	70.7	- 1.5	- 0.1
Foreign firms	229.4	243.6	252.3	6.2	3.6	80.5	86.2	89.3	7.0	3.7
- cabotage included	8.4	10.0	11.6	18.4	16.3	1.9	2.3	2.7	1.5	1.9
Inland waterway transport	233.5	236.6	232.4	1.4	- 1.8	62.2	63.9	63.5	2.8	- 0.7
Railways	316.0	306.4	298.4	- 3.1	- 2.6	72.7	73.8	72.8	1.5	- 1.3
- integrated transport	31.2	31.6	32.0	1.1	1.5	-	-	-	-	-
Air freight transport	2.0	1.9	1.9	- 4.0	- 1.0	0.5	0.6	0.6	17.6	- 1.3
Oil pipelines	87.4	90.4	93.0	3.5	2.9	13.2	14.7	15.3	12.1	4.1

The amounts carried by road hauliers (see Table 3[64]) went down slightly by 0.3 per cent to 3.196 million tonnes in 1998. Owing to the average increase in the freight segments and trading links involving transport over greater distances, the ifo Institute estimates the corresponding inland transport service at 315 billion tonne-kilometres (+ 3.7 per cent). The building sector losses could not be balanced out by the increase in semi-finished and finished industrial products.

In 1999, the ifo Institute expects that quantities carried by road hauliers will increase by just 1 per cent to 3.227 million and that transportation will increase by 1.4 per cent to 319 billion t-kms, owing to the macroeconomic developments referred to above.

With the expected revival in the building sector, the ifo-Institute reckons that in 1999 the quantities carried in national traffic will increase by barely 1 per cent to 2.907 Mio. t and that transportation will rise by 0.5 per cent to 211 billion tonne-kilometres.

In spite of a diminishing foreign trade drive, the amount of transboundary traffic on the roads was able to rise once again in 1998. Quantities carried increased by 5.1 per cent to 311 billion tonnes, and transportation rose by 5.9 per cent to104 billion tonne-kilometres.

For 1999, the ifo Institute expects an increase in growth rates both for German and foreign transport enterprises, with transportation by foreign enterprises increasing by 3.6 per cent to 252 million tonnes or by 3.7 per cent to 89 billion tonne-kms, and transportation by German enterprises increasing by around 0.8 per cent to 2 975 million tonnes or by 0.5 per cent to 230 billion tonnes; the market share of foreign enterprises will therefore increase in the process.

NOTES

1. In connection with the Closed Substance Cycle and Waste Management Act, the following ordinances were issued:
   - ***Ordinance on the designation of waste requiring special supervision*** (BestbüAbfV) of 10 September 1996 (BGBl. I, p. 1366).
   - ***Ordinance on the designation of waste intended for recovery and requiring special supervision*** (BestüVAbfV) of 10 September 1996 (BGBl. I, p. 1377).
   - ***Ordinance on certification of recovery or disposal*** (NachwV) of 10 September 1996, (BGBl. I, No. 47 of 20.09.96, p. 1382), last amended on 20 November 1997 (BGBl. I, No. 81 of 11.12.97, p. 2860).
   - ***Ordinance on Transport Licensing*** (TgV) of 10 September 1996 (BGBl. I, No. 47 of 20.09.96, p. 1411), last amended on 20 November 1997, (BGBl. I, No. 81 of 11.12.97, p. 2861).
   - ***Ordinance on Introduction of European Waste Catalogue*** (EAKV) of 13 September 1996, (BGBl. I, p. 1428).
   - ***Ordinance on Waste Management Concepts and Waste Audits*** (AbfKoBiV) of 13 September 1996 (BGBl. I, No. 47 of 20.09.96, p. 1447), last amended on 20 November 1997 (BGBl. I, No. 81 of 11.12.97, p. 2862).
   - ***Ordinance on specialised disposal facilities*** (EfbV) of 10 September 1996 (BGBl. I, p. 1421).

2. These include the:
   - ***Animal Carcass Disposal Act*** [on the disposal of animal carcasses, parts of animal carcasses and animal products (TierKBG)] of 2 September 1975 (BGBl. I, No. 104 of 06.09.75, p. 2313), amended on 30 September 1975 with Amendment of Animal Carcass Disposal Act, (BGBl. I, No. 113 of 08.10.75, p. 2610).
   - ***Federal Soil Conservation Act*** [on protection of the soil from detrimental impacts and decontamination of sites (BBodSchG)] of 17 March 1998 (BGBl. I, No. 16 of 24.03.98, p. 502).
   - ***Waste Oil Ordinance*** (AltölV) of 27 October 1987 (BGBl. I, No. 49 of 31.10.87, p. 2335).
   - ***Ordinance on the disposal of used halogenated solvents*** (HKWAbfV) of 23 October 1989, (BGBl. I, p. 1918).
   - ***Old Car Ordinance*** (on the surrender and ecological disposal of old cars (AltautoV) of 4 July 1997 (BGBl. I, No. 46 of 10.07.97, p. 1666).
   - ***Ordinance on Batteries*** (on the return and disposal of used batteries and accumulators (BattV) of 27 March 1998 (BGBl. I, No. 20 of 02.04.98, p. 658).
   - ***Ordinance on Biowaste*** (on the recovery of biowaste on land used for agriculture, forestry and gardens (BioAbfV) of 21 September 1998 (BGBl. I, No. 65 of 28.09.98, p. 2955).

3. In this connection, paragraphs 4 and 11, KrW-/AbfG, also give the corresponding "order of rank" for disposal measures: in the first place, waste should be avoided. In the second place, it should be subject to substance recycling or used to obtain energy. Only if waste is not recycled is it to be disposed of in a manner compatible with the public interest.

4. According to the requirements of the TASi, domestic refuse must be burned as from the year 2005 at the latest. It is still only possible to dump ashes and remains of domestic waste in refuse sites.

5. In this paper of 17-18 March 1997, it is stated in the first chapter ("Foreword") that the implementation of waste management measures in the *Länder* must move away from the prevailing trend whereby waste producers increasingly recover their waste instead of disposing of it.

6. *Source: Frankfurter Allgemeine Sonntagszeitung* of 6.6.99: „Das Geschäft mit dem Müll“.

7. With a total turnover of more than 3.4 billion DM.

8. Law on promoting closed substance cycle management and ensuring the ecologically sound disposal of waste [Closed Substance Cycle and Waste Management Act (KrW-/AbfG) of 27 September 1994, promulgated as Art. 1, Waste Avoidance, Recovery and Disposal Act of 27.9.1994 (BGBl. I, p. 2705); modified by Art. 3 of the Act on speeding up the licensing process, dated 12.9.96 (BGBl. I, p. 1354)].

9. Act on the Supervision and Control of Transboundary Transportaion (Waste Transportation Act, AbfVerbrG) of 30.9.94, promulgated as Art. 1, Implementation Act to Basel Convention of 30.9.94 (BGBl. I, p. 2771), BGBl. III/FNA 2129-15-8.

10. Ordinance on transport licensing (TgV) of 10 September 1996 (BGBl. I, p. 1411, ber. BGBl. 1997 I, p. 2861.

11. Annex IIA of the Closed Substance Cycle and Waste Management Act.

12. Annex IIB of the Closed Substance Cycle and Waste Management Act.

13. Ordinance on the classification of waste requiring special supervision (BestbüAbfV), of 10 September 1996, BGBl. I, p. 1366.

14. European Waste Catalogue.

15. The reason lies in the fact that the term "*Abfälle*" (wastes), used in paragraph 10 AbfVerbrG, covers all possible categories of waste.

16. 1. Transport licence application form (AT).
    2. Transport licence form (TG).

17. Licensing the transboundary shipment of waste in accordance with Council Regulation 259/93/EEC.

18. Legal basis: paragraph 7, Abs. 2, No. 1 e) TgV.

19. Legal basis: paragraph 7, Abs. 2, No. 1 e) TgV.

20. Legal basis: paragraph 7, Abs. 2, No. 1 f) TgV.

21. Storing, within the meaning of the Ordinance on Transport Licences, is carried out if the contents of the shipment are taken off the vehicle and placed on the plant site.

22. If the volume of waste unloaded or stored falls short of the threshold values in 4. BlmSchV, so that no facility required under the licence is available, the insurance against damage to the environment is sufficient to cover the associated risks. This is a basic element of the employers' liability insurance.

    As soon as a facility corresponding to the licensing requirements becomes available, insurance against harm to the environment is required to insure against the corresponding component risks. In the case of storage of water polluting waste (old paint, etc.), where there is a shortfall in the threshold values in respect of licensing requirements, the component risk 2.1 (WHG-Annex) is also to be covered.

    If the intention is not to engage in activity calling for the approved use of vehicles, the following risks to water (including inland waters), ground and air are covered:

    When unloading:
    - Harm caused by the environmental effects of waste from transported material.
    - Harm during the unloading process (e.g.transfer of waste into another transport container).

    When storing:
    - Harm caused by the environmental effects of the use of vehicles;
    - Harm caused by the environmental effects of waste from transported material;
    - Harm during storage period;
    - Harm caused by the gradual effects of temperature, gases, steam, humidity and sediments;
    - Harm caused by burning, explosions.

    When engaging in other activities not calling for the use of a vehicle:
    - Harm caused by the environmental effects of activity in the normal course of work (e.g. harm caused by dust, noise);
    - Harm caused by the environmental effects of activity in the case of malfunction (e.g. leakage of water pollutants);
    - Harm caused by environmental effects of contact with waste as part of the activity (e.g. harm caused by gases and vapours produced);
    - Harm caused by gradual effects of temperature, gases, steam, humidity and sediments;
    - Harm caused by fire, explosions.

    If the licence is granted for a period that extends beyond the period of validity of the respective insurance, it will only remain valid if the insurance coverage is prolonged at the appropriate time. A collateral clause to this effect is to be included in the licensing information.

    Relevant criteria may include the dangerous nature and the amount of stored waste.

    Any risk insured against must be in the policy or in a corresponding confirmation provided by the insurer. It must be indicated whether the type and scope of the insurance have been worked out on the basis of a risk assessment carried out within the company.

23. The required original of the certificate issued by the police and extracts from the central trade register should not be more than three months old. The following should be applied for at the official local registration office:
    - Certificate issued by the police stating that the holder has no criminal record;
    - Information on the individual from the central trade register;
    - Information on the firm from the central trade register.

24. Legal basis: paragraph 49, 4), KrW-/AbfG.

25. The licensing requirements are given in paragraph 49, 2), Clause 1, KrW-/AbfG.

26. Legal basis: paragraph 8, Abs. 2 TgV.

27. This includes in particular a change in the personnel responsible for running the business and a change in circumstances that might affect the reliability of the applicant.

28. Laid down in paragraph 51, KrW-/AbfG.

29. Laid down in paragraph 51, KrW-/AbfG.

30. Laid down in paragraph 10, 1), i.V.m. paragraph 13, 4), Ordinance on certification of recovery or disposal (NachwV).

31. Laid down in paragraph 2, 5), AltautoV (Ordinance on the disposal of old cars and conformity with road traffic legislation). The ordinance entered into force on 1st April 1998.

32. Annex IIA of Closed Substance Cycle and Waste Management Act.

33. Annex IIB of Closed Substance Cycle and Waste Management Act.

34. Ordinance on the designation of waste requiring special supervision (BestbüAbfV) of 10 September 1996, BGBl. I, p. 1366.

35. European Waste Catalogue.

36. The reason lies in the fact that the term "*Abfälle*" (wastes), used in paragraph 10, AbfVerbrG, covers all possible categories of waste.

37. *Source:* Federal Statistics Office.

38. *Source:* Federal Statistics Office.

39. *Source:* Federal Statistics Office.

40. *Source:* Federal Statistics Office.

41. *Source:* Federal Office for the Environment, *Information on the environment in Germany*, 1997.

42. Third sub-regulation to the Waste Management Act (TA Siedlungsabfall); Technical Instructions on the Recovery, Treatment and other Management of Waste from Human Settlements of 14 May 1993 (BAnz. No. 99a).

43. *Source: EUWID* Recycling *und Entsorgung*; Europäischer Wirtschaftsdienst GmbH, No. 3/1999 of 19.01.99.

44. Relevant regulations include, in particular, The Technical Instructions on Waste (TA Abfall) and The Technical Instructions on Waste from Human Settlements (TASi).

45. *Source:* Federal Office for the Environment, *Information on the environment in Germany*, 1997.

46. See "Disposal Sites".

47. *Source:* Federal Office for the Environment, *Information on the environment in Germany*, 1997.

48. Council Regulation (EEC) No. 259/93 (on the supervision and control of shipment of waste …).

49. *Source:* Federal Office for the Environment, *Information on the environment in Germany*, 1997.

50. *Source:* Federal Office for the Environment, initial source Basel Convention, Status: 8.6.98; information partly at variance with: Federal Office for the Environment, *Information on the environment in Germany*, 1997.

51. *Source:* Federal Office for the Environment, initial source Basel Convention, Status: 8.6.98; information partly at variance with: Federal Office for the Environment, *Information on the environment in Germany*, 1997.

52. *Source:* Federal Office for the Environment, *Information on the environment in Germany*, 1997.

53. *Source:* Federal Office for the Environment, initial source Basel Convention, Status: 8.6.98; information partly at variance with: Federal Office for the Environment, *Information on the environment in Germany*, 1997.

54. *Source:* Federal Office for the Environment, *Information on the environment in Germany*, 1997.

55. See Annex II of EEC Regulation 259/93.

56. *Source:* ZEW Branch Report Services, September 1995.

57. When this paper was being written, the EU Parliament had agreed the Draft Directive (1999/C 116/10); the first reading by the Council was planned for 25 June 1999.

58. This Regulation is to cover the following devices:
    - Computers;
    - Monitors, printers, plotters and other output devices used in the field of information technology;
    - Keyboards, scanners and other input devices used in the field of information technology;
    - Typewriters;
    - Photocopiers and other reprographic devices;
    - Fax machines;
    - Telephone appliances;
    - Equipment used for presentations;
    - Inclusive of parts of devices and electrical or electronic accessories.

59. Directive 75/442/EC as amended by Directive 91/156/EC.

60. During the discussions in the above-mentioned EC Working Group, the EC Commission expressed the intention to draft proposals for harmonized action with respect to the disposal of electrical and electronic devices. However, there is no sign at present of when such proposals will be submitted in concrete form and how the details will be worked out. The Federal Government nevertheless thinks it advisable, for ecological reasons, to demand the disposal of old IT devices at an early date.

61. As far as can be ascertained from the data, road haulage traffic operated by national companies is described for the purpose of market analysis according to different characteristics and different distances covered, a distinction being made between the local sector (1 to 50 km), the regional sector (51 to 150 km) and the long-distance sector (151 km or more).

62. *Source:* ifo Institute for Economic Research, Munich.

63. Owing to the technical link between the building material sector and the building rubble disposal sector, this study provides a conservative indication.

64. *Source:* ifo Institute for Economic Research, Munich.

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ECONOMIC ASPECTS OF THE INTERNATIONAL TRANSPORT OF WASTE: IMPACT ON THE EUROPEAN WASTE FACILITIES NETWORK

SUMMARY

Stuttgart, October 1999

1. INTRODUCTION

1.1. Overview/Executive Summary

This report, perhaps surprisingly, takes the view that we are suffering from a "lack of waste". It may also partly contradict views in the paper presented by Mr. Guido Koschany (Waste Transport in the Federal Republic of Germany), to the effect that regulations imposed by waste authorities in order to preserve waste for their own plants are too restrictive.

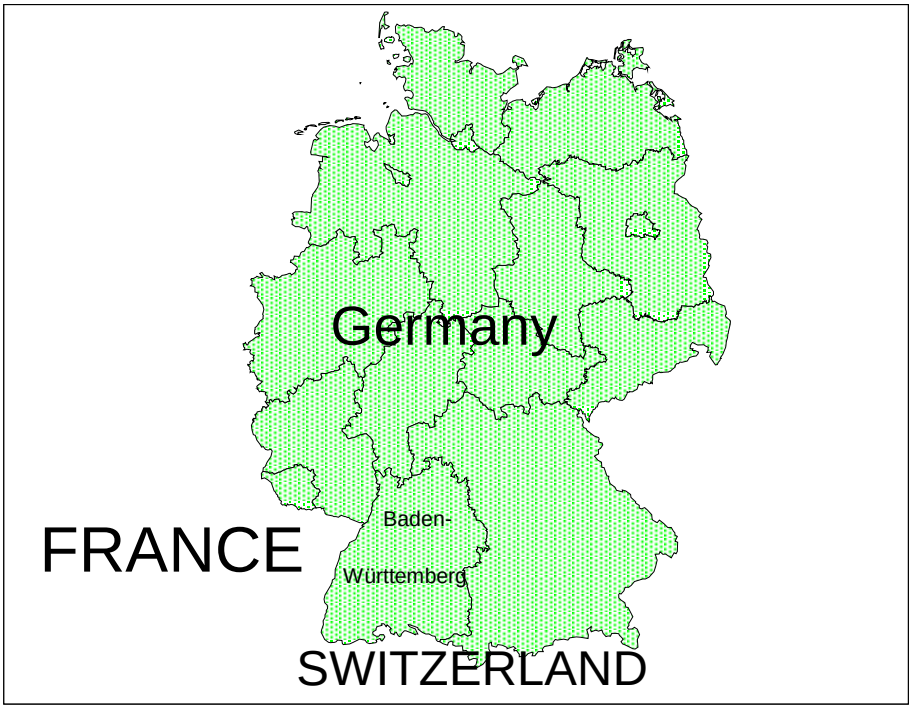
The facts are these. Waste transport activities have increased considerably, while the quantities of wastes going to disposal are decreasing dramatically. In theory, this increase in transport and recovery activities is a positive development. However, we should also look at the opposite side of the coin. We also have to take into consideration the fact that operators of waste facilities have been forced, by policy and pressure groups, to make substantial investments in incinerators, landfills, etc. But, now, due to shrinking demand, a return on those investments seems to be very far off. In Germany and, indeed, the Netherlands, the underutilisation of waste facility capacity is uneconomic. Waste is bypassing expensive disposal facilities and is instead going to cheaper plants not originally designed for waste treatment. The latter claim that they are recovering waste, which is perfectly legal since wastes for recovery -- in contrast to those for disposal -- are considered as goods and thus can circulate freely. Consequently, there have been calls for the closure of uneconomic waste treatment plants. Besides questioning the wisdom of transferring pressure on the environment to other media (a closer look at recovery processes reveals methods that are sometimes not reassuring), the definitive closure of disposal plants could be a fatal error, since experience demonstrates (typical examples are given in the report) that, from time to time, wastes which could not have been foreseen do arise, and no-one wants or is indeed qualified to accept them for recovery. Moreover, in an industrialised society there is always industrial waste that is unsuited to recovery and the industrialised countries owe it to others to maintain adequate capacities for waste treatment to satisfactory standards of technology. Thus, the author concludes that a certain portion of wastes generated should remain in the hands of disposal plants. An appropriate definition for differentiating between disposal and recovery operations is proposed in the following report.

1.2. The geographical and administrative context

The Federal Republic of Germany consists of 16 *Länder*, of which Baden-Württemberg is one. Located in the south-west of Germany, bordering on France and Switzerland (see Figure 1), Baden-Württemberg has a population of about 10.5 million and covers a land area of roughly 35 000 km^2. It is a highly industrialised region, one of the major industries being mechanical engineering. Three German car manufacturers have plants in this area of Germany: Mercedes, Audi and Porsche.

Under the federal constitution, the German *Länder* are responsible for implementing federal laws and can pass their own laws, e.g. in the field of waste management. The *Länder* have their own parliaments, governments and administrative machinery. Thus, it is not the staff of the Federal Government in Berlin that has to implement waste legislation on a day-to-day basis. Due to Germany's constitutional structure, that task falls to the staff (e.g. factory inspectors) employed by the various *Länder*.

Figure 1. **Geographical context**



2. CURRENT WASTE TRANSPORT SITUATION AND ITS EFFECTS

This account of the current situation focuses on the hazardous waste sector and on the Baden-Württemberg region. However, within this relatively limited scope, the situation described is representative of that of all types of waste and of Germany as a whole.

German legislation imposes strict distinctions between hazardous waste for:

- landfill;
- deep underground disposal; and
- incineration.

The wastes that most interest us in this report are those designated for the incineration route.

Exports of mainly combustible waste grew from 152 000 tonnes to 303 000 tonnes per year from 1995 to 1998, as shown in Table 1.

Table 1. **Growing quantities of waste for recovery exported from Baden-Württemberg**

Year	**1995**	**1996**	**1997**	**1998**
Quantity (tonnes)	152 000	157 000	223 000	303 000

The trend was the reverse for wastes sent for disposal in the region. A brief history follows.

- In 1987, about 260 000 tonnes of hazardous waste for incineration were generated in Baden-Württemberg. The figure for the whole of Germany (before reunification) is an estimated six times higher.

- In 1990, plans for the construction of two incinerators for hazardous waste were pushed through. The design capacity of these incinerators was 100 000 t each. The incinerators, at an estimated cost of Euro 250 million each, were never built.

- Then, in about 1993-94, new plans were proposed, still for two incinerators or other types of thermal technology plant, with a total capacity of 90 000 t of hazardous waste. These plants were never constructed.

- Instead, the Ministry signed a contract for the delivery of 20 000 t of hazardous waste per year with the City of Hamburg, which had just constructed a hazardous waste incinerator. The contract contained a clause imposing a financial penalty in the event that the Baden-Württemberg region would be unable to deliver the total amount of 20 000 t. At the time, there appeared to be no danger that it would be unable to do so, given the quantities of waste generated in the region in earlier years.

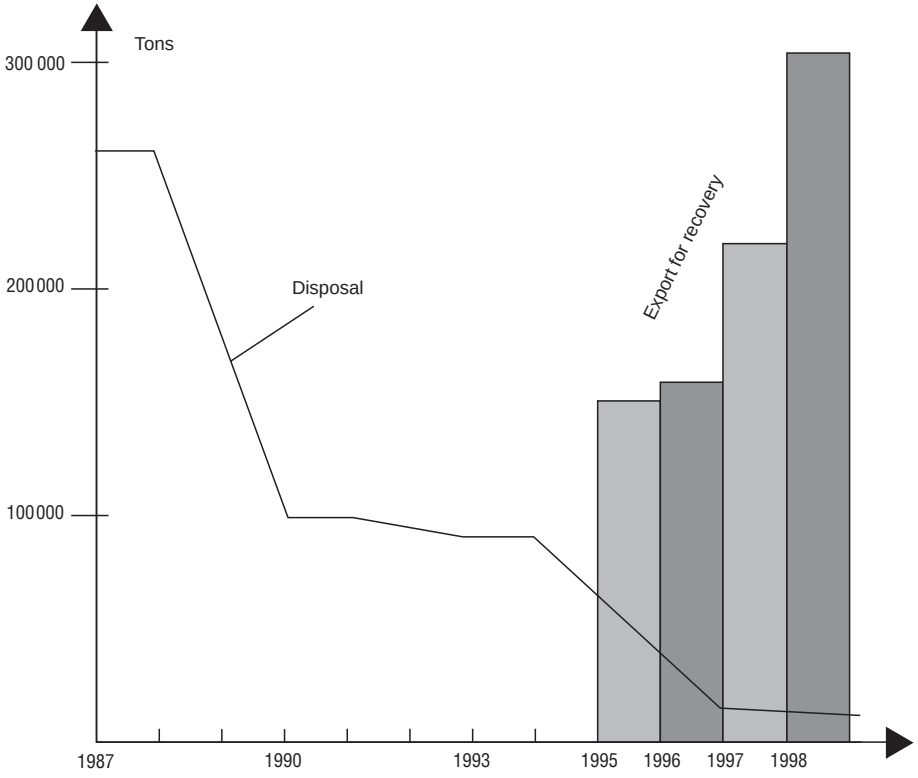
- As things now stand, the Baden-Württemberg region can barely scrape together the 20 000 t needed to comply with the contract.

Table 2. **Shrinking waste quantities**

Year	**1987**	**1990**	**1993-94**	**Today**
Quantities (Tonnes)	260 000	100 000	90 000	< 20 000

For a comparison of Tables 1 and 2, see Figure 2.

Figure 2. **Growing and shrinking waste flows**



So what has happened? Almost 250 000 t of hazardous waste have disappeared in less than one decade. This situation is representative of that in the other *Länder* of Germany as well. Other *Länder*, which did make substantial investments in incinerators, are faced with even more difficulties than Baden-Württemberg. Their companies -- whether privatised or public -- are operating in the red. There seems to be no prospect of a return on their investment.

This tremendous reduction is clearly not due to the success of waste minimisation at source, but rather to the large quantities of combustible hazardous waste that are being incinerated in industrial plants, especially cement kilns.

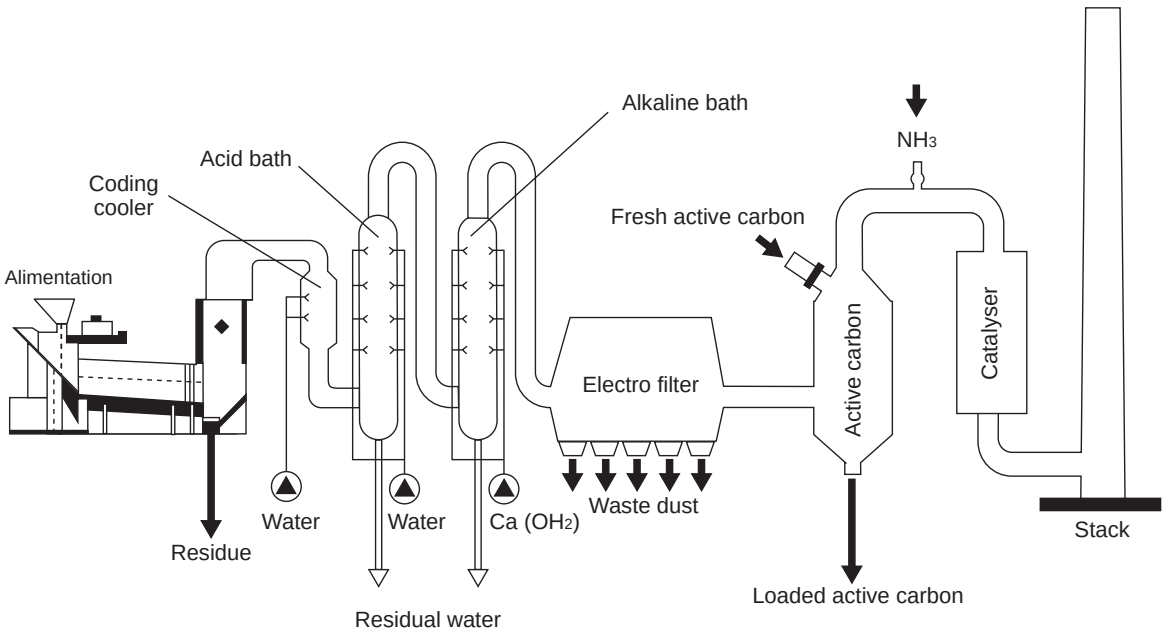
3. LEGISLATIVE BACKGROUND

Article 13 of the German Waste Avoidance, Recycling and Disposal Act allows municipalities and other public operators to stipulate that waste has to be deposited with them -- but this applies only to wastes for disposal, not to wastes for recovery. What happens is that private hauliers collect waste

from small and medium-sized enterprises purportedly for recovery. The reason for their success is the comparatively low prices they have to pay for access to plants, such as cement kilns, that were not originally designed to treat waste. The reason for the large discrepancy in price is that waste facility operators have been forced by policy and pressure groups to invest substantially in incinerators. Germany's Clean Air Act, applicable to waste incinerators (17. *Bundesimmissionsschutz-Verordnung* passed in 1990) imposes stringent flue gas quality requirements, entailing considerable investment in air treatment plant. Figure 3 shows very clearly the dimensions of the air treatment plant required compared with the actual incinerator, the original core of the plant. In contrast, air quality requirements for cement kilns have remained more or less unchanged since the eighties.

Transport costs do not seem to be a determining factor. Obviously, the difference in disposal prices more than covers the 0.x Euro per tonne-kilometre charge for long-distance waste transport (of about 500 to 1 000 kilometres). The cement works of a neighbouring EU country reportedly take about Euro 75 per tonne of waste, whilst German waste incinerators charge Euro 600. Although the latter have cut their prices, they can still hardly compete with cement works.

Figure 3. **Outline diagram of a hazardous waste incinerator and air cleaning plant required under German Act**



4. ATTEMPTS TO COUNTER THE TREND

4.1. Legal basis

There does appear to be a legal basis for countermeasures: the German Waste Avoidance, Recycling and Disposal Act.

The Act was passed in order to highlight the need for waste management and recycling. However, since it was passed in September 1995, its practical implementation seems to be encountering some obstacles. A closer look at the Act may shed some light on these problems. The crucial point here is the distinction between waste for recovery and waste for disposal. Hence, the need for a definition that will clearly differentiate between the two operations. As outlined above, the reason that this item is subject to such intense debate is that German law attaches further legal requirements to these operations (disposal or recovery). As we have said, waste for disposal must be delivered to state-owned operators, usually at higher than market prices. So, industrial waste generators tend to prefer the recovery route, while waste authorities prefer the disposal route because they have invested astronomical sums in waste disposal plants. A closer look at the relevant articles may shed some light on the issue (see flow chart in Figure 4 at the end of the report).

The first relevant article is Article 4, para. 1), which reads as follows:

Art. 4: Basic Principles of Recycling and Waste Management

1) Waste

a. must, firstly, be avoided, especially by reducing its amount and toxicity;
b. must, secondly,
- *be recycled or*
- *used as a source of energy (energy recovery).*

2) ...That sounds progressive. But the progressive approach is qualified somewhat by para. 3), second sentence, which is known as the "main purpose clause":

3) ...Substance recycling is considered to occur when, in keeping with an economic perspective, and taking into account the impurities present in the relevant waste, the main purpose of the relevant measure is to use the waste, and not to eliminate its pollution potential.

That sounds reasonable enough, but who is to judge what the "economic perspective" should be, when the "main purpose" starts and ends, or what unit of measurement we are to use? At what point do impurities become the determining factor?

Para. 4) refers to energy recovery, mentioning criteria such as impurities, emissions and the creation of new wastes:

4) ...The main purpose of a measure in question shall be taken as the criterion for differentiation. For a given waste sample that has not been mixed with other substances, the type and extent of the waste's impurities, and additional waste and emissions occurring as a result of its treatment, are the criterion for determining whether the main purpose of the relevant waste management measure is recycling or treatment.

The questions that it leaves unanswered are "What are the relevant concentrations of impurities?"; "What are the appropriate types of waste?"

Article 5, para. 2), known as the "high-quality clause", assigns additional tasks to the implementing authorities. It reads as follows:

2) ....High-quality recycling appropriate for the type and the nature of the waste in question is to be pursued....

This requirement might be interpreted as meaning "use foundry sand again as foundry sand, instead of using it for refilling excavated pits" or possibly "use electroplating sludge as e.g. copper source instead of mixing it with clay in a brickworks" -- but who is to say?

Article 5, para. 3) relates to the public interest:

3) Waste recycling, especially the binding of waste within products, must take place properly and safely. Recycling takes... ...place safely when, given the waste's nature the extent of the impurities it contains and the type of recycling in question, no impairment of the public interest is expected and, in particular, when no increase in pollutant concentrations occurs within the life-cycle of the substance.

4) ...How can the requirement "no increase in pollutant concentrations" within the life cycle of the substance be met, and what are the limit values? Electroplating sludge is recycled for use instead of clay as a feedstock in the manufacture of bricks. But the cycle does not stop there: bricks containing copper will appear as future demolition waste. Another example is the burning of waste containing heavy metals in cement kilns, which will of course mean that the cement produced will have a higher heavy metals content. How are the limits to be defined? Natural fuel itself contains a certain background level of heavy metal contamination. Could these values serve as a basis? The cement industry claims that this would be "too stringent", and it has to be said that burning waste in cement kilns does make some ecological sense in that it conserves fuel resources and avoids the need to construct incinerators, etc.

Para. 5) was originally inserted to provide a loophole in the event that materials recovery requirements became too stringent or too expensive for operators. But, as pointed out at the beginning of this report, the scene has changed and economic operators are now keen on recycling. Lawyers think this paragraph could be used to the opposite effect as well. It reads as follows:

5) The priority set forth in para. 2) for waste recycling does not exist in cases in which waste disposal is the more environmentally compatible solution. In this connection, the following must especially be taken into account:

1. *The expected emissions;*
2. *The aim of conserving natural resources;*
3. *The energy to be consumed and yielde; and*
4. *The resulting increased concentrations of pollutants in products, waste for recovery or products made from such waste.*

From this, it is quite clear that limit values, which the Act does not specify in concrete terms, are necessary.

Article 6 contains an arsenal of minimum requirements for energy recovery:

Art. 6: Substance Recycling and Energy Recovery

2).....energy recovery within the meaning of Art. 4, para. 4) is permissible only when:

a. *the calorific value of the waste in question, without the waste's being mixed with other substances, is at least 11 000 kJ/kg;*
b. *a combustion efficiency of at least 75*per cent *is achieved;*
c. *the resulting heat is either used by the person/entity recovering the energy or supplied to a third party; and*
d. *the additional waste occurring as part of the recycling can be stored with little or no further treatment.*

The EU Commission itself put the issue of energy recovery on the agenda. France proposed a calorific value of 5 000 kJ/kg. Incidentally, the value of 11 000 kJ/kg in the German Act is derived from that for poor-quality brown coal.

4.2. Interpretation of German and EU waste legislation

4.2.1. Guidelines issued by the Länder administrations (LAGA)

In order to translate the provisions of the Act into concrete terms, the administrations of the German *Länder* got together and worked out guidelines for differentiating between disposal and recovery operations. A separate section of the guidelines dealt with the distinction between waste and non-waste. Before going into detail, it should be noted that the guidelines were not a success and are no longer in force, for political reasons. But their content seems interesting enough to warrant comment here (see flow chart in Figure 5 at the end of the report).

- The first question that the guidelines ask is whether more than 50 per cent of a given waste can be recovered. If the answer is "yes", then the main purpose of the operation is considered to be recovery, except where the answer to the next question (on contamination) is "no". This assumption seems self-explanatory.

- The next question is whether there are any contamination constraints. For instance, German legislation on chemicals prohibits the marketing of products containing more than a specified amount of toxic substances. Examples are limits on cadmium compounds or Pentachlorophenol (PCP). Excavated soil, usually reused in road construction, must meet requirements in order to protect soil and groundwater. If the answer to this question is "no contamination problems", the operation is considered to be a recovery operation. If the answer is "there are problems", the waste is unfit for recovery and the appropriate operation is disposal.

This "quantity" approach is not sufficient for all types of waste. Many wastes contain substances whose recovery is profitable even at a much lower recovery rate than 50 per cent (galvanising sludges containing about 1 to 2 per cent copper or chromium, for example). For these cases, an economic approach was taken.

– The question the guidelines asked was "does the value of the recovered substance (e.g. 20 kg of chromium per tonne of waste) amount to 50 per cent of the recovery costs. Usually, an economic operator would start the process only if 100 per cent of the costs were covered and a profit could be made. However, in the case of waste, besides the profits from recovering the material, the sum that the waste generator is willing to pay for disposal is also a consideration.

The following example clarifies the intention behind this complex question. The industrial waste "phenol water" usually contains about 5 per cent phenol (= 50 kg per tonne of waste). Suppose that a waste operator, claiming that he is recovering phenol, charges a gate fee of about Euro 150 per tonne. On the market, phenol can be bought for about Euro 0.30 per kg. So, the 50 kg that could be recovered from the waste represents an economic value of just Euro 15. Bearing in mind that the cost of treatment is Euro 150, the operator's profit would fall far short of the 50 per cent margin. The result of the exercise, based on these prices, is that the treatment of phenol water must be considered as disposal operation. In contrast, if the 20 kg of copper contained in a galvanising sludge were worth about 50 Euro, then a recovery process at about 100 Euro would indeed be a recovery operation.

It was crystal clear to all of the authors of the guidelines that no hard and fast limits could or should be imposed, or that profits of only 49.9 per cent would necessarily mean that an operation should be considered a disposal operation. The economic checklist was simply intended as a rough guide for decisionmaking. It was agreed that, in borderline cases, the economic operator should be given the benefit of the doubt. In addition, classical recovery routes such as scrap recycling, composting, re-use of waste paper, etc., were not to be subject to the guideline questions. Nevertheless, the economic checklist would have provided a means of detecting and addressing clear cases of spurious recovery operations.

– Of course, in accordance with the flow chart, wastes for recovery also had to satisfy the contamination requirement. Usually in recovery processes, the contamination (copper in the example given) is also the substance that is to be recovered and the higher the level of contamination the more efficient the recovery operation will be.

Among other things, the guidelines also addressed the distinction between waste and non-waste. However, since the OECD has also drafted a paper on this subject, the author will simply draw attention to Figure 6 at the end of the report, showing a flow chart for deciding whether a material is waste or non-waste. Moreover, the issue of waste and non-waste does not seem to be so crucial for the European network of disposal facilities.

4.2.2. The "Cement Paper"

The "Cement Paper", as it is known, was issued as a kind of *lex specialis* in the framework of the aforementioned guidelines. This was an attempt by the *Länder* administrations to tackle a specific but important issue, since considerable amounts of waste are used as a substitute fuel in cement kilns.

The introduction stated that, with respect to process technology, wastes featuring in the list attached to the paper, "List of wastes suitable for energy recovery in cement plants", generally met the main purpose of energy recovery in accordance with Article 4, para. 4) of the German Waste Avoidance, Recycling and Disposal Act (*Kreislaufwirtschafts- und Abfallgesetz*), without prejudice to the review of further requirements under Article. 6, para. 2) (e.g. 11 000 kJ/kg).

Secondly, the "Cement Paper" highlighted the specific characteristics of the cement manufacturing process, its advantages and disadvantages.

- The combustion process runs at high temperatures and long dwell times. The primary combustion zone in particular provides satisfactory conditions for the transformation of hazardous organic compounds: → positive aspect;

- The gas stream flows in the opposite direction to the heavily calcareous raw meal flow, ensuring the adsorption of hazardous substances: → positive aspect;

- Unlike organic compounds, inert hazardous compounds of the burned material are incorporated into the product: → negative aspect;

- Apart from the removal of dust by electrostatic precipitators, air emission standards do not require any further devices for air treatment. Any organic compounds still present in the flue gas and especially volatile metallic components of the waste are not selectively removed: → negative aspect.

In order to improve practical implementation, a list of wastes suitable for energy recovery in cement plants was attached to the Cement Paper. The list included types of waste of generally known composition and contaminants, which, given waste management experience with their expected composition, were considered suitable for recovery in cement plants.

The aim of the special "restrictions" was to exclude from energy recovery in cement plants mainly sub-types of waste of heterogeneous composition or containing a wide range of toxic contaminants, which typically should go for disposal. In addition, wastes with especially environmentally harmful contaminants, such as kyanized wood and PCB-containing wastes, were considered unsuitable for energy recovery.

Domestic waste was not included in the list. In accordance with Article 4, para. 4), first sentence, the thermal treatment of wastes with heterogeneous and varying composition, thus typical "residual waste", has invariably been classed as a disposal operation by the legislation. The same applies to commercial wastes insofar as they have the same characteristics and composition as residual waste from private households. This notwithstanding, energy recovery from suitable fractions separated out of domestic or commercial wastes is considered a recovery operation if the main purpose lies in the benefit of energy recovery and recovery is permitted in accordance with Art. 6, para. 2) of the Waste Avoidance, Recycling and Disposal Act.

The purpose of the Cement Paper was to provide an evaluation standard for the authorities responsible for supervising waste generators. If wastes mentioned in the list are fed into cement plants in accordance with the provisions of Art. 6, para. 2) of the Waste Avoidance, Recycling and Disposal Act, the operation can legitimately be considered a recovery operation.

For wastes that do not figure in the list, a decision can be based on the values given in column 2 of Table 3, which can be taken as the limit values. Wastes with a contaminant content higher than indicated in column 2 would not be eligible for energy recovery. The logic behind this is that cement plants are licensed to use natural fuel, so why should waste used as fuel be allowed to exceed these values?

Table 3. **Contamination of natural fuel compared with industrial hazardous waste**

1	2	3	4
Contaminant	**Content in natural fuel usually used by cement works [mg per MJ]**	**Content in hazardous waste [mg/MJ] calculated at 14 MJ per kg**	**Factor**
Lead	10.00	57.80	5.8
Cadmium	0.30	0.78	2.6
Chromium	3.70	41.70	11.3
Copper	3.70	33.50	9.0
Nickel	3.50	10.50	3.0
Mercury	0.06	0.17	2.8
Zinc	8.00	166.00	20.8

This approach seemed a bit over-ambitious, since burning wastes in cement kilns does conserve fuel resources. Nevertheless, a key question was: where does the difference between columns 2 and 3 go? The answer is that it can only be incorporated into the product or released as airborne emissions (see Figure 7 at the end of the report: Comparison between background contamination found in natural fuel and the contaminants in hazardous waste used as a fuel substitute).

4.2.3. The EU paper

The EU Commission has issued a draft working paper proposing a way of differentiating between incineration as a recovery operation and incineration as a disposal operation. It proposes to establish criteria for waste, which it sees as the best means of ensuring a high degree of environmental protection without distorting the operation of the internal market.

Under Article 4 (3) i of Regulation EEC 259/93, Member States may ban the shipment of wastes intended for disposal on the basis of the principles of proximity and self-sufficiency. This would give Member States a means of controlling disposal operations that enabled them to plan the necessary disposal capacity, prevent emissions from long-distance transport and avoid transport to installations with lower standards. For Member States, these were the main issues to be resolved in differentiating between incineration for recovery and incineration for disposal.

Briefly outlined, the EU paper stipulates that the incineration of:

- unsorted household waste,
- waste with a calorific value of less than 17 000 kJ/kg,
- any mixed material containing household waste or waste with a calorific value of less then 17 000 kJ/kg,

is considered to be a disposal operation.

To date, the paper has been discussed at several meetings of the Technical Adaptation Committee (TAC), most recently in February 1999. The proposal has not yet been adopted, but it may receive further consideration.

5. THE ECONOMIC DIMENSION OF WASTE TRANSPORT

Compared with transport overall, the total quantities of waste transported seem insignificant.

According to Table 1, 303 000 tonnes of hazardous waste were exported from the Baden-Württemberg region in 1998. For the whole of Germany, a factor of eight can be assumed (very conservatively). Thus, arbitrarily, about 2.4 million tonnes of hazardous waste are shipped from Germany to other countries. According to the report by Mr. Koschany (page 35), in 1998 about 311 million tonnes of goods were transported across German frontiers. Thus transfrontier movements of hazardous waste represent less than 0.8 per cent of total transfrontier movements. However, this relatively small economic benefit to the transport sector seriously disrupts the efficient management of well-equipped waste facilities. In Germany, about a dozen incineration plants designed for hazardous waste are in operation. Each of them represents an average investment of Euro 200 million. Allowing for operating costs, capacity should be offered at about Euro 300 to 600 per tonne of hazardous waste. Meanwhile, operators are having to cut their prices in order to survive and the closure of modern facilities is now a real possibility.

It is practically impossible to obtain figures on transport costs. However, it seems clear that the difference between disposal charges of Euro 300 to 600 per tonne and the lower charges for recovery more than covers the cost of long-distance transport, even expensive one-way transport.

6. REASONS FOR MAINTAINING AN ADEQUATE NETWORK OF WASTE FACILITIES

As indicated above, the closure of incinerators might well be on the agenda, especially for industrial waste generators. The latter want to be free to use the cheapest waste disposal/recovery option possible. Consequently, there have been calls for the withdrawal of disposal operators from the market. Industrial waste generators claim that they are able to look after themselves. Public involvement in disposal plants is, as they see it, unnecessary or even counterproductive for the economy as such.

The author cannot entirely share this view. Quite recent examples show that an industrial society must maintain adequate capacities for waste treatment.

One recent example was the appearance of liquid gas contaminated by vinyl chloride on the market in southern Germany. Not only does vinyl chloride release toxic constituents when the gas is burned, but there is also a danger that it will corrode equipment such as containers, pipes and valves. So the gas had to be collected urgently from quite a number of private consumers and burnt under controlled conditions. Industry was not prepared to take back the contaminated liquid gas and burn it in privately-run installations. Consequently, it was one of the, supposedly, economically inefficient incinerators that took charge of the contaminated liquid gas. The disposal process is still going on under the supervision of well-trained personnel and the authorities. To repeat: industry was far from being able to provide any substantial assistance.

Another more well-publicised example was perhaps the dioxin-contaminated chicken incident, which occurred in the summer of 1999, demonstrating the need for a sustainable disposal outlet that can keep contaminated material out of the ecological cycle (in this case, the food chain).

7. CONCLUSION

7.1. Summary

Given that:

- German transfrontier waste transport represents just 0.8 per cent of cross-border goods transport movements and that the economic benefit that the transport sector derives from waste is not a key factor;
- Taxpayers' money already spent on sophisticated waste facilities should not be allowed to go to waste;
- Industrialised regions should have the potential to treat waste in an environmentally sound way (dioxin contamination in chickens);
- The re-use of hazardous substances, for instance as fuel substitutes, inevitably entails the uncontrolled spread of harmful substances and therefore should be **subject to restrictions**;
- Soft legal provisions (as in German law) are not useful for uniform implementation;
- Sustainability and caution are advisable as regards waste flows (what happens if the receiving contracting party is suddenly "not inclined" to accept foreign waste?),

the author proposes the recommendations given in 7.2. below.

7.2. Recommendations

The author recommends the following points for discussion:

1. International legislation or conventions should acknowledge the necessity of an appropriate network of sustainable waste disposal facilities.

2. The legal basis for a definition differentiating between recovery and disposal operations should be prepared.

3. The definition should be put into concrete terms. This does not necessarily (exclusively) need to be by setting limit values. Waste lists already available, such as Annexes VIII and IX to the Basel Convention, the OECD lists or the European Waste Catalogue, could serve as a tool, e.g. by clearly indicating waste types suitable for recovery and designating the method of recovery.

Figure 4. **Recovery according to the German Waste Law**

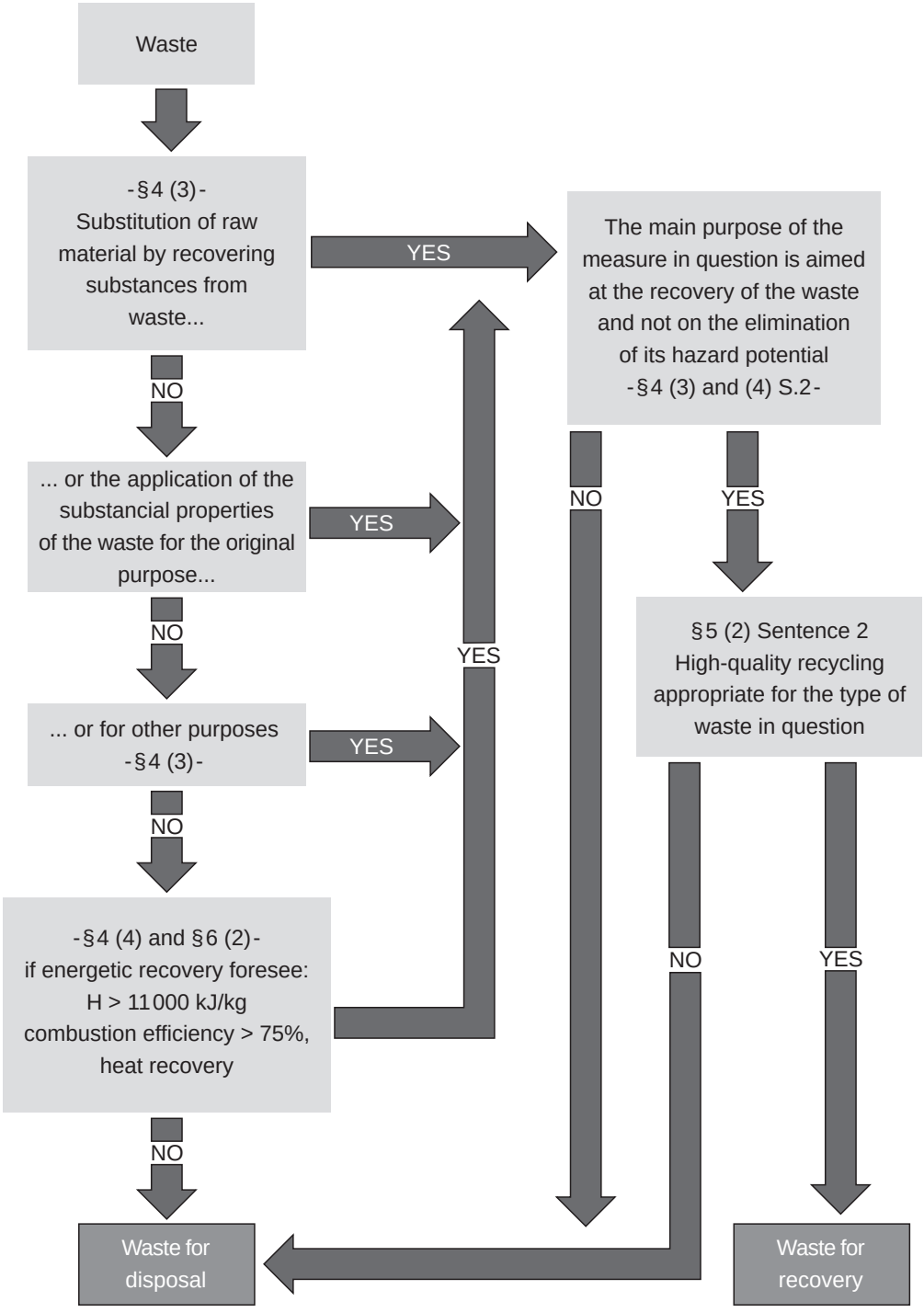


Figure 5. **Attempts for concretisation**

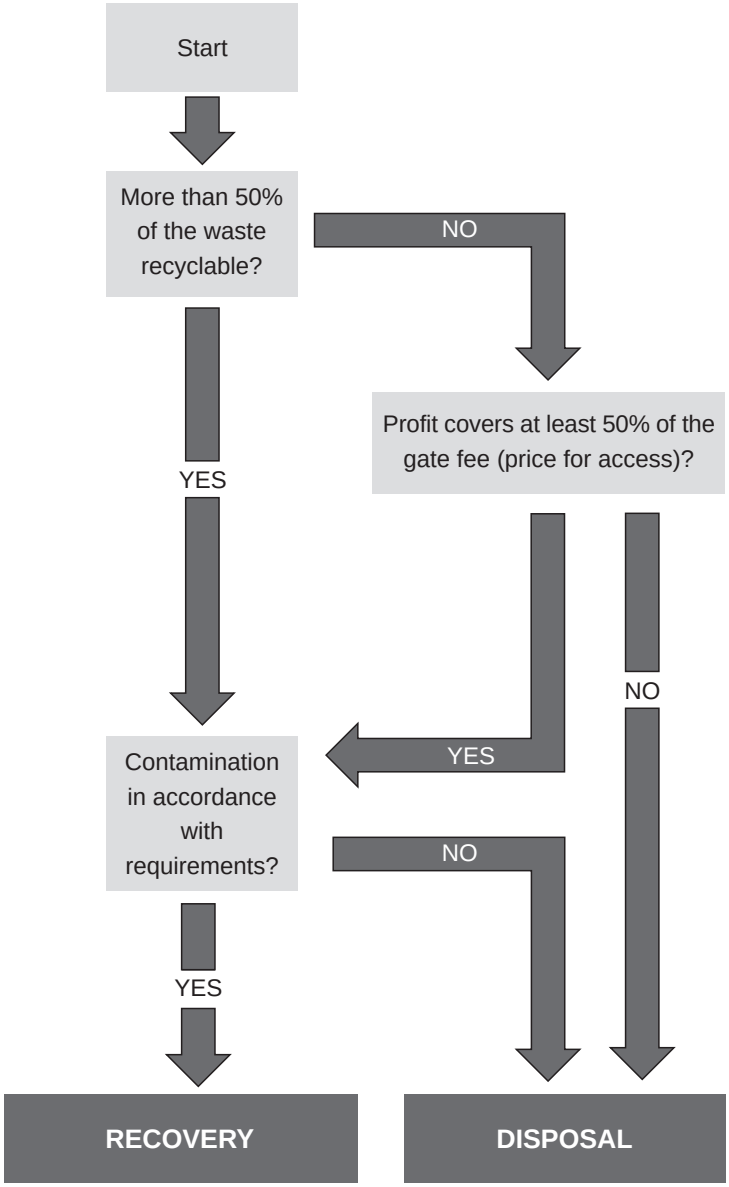


Figure 6. **Waste or non-waste**

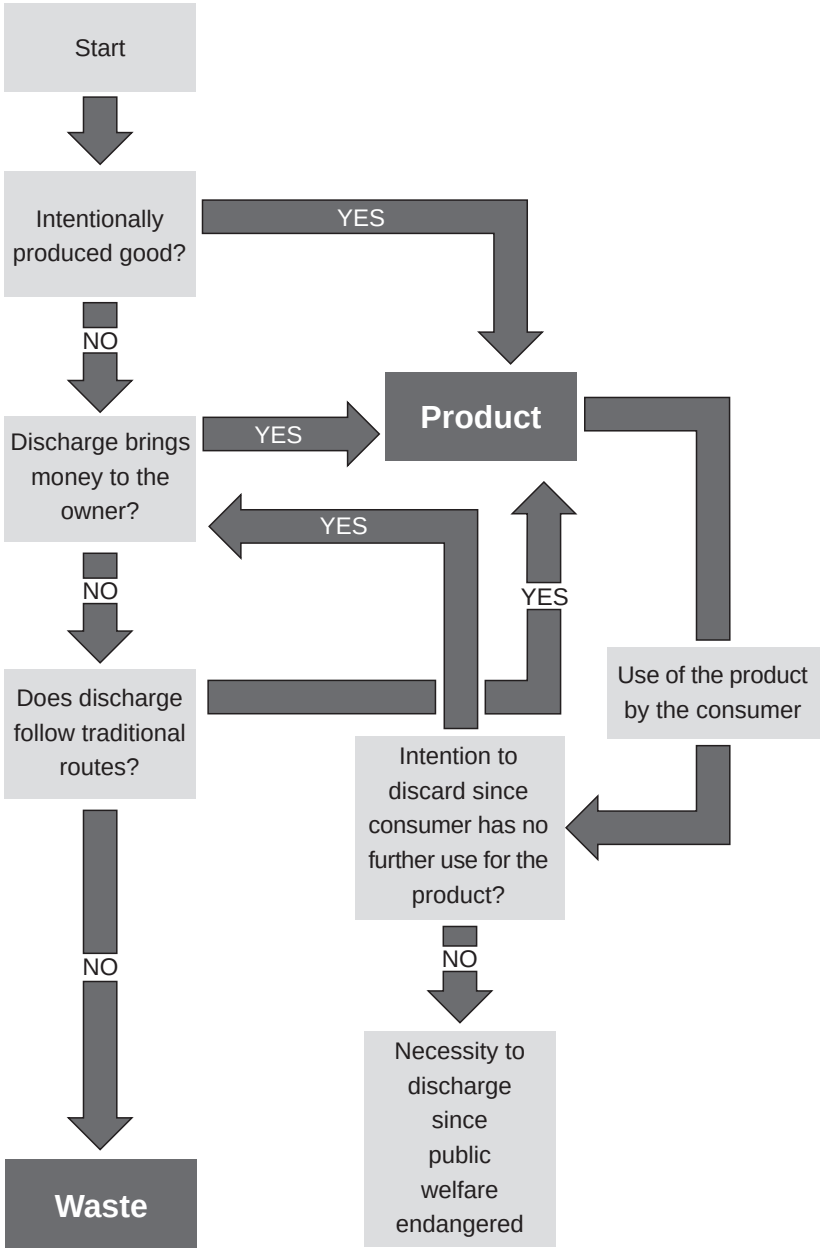
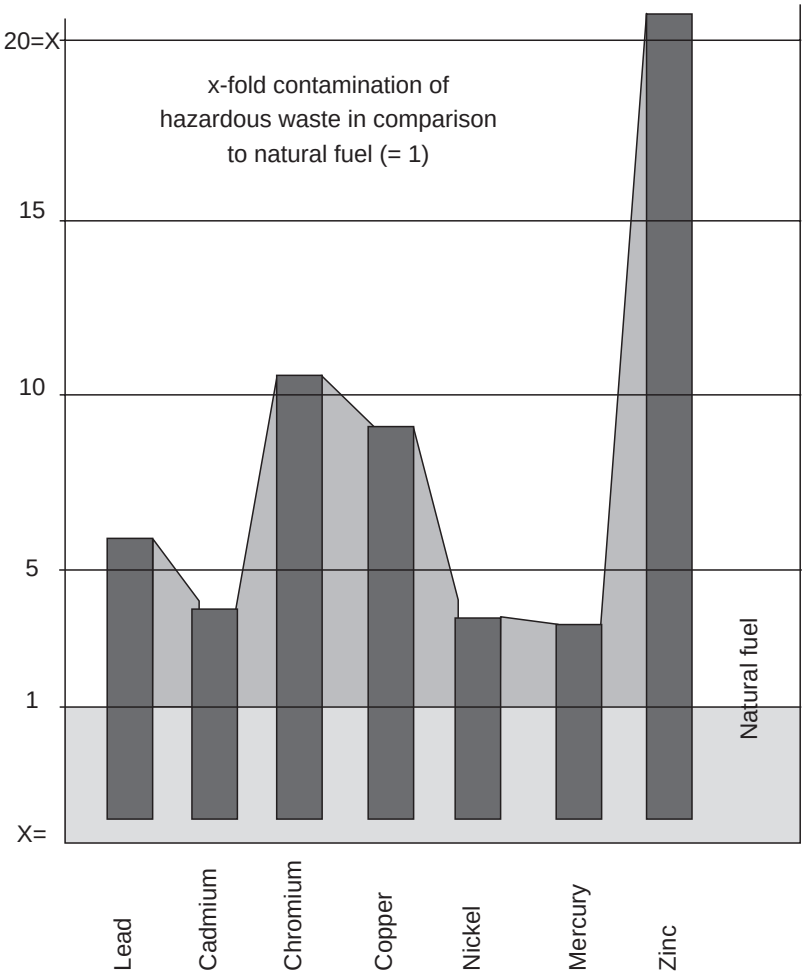


Figure 7. **X-fold contamination of hazardous waste in comparison to natural fuel**



ANNEX

INDUSTRIAL WASTE MANAGEMENT IN GERMANY

SUMMARY

Stuttgart, March 1999
(Text revised January 2001)

Dedication

This report is dedicated to Giselinde Dieterle-Stephani

1. THE SOURCES OF LEGISLATION IN GERMANY

1.1. The geographical situation

The Federal Republic of Germany is divided into 16 regions, known as *Länder*. The region, or rather the *Land*, of Baden-Württemberg is in south-west Germany and has common frontiers with France and Switzerland. The region has about 10 million inhabitants and covers a land area of 37 751 km^2. The corresponding population density is thus 265 inhabitants per km^2. The region is highly industrialised, with manufacturing industries (mechanical engineering and motor manufacture) predominating, as is typically the case in the EEC.

1.2. The historical roots

The map of Central Europe in the post-napoleonic era (1815) shows that it consists of a patchwork of countries, while at the same time France already stands out as a distinct entity. It could well be maintained that the federal structure of Germany is traditional. Amongst other things we note the predominance of Prussia, although the two countries of Baden (a grand duchy) and Württemberg (a kingdom) already existed.

In 1848, revolution broke out, only to fail: however, it was not comparable to the revolution in France sixty years earlier. One of the prime objectives of the 1848 revolution had been to unify the German provinces, but the specific interests of the different sovereigns contributed to the failure to achieve this.

The German provinces were not united until 1871, more or less as a result of the pressure brought to bear by the Prussian, Bismarck. But they were still far from acquiring a sense of national identity, whereas in France the concept of nationhood was no longer called into question and was now firmly established (the indivisible republic).

In Germany, there followed less glorious eras, accompanied by a trend towards centralism. The unconditional surrender of 1945 brought the last centralist regime to an end. Initially the victors showed no interest in reconstructing Germany. But between 1947 and 1948 the Western allies began to regard the country as a future partner (and commercial market). Democracy was restored, though -- and this is important – from the bottom up. The German regions, the *Länder* were therefore established to prevent the rise of a centralist government that was likely to pave the way for a new power in Central Europe. The "patchwork" tradition proved its value in this respect and served as a starting point. When the Federal Republic became truly "operational" in 1949, the eleven *Länder* maintained a strong position in the Republic. Reunification led to the addition of five new *Länder*, but there was no consequent change in the Constitution.

1.3. The German legislative structure

Under the German Constitution, it is a basic assumption that power is the preserve of the sixteen *Länder*. To this end, each of the *Länder* has its own government, parliament and judiciary.

But the exception confirms the rule: As regards the distribution of power between the federal level and the *Länder*, the Constitution provides for four categories of legislation:

1. Power is exercised **exclusively** by the **federal** administration, in the fields *inter alia* of defence, foreign affairs, post and telecommunications and railways.

2. The right to legislate on **competition** is the prerogative of the **federal** administration. This means that the federal legislative body passes laws, which may contain more or less detail, whereas the *Länder*, for their part, are responsible for introducing regulations. Legal texts on waste are to be found in the latter type of legislation.

3. The right to pass **framework** legislation. This means that federal legislation lays down the broad thrust of legislation, which must be given more precise form in the legislation of the *Länder*. Legislation on water falls into this category.

4. The *Länder* have total **autonomy** in certain areas, *inter alia* policing, education and culture.

Every draft law that comes under the second or the third category mentioned above or that might have an impact on the financial situation of the *Länder* must be adopted by the Federal Council (*Bundesrat*), the upper parliamentary chamber, the German equivalent of the French Senate (if any comparison is possible). It is made up of representatives of the *Länder*. The law must also be adopted by the Federal Council where regulations, such as ordinances and administrative requirements, are to be introduced.

The consequences of the power exercised by the *Länder* through the Federal Council are by no means negligible: the *Länder* may well overturn a draft bill, especially when the political majority in the *Bundesrat* is different from that of the *Bundestag*, the equivalent of the French *Assemblée Nationale*. This was so during the tenure of Chancellor Kohl, with the blocking of the bill on tax reform, for example, which had been introduced at federal level.

It should be noted that the two-chamber parliamentary system guarantees a degree of control on the part of the central authority, though it can lead to ineffectiveness. Moreover, it must be realised that the tax payer has to finance seventeen parliaments and seventeen governments. When there are so many, there is a sense that elections are taking place continually.

1.4. The enforcement of federal laws

The enforcement of laws in general is the responsibility of the *Länder*. This means that each must provide an administration, including, of course, local officials. Environmental inspectors, for example, are employed exclusively by the administrations of different *Länder*. There are no federal inspectors, so that the *Länder* officials have solid experience in everyday administration, particularly

in the field of the environment. The Federation and the *Länder* are quite separate "employers"; the staff salaries are therefore funded from quite different sources and it is almost impossible for officials to change from a *Länder* administration to the federal administration and *vice versa*.

A part of the State's tax income is redistributed to the *Länder*. The latter use it, amongst other things, for financing the administration. In order to provide the right balance of financial power, the "financial compensation" law was passed. The richest regions and the Federal Finance Minister have to transfer money to the less affluent regions. At present, the latter tend to be situated in the East of the country.

1.5. The repercussions of the federal structure on the European Union

Community legislation, i.e. directives from Brussels, is becoming increasingly extensive and increasingly detailed. This could pose a problem for Germany, since the European Commission normally only communicates with the central governments of the Member States. But in the case of Germany, as mentioned above, the administration at that level often lacks experience of "everyday life". This arrangement weakens the position of Germany with respect to the action taken by the European Commission. In order to counterbalance this situation, a law has been passed on co-operation between the federal level and the *Länder* level in matters relating to Brussels. The most obvious result of this law is that German delegations to the working groups of the European Commission or the Council of European Communities always include a member of one of the *Länder* administrations.

2. THE APPLICATION OF GERMAN LEGISLATION ON WASTE TRANSPORT

2.1. Directions for use in seven stages

For the everyday life of an enterprise, the ancillary regulations associated with a law are of special interest. In this context we are referring to the ordinances on waste management and administrative requirements. In order to make it easier to understand the rather complicated legislative structure on waste management, the author has chosen to adopt a practical standpoint: the initial situation is that an industrial enterprise produces waste. This waste is on the enterprise's premises, and must therefore be disposed of. The process of disposal involves different stages, which we shall describe below. The legal basis of the whole procedure will also be described. The explanation takes the form of answers to the following questions:

- **Action:** What measures are to be taken by the enterprise?
- **Instruments:** What are the essential administrative instruments?
- **Bases:** What are the legal, administrative or scientific bases?

FIRST STAGE: The waste is on the enterprise's premises

Action

It is necessary to name and classify the waste. Terminology valid for the whole of the European Community has been drawn up as a reference.

Instruments

The European Waste Catalogue, or EWC.

The aim of the EWC

A common language is required for waste management. The Member States of the European Union now have a nomenclature of common waste products at their disposal. This nomenclature does not provide a way of distinguishing the waste product from the product, but it gives a practical illustration which provides actors with a clearer picture and gives them better legal protection. The inclusion of a material in the EWC does not mean that it is a waste product in all circumstances.

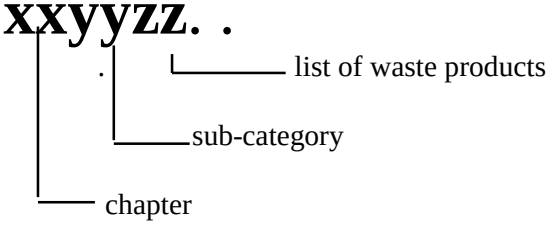
The structure of the EWC (see Figure 1)

To avoid getting lost among all the 645 types of waste listed, it is necessary to be familiar with the logical structure of the EWC. The first level of classification comprises twenty chapters. Chapters 1 to 5, 8 to 12 and 17 to 19 correspond to industrial sectors: 1 = mining industry, 2 = agriculture, 3 = transformation of wood, etc. Chapters 6 and 7 deal with industrial processes, and Chapter 20 deals with household waste. Chapters 13, 14 and 15 distinguish between waste according to their type: 13 = oils, 14 = solvents, 15 = packaging. Chapter 16 is a catch-all and includes other waste products not referred to elsewhere in the catalogue.

The second level of classification comprises sub-categories of waste, based on their nature or origin. Depending on the field covered by the chapter, there may be one (Chapter 9) or thirteen sub-categories (Chapter 10).

The third and last level of classification comprises individual forms of waste, each with a specific code. In other words, the waste is identified by a six-figure code, xxyyzz, of which the first two figures, xx, correspond to the chapter number, the next two, yy, to the sub-category number and the last two, zz, to the particular waste product. The final code in certain categories designates a waste product not specified elsewhere (zz = 99).

The coding system of the EWC is as follows:



Instructions for use

In order to meet the principal objective, i.e. to designate a specific waste product as clearly as possible, it is necessary to conduct a search, which may comprise five stages:

1) Find the chapter on the appropriate industrial activity or process, including Chapter 20 (for household waste).

2) If an appropriate chapter is not found, look in Chapters 13 to 16, which list products in terms of their general characteristics.

3) Look for the appropriate category.

4) If an appropriate category is not found in the selected chapter, the reader should look for a category or a designated substance in another chapter. For example: a cellulose factory where mechanical maintenance work is carried out on site will produce waste typical of the kind listed in Chapter 12 and is required to designate such waste by a 12yyzz code rather than by 030399.

5) Look for the description of the waste product. If no appropriate description is found, it is necessary to select the code xxyy99 in the most appropriate sub-category.

Bases

The legal basis is Council Directive 91/156/EEC, which modifies Council Directive 75/442/EEC on waste. This directive requires the European Commission to establish a list of waste products. The latter include all waste products, irrespective of whether they are destined for disposal or for recovery operations. EEC Member States must incorporate the text of the EWC into their own national legislation. Germany has issued an ordinance (*EAK Verordnung*) for this purpose.

Important note:

The EWC is adapted to keep up with scientific and technical progress. This work is the responsibility of the European Commission. It is supported by a committee set up on the basis of Article 18 of Council Directive 75/442/EEC, as modified by Council Directive 91/156/EEC. The author is a member of this Committee. There are plans to distribute a modified EWC around the beginning of 2001.

Figure 1. **The structure of the EWC as from 2002**

Chapter	**Sub-category**													
0100 Mines	0101	--	0103	0104	0105									
0200 Agriculture	0201	0202	0203	0204	0205	0206	0207							
0300 Wood/Paper	0301	0302	0303											
0400 Leather/ Textiles	0401	0402												
0500 Oil	0501	--	--	--	--	0506	0507	--						
0600 Inorganic Chemistry	0601	0602	0603	0604	0605	0606	0607	0608	0609	0610	0611	--	0613	
0700 Organic Chemistry	0701	0702	0703	0704	0705	0706	0707							
0800 Paints, sealants	0801	0802	0803	0804	0805									
0900 Photo	0901													
1000 Thermal processes	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014
1100 Galvanic	1101	1102	1103	--	1105									
1200 Mechanical	1201	--	1203											
1300 Oil wastes	1301	1302	1303	1304	1305	--	1307	1308						
1400 Solvents	--	--	--	--	--	1406								
1500 Packaging	1501	1502												
1600 Other	1601	1602	1603	1604	1605	1606	1607	1608	1609	1610	1611			
1700 Building	1701	1702	1703	1704	1705	1706	--	1708	1709					
1800 Hospitals	1801	1802												
1900 Waste treatment	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	
2000 Municipal	2001	2002	2003											

SECOND STAGE: The waste must be identified by the EWC code

Action

The enterprise must check the category into which the waste falls. Is the waste in question hazardous or not?

Instruments

List of hazardous wastes. This list comprises 237 waste codes taken from the EWC nomenclature. Of the 645 types of waste referred to above, therefore, there are 237 that are regarded as hazardous. The official reference document is the "Council Decision of 22 December 1994 establishing a list of hazardous waste, pursuant to Article 1 (4) of Council Directive 91/689/EEC on hazardous waste", Official Journal of the European Communities L 356, 31.12.1994.

Bases

The legal basis for this list is Council Directive 91/689/EEC on hazardous waste, Article 1, paragraph 4 of which requires the European Commission to establish a list of such wastes. German legislation has adopted the very same list under another ordinance with the addition of 17 additional waste codes.

Important note:

As part of the modification of the EWC, referred to above, the European Commission has gone further and combined the two lists, publishing the EWC in full and marking hazardous wastes with an asterisk. This will make it easier to use the lists, as it will no longer be necessary to refer to two separate documents. This will provide a more all-encompassing view and it will be possible to check similar types of waste. As has already been stated, the EEC has revised the EWC and the list of hazardous waste and intends to distribute a combined list around May 2001, which will replace the Council Decisions referred to above (94/3/EC and 94/904/EC).

THIRD STAGE: Who is to dispose of this waste?

Action

The enterprise must find a partner who is charged with disposing of its waste.

Instruments

The regulations of the *Landkreis* – an administrative institution comparable to the canton or district (*sous-préfecture*) in France – define the types of waste accepted. If the waste is of a kind not

accepted by the *Landkreis*, it is necessary to find another partner and if it is a hazardous waste, according to the list referred to above, the waste must be dealt with by Baden-Württemberg's own hazardous waste agency, the SAA.

Bases

Normally (leaving aside exceptions), the different *Landkreise* deal with *non*-hazardous waste. Dangerous waste, on the other hand, remains the responsibility of the producer and it is taken in charge by companies set up by the *Länder* to dispose of dangerous waste. In Baden-Württemberg, the SAA has the exclusive right to collect and dispose of dangerous waste and must therefore have the required facilities for disposing of it. A site for controlled disposal is currently being operated in Billigheim in the north-west of the region, as is a physical-chemical treatment facility in the dockland area of Stuttgart. For the incineration of dangerous organic waste, the SAA has signed a contract with an incineration centre in Hamburg.

FOURTH STAGE: What steps are to be taken in dealing with waste?

Action

The way waste is dealt with must be determined on the basis of the treatment technology called for.

Instruments

Technical instructions on waste management (*Technische Anleitung Abfall – TA Abfall*).

Bases

Article 12 of the Federal law stipulates that the Government must lay down what is required in terms of appropriate waste management. This has been done through the technical instructions on waste management (*TA Abfall*) – an administrative requirement of the Federal Government. The essential provisions of the technical instructions are the following (see Figure 2).

1. If the waste contains significant quantities of (persistent) toxic organic materials, these must be converted into non-hazardous materials. The waste will be subjected to processes capable of destroying the persistent organic matter. This will mainly take place in **incineration plants**. This group of waste materials includes organic solvents, paint sludges, etc. This is regarded as a preliminary process before the waste is tipped and its purpose is to ensure that there are no organic materials that may cause emissions or uncontrollable chemical/biological transformations in the tip. The tipping of reactive waste in the past has often led to the contamination of sites and of the water table.

2. If the waste contains elements that are soluble in water, such as salts, but contains very little organic matter, it must be **stored below ground** in salt mines. Examples of such waste are the residues from the purification of the fumes given off by incineration or the concentrates resulting from evaporation. Underground storage of organic matter is not authorised, owing to the risk of toxic or explosive gas formation. The same is true of waste that can react with surrounding rock.

3. Open-air storage, i.e. putting waste in a **controlled tip**, may be contemplated if leaching does not exceed a certain limit. But how are the cut-off values to be established? To this end, a convention has been established under which an elution test is carried out. This test, which has been developed for this purpose, involves simulating and anticipating the situation on a tip. Waste materials on a tip are exposed to bad weather, which can cause soluble matter to leach. The point is to limit this leaching. The elution test consists in placing a sample of 100 g of waste in a litre of distilled water and shaking it for 24 hours. The harmful substances detected in the water after the test results are analysed are taken as the principal element in appraising the waste material in question. The cut-offs stipulated in the technical instructions on waste management may be found in Table 2.

Annex C to the technical instructions on waste management is intended to facilitate the work of administrations and enterprises. This annex contains a catalogue of waste materials (only available in the old German nomenclature at present, but there are plans to convert it to the EWC system) and a table with columns showing how different types of waste should be dealt with. With this annex, it is possible to see at a glance that, for example, galvanisation sludge must be sent to the tip and organic solvents must be incinerated (see extract in Table 1 for examples).

Figure 2. **Steps to be followed according to the instructions on waste management (*TA Abfall*)**

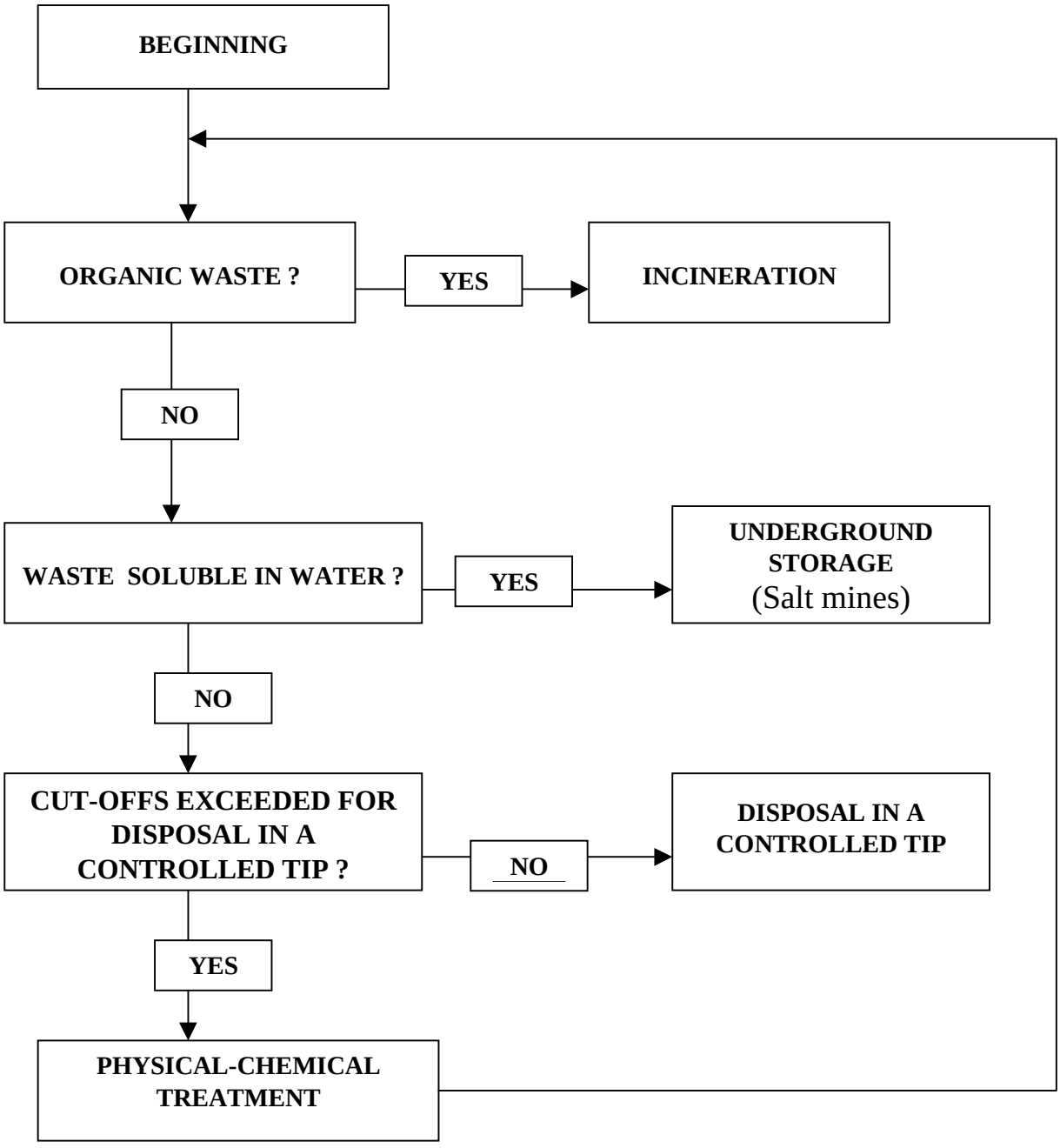


Table 1. **Extract from Annex C to the *AT Abfall,* adapted to the EWC system**

Waste (EWC)	**PCT**	**INC-M**	**INC-I**	**T-M**	**T-I**	**UND**
030306 fibre and paper sludge		1		2		
060103 hydrofluoric acid	1					
060402 metallic salts						1
080101 waste paint and varnish containing halogenated solvents			1			
100101 bottom ash				1		
110103 cyanide-free wastes containing chromium				2	1	
120108 waste machining emulsions containing halogens	1		2			
140201 halogenated solvents and solvent mixes			1			

Key: PCT = Physical-chemical treatment

INC-M = Incinerator for municipal and similar waste

INC-I = Incinerator for hazardous industrial waste

T-M= Tip for municipal and similar waste

T-I = Tip for hazardous industrial waste

UND = Underground tip

1 = first choice, 2 = second choice.

Beware of trap!

The basic idea of the technical instructions on waste management seems very clear and consistent: burn organic waste, put water-soluble waste in underground tips and put fairly persistent waste in open-air tips. But there are types of waste that cause trouble, such as the sludge from effluent treatment in tanneries. In Germany, tanneries use tanning liquor containing chromium. The sludges are obtained through precipitation and have a high trivalent chromium (Cr. III) content, but also a high organic matter content, owing to the nature of the raw material: animal skins. Because of their organic content it would seem that the sludge should be incinerated; however, incineration would transform the trivalent chromium into hexavalent chromium (Cr. VI), which is highly toxic. The solution adopted at present consists in putting it in a municipal tip, which is in line with Community law: EWC 040106, "sludges containing chromium", are not marked as hazardous waste.

Table 2. **Tipping authorisation cut-offs (hazardous waste)**

Stability	
Shear strength	≥ 25 kN/m^2
Axial displacement	< 20 %
Compression strength	≥ 50 kN/m^2
Loss on ignition of dry residue	10 % by weight
Extractives lipophilic substances	< 4 % by weight
Criteria by elution	
pH value	4 - 13
Conductivity	< 100,000 µS/cm
Total organic carbon content	< 200 mg/l
Phenols	< 100 mg/l
Arsenic	< 1 mg/l
Lead	< 2 mg/l
Cadmium	< 0.5 mg/l
Chromium (VI valent)	< 0.5 mg/l
Copper	< 10 mg/l
Nickel	< 2 mg/l
Mercury	< 0.1 mg/l
Zinc	< 10 mg/l
Fluoride	< 50 mg/l
Ammonium	< 1,000 mg/l
Cyanide	< 1 mg/l
Sulphate	< 5,000 mg/l
Nitrite	< 30 mg/l
Adsorbed organic halogens	< 3 mg/l
Water-soluble substances	< 10 % by weight

Extract from Annex D to *AT Abfall*

FIFTH STAGE: Preparing the way at administrative level for disposal or recovery

Action

The enterprise must take the necessary measures for disposal.

Instruments

Physical-chemical analysis of the waste; Federal ordinance on the supervision of waste, which provides for the use of a form, divided into three parts: 1."Declaration of Responsibility" where the results of the physical-chemical analysis of the waste should also be entered; 2. “Declaration of acceptance”; and 3. "Confirmation by the authorities".

Bases

The Federal ordinance on the supervision of waste. It requires that the following procedure be adopted (see Figure 3).

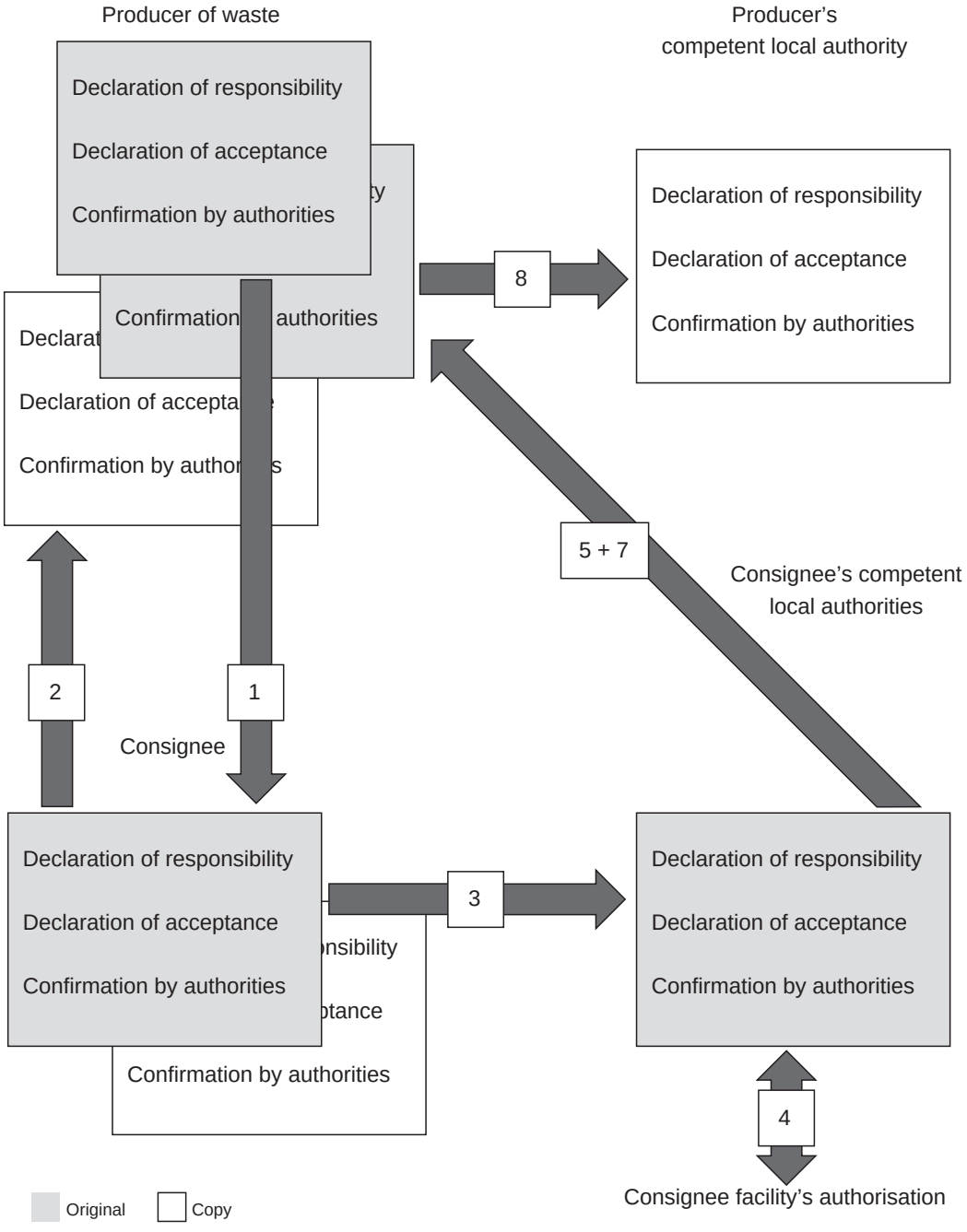
The enterprise producing or holding the waste fills in the "Declaration of Responsibility" part, indicating the type of waste, using the EWC code and including the results of the physical-chemical analysis of the waste. It indicates the provenance (what type of production or service produced this waste) and the estimated quantity. It is forbidden to combine different categories of waste for the purpose of obtaining a less dangerous mix.

The form is then sent to the operator of a disposal or recovery centre (1). If the operator agrees to take charge of the waste in question, he fills in the declaration of acceptance on the same form. A copy of the form is then sent to the producer/holder (2). The original is sent to the competent local authority of the disposal or recovery centre (3). The authority will forward an acknowledgement of receipt (4) to the producer/holder within ten working days. The competent authority must check to see whether the facility’s authorisation allows it to deal with the type of waste in question. If it does, the authority affixes its confirmation to the same form and sends the original back to the producer/holder (7) and a copy to the operator (6). If the competent authority does not respond within 30 working days, tacit agreement is assumed to have been given.

The producer/holder sends a copy to his competent local authority (8).

Having completed this procedure, the producer/holder is authorised to dispose of the waste as planned.

Figure 3. **Preliminary procedure for the disposal or recovery of hazardous waste**



SIXTH STAGE: The waste is taken away

Action

The enterprise must fill in a dispatch note.

Instruments

The Federal ordinance on the supervision of waste (*Abfallnachweisverordnung*); form for the dispatch note.

Bases

Under the terms of the Ordinance, the process must follow the course described below (see Figure 4).

Each transport of hazardous waste must be accompanied by a dispatch note, i.e. for each lorry, rail wagon, boat, etc.

The dispatch note consists of six differently coloured sheets which produce carbon copies. The document is used as follows: the enterprise, as holder/producer of the waste, gives his own address, the EWC code for the waste, the address of the consignee and the quantity of the units transported. The transport operator acknowledges receipt of the document by signing it and gives back the first sheet (1 = white) to the holder/producer of the waste. Copies 2 to 6 accompany the transport. Having arrived at the treatment centre, the consignee signs copies 2 to 6 to confirm the arrival of the waste and allocates the copies as required under the ordinance: copy 2 (pink) must be forwarded to the producer's competent local authority. Copy 3 (blue) must be submitted to the consignee's competent local authority. The transport operator receives Copy 4 (yellow) as a delivery receipt. Copy 5 (brown) must be sent back to the holder/producer. Upon receiving this copy, the holder/producer is informed that the legal process has been duly followed. He keeps the two sheets in a file of supporting documents (*Nachweisbuch*). The consignee keeps copy 6 (green).

Simplifying matters for small enterprises

If an enterprise produces less than 15 tonnes per year of the same kind of waste, the ordinance provides for a simplified procedure: the waste producer has the right to hand over responsibility for the waste to a collector/transport operator, who fills in and signs the declaration of responsibility and the dispatch note in his place. The collector/transport operator can collect waste from several producers in a recognised round; as the waste is all of the same kind, the same EWC code applies to all of it. The producers thus rid themselves of a bureaucratic burden. They obtain a receipt from the collector, which constitutes documentary proof that the waste has been legally disposed of, for presentation to the authorities. For certain types of waste the ordinance stipulates 20 tonnes rather than 15 (the author does not know why) and prescribes no limit for waste product 160702, "waste from marine transport tank cleaning, containing oil."

Figure 4. **Use of the dispatch note**

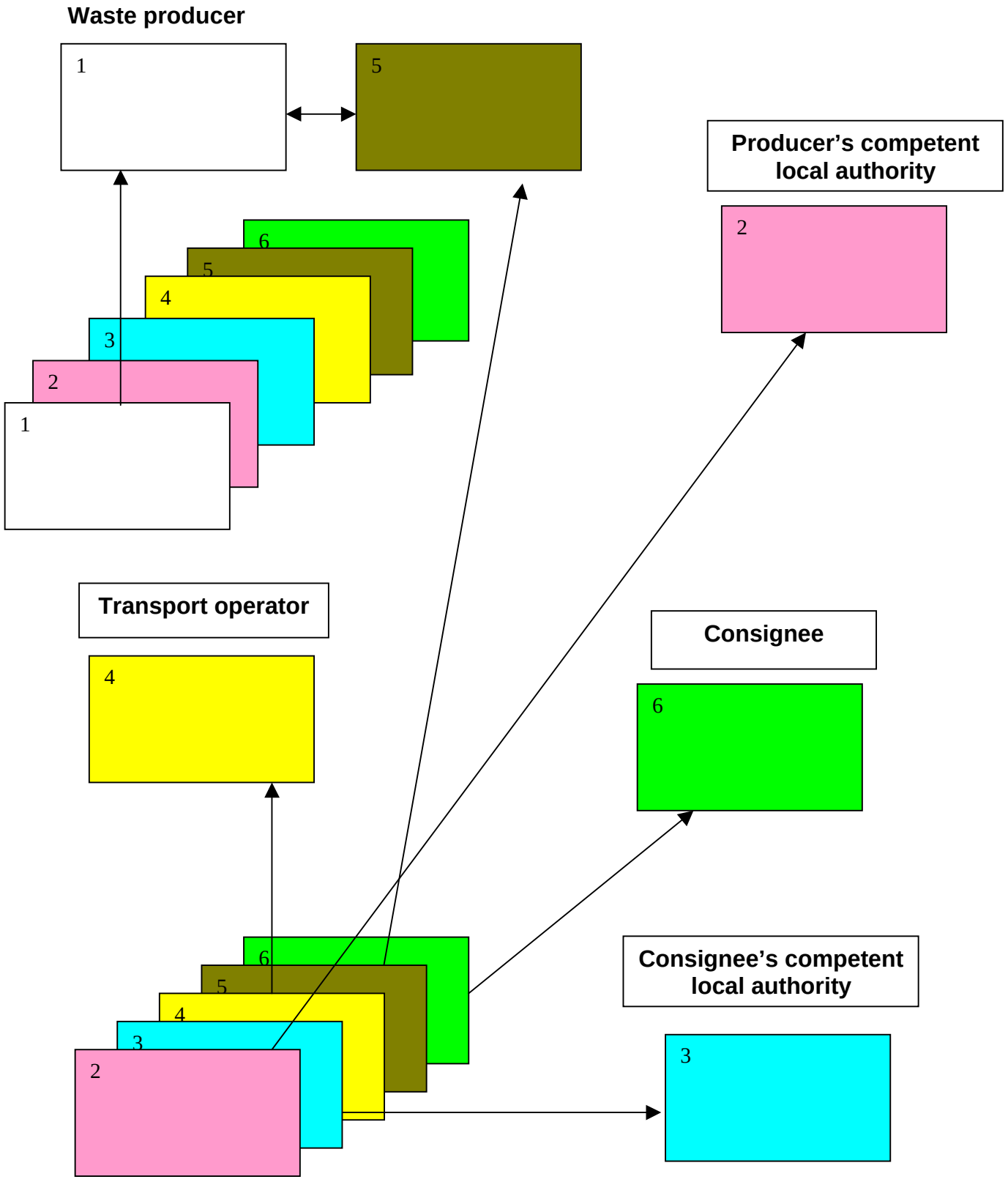
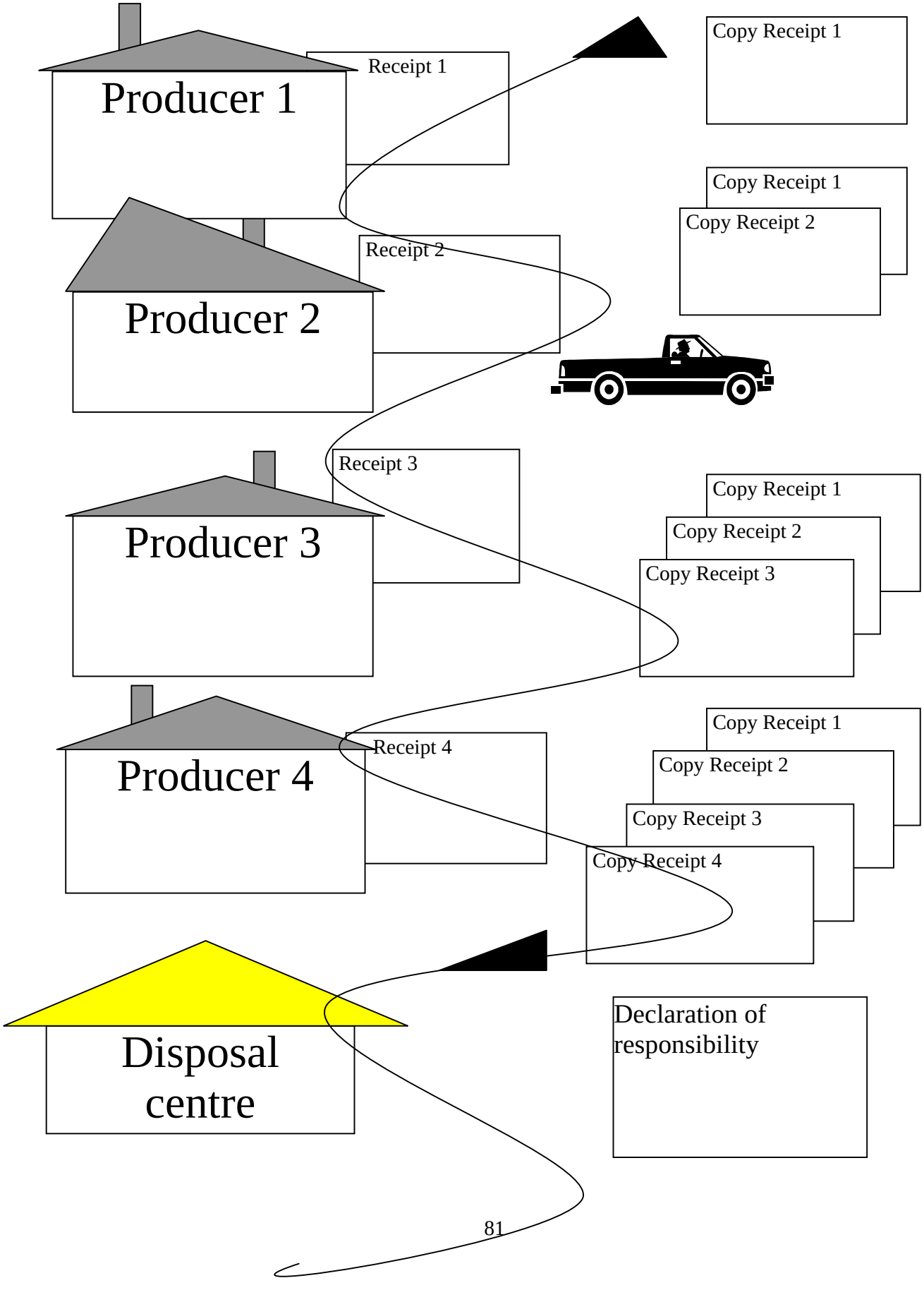


Figure 5. **Simplified procedure for small enterprises**



SEVENTH STAGE: The waste is to be exported to another country

Action

The enterprise must check to see where the waste in question is listed: whether on the green, amber or red lists contained in Council Regulation (EEC) N° 259/93 on the supervision and control of shipments of waste within, into and out of the European Community, or in Annex V of the Regulation, if the country of destination is outside the OECD area.

Instruments

Council Regulation (EEC) N° 259/93 on the supervision and control of shipments of waste within, into and out of the European Community. Annex V of this Regulation incorporates Annexes VIII and IX of the Basel Convention into Community law. Annex V thus comprises Annexes VIII and IX of the Basel Convention, the amber and red lists of the OECD Decision and the list of hazardous wastes described in 94/904/EC.

Moreover, it is advisable to contact the competent authorities, since the regulations are not easy to understand. In Germany, provision is made, where appropriate, for the authorities rather than the enterprises themselves to contact the authorities in the country of destination.

Bases

German law and Community law apply the Basel Convention, the OECD Decision and Council Regulation N° 259/93. A Council Regulation has greater weight than a Council Directive. A Regulation is directly applicable in Member countries, whereas a directive must be incorporated into national legislation by laws passed in each of the Member countries.

Problems

The problem arising from this situation is that the enterprise encounters several different nomenclatures for the designation of waste:

- The Y entries of the Basel Convention;
- Annexes VIII and IX (lists A and B) of the Basel Convention;
- The green, amber and red lists of the OECD Decision;
- The EWC;
- and sometimes old national nomenclatures (replaced by the EWC in Germany, effective from 1 January 1999).

From this point of view, the measures taken by the European Commission, with a view to incorporating three nomenclature systems into a single Annex V, are understandable. Moreover, there is a debate in the European Parliament on the prohibition of the export of hazardous waste, and the fact is that the European Commission had to add the list of hazardous wastes. If there is a conflict between List B (Annex IX) of the Basel Convention and the list of hazardous wastes, the latter will have priority. At present it is felt that the two systems, EWC and Basel Convention, will continue to coexist. The EWC has the advantage of being valid throughout the EU and of being more exhaustive than Lists A and B, since the latter tend to concentrate on waste that is suitable for recovery. But, on the other hand, Lists A and B have an international basis.

Christophe RIPERT
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SUMMARY

Valbonne, June 1999

GENERAL INTRODUCTION

Our society, based on manufacturing and mass consumption, generates increasing amounts of waste, a problem exacerbated by continued urban growth which in a country like France now affects over 80 per cent of the population. For many years simply abandoned in unregulated landfills, this mass of material, made up of household, municipal, industrial, building site and agricultural wastes, is starting to attract growing attention.

Having regained its place among the issues raised by the depletion of terrestrial energy reserves and raw materials and the risks arising from pollution of our environment, waste has become one of major challenges facing the 21st century.

It is against this background that European legislators, followed by those in EU Member States, have put in place a regulatory framework under which all wastes must be processed prior to their disposal in landfill sites or reintroduction into industrial supply chains and which promotes the recycling of recoverable wastes over other means of disposal.

Pursuit of this two-fold objective, with a view to avoiding pollution, is beginning to have secondary effects, particularly in terms of the financial and logistical aspects of process organisation. The changes that may be observed in organisational structures in response to the increased stringency of waste disposal regulations reflect the development of increasingly complex systems requiring large numbers of transport movements.

This increase in the number of waste movements raises several issues and, among other things, prompts us to consider, firstly, the context and scale of this development, and secondly the limits to existing systems and the scope for action.

The following discussion, which has been divided into three sections, attempts to shed some light on the issues raised by the transportation of waste products.

The **first section** of this report considers the size of the waste disposal sector in France and has three main objectives: to consider the concept of waste; to set out a classification of the waste generated, together with statistics for 1998; and lastly, to analyse the regulatory framework for waste disposal from the standpoint of transport.

The **second section** reviews the organisational systems that have been put in place to ensure the systematic processing of wastes and looks in turn at the development of logistical systems, the scale of national waste movements, and lastly the technical and economic aspects of the waste transport sector.

The **third section,** starting in chapter 6, consists of an analysis of the current situation and a discussion of the limits to “movements” within disposal chains and the size of the waste transport

sector in urban centres. The final chapter, chapter 7, considers the theme of "waste transport" in relation to sustainable development.

1. THE SIZE OF THE WASTE SECTOR IN FRANCE

1.1. The concept of waste

Law No. 75-633 of 15 July 1975 defines waste as any residue from a manufacturing, processing or application process, and as any substance, material, product or, more generally, any movable good that its owner wishes to dispose of.

This Law defines final waste as one which, regardless of whether or not it arises as a result of the processing of wastes, can no longer be processed, using current state-of-the-art technologies or under current economic conditions, by removing the portion of it that remains of value or by reducing its polluting or hazardous characteristics.

As a result of our way of life, the wastes produced in the developed world continue to grow in terms of volume, toxicity and complexity. This growth is the result of two trends which are intrinsically very different but whose impacts are combined:

- firstly, the trend in manufacturing processes, marketing methods and distribution and modes of consumption;
- secondly, the trend towards increasingly stringent environmental regulations.

Although it is a source of nuisances, waste is also a source of energy and of raw materials. Perceived as a polluting agent, waste is in many instances the outcome of an active policy of pollution clean-up or prevention. The recycling of a growing number of materials generates wastes deemed to be final wastes that must subsequently be disposed of; the treatment of ever-larger quantities of wastewater to higher standards of purity generates larger quantities of slurries; the incineration of growing volumes of wastes generates ash and air emissions which must in turn be purified, stabilised and disposed of.

1.2. Classification and quantification of wastes generated in France (1998)

Every year France produces a total of 880 million tonnes of waste which may be broken down into household and assimilated waste, municipal waste, industrial wastes, waste from building and construction sites, agricultural wastes and wastes from the agro-food industry.

These categories of waste comprise materials generated by composite sectors. The classification proposed is therefore based on the type of waste producer: local authorities, industry, the building/public works sector, and agriculture.

The following table breaks down each category of waste listed in the "producer" classification according to the constituent materials, annual tonnages, and the waste disposal systems in place.

Table 1. **Classification and volume of wastes produced in France in 1998**

Wastes	Breakdown of materials	T/year millions		Disposal systems
Household and assimilated wastes	Household wastes Bulky wastes Garden wastes DIY wastes Wastes produced by craftsmen, tradesmen and miscellaneous establishments collected mixed with household wastes	22 5 5		 Incineration Recycling Composting Disposal to landfill (class 2)
Total for household wastes and similar :		32	3.6%	
Municipal wastes	Slurries from wastewater treatment plants Drainage effluents Wastes from parks and open areas Wastes from markets Street-cleaning wastes	1.5 3.5 6.5		Incineration Recycling Composting Disposal to landfill (class 3 for inert wastes and class 2 for others)
Total for local authority wastes :		25	3.9%	
Industrial wastes	Ordinary industrial wastes (OIW collected separately from household and assimilated wastes: glass, metal, plastic, rubber, textiles, paper, cardboard, wood, leather and mixed materials) Special industrial wastes (SIW or hazardous wastes)	51 7		Incineration Recycling Disposal to landfill (class 2) Incineration Disposal to licensed landfill (class 1) Chemical treatment
Total for industrial wastes :		58	6.5%	
Wastes from building sites and public works	Building wastes • Inert wastes • Ordinary wastes • Special wastes Public works wastes • Fill • Spoils • Stone wastes	24 330		 Disposal to landfill Fill for earthworks Fill for disused quarries
Total for building site and public works wastes :		354	40%	
Agricultural wastes and wastes from the agro-food sector	Farm wastes Forestry wastes Fishing wastes Agro-food industry wastes	 375 45		Incineration Disposal to landfill Fodder Muck-spreading Recycling Incineration
Total for agricultural and agro-food industry wastes :		420	47%	
TOTAL WASTES FOR FRANCE IN 1998 :		**889**	**100%**	

*Sources***:** Table based on the following data:

Classification: "*La logistique et le transport des déchets ménagers, agricoles et industriels*", ADEME/METL, September 1997, Ref. 2265.

Statistics: "*La logistique des déchets ménagers, agricoles et industriels -- synthèse 1999*", Study carried out by Gérardin Conseil on behalf of ADEME, Direction de l'Air et des Transports, March 1999.

Wastes from building sites and public works, together with agricultural wastes, account for 87 per cent of the waste generated in France. While other types of waste account for a smaller share of the total, their nature and the trends in their production are such that the volume generated is steadily rising. In France, for example, production of household waste has risen by over 97 per cent over the past 34 years, increasing from an average of 220 kg per inhabitant per year in 1960 to 434 kg in 1995. In contrast, the volume of industrial waste processed in municipal centres doubled between 1985 and 1990.

The classification of waste by type of producer, as proposed in Table 1 above, may be challenged, however, if account is taken of the following parameters:

- logistical chains, which within a given organisation often accommodate wastes generated by other producers;
- disposal techniques requiring large-scale industrial plant which in order to achieve economies of scale generally process different types of waste;
- collection, transportation, handling equipment or multi-purpose disposal procedures that can be applied to several different types of waste.

Setting out these parameters in full, which is necessary in order to gain a proper insight into the subject matter, illustrates the complexity of the waste sector, an aspect that emerges even more strongly in legislative, territorial, financial and business analyses of this sector of activity.

The task of dealing with this mass of waste, which is constantly growing, calls for increasingly extensive resources and has led to the introduction of regulations which set out the principles governing the management and disposal of wastes.

1.3. Transport aspects of the legislative and regulatory framework for waste disposal

National and EU legislation on waste regulations are closely linked. While each set of legislation retains its own distinctive characteristics, most new legislation at the national level amounts to the translation into national law of EU directives.

Table 2 overleaf sets out the main regulations on waste disposal and provides a parallel list of European and national texts.

Examination of this table reveals the absence of transport and logistics from French regulatory texts. Prior to 1998 and the publication of the decree relating to the transport of waste products by road and to the trading and brokering of waste products, there were no specific regulations on waste transport in force in France.

Until 1998, waste was treated as a conventional good whose transportation was governed by:

- the *Loi d'Orientation des Transports Intérieurs* (LOTI) of 30 December 1982 and its enabling decrees, notably that of 14 March 1986 with regard to transport of goods by road for reward or hire;
- the Act of 5 February 1942 and the *Règlement pour le Transport des Matières Dangereuses* (RTMDR) of 15 April 1945, in cases where the load transported was of a hazardous nature.

Table 2. **Waste legislation**

EU regulations	French regulations
Council Directive of 15 July 1975 (75/442/EEC) Provides the general framework for EU legislation on waste. The main objective of the Directive is to protect human health and the environment against possible damage arising from the collection, transportation, storage and tipping of waste.	**Law No. 75/633 of 15 July 1975** Law relating to waste disposal and the reclamation of materials. **Decree No. 77/974 of 19 August 1977** Decree relating to the information to be provided with regard to wastes causing a nuisance. **Order of 4 January 1985** Order regarding the monitoring of systems put in place for the disposal of wastes causing a nuisance.
Council Directive of 18 March 1991 (91/156/EEC) This Directive modifies the Directive of 1975. It requires Member States to: • Either set up a licensing system for firms, notably with regard to the collection, transportation and storage of waste; or • Establish a plan covering the basic information to be taken into consideration during the various stages of waste disposal.	**Law No. 92/646 of 13 July 1992** Law on the disposal of all types of waste and all the logistical activities associated with waste disposal. The Law sets out the four objectives which the waste disposal plans drawn up by *départements* and regions must meet. One of these objectives is to organise waste transport operations and to limit them in terms of both distance and volume, and in this respect is designed to apply the proximity principle set out in the Directive of 18 March 1991 (91/156/EEC). This Law is supplemented by the enabling decrees Nos. 93/139 of 3 February 1993 and 96/1008 of 18 November 1996 which set out the methods and procedures for drawing up, publishing and revising such plans. **Law No. 95/101 of 2 February 1995** Law relating to the strengthening of environmental protection measures. This law introduced changes with regard to the drafting, monitoring or revision of plans drawn up at the level of *départements*.
Council Directive of 12 December 1991 (91/689/EEC) This Directive constitutes a special regime for hazardous wastes, in accordance with the Basel Convention, and provides for a licensing or notification system for the transportation of such wastes. **Council Directive of 1 February 1993 (93/259/EEC)** This Directive deals with the monitoring and surveillance of waste shipments to and from the European Union.	**Decree of 30 July 1998** The provisions of this Decree relate to the transportation by road of waste and to the trading and brokering of waste products.

Source: ADEME, Direction de l'Air et des Transports.

The situation presented above may be compared with the very minor role accorded to transport and logistics in plans for the disposal of household and assimilated wastes drawn up by the *départements* and plans for the disposal of industrial waste drawn up at the regional level.

However, as noted above and in application of the Council Directive of 15 July 1975 (75/442/EEC), a special Decree on waste transport was issued on 30 July 1998.

This Decree sets out requirements with regard to the transportation of wastes by road and to the trading and brokering of waste. The scope of transport within this text covers all or part of the following operations: collection, loading, transportation and unloading. The Decree significantly increases the stringency of the regulations applicable to the transportation of waste by road. It makes it mandatory to firms to notify the Prefect of the *département* in which the firm's head offices are located, or in which the party submitting the notification resides in the case of road hauliers, of any shipment of more than 100 kg of hazardous waste or 500 kg of non-hazardous waste. This notification must be renewed every 5 years.

However, exemptions to this mandatory notification are granted to the following:

- firms transporting the waste they produce;
- firms engaged solely in the collection of household waste on behalf of municipal authorities;
- firms transporting the following by road: brick, concrete and ceramic wastes, and other clean and sorted demolition materials; rubble and tyres;
- accredited used oil collectors.

Article 6 specifies that shipments by road of wastes that fall into the category of hazardous waste must be licensed. Licences already issued for the transportation of dangerous goods are equivalent to those specified in the Decree.

Lastly, the Decree requires that waste traders and brokers declare their activities to the Prefect of the *département* in which their head offices or domiciles are located.

This Decree entered into force on 1 January 1999, a fact recalled to Prefects in a Ministerial Circular of 16 December 1998 which also specified that the regulations relating to the transportation of waste by road would be extended in the course of 1999 to transport by rail, sea, air and inland waterway.

Logistics still remains no more than a principle in French waste legislation. This is an unfortunate state of affairs given that the obligation to "dispose" of waste considerably complicates the systems that have already been put in place to manage the various waste processing operations currently in use. This observation leads us into the second section of this report in which we analyse the changes in these organisational systems, on the one hand, and their impacts in terms of transport and the environment and also in economic terms.

2. ORGANISATIONAL SYSTEMS PUT IN PLACE TO DEAL WITH WASTE DISPOSAL: WHAT ROLE FOR TRANSPORT?

Historically, the logistics involved in waste transport were perceived in linear terms with priority being given, in simple organisational structures, to the disposal of wastes in landfill. In response to the quantity of waste being generated (over 889 million tonnes a year) and also to take account of the concept of sustainable development, notably the risks of environmental pollution and the depletion of raw material resources, the legislators introduced the requirement, under the Law of 13 July 1992, that all wastes be processed.

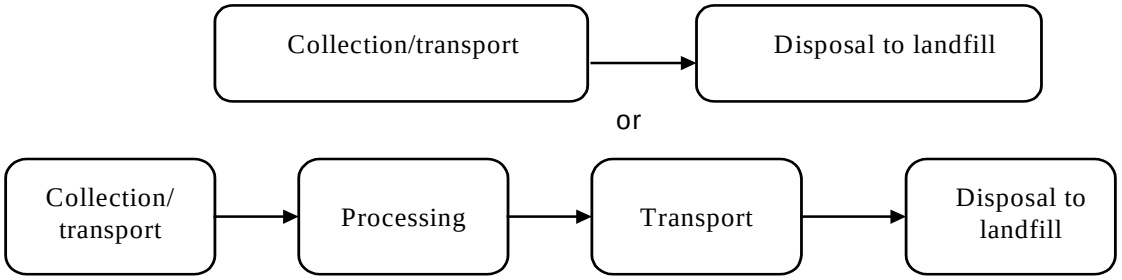
This requirement has the two-fold objective of giving priority to the disposal of waste through recycling over disposal by other processes such as landfill or incineration, and of restricting the use of landfill solely to wastes for which landfill constitutes final disposal.

The application of this principle has complicated the structures put in place for the processing and disposal of household and assimilated waste as well as that of industrial waste.

2.1. Changes in "waste" flow charts

Traditionally, waste disposal logistics were limited to the three main stages of collection, processing in certain cases, and transportation to a landfill site.

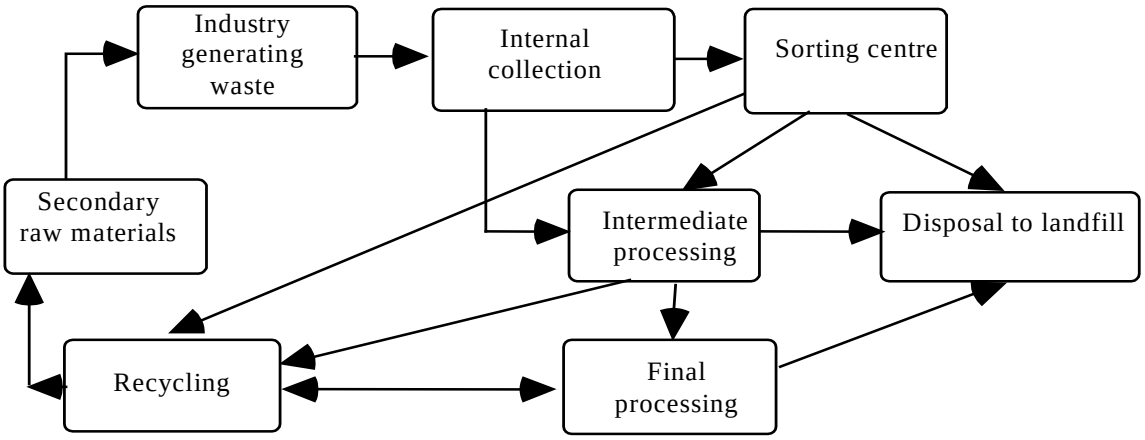
Figure 1. **Linear organisation of waste processing operations**



Source: ADEME, Direction de l'Air et des Transports.

The introduction of increasingly stringent procedures for the processing and disposal of waste, notably in application of the Law of 13 July 1992 which requires that all wastes must first be processed before disposal to landfill or reintroduction to the market, resulted in increasingly lengthy and complex logistical chains for waste disposal. In the case of industrial waste the resultant flow chart was as follows:

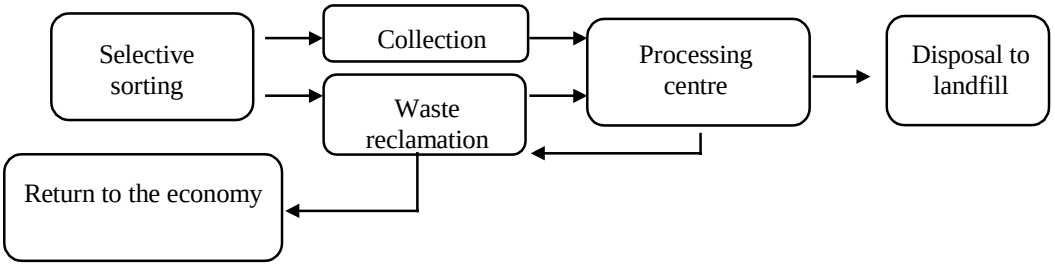
Figure 2. **Complex chain of industrial waste processing operations**



Source: ADEME, Direction de l'Air et des Transports.

In the case of household and assimilated wastes, the development of recycling called for the introduction of sorting and selective collection procedures within parallel logistical chains, leading to the emergence of a specific type of organisation for this category of waste.

Figure 3. **Complex chain of processing operations for household and assimilated wastes**



Source: ADEME, Direction de l'Air et des Transports.

This type of organisation reduces the amount of waste disposed of in landfills, but at the same time creates breaks in the chain and encourages greater use of transport and handling systems.

2.2. Assessment of waste flows

The figures given in this section are based on data for 1993[1], the only year in which all waste movements were quantified.

2.2.1. Generation of waste and transport movements in 1993

As part of their disposal, almost 60 per cent of waste, i.e. 514 million tonnes out of total volume of household waste of 880 million tonnes, were moved in a transport operation. Apart from agricultural waste, of which only 12 per cent of the 420 million tonnes were transported, the remainder being reused directly on the farm, all wastes from other waste categories gave rise to a transport operation.

Table 3. **Volume of waste and transport movements in 1993**

Type of waste		Volume (tonnes million)	Tonnage transported (tonnes million)	Km millions travelled	T-km millions generated	Average trip km
Household and assimilated wastes		29.5	Flows outside communes 29.40	65.00	770.54*	26
			Flows inside communes 0.10	0.03	0.30	4
Municipal waste		22.5	22.50	37.50	585.00	26
Industrial waste	**OIW**	50.0	50.0	568.00**	3 982.40**	80
	SIW	7.0	7.0	194.00	1 362.20	195
Site wastes	**Building**	23.9	23.9	38.85	717.00	30
	Public works	330.4	330.4	396.50	9 912.40	30
Agricultural wastes and waste from the agro-food industry		420.0	51.1	335.60	5 034.00	99
TOTAL:		**883.3**	**514.4**	**1 633.382**	**22 363.84**	**43**

Source: ADEME, Direction de l'Air et des Transports.

-- Household and assimilated wastes, municipal waste: ADEME ITOM 6, 31 December 1993[2];
-- OIW: ADEME INDI -- 1993[3];
-- SIW: ADEME ARTHUIT -- 1993[4];
-- Building site wastes: National quantitative study of building site wastes, FMB ADEME;
-- Waste from public works sites: SITRAM database, Ministry of Transport, 1993;
-- Agricultural and agro-food industry wastes: SITRAM database, Ministry of Transport, 1993;

* Estimate based on data relating to 28.4 million tonnes;

** Estimate based on data relating to 40 million tonnes.

Waste flows at the national level generate a significant amount of traffic. The tonnage carried amounts to over 514 million tonnes, i.e. around a third of total domestic freight traffic, and waste movements amount to over 22.3 billion t-km, i.e. almost 15 per cent of all domestic traffic flows.

The average distance of 43 km travelled is relatively low; however, there are major disparities between:

- The regions, e.g. 24 km for the Limousin and over 93 km for Poitou-Charentes;
- Categories of waste; for example, the average distance over which iron and steel scrap for recasting and basic slag are transported is over 400 km, whereas municipal waste is transported no more than 26 km;
- Lastly, the mode of transport utilised; for example an average of 36 km by road, 87 km by inland waterway and 310 km for scrap steel.

2.2.2. Modal split

Analysis of the modal split shows that most wastes are transported by road. In 1993, 96 per cent of all waste shipments were by road.

Table 4. **Transportation of waste products -- Modal split by tonnage**

Type of waste		**Quantity transported (tonnes million)**	**Modal split by tonnage**		
			Road	**Rail**	**Inland waterway**
Household and assimilated		29.5	29.21	0.29	
Municipal waste		22.5	22.50		
Industrial wastes	**OIW and SIW**	57.0	48.21	7.51	1.28
Building site waste	**Building sites Public works sites**	354.3	347.75	3.55	3.00
Agricultural wastes and waste from the agro-food industry		51.1	50.29	0.72	0.09
TOTAL:		**514.4**	**497.96**	**12.07**	**4.37**
%		**100.0%**	**96.80%**	**2.35%**	**0.85%**

Source: ADEME, Direction de l'Air et des Transports.

Given that road transport is primarily used for trips whose average distance is far lower than that of shipments by rail or by inland waterway, road will have a smaller share of the modal split in terms of t-km.

Table 5. **Transportation of waste products -- Modal split by t-km**

Type of waste		T-km millions	Modal split by tonnage		
			Road	**Rail**	**Inland waterway**
Household and assimilated wastes		770.54	734.54	36.00	
Municipal waste		585.00	585.00		
Industrial wastes	**OIW and SIW**	5 344.60	3 023.80	2 275.90	44.90
Building site waste	**Building sites**	10 629.40	8 944.50	1 335.90	349.00
	Public works sites				
Agricultural wastes and waste from the agro-food industry		5 034.00	4 811.85	219.00	3.15
TOTAL		**22 363.84**	**18 099.69**	**3 866.80**	**397.05**
%		**100.00**	**80.93**	**17.29**	**1.78**

Source: ADEME, Direction de l'Air et des Transports.

Rail is only in a dominant position over longer distances, particularly with regard to the transport of waste from steelworks.

The inland waterways, on the other hand, have only a marginal role to play, two exceptions being the transport of molasses, where the waterways carry 28.76 per cent of the tonnage, and the removal of waste from building sites in urban areas.

2.2.3. The collection component has yet to be properly defined

Collection is an essential part of the logistical organisation of waste management. Collection must include an initial sorting operation to encourage recycling and prepare for subsequent sorting/recycling and processing operations.

In accordance with the Circular of 18 May 1987, the collection of household and assimilated wastes concerns the following four categories of waste:

- Household waste;
- Bulky waste;
- Special household waste (wastes that are inflammable, toxic, corrosive or explosive);
- Waste arising from commercial, craft, industrial or similar activities.

Table 6. **Waste collection**

Waste	Type of collection	Operator	Comments
Household and assimilated wastes	• On-site handling • Conventional collection • Selective collection – By householder – Kerbside (single, double or multi-stream) • Pneumatic collection • Waste centre	• Government-operated system; or • Private operator under a service contract (further to a competition, call for tender or franchise contract).	The collection stage is important for this type of waste because the dispersed nature of the waste requires the use of a specific form of logistical organisation that is frequently both complex and expensive.
Ordinary industrial wastes	OIW treated as HAW (household and assimilated wastes). Selective collection of other OIW.	76 per cent of OIW are collected by private operators, 19% by firms' own internal services and 5% by municipalities. Wastes are collected once a week in 75% of cases, once a month in 15% of cases and approximately once a year in the remaining 10% of cases.	The collection of industrial wastes requires: • Firms to have an internal collection procedure with selective sorting; • The use of special bins (glass, paper, cardboard, metal, chemical products, etc.); • Provision of a dedicated area to facilitate removal and safeguard against risks associated with storage; • Timing waste removal operations to ensure that bins are full when emptied.
Special industrial waste	Internal collection followed by sorting and selective collection for shipment to processing centres.	Accredited suppliers working on behalf of the managers of waste disposal centres.	As per ordinary industrial wastes. The collection of SIW must comply with regulations relating to the transportation of dangerous materials.
Agricultural wastes and waste from the agro-food industry	Collection of agricultural waste Agro-food industry	Internal systems on farms Selective collection	There are no regulations relating specifically to the collection of agricultural and agro-food industry wastes, apart from the collection and disposal of animal carcasses, which constitutes a public service, carried out by knackers. Law No. 96-1139 of 16/12/96.
Wastes from building sites and public works	All types for inert wastes; Selective collection for other types of waste.	Either the operator himself or sub-contracted to a public carrier.	

Source: ADEME, Direction de l'Air et des Transports.

Operators are making increasing use of selective collection procedures, either in addition to or in place of conventional collection techniques.

Specialised bodies[5], financed by means of a tax levied on producers of consumer goods, endeavour to help local councils to put in place an efficient system for the selective collection of recyclable materials. They also play an important role in stabilising market prices.

Many recycling firms have experienced severe problems due to substantial variations in the prices of certain recycled materials (e.g. paper and cardboard). In order to close the circle for the recycling of selectively collected wastes, it is first necessary to be able to sell the recycled products. This is not always an easy task, given fluctuations in world prices for materials and the intrinsic costs of recycling, notably for transport.

The development of selective collection is a major challenge in terms of transport and logistical organisation. Selective collection reduces:

- The volume and tonnage of household wastes transported to processing facilities and the tonnage of residue to be transported to landfill sites (slag, etc.);
- Requirements in terms of new installed capacity, and at the same time prolongs the lifetime of existing facilities;
- Emissions (fumes, effluent, etc.) and the quantity of residual pollutants.

This subdividing of flows makes modal transfers from road to rail and inland waterway more difficult. At the same time, the number of kilometres travelled and the t-km carried in relation to the place of collection, as well as in other parts of the logistical chain, are increasing.

While figures are available for the transport component, at present, we have no overall statistics for the trips generated by the collection of wastes.

2.2.4. Annual growth in waste flows

It is difficult to establish an order of magnitude for growth in waste flows. This growth depends upon a number of parameters, including:

- Increase in the volume of waste generated by various waste producers (households, local municipalities, industry, commerce, etc.);
- The choice of processing technique used to dispose of wastes, which make use of organisational structures that make use of transport services to varying degrees.

Analysis of a number of factors currently leads us to believe that the overall volume of flows is tending to rise. This opinion is based on the fact that:

- Economic growth stimulates household consumption and industrial output;
- The increased stringency of regulations is redirecting the waste disposal systems in place towards systems that generate larger numbers of trips (recycling, selective collection, systematic processing prior to disposal in landfill, etc.);

- The growing share of wastes generated in France that are now taken into account as part of the general policy towards processing;
- The development of an international market for waste products, which is encouraging trade over a larger economic area.

A comparative analysis of the overall balance for waste presented above with the partial balance established for 1998[6] provides some insight into the growth in waste flows. The total volume of waste products reported in 1998 reveals an increase of over 6 million tonnes of waste compared with 1993. This difference is due to an increase in the tonnage of household and assimilated waste (+2.5 million tonnes), municipal waste (+2.5 million tonnes) and industrial waste (1 million tonnes).

In terms of waste flows, the comparison of the two balances shows an increase of over 1 050 million t-km, broken down as follows: +779 million t-km for household waste; +65 million t-km for municipal waste; +115 million t-km for industrial waste and +91 million t-km for building site wastes. The overall modal split remains unchanged, however, apart from a slight decline in inland waterways in favour of road.

This trend is primarily attributable to the additional flows generated by the development of recycling and resource recovery, primarily with regard to household and assimilated wastes and industrial wastes.

In order to examine this issue more closely, it would be helpful to study the plans drawn up by the *départements* and the organisations associated with other types of waste in order to establish "before/after" scenarios that would make it possible to estimate the increased trips generated by the factors listed above.

2.3. Environmental balance generated by waste flows

Waste shipments are mainly transported by road and, to a lesser extent, rail and inland waterways.

2.3.1. Consumption

On the basis of the traffic volumes reported in 1993, the energy consumption of the waste transport sector may be estimated to amount to 623 810 TOE[7], i.e**. 5 per cent of the total energy consumption of the transport sector in France.**

Energy consumption is calculated on the basis of:

- T-km per type of waste and mode of transport in Tables 4 and 5;
- Urban unit consumption,expressed in GOE[8] and broken down as follows:

  32 GOE/t-km for road;
  32 GOE/t-km for rail;
  32 GOE/t-km for inland waterways.

Table 7. **Total consumption by mode of transport**

Type of waste		T-km millions	Modal split			Total consumption TOE
			Road TOE	Rail TOE	Waterway TOE	
Household waste		770.54	23 505	360		23 865
Municipal waste		585.00	18 720			18 720
Industrial waste	**OIW SIW**	5 344.60	96 760	22 760	670	120 190
Building site wastes	**Building & public works**	10 629.40	286 225	13 360	5 235	304 820
Agricultural waste and waste from agro-food industry		5 034.00	153 980	2 190	45	156 215
Total in TOE:			**579 190**	**38 670**	**5 950**	**623 810**
Total as a %:			**92.85**	**6.20**	**0.95**	**100.00**

Source: ADEME, Direction de l'Air et des Transports.

The very large share of the total energy consumption in the waste transport sector accounted for by road, namely, 92.85 per cent, must be set against the 80.93 per cent of the t-km accounted for by this same mode of transport in the modal split in 1993. Furthermore, the virtual monopoly which road has on the collection portion of the cycle, and the relatively high unit consumption of the road vehicles used for this purpose (over 70 litres per 100 km for a household refuse collection lorry with a permissible maximum weight of 19 tonnes) exacerbates this trend.

As a result of this consumption of energy, primarily in the form of diesel fuel, the transportation of waste is a significant source of pollution.

A comparative analysis of the figures for 1993 and 1998 from the standpoint of energy consumption reveals an overall increase of 31 099 additional TOE. This increase is attributable to an increase of +23 975 TOE for household and assimilated waste, +1 860 TOE for municipal waste, +2 615 TOE for industrial waste and +2 667 for building site waste. Overall, road accounts for over 93 per cent of the 1998 total, whereas in 1993 it amounted to merely 92.85 per cent.

This increase in consumption can also be attributed to the additional flows generated by growth in recycling and the resource recovery, which in the case of household and assimilated waste resulted in an increase of around 50 per cent in transport-related energy consumption.

2.3.2. Emissions of pollutants

The unit data for pollutant emissions by mode, published by CORINAIR 94 (CITEPA updated March 1994), have been used to estimate the overall emissions of pollutants related to the transport of waste products.

Table 8. **Unit emissions of pollutants by mode**

	Road G/TOE	**Rail G/TOE**	**Waterway G/TOE**
NOx	43 481	8 879	50 000
VOC	6 275	1 791	7 143
CO	18 972	4 439	28 571
CO_2 in kg	3 101	796	4 186

Source: CORINAIR 94 – CITEPA, updated March 1994.

The transportation of building site waste accounts for half of the total emissions generated by waste transport activities. Agricultural and agro-food industry wastes account for 26 per cent of this total, and industrial waste (ordinary and special) 17 per cent. Household and municipal wastes account for no more than 7 per cent.

We have limited our discussion here to an estimate of the pollutant emissions that are directly attributable to transport. These emissions are exacerbated by the fact that most of the logistical chain for waste disposal is located within urban areas.

Carbon monoxide and dioxide emissions generated by waste transport can therefore be estimated to amount to around 2 million tonnes, **representing 4.5 per cent of the emissions from the road freight sector at the national level.**

The share of waste transport in pollutant emissions in the road transport sector may be broken down as follows:

1% of CO;
2% of VOC;
6% of No_x.

Lastly, a comparative analysis of the emissions figures for 1993 and 1998 reveals the following increases in pollutant emissions: +93 591 tonnes for CO_2; +587 tonnes for CO; +188 tonnes for VOC and +1 360 tonnes for NOx.

Table 9. **Pollutant emissions -- estimates by mode for 1993**

Type of waste	Mode of transport	CO_2[9] t	CO[10] t	VOC[11] t	NOx[12] t
	Road	72 890	445	150	1 020
	Rail	286	2	~0	~0
Municipal waste	**Road**	58 050	355	117	814
Industrial waste (ord. + special)	**Road**	300 060	1 835	605	4 200
	Rail	18 115	100	40	200
	Waterway	2 820	20	5	35
Waste from building and public works	**Road**	887 575	5 430	1 795	12 415
	Rail	10 635	60	25	120
	Waterway	21 915	150	35	260
Agricultural waste	**Road**	477 490	2 920	965	6 680
	Rail	1 745	10	5	20
	Waterway	195	~0	~0	~0
TOTAL:		**1 851 776**	**11 327**	**3 742**	**25 767**

Source: ADEME, Direction de l'Air et des Transports.

The share of household and assimilated waste in these totals has primarily risen because of transport flows to resource recovery systems.

2.4. Technical and economic balance

The disposal of waste products (collection, intermediate processing, storage, recycling, incineration, etc.) may be considered as an industrial sector in its own right given the turnover it generates, the number of people employed, the size and skills of the operators involved in this type of activity and the technological sophistication of the equipment used.

2.4.1. Operators

Transport is a secondary activity required during the pre-processing and final processing stages of waste disposal. The way in which this activity is managed will differ according to its position within the organisational structures put in place and the type of waste to be disposed of. However, it is possible to identify the following types of operator:

– ***Integrators*** -- Integrators offer a comprehensive service, ranging from collection to transport, pre-processing and final processing of not only household and assimilated wastes but also industrial waste;

- ***Recoverers*** -- Recoverers collect materials and prepare them for recycling. They work in partnership with processing specialists and use their own vehicle fleet to transport materials to be recycled;
- ***Collectors*** -- Collectors are only involved in the collection of household and assimilated waste or industrial waste;
- ***Carriers*** -- Carriers ensure the mass shipment of materials corresponding to the subsequent stages of the logistical chain for waste disposal after collection;
- ***Government-operated system*** -- This type of system is put in place by local municipalities (councils or groups of councils) and can ensure the collection and transportation of household and assimilated wastes.

The transportation and disposal of industrial wastes are increasingly contracted out to specialised suppliers offering a comprehensive logistical service that includes collection, grouping, transport, etc. The supplier has therefore become an organiser of logistical chains for the disposal of waste. The supplier integrates into his service all end-to-end actions by sub-contracting individual links such as collection and transport.

The transport supplier in the waste sector acts as a specialised carrier whose services are subject to, *inter alia,* the following criteria:

- ***Equipment used***. The carrier must have the equipment needed for him to be able to collect and transport waste without damage to the environment in terms of the dispersal of materials, smells, slurries, etc.;
- ***Regulations in force***. The carrier must comply with regulations and in particular is required to enrol on a "waste transport" register maintained by the *Préfectures* of the *département* concerned, in accordance with the requirements of the Decree of 30 July 1998, and to maintain accompanying documents such as the routing sheets which allow all waste shipments to be traced;
- ***Type of waste transported***. Certain types of waste cannot be grouped with other types of goods in the same vehicle;
- ***Consignors' market***. This market is fairly narrow since it is controlled by the three major integrators at national level presented in Table 10 below;
- Etc**.**

This list of waste transport criteria, which is not exhaustive, suggests that a new branch is starting to emerge within the transport sector in the same way that other branches such as controlled temperature, bulk liquids, express freight, etc., have emerged in the past.

Table 10. **Collection and transport operators**

Waste	Operations	Operators	Comments
Household and assimilated waste	Collection	System operated directly by public authorities Concession for collection service (integrator)	The provision of collection services directly by the public authorities is the most common type of system in terms of the number of communes that benefit from such services. Concessions are the most common system in terms of the number of people served and the tonnage collected.
	Transport	System operated directly by public authorities Integrator (own-account transport) Transport sub-contracted (public carrier for hire or reward)	Integrators: Vivendi, SUEZ-Lyonnaise des Eaux et Bouygues. Integrators work through local subsidiaries of which there are around 500. They employ over 30 000 employees in the sector. The public carriers in the road, rail and inland waterway sector serve as contractors.
Industrial waste	Collection and transport	Recycler Integrator	Number of firms: 3 700 Number of jobs: 25 000 Annual turnover: FRF 40 billion Vivendi and SUEZ-Lyonnaise des Eaux with specialised subsidiaries. Industrial firms rarely use a carrier directly. Practically all such firms prefer to use a specialised carrier who will ensure not only collection, sorting and transfer but also the disposal of waste. The supplier sub-contracts the transport portion of the contract to a public carrier (road, rail, inland waterway). However, in the case of hazardous waste, suppliers often prefer to provide all the services involved, including that of transport.
Building site waste	Transport	Firm (building or public works) Sub-contracted to a public carrier	Removal of rubble, in-fill and other wastes is often integrated into building site management procedures and is carried out by the firm on its own account or sub-contracted to specialised public carriers (road, rail, inland waterway) who are paid per transfer.
Agricultural and AFI waste	Transport	Farmer Firm (agro-food) Public carrier Specialist	Since most agricultural waste is recycled *in situ*, the farmer transports such waste himself using his own equipment. The removal of wastes generated by the agro-food industry is often sub-contracted to public carriers (road, rail, inland waterway). The only mandatory requirement is that animal carcasses be disposed of by licensed knackers.

Source: ADEME, Direction de l'Air et des Transports.

2.4.2. Cost of the transport of waste products

Household and assimilated waste

Most movements of waste between transfer centres and processing facilities are made by road and by lorry. The total cost is generally estimated to amount to FRF 0.3/m^3-km. For an average movement of 50 km (carriage), the cost of transporting a cubic metre of household waste is estimated to amount to FRF 15, i.e. FRF 1/t-km. The cost of using other modes of transport varies significantly according to circumstances and depends upon:

- The quantity of waste products to be transported;
- Whether or not it is possible to link up with an existing rail line or to install the transfer station or processing facility near to an inland waterway;
- The transport technique utilised.

On the whole, the logistical cost of a tonne of waste amounts to more or less 50 per cent of the cost of final disposal, that is to say, FRF 500 per tonne.

This logistical cost may be broken down into the following orders of magnitude:

- Collection: FRF 360 per tonne (72%);
- Transfer: FRF 60 per tonne (12%);
- Upstream transport: FRF 40 per tonne (8%°);
- Downstream transport: FRF 40 per tonne (8%).

The additional costs incurred in selective sorting vary substantially according to the mode of organisation used. It can be controlled and should, in most cases, amount to less than 50 per cent of the average cost of conventional collection techniques.

The collection of bulky waste items often requires separate collection rounds which can cost as much as twenty times more than a normal household waste round.

On the whole, environmental costs, notably those relating to the collection and transportation of waste products, are rising. A survey carried out by BIPE has shown that 71 per cent of the communes surveyed think that such costs will continue to rise rapidly in the future.

Industrial wastes

On the basis of the survey of 600 firms carried out by Gérardin Conseil in 1994 and 1995, it has been estimated that collection and transport costs amounted to between:

- FRF 250 and FRF 300 per tonne of ordinary industrial waste, i.e. around 50 per cent of the total cost of disposal;
- FRF 150 and FRF 900 per tonne of special industrial waste, i.e.7-42 per cent of the total cost of disposal.

The cost of transporting highly toxic wastes (arsenic, cyanide, dioxine) can be as high as several thousand francs per tonne.

The costs relating to investment in waste collection and transport equipment are described in section 2.4.3 below.

2.4.3. Techniques and equipment used in waste disposal logistics chains

While road transport accounts for over 96 per cent of the modal split for waste transport in terms of the tonnage carried, other techniques have been introduced in waste logistics chains. These alternatives to road transport are in use for both collection and transport and are used for all types of material. Many types of equipment have been introduced and have been developed specifically for the waste sector.

Table 11. **On-site handling and collection technology and equipment**

Technique	Equipment	Comments
On-site handling	Ordinary bins Air-tight bins Disposable bags 2-wheeled bins 4-wheeled bins High-capacity containers	The size of bins must be commensurate with the quantity of waste generated between two collection rounds. They must facilitate the work of the bin-collectors and must be adapted to the systems installed on the collection vehicle, notably with regard to the bin-emptying system. The introduction of selective collection may require the use of special wheeled bins with several compartments.
Collection by road vehicles	Conventional collection vehicle (chassis, hopper) Household waste hopper	There exists a wide variety of equipment differing in terms of: Body volume: from 5 to 24 m^3; Mode of traction: gasoline (petrol or diesel), electric, hybrid (electric/gasoline) or alternative fuels (NGV[13] and LPG[14]); Bin-lifting system; Compaction system (impeller, plate, etc.). The choice of equipment must take account of the following criteria: Type of building on collection round (apartment blocks, houses, firms, etc.); Amount of waste to be collected; Type of waste receptacle (bins, bags, etc.); Length of collection round in km and type of areas in which waste is to be collected.
Pneumatic collection[15]	Fixed pneumatic collection network linked to a transfer station. Pneumatic network connected to the processing facility	The pneumatic collection of waste can replace the conventional system of waste collection round by an underground network that directly removes waste produced by firms or households and transfers to the transfer station or recycling processing centre. This is a dedicated transport system consisting of a network of pipes that in most cases are used solely for wastes.

Source: ADEME, Direction de l'Air et des Transports.

The energy consumption of pneumatic collection systems is higher than that of conventional systems (twice as high). However, pneumatic systems are electrically powered and are more environmentally friendly in terms of emissions. This benefit takes the form of both lower emissions of pollutants as a result of the replacement of lorries and less congestion on the roads.

Such systems are also environmentally friendly in that waste need no longer be left at the kerbside awaiting collection and there is no need for on-site handling, both of which are responsible for noise, congestion and the dispersal of materials.

A financial analysis of the different types of collection available reveals two different time horizons:

- ***Short and medium term***. Pneumatic collection systems are more expensive than conventional collection rounds by lorry since they require heavy investment in equipment, which can amount to up to FRF 10 000 per household. However, the high annual costs are offset by the reduced number of operatives required to run the service, which in the case of pneumatic collection amounts to no more than one or two employees per network.
- ***Long term***. The depreciation of equipment is one major factor that can result in a capital gain for pneumatic collection. On the other hand, once the equipment has been fully paid for, the pneumatic system is cheaper to operate than a conventional collection system.

It should be noted that the cost of a conventional collection system is set to rise as a result of the increased costs relating to staff and the increasingly stringent restrictions on emissions from collection vehicles. In contrast, a system of subsidies for pneumatic collection systems (in view of the environmental benefits) would help to lower the costs of such systems. These two factors could therefore reduce the cost differential between the two types of system in the short and medium terms.

At present, there are over 400 pneumatic collection systems in operation world-wide. In France, pneumatic collection systems have been installed in one district of Grenoble, in one establishment within the Ministry of Economy and Finance at Paris Bercy and the hospital centre in Montpellier. It is surprising that a country such as France has not made greater use of this technology, particularly in the new towns that have been built over the past thirty years.

Lastly, the initial results from a survey[16] of the specifications of the vehicles used in waste disposal logistics chains provides some interesting further details of the type of vehicle used for the collection of household and assimilated wastes.

On the whole, larger vehicles are used in the most highly-developed urban areas and the average quantity of waste collected per vehicle rises in proportion to the density of the population served.

The figures derived from the survey and summarised in the table below show a constant increase in the distances travelled and a large disparity between rural and urban areas.

Table 12. **Categories of household waste collection vehicles**

Characteristics	Typical values	Comments
National fleet of household waste collection vehicles	9 000 vehicles	Average service life: 10 years The fleet is almost exclusively diesel-powered with some electric or hybrid vehicles. Market dominated by: Grange, with over 58% of the market, Sémat with 25%, Ordumat with 11% and Eurovoirie with 5%. Chassis: 88% Renault
Payload Capacity	8 tonnes 16m^3	Values given range from 1.2 to 26 tonnes; however, 55% of the fleet are 8-tonne vehicles. Values given range from 2 to 23m^3; however, over 60% of the fleet has a capacity of 16m^3
Power	160 kW	From 82 to 219 kW
Kilometres/year	-	For a total of 553 vehicles, values range from 1 572 km to 50 000 km per year
Quantity of waste collected annually	2 750 t	For a total of 284 vehicles, values range from 30 to 5 716 tonnes per year. However, of these, 63% collect between 2 500 and 3 000 tonnes per year.
Fuel consumption	60 litres per 100 km	For a total of 511 vehicles, values range from 12.2 to 106.21 per 100 km
Distance per tonne of waste collected	6 km	For 167 vehicles, values range from 1.8 to 125.6 km per tonne collected However, over 60% of these vehicles travel a distance of 4 to 8 km.
Fuel consumption per tonne of waste collected	4 litres	Consumption for 132 vehicles ranged from 2.5 to 26 litres per tonne collected, for most (over 50% of vehicles) consumption was between 3 and 4 litres.

Source: ADEME, Direction de l'Air et des Transports.

Table 13. **Waste transport modes and equipment**

Transport modes	Equipment	Comments
Road	Articulated vehicle, Permissible Maximum Weight 40t Carrier, Permissible Maximum Weight 26t Carrier, Permissible Maximum Weight 19t	To maximise capacity, waste is often compacted to a density of 400kg/m^3 (0.4), except where recycling or the hazardous nature of the waste restricts compacting.
Rail	Conventional, high-sided open goods wagon	Rolling stock: conventional wagons covered with a tarpaulin or netting to prevent wind-blown litter. Rail transport is economically viable only if there is a branch line from the transfer station to the processing facility, which is rarely the case. A rail link costs about FRF 1 000 per linear metre, excluding earthworks, plus approximately FRF 80 000, plus taxes, per switch (at least one per site for a branch line to the rail network).
Combined rail/road	Multi-cradle system	The result of collaboration between SNCF and road hauliers, the multi-cradle system is a combined transport unit. It uses a **special wagon**, fitted with swing bolsters (FRF 180 000 to 215 000 plus taxes, for bolsters and fitting to wagons), **a conventional lorry** fitted with a hydraulic lifting arm [FRF 550 000 to 680 000 plus taxes for the 6x4 (3-axle) vehicle with lifting arm] and a range of **road/rail swap bodies** for different waste densities (FRF 25 000 to 55 000 plus taxes per multi-cradle container, depending on load characteristics).
	Polyrail system	The polyrail system enables side-loading of suitable containers from a special road vehicle to the wagon. The main investments needed are: Modifications to wagons (FRF 200 000 plus tax). Purchase of **containers** (FRF 30 000 to 80 000 plus tax per container, depending on capacity, options, etc.). Purchase of **traction unit** (FRF 400 000 plus tax) and **trailer fitted with traverse table** (FRF 600 000 exc. tax). The system can handle containers with a capacity of 30 to 50m^3.
Inland waterway	Bulk or container	Barges for transporting waste by inland waterway range from 160 to 5 000t. One 3 000t push-tow can carry as much cargo as 100 x 30t lorries or a 40-wagon train. It can carry 250 TEU (Twenty-foot Equivalent Unit) containers. The average cost of transporting one tonne of waste by inland waterway varies from 10 to 30 centimes per kilometre.
Pipeline	Pipe	After liquefaction, transport by waste pipeline of fly ash, dust and sludge.

Source: ADEME, Direction de l'Air et des Transports.

The environmental impact of the transport modes described in Table 13 depends not only on the fuel consumption and emissions of the vehicles or vessels used, but also and primarily on the organisation of transport operations.

An intermodal study commissioned by the ADEME gives comparative estimates of the environmental impacts of the various modes used for waste transport.

- ***In terms of external costs*** (pollution, accidents, landtake, water consumption), the estimated figures for the three modes of transport were as follows: ***Road***, FRF 17.03/100 tonne-km; ***rail,*** FRF 3.91/100 tonne-km; ***Inland waterway,*** FRF 1.22/100 tonne-km;
- ***In terms of energy efficiency***, i.e. the distance covered in kilometres per 5 litres of fuel per tonne of waste was: 100 km for ***road***, 312 km for ***rail*** and 215 to 500 km for ***inland waterway***;
- ***In terms of loading units by mode***, the number of vehicles needed to carry 4 400 of waste was: for ***road*** haulage, 220 lorries (permissible maximum weight); for ***rail transport,*** 110 wagons; and for ***inland waterway transport,*** one two-barge push-tow.

This comparison shows that rail and inland waterway are more energy-efficient than road and that there are obvious advantages to be gained from developing combined transport.

Other substantial gains are reduced congestion, air and noise pollution and improved safety.

Once the full external costs are included in calculations of the social and economic returns on public investment in the waste field, choices should clearly turn towards solutions that make use of combined transport[17].

Despite being less energy-efficient, road is a competitive, responsive, reliable and fast mode that has been able to adapt to the logistics and economic requirements of the actors and is still the most frequently used means of transport in the waste disposal sector.

3. WASTE TRANSPORT AND LOGISTICS: A FAST-CHANGING BUSINESS

3.1. Analysis of the current situation

3.1.1. Limitations of existing systems

Existing waste disposal systems in France were set up under general pollution control initiatives implemented by the 15 European Union Member States. However, waste disposal now requires a series of transport and handling operations at each stage of the process. Because transport pollutes, by increasing the transport operations necessary pollution control measures are themselves indirectly contributing to pollution.

Of course, the transport leg of these systems is not the only source of pollution arising in the waste disposal process. Waste treatment plants consume energy as well as being responsible for substantial emissions; as in the case recently reported in the media of the release of dioxin emissions from incinerators in Lille in the North of France.

However, as the life-cycle assessment referred to in Chapter 2 of this report indicates, transport is a major and increasingly large contributor to pollution.

This is due to practices that have added to the negative environmental impact of existing organisational frameworks. For example:

- ***The virtual monopoly held by road transport***, which accounts for more than 96 per cent of the modal split in terms of tonnage of waste carried and 82 per cent in terms of traffic (t-km);
- ***Longer distances*** between waste generation and treatment points, sometimes over 500 km for materials such as plastics or hazardous wastes;
- ***Widespread increase in collection frequencies*** in urban areas, now almost every day in many towns (6 days a week);
- ***Poor understanding of where to site transfer stations***[18], which would allow vehicles to be matched to the tonnage to be carried and the distance travelled;
- ***Piecemeal transport operations*** and the difficulty of waste flow consolidation.

As with all logistics systems, those for waste have to adapt to their regulatory, economic, political and technical environments. Generally, these unsustainable practices can therefore be put down to five main constraints.

First, *a regulatory framework for "waste" that fails to take adequate account of transport*:

- The approach taken focuses primarily on the type of waste and the disposal technology imposed by the hazardous character of those wastes;
- Disposal systems based on territorial lines: at the *département* level, for household and assimilated wastes. The choice of this administrative level results in patchy local disposal plans, making flow consolidation more difficult and causing organisational rigidities, particularly in areas close to the boundary between *départements*;
- The existence of an unstated "proximity" principle, particularly in the context of the overall "life-cycle" approach that organisation takes.

Second, *too piecemeal an approach to disposal plans*, whether for industrial waste – which is rarely integrated into the firm's overall logistics chain and is usually treated separately in-house – or for household and assimilated waste where the priority is treatment technology with no broader overview of plans.

Third, *the lack of information on "waste transport and logistics"* until 1995-96 and a lack of communication between the Ministries of Environment, Transport, the ADEME and the European Communities and their target audience, the waste management authorities responsible for making waste policy and the engineers involved in setting up and implementing disposal procedures. These two factors partly explain the scant attention paid to transport and logistics criteria in local policy decisions on waste disposal.

Moreover, public resistance to waste plants often forces elected representatives into decisions on the siting of treatment facilities that make no economic or environmental sense. Conversely, the same facilities can be a source of employment and this criterion can undermine or outweigh location decisions that would be better from a logistics and economics standpoint.

Fourth, *an economically complex processing market*.

There are two types of facility that specialise in waste processing: first, public facilities, including sorting centres, incineration plants and landfill sites; and second, private industrial facilities for recycling, storage or other treatment. For industrial wastes, the choice of processing facility may depend on whether or not there are local facilities specialised in handling a particular material but also on the price of processing. Hence, it is not unusual for wastes to travel long distances for processing even if there is a suitable facility close to the point of generation.

For household and assimilated wastes, the proximity principle encourages local authorities to select processing sites in their own *département*, if there are any. However, stricter technical standards for registered installations restrict the number of disposal facilities, particularly class 1 landfills and incinerator plants and, as a direct result, increase the average distance that waste travels for disposal.

Lastly, materials from segregated collection or sorting procedures that are to be sent for recycling are subject to the law of supply and demand, which can change the choice of processing facility radically.

It is also important to note that wastes, whether inert, ordinary or special, may be handled by just one industrial group providing the full range of services from collection through to treatment and disposal of final waste to a class 1 landfill[19]. In this case, facilities owned by a group will be selected in preference to a competitor's facility, even if it is closer.

Fifth, *transport infrastructure supply rigidities.*

The main mode used for the transport leg of waste logistics strategies is road transport. The possibility of securing a modal shift depends, obviously, on the political will of waste holders, but also on the availability of alternative infrastructure. Rail is an alternative that is quite widely available, with a network that provides good coverage nationally, while the use of the inland waterway mode is restricted to river basins that have infrastructure with sufficiently large clearances (Rhine, Seine, Rhône, and the canals in the North) and where a waterway transport supply chain still exists.

3.1.2. The importance and specific features of waste transport in urban environments

Following decades of rapid urbanisation, cities now account for most (over 80 per cent) of France's population and most of its economic activities. The same trend, observable in all the industrialised countries, explains why urban wastes account for a substantial portion of all waste arisings.

In actual fact, an estimated 80 per cent of household and assimilated wastes, municipal wastes, industrial and construction wastes and a major portion of civil engineering wastes (50 per cent) are generated in cities and part of the disposal logistics chain is located in urban areas. This is equivalent to over **270 million tonnes of waste** per year and **10.8 billion t-km**, or over **48 per cent** of national waste traffic flows.

The fact that these wastes are generated in urban areas justifies our dealing with them under the issue of Urban Transport Plans (PDU), as defined by the Air and Energy Conservation Act of 31 December 1996.

Under the Act, freight traffic[20] must be taken into account alongside passenger traffic in urban transport planning procedures. The aim is to enable local elected representatives to reconcile the demands of economic development and improved quality of life in urban areas through an integrated approach to urban transport.

Special surveys carried out as part of France's national research programme, "Freight Transport in Towns[21]", have established that freight transport in urban areas accounts for around 30 per cent[22] of road occupancy rates by motor vehicles in circulation (in PC-km). These urban freight flows can be broken down into three main categories of travel as follows:

- 40 per cent for pick-up and deliveries by private sector industry, business and service companies;
- 40 per cent for shopping trips; and
- 20 per cent for other associated flows needed for the town to function (postal services, hospitals, home deliveries, removals, etc.).

Urban waste flows are classed as ancillary traffic and account for over 3 per cent[23] of total freight transport in urban areas. To this can be added a portion of the traffic generated by construction sites, which accounts for 5 per cent of the same total. An integrated approach to wastes and urban planning has advantages from the environmental and logistics standpoints.

From the **environmental standpoint**, cities and their suburbs can be defined as a natural space in which a large human population is concentrated and whose ecosystem, compromised at the point where the biosphere and human activities intersect, is no longer capable of regulating itself to maintain a viable balance on its own. The life of this ecosystem is therefore as much dependent on trade with the outside world as on its own inner workings. From the waste standpoint, this means:

- Firstly, that the inclusion of waste collection and disposal in logistics plans is essential for the urban area's survival under acceptable sanitary conditions; and
- Secondly, that the disamenities (pollution, noise, landtake, etc.) arising from waste management, particularly those generated by transport, present more of a problem in urban than in rural areas.

These features of the urban environment make efforts to achieve ***logistics synergies***[24] between different freight flows, even more essential in cities than in other places. For wastes, these efforts could focus on:

- The collection stage, where thought might usefully be given to:
  - ***combining trade deliveries and the collection of packaging wastes*** in the same runs using the same vehicles;
  - ***siting transfer stations in densely populated urban areas***, to consolidate disposal flows using modes of transport other than road;
  - ***putting in place new collection procedures*** using either innovative techniques such as pneumatic transport networks or technologies that already exist for other types of traffic, such as tramway networks;

- ***developing multi-purpose*** waste/goods vehicles, combining straight truck chassis and swap-bodies suitable for intermodal transport.

– Noise generation: developing the concept of a silent process, integrating all of the stages in waste disposal logistics chains, along the lines of what the refrigerated transport sector has already achieved with the cold chain.

These aspects should be considered within the framework of a zonal approach to the city, since the densest zone of urban areas – the city-centre – does not offer the same development potential or characteristics as outer areas.

3.2. Sustainable organisational frameworks for waste disposal

3.2.1. An issue that should be viewed from a sustainable development perspective

Developed countries now account for one-quarter of the total population of the world. Together, the countries of Western Europe, North America, Japan and Australia account for over 85 per cent of the annual consumption of the world's raw materials and energy.

This brings us to the issue of the division of the world's resources between the rich and poor countries of the world, the question of damage to the ecosystem which will be passed down to future generations and, more generally, the principle of sustainable development.

There are three ways in which this principle relates directly to waste:

– Source reduction of wastes generated by the developed countries;
– Disposal of remaining waste primarily through recycling and energy recovery techniques;
– Lastly, putting in place disposal plans based on systems that have the least possible negative impact on the environment.

As this report deals with waste transport, we will concentrate our analysis on the third of the above points and more specifically on the logistics stages: i.e. collection, transport, transit and handling of wastes.

As we have shown, the operation of the freight transport sector, and the waste transport sector in particular, is not neutral from an environmental standpoint.

Corrective measures are therefore needed, through technical improvements but also, and most importantly, organisational improvements to the systems put in place by the actors managing disposal processes.

3.2.2. Technical initiatives

Technical improvements concern mainly transport and collection equipment and, to a lesser extent, handling equipment and infrastructure. Accounting for more than 92 per cent of the waste transport sector's energy consumption, road transport is a major target for technical improvements, which can be classed into four categories:

- ***Engine technology improvements*** by industrial vehicle manufacturers, to reduce pollutant exhaust gases, principally in response to the Euro 1, Euro 2 and, soon, Euro 3 standards;
- ***Fuel improvements*** by oil companies, chiefly to reduce the sulphur content of fuel or remove certain hazardous substances such as lead;
- ***Post-treatment of exhaust emissions***, chiefly by fitting catalytic converters;
- ***Measures aimed at introducing new technologies onto the market,*** alternatives to diesel engines, such as electric, gas-powered and hybrid vehicles.

Although these technical measures are essential and have positive benefits for the environment, it can be difficult to gauge the overall impact they will have and, in the short term, they are not enough by themselves to improve the environmental performance of freight transport in general and waste transport in particular.

The difficulty of gauging the overall effect of such measures is illustrated by the conflicting aims of reducing pollutant exhaust gases (urban environment) and preventing greenhouse gases, which requires a reduction in CO_2 emissions and therefore in fuel consumption (intercity environment).

Since we know that, in the case of industrial vehicles, it is extremely difficult to reduce pollutant exhaust emissions and fuel consumption at the same time and that it is not possible for waste transport operators to use vehicles specially designed for each of these geographical operating environments, we are confronted with an environmental double-bind situation that will be difficult to resolve.

Finally, stricter technical standards for vehicles over the period 1995 to 2005 and traffic growth forecasts to 2005 should result in a reduction in the environmental burden from CO, NO_x and HC emissions while other pollutants, particularly CO_2, look set to rise slightly or remain unchanged.

However, after 2005, when forecast traffic growth will outweigh technical advances, this trend is likely to be reversed.

An analysis of this first type of measure shows the limited lifespan of technical improvements and their narrow scope of application, strictly limited to energy consumption, exhaust emissions, greenhouse gas emissions or noise. Issues such as traffic generation, infrastructure congestion, landtake and development planning still have to be addressed, which brings us to the consideration of integrated measures that would have a greater and more sustainable effect on the environment.

3.2.3. Organisation-based approach

The attempt to identify relevant policies has led us to an approach that is as far upstream as possible in the decisionmaking chain and to base our course of action on the organisational framework. Indeed, waste transport practices in general depend largely on the form of organisation put in place by specialist waste disposal operators, who are themselves dependent on factors in their business, regulatory, fiscal, technical and development planning environment.

With the overview that this approach gives us, we are able to see all the possible ways of achieving our dual objective, i.e. “less transport, better transport”.

First, *less transport*. This ambitious objective is aimed at reducing waste transport by addressing the organisational aspects of disposal, which until now have been based on the trial-and-error method. This unsatisfactory approach has resulted in the fragmentation of flows, empty runs and unnecessary transport operations and longer travel distances.

Challenging the principles which have led to poor economic and environmental performance will mean introducing a logistics approach into the organisational framework.

Second, *better transport*. Although waste minimisation is primordial, it is unrealistic to think that waste movements can be totally eliminated. Transport may be inevitable, but we should not forget that there are interactive means of transport available which are fairly energy-efficient.

Alternatives to "road only" are available, including intermodal transport, which uses a combination of road for the initial and final hauls and rail or inland waterway for the line-haul component of any one shipment. This technique makes the best use of each of the inland modes, combining the flexibility that road offers with the efficiency of rail or inland waterway transport.

The use of combined transport requires partnerships between the hauliers and shippers who are the key players in waste logistics chains.

Unfortunately, at the moment, intermodal transport is still encountering some development difficulties owing partly to service quality, capacity and pricing problems.

3.2.4. Organisational impact on waste disposal planning

In order to introduce a logistics approach into the waste disposal framework, the following points will need to be further developed:

- Revision of public authority/treatment plans for household and assimilated wastes;
- Analysis of the concept of "reverse logistics" in the industry and distribution sector.

Revision of plans for the disposal of household and assimilated wastes by the public authorities

Departmental plans are a means of ensuring the consistency of the resources used in order to achieve the objectives defined in the 1992 Act, particularly as concerns the organisation of waste transport operations and restrictions on flows in terms of quantities and distances.

They require the institution of an efficient waste management system at reasonable costs, i.e. transport[25] as well as treatment facilities. As we showed earlier, waste collection and transport generate substantial financial and environmental costs that should be factored into the overall costs of the disposal process.

This process, which has been complicated by the stricter regulatory environment, includes the following types of logistics operations:

- ***On-site handling and collection operations***
  On-site handling includes all the operations necessary for the removal of household wastes from the home or generation point to the point where they are picked up by the collection service.

Collection operations consist of regular collection rounds to pick up wastes.

- **Transit operations**
  The household waste collected is taken to waste transit or transfer stations where it is consolidated and off-loaded into bunkers, storage areas or containers. It may then be compacted and removed by large capacity vehicles to a treatment facility.

- **Storage, sorting and pre-processing operations**
  This phase involves sorting waste by type, rendering it less harmful to the environment, and compaction to reduce volume and facilitate onward transport and treatment.

- **Industrial operations**
  All of the operations performed on a waste: disposal (incineration), processing to produce raw materials (recycling and composting) or controlled landfill, i.e. storage for an indefinite duration.

- **Transport operations**
  The carriage of waste by large-capacity vehicles. There are two types of operation:
  - *Upstream operations*: the carriage of waste from the transfer station to the pre-treatment or end-treatment facility or directly to landfill and transport between pre-treatment and final processing facilities;
  - *Downstream operations*: comprising the transport of residues that cannot be reused or recycled from the end-treatment facility to landfill and the transport of recycled materials to consumer industry supply points.

- **Handling operations**
  Each of the logistics operations described above involves waste handling operations that either use special equipment or rely on gravity.

- **Information operations**
  Transmission of data on the nature, quantity, packing, hazardous character, etc. of the waste, is essential for managing the logistics chain and for tracking wastes. These information flows precede waste transport movements.

- **Lastly, end-destination operations**
  The final destination of waste, which will end its cycle either as it is or after treatment in a landfill, or as a recycled material that will be reintroduced into the economic cycle.

Logistics operations can be divided into three areas of responsibility or "organisational subsystems", which may be separately managed, as illustrated in Figure 4.

Each operation has an impact on the other components of the chain and hence on the operation of the chain as a whole. Moreover, optimal operation of each of the links does not necessarily mean optimal operation of the whole chain, which tends to be more a result of trade-offs between diverging interests.

Figure 4. **Sustainable organisation sub-systems for the disposal of household and assimilated wastes**

Upstream sub-system	Industrial facility	Downstream subsystem

Information flows

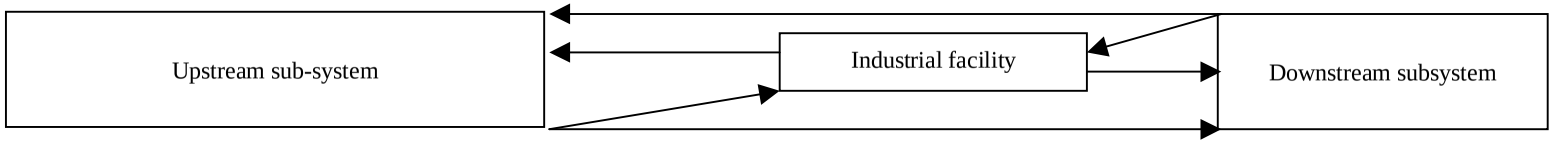
Downstream to upstream flow of statistical data on end destination of waste and its treatment – essential for managing the logistics chain

Upstream to downstream flow of operating data on quantities, schedules, etc. in advance of material flows

Materials flows

<u>On-site handling and collection</u> • Match collection techniques to treatment (conventional, public, etc.) and attempt to optimise rounds. • Sustainable collection: - Limited frequency; - Use of gas, electric, hybrid vehicles; - Pneumatic network. **Transit** • Advantages: - Limits use of household waste collection vehicles and crews to collection, not transport; - Allows flow consolidation; - Promotes use of intermodal techniques; - Optimises use of treatment facility by enlarging its hinterland and reducing delivery traffic. • Disadvantages: Necessitates load transfers and therefore increases logistics costs although this is set off by economies of scale through load consolidation and therefore lower transport costs. **<u>Upstream transport</u>** • Aimed at: - Flow consolidation; - Minimising empty return trips; - Complementarity of treatment processes in neighbouring areas; - Use of maximum capacity vehicles or introduction of alternative modes to road, particularly road/rail and road/inland waterway modes.	**Intermediate and final processing** Material flows Size and location of facilities will have an impact on both upstream and downstream parts of the process, particularly on transport in terms of distance, environmental impact and costs. Material flows Landfilling of untreated wastes (This link to cease under 1992 Act. From 1 July 2002 only final residues can be landfilled.)	**Downstream transport** - landfill; - encourage flow consolidation and use of multimodal techniques. **End destination** - landfill; - recycling (raw materials). The end destination of the wastes will shape the entire logistics chain.

Interrelationships between subsystems



There is no universal model that can consistently be used to locate the best possible site for transfer stations and treatment plants. The use of technical operational research tools can nevertheless be helpful in the process of identifying a compromise solution. An iterative process should therefore be used to identify the least disadvantageous solution.

The savings that can potentially be made justify systematising this approach by calculating the volume, tonnage and tonne-kilometre figures for each location scenario for transfer centres, treatment plants and controlled landfills

Analysis of the emerging concept of "reverse logistics" in the industry and distribution sectors

Environmental protection is changing the logistics balance of firms. Environmental issues have led, on the one hand, to changes in firms' transport policy and, on the other, to a longer logistics chain with compulsory recovery of wastes for reuse or recycling.

As a concept, logistics is constantly evolving and has to adapt to the requirements of the day. There have been three discernible stages in the development of integrated logistics, each involving a wider and wider scope of operations.

In the 1970s, logistics was a set of methods, tools and techniques aimed at managing the physical flows of a firm. Each function of the firm tended to be concerned with logistics but in a compartmentalised way.

In the 1980s, logistics was beginning to be an integrated process that sought to group distribution, production and supply operations under a single planning process with a view to optimising flows.

Today, logistics is becoming an integrated process that takes all the stages in a product's life cycle into account: design, procurement, production, distribution, maintenance, replacement and recycling/disposal. Since we cannot allow wastes to build up at points of production or consumption, substantial flows are generated. National and European regulations and public pressure are forcing firms to take into account and manage their waste flows.

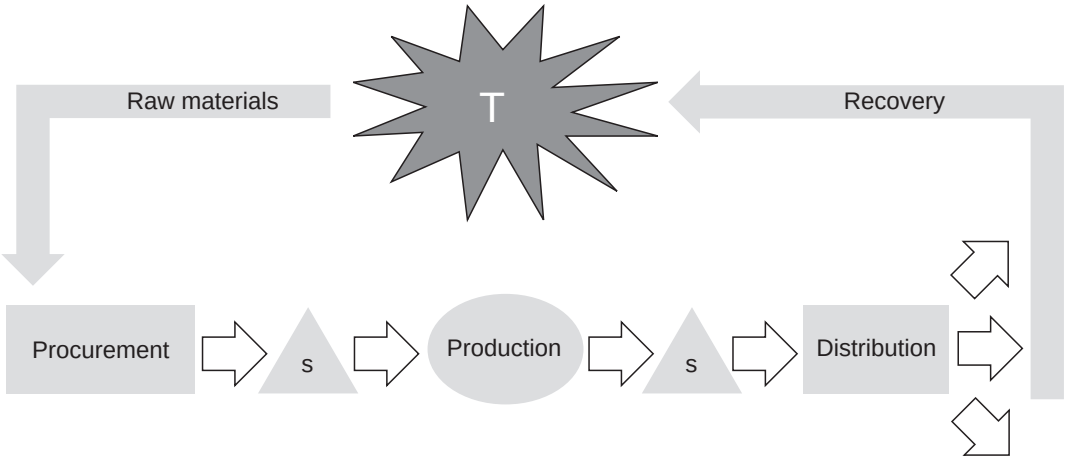
The European aim of banning any product that can be recycled from landfills is forcing industry to adopt new production and distribution methods.

Manufacturers are required to put in place strategies aimed at the concept of zero landfilling: recycling products at the end of their service life is now one of the criteria for a firm's future competitiveness.

This is indeed a logistics issue, because recovery gives rise to flow circulation problems and consequently flows have to be organised. This poses two problems:

- *Physical flow problems:* to deal with physical flows, strategic decisions regarding transport and storage options have to be taken;
- *Problems with information flow*: information should precede the physical flows. Data management is essential from both an organisational and a safety standpoint and covers information on waste identification, classification, transport and storage.

Figure 5. **Reverse logistics**



Source: ADEME, Direction de l'Air et des Transports.

Today, not all firms have yet begun integrating waste into their logistics plans, a process known as reverse logistics or closed-loop logistics.

This said, special systems have already been put in place by some companies, including:

- Waste collection and transport systems from factory to processing facility by collection/processing contractor;
- Supplier take-back systems;
- Segregated collection systems (voluntary return);
- On-site recovery system at processing facility;
- Integrated collection system.

In the majority of firms, these recovery networks are all separate from existing networks (distribution, after-sales and procurement).

This may be indicative of deficiencies in the logistics design of recovery networks. The strategy of returning wastes through distribution and after-sales channels would seem to be much better for the firm. At any rate, it should be pointed out that there are obstacles to setting up recovery operations based on distribution circuits: these are both technical and financial:

- Technical obstacles: the difficulty or impossibility of transporting used and new products in the same vehicle;
- Financial obstacles: the introduction of efficient recovery systems is expensive. Moreover, not all firms are capable of managing such flows. This is why they delegate these operations to specialist service providers which then set up ancillary recovery networks.

The examples listed in the above table show the commitment of the industry, distribution and logistics sectors to the problem of waste.

Table 14. **Examples of industrial waste recovery networks**

Firm	Business	Waste	Recovery network
Rank Xerox	Manufacturer	End of life photocopier and toner cartridges	Recovery of leased materials and consumables. Introduction of reverse distribution system: recovery rate 80 per cent. Grouping of wastes at Xerox Europe, which is also the production site. Logistics set up as an integral part of firm's overall policy. Environment is factored in right from product design stage.
General Electric Medical Services	Manufacturer	Medical equipment	Introduction of reverse distribution with recovery of all brands of used equipment by a logistics service provider which incorporates it into an extended dismantling, maintenance and reconditioning process.
Mercedes	Manufacturer	Cars	Dismantling of private cars and maintenance of a spare parts database.
Darty	Distributor	Household electrical appliances and packaging	Darty unpacks new appliances at its logistics site, checks their condition, covers them with temporary reusable protective packaging for delivery to customer. Darty's distribution centre therefore generates packaging wastes. Introduction of reverse distribution, taking back end-of-life appliances, which are then compacted for recovery of scrap metals or integrated into the "Envie"network for reconditioning and reintroduction to the domestic market.
France Logistique Service	Logistics	Office, information and other systems	Environmental logistics services set up for SMEs. They comprise: waste treatment, identification of treatment route, flow consolidation, bulk storage, regulatory watch, etc.
Paté	Waste operator	Glass	Segregated collection of glass from industry, retreatment. Segregated collection: crystal, window glass, bullet-proof glass, windscreen glass and cathode ray tubes. Processing: adapted to each different type of glass. Supply of remanufactured bottle, glass and fibreglass markets. Operates as sub-contractor for major customers covering the entire French market.

Source : This table was compiled following the round table of the *Cercle Interprofessionnel des Responsables Pour le Respect de l'Environnment* (CIPPRE), organised by the French Ministry of the Environment, on the theme "Logistics and the Environment", on 9 July 1998.

This commitment is underpinned by ongoing dialogue among the economic operators, consumers and the public authorities.

It is interesting to note that reverse distribution can cost three to four times less than collection and processing by local authorities as is shown by case studies on electrical and electronic materials and that it can result in source reduction of waste. For example, in the household appliances sector, Darty recycles around 5 kilograms of waste (average per delivery), equivalent to the recovery of 1 kilogram of waste per capita per year or 60 000 tonnes less for local authorities to handle. Another example is Paté, which recycles 1 000 tonnes of glass – i.e. 16 per cent of the French market – in its facilities daily.

These actors have committed themselves to this approach for three reasons:

- The introduction of industrial waste recovery regulations in the near future;
- The need to have dedicated logistics operations in place;
- The birth of a new business.

Lastly, it is difficult to keep track of and even sometimes to implement all the regulations in force in this area, particularly for SMEs. Making industry more aware and seeing that it is better informed about environmental aspects would seem to be the responsibility of public authorities.

The question that reverse logistics raises is whether the return of recovered wastes changes a firm's procurement systems in any way.

Changes to procurement procedures

Undeniably, these networks have an impact on the raw materials procurement policies of the industries concerned. Thirty per cent of non-energy raw materials supplied to French industry come from recycling processes.

Recycling networks do change raw materials procurement, since recovered products reduce the quantities of natural raw materials required. This change has an impact on:

- Networks (sourcing, distance);
- The means of transport used.

Recycled glass, for example, has totally revolutionised glass manufacturers' raw materials procurement systems since tonnes of cullet (recycled glass) reintroduced into the manufacturing process substantially reduce natural raw materials (silica) requirements. As a result, raw materials transport has changed radically too.

Cullet is transported in HGVs. The number of trains needed to transport sand is reduced: transport chains upstream have changed.

Lastly, logistics is now considered a tool for maximising capacity and streamlining operations. The aim is to avoid any operational problems and wastage: what could be more natural than to tie in logistics with waste disposal and, more generally, environmental protection.

GENERAL CONCLUSION

The study of organisational development in the current context of stricter regulation clearly shows a considerable increase in the transport flows associated with waste disposal.

In a country the size of France, total waste arisings of more than 880 million tonnes per year – over 30 per cent of which are transported, accounting for 15 per cent of all domestic traffic flows – give rise to a substantial waste transport problem.

Since transport typically involves heavy shipments over short distances – 43 km on average – the environmental impact of the sector is still within reasonable limits: 5 per cent of total energy consumed by the transport sector in France; 1 to 6 per cent of all freight sector emissions. However, these findings should be supplemented by further details on as yet unquantified urban and international collection flows. Furthermore, they should also be reviewed in the light of sustainable development – which, paradoxically, is the cause of the dramatic increase in waste transport – and revised in the short, medium and long term to include increases in both tonnage treated and shipments generated.

This increase concerns all types of materials, with the exception of agricultural wastes, the vast majority of which are treated *in situ*.

The growth in waste transport flows can be explained by two different factors, as follows:

- *"Natural" factors*, including the increase in the tonnage sent for treatment and the institution of disposal procedures that promote recycling, which naturally generates transport, to the detriment of more conventional techniques such as landfilling and incineration, which require less transport;
- *"Exacerbating"* factors: the failure to take transport and logistics criteria into account in setting up organisational frameworks; this exacerbates the problem.

An analysis of waste transport shows the emergence of a new industry within the freight transport sector, as happened with refrigerated and tanker transport. At the same time, the very strong position occupied by the three main integrated service providers is forcing specialist waste hauliers to provide a steadily wider range of services, including waste handling operations such as sorting and dismantling, not just transport.

It is interesting to note that the same phenomenon is also occurring in logistics. Requiring manufacturers to recover wastes generated by their production processes and sales of finished products is beginning to prompt a number of questions within the industrial logistics sector as well as innovative schemes, particularly in the field of reverse logistics.

Waste transport is a complex issue. The purpose of this report is to provide an overview and a tentative analysis of that issue. However, a number of questions still have to be answered, inter alia:

- **The definition of waste**. At what stage of recycling or recovery may it be considered that waste ceases to be waste and becomes a secondary raw material?

- **The classification of waste in statistical nomenclatures and statistical methodologies for monitoring the transport of waste**. Currently, waste cannot be distinguished in most of the statistical nomenclatures used in transport. Furthermore, it would be desirable that the statistical methods for monitoring waste transport at European level be defined more precisely and made consistent (type of waste investigated, types of transport monitored, etc.), and that the publication of minimum statistics on waste transport be made mandatory.

  With this aim in mind, a study could be done of two or three countries (France, Germany, the Netherlands) in order to propose a reference methodology for the European level, similar to that drawn up by France for statistics on packaging.

- **Improving knowledge**: While it is important to have general data on the various areas of waste transport, it is especially necessary to concentrate on certain areas which, while not the most important in absolute terms, offer the most significant scope for progress.

  Our level of knowledge concerning household waste is very uneven/sufficient, but inadequate concerning industrial waste.

- **Urban and interurban waste transport**: As regards urban transport, it is difficult to reduce distances, so the emphasis should be put on seeking ways of limiting the atttendant disamenities (by means of auto oil standards, LPG, noise abatement, etc.). Non-urban transport in contrast involves longer distances and thus lends itself to logistical solutions. Studies need to be carried out to compare the environmental effects and social impacts (road accidents, etc.) of the various possible types of organisation. The studies carried out by the ADEME of waste transport did not evaluate the social impacts of the various transport modes.

- **Alternatives to road transport**: Studies of alternatives to road transport should be made mandatory in territorial plans for waste disposal. It is also necessary to be able to detect in statistics the most blatant cases of environmentally-damaging road transport with a view to proposing alternative solutions to the parties concerned, with internalisation of the induced social and environmental costs.

NOTES

1. See the study by ADEME METL/Gérardin Conseil, “La logistique et le transport des déchets ménagers, agricoles et industriels”, September 1997, ref. 2265.

2. ITOM 6: National inventory of transfer processing facilities or municipal tips.

3. INDI: Survey (10 000 firms) to assess the volume of ordinary industrial waste.

4. ARTHUIT: Non-exhaustive reporting file of the processing of special industrial wastes.

5. The firm Eco-Emballage for the recovery of materials from paper, cardboard, plastic wastes, etc.;
   The firm Adelphe for glass bottles;
   The firm Cyclamed for pharmaceutical products.

6. See study by ADEME/Gérardin Conseil, “La logistique des déchets ménagers, agricoles et industriels; synthèse 1999”, March 1999, 101 pp,.

7. TOE = Tonnes Oil Equivalent.

8. GOE = Grammes Oil Equivalent.

9. CO_2 = carbon dioxide.

10. CO = carbon monoxide.

11. VOC = volatile organic compounds.

12. NOx = nitrogen oxides.

13. NGV = natural gas vehicles.

14. LPG = liquid petroleum gas.

15. See study by ADEME/Beture Environnement, “Analyse comparée de la collecte pneumatique des déchets”, October 1997, 120 pp.

16. See the study by ADEME/Erdyn Consultants, “Characterisation de l’utilisation des véhicules dédiés à la logistique des déchets, May 1999.

17. Combined rail-road transport:
    ECORAIL, Immeuble Cardinet, 5, Impasse Chalabre, BP 903, 75017 Paris. Tel: 01 44 85 86 96. Fax: 01 44 85 86 73.
    Combined waterway-road transport:
    Voies Navigables de France, 175, rue Ludovic Boutleux, BP 820, 62408 Béthune Cedex. Tel: 03 21 63 24 24. Fax: 03 21 63 24 42.

18. See: *Gestion des déchets ménagers et assimilés: transport et logistique*, Editions ADEME, Données et References. Ref. 3010, July 1998 (Gérardin Conseil). Chapitre 4,"L'organisation du transfert et du transport", pp. 51-61.

19. The circular of 22 January 1980 on disposal to landfill of industrial wastes, as supplemented by the order of 18 December 1992, defined three categories of landfill (sanitary landfill): Class 1 Landfill: impermeable sites (for industrial special wastes and municipal special wastes); Class 2 Landfills: semi-impermeable sites (household and ordinary wastes); Class 3 Landfills: permeable sites (inert wastes).

20. See: *Guide méthodologique -- Plans de Déplacements Urbains: prise en compte des marchandises*, co-edition CERTU/ADEME, September 1998.

21. See quantitative surveys, *Transport de Marchandises en Ville*, for Bordeaux, Marseilles and Dijon.

23. National TMV research programme, initiated by the ADEME and the METL in 1993, PREDIT 1996/2000.

24. See LET study, "Rapport détaillé, transport de marchandises en ville, enquête quantitative de Bordeaux: premiers enseignements", 1995.

25. See ADEME/CRET - LOG/BCEOM study, "Le transport des déchets en milieu urbain; recherche de synergies logistiques".

26. "Comparison multi-critère des techniques d'acheminement". See ADEME/BCEOM study, "Prise en compte du transport dans le cadre du plan départemental d'élimination des déchets ménagers du department de l'Aude".

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- Logistique et transport des déchets ménagers et assimilés
- Logistique et transport des déchets industriels
- Logistique et transport des déchets agricoles.

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Available = available for consultation at ADEME documentation centres.

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SUMMARY

Newcastle-upon-Tyne, June 1999

EXECUTIVE SUMMARY

The production of waste has, historically, been an intrinsic part of human endeavour aimed at wealth creation. The gathering of statistics on waste in Europe has gained momentum in the 1990s, but even now, approaching the millennium, the data is incomplete and riddled with inconsistencies related to elements as fundamental as waste definition and measurement technique. Detailed data on the modal transportation of wastes in terms of a unitary measurement such as vehicle-kilometres per tonne of waste type simply is not collated centrally and is therefore not available for strategic planning.

The data which is available shows a steady climb in waste quantities, with an estimated 10 per cent increase in the European Union since 1990. Such growth raises concerns about the potential impact on the ability of authorities to protect human health and the environment and of companies to continue to generate wealth through sustainable profitable growth. It is currently estimated that OECD Europe countries generate 4 billion tonnes of waste every year.

So far, legislation and voluntary agreements have addressed the need to prevent the creation of waste, to recycle or re-use materials and to dispose of waste, using approved facilities, as closely as possible to where it is generated. The impact of global warming gases from landfills is under scrutiny and specific legislation has been passed in Europe to ensure the safe disposal and treatment of hazardous wastes. Moving closer to transportation of wastes, transfrontier shipment of waste is controlled and a system of consignment notes is required to provide an audit trail of the fate of hazardous wastes.

Meanwhile, road freight continues to grow faster than the growth of GDP, at the apparent cost of rail freight, which has been declining. In 1996, road freight represented 73 per cent of the freight market. It is generally accepted that freight transport dominates also in the shipment of waste.

Current and future strategic planning is concerned about managing a sustainable built environment. In the field of waste management, it is important that transport and environmental policies are not developed in isolation. In order that the impact of transport may be properly accounted for in strategic planning of waste management, the following actions are recommended:

- Ensure comparable data is collected on all aspects of waste management, including for the first time information relating to the transport of wastes (in terms of tonne-kilometres) by mode;
- Examine the application of full cost pricing on waste in order to encourage shipment by the most sustainable mode;
- Review the effectiveness of the present waste strategies, with particular regard to the application of self-sufficiency and the proximity principle;
- Document proven best practice and encourage widespread take-up through effective information transfer and supported pilot schemes.

1. INTRODUCTION

This paper examines current issues regarding the transportation of waste products in Europe.

Economic development has caused increased production of waste worldwide. There is concern in Europe, as elsewhere, about the possible environmental impacts of the increasing volumes of waste and, particularly, the risks associated with uncontrolled waste disposal. Consequently, the EU has developed a framework for waste management in which Directives on Waste, Incineration, Hazardous Waste, Transfrontier Shipment of Waste and a proposed Directive on Landfilling, form a central part. The approach is based on the principles of waste prevention, reduction, reuse, recycle and proximity of disposal. With regard to costs, the key principle is that of the polluter pays.

These principles are fundamental to sustainable management of waste and are equally relevant to all OECD countries. The implementation of measures to meet legislation which is based on these fundamental principles will inevitably have an effect on the transportation of waste at all levels, from local to international operations. In addition, while it is clear that the commonly used methods of waste disposal, such as landfilling and incineration, can directly lead to pollution, other activities within the disposal cycle also contribute to the total environmental burden, for example, the shipment of waste. In this context, some modes of waste transport, notably rail and inland waterway, may be considered to have lower environmental impacts than others, particularly road and air.

During the past decade, the problem of transfrontier shipment of hazardous wastes and their final disposal far from the place of generation, has become a major environmental issue acknowledged by the international community. A number of widely publicised incidents of uncontrolled dumping of hazardous wastes, originating from industrialised nations, in developing countries, created worldwide awareness of the dangers connected with this practice.

With these factors in mind, the objective of this paper is to provide an overview of legal, economic and environmental issues associated with the transportation of wastes across Europe. In particular, it examines:

- Waste generation and treatment;
- Demand for freight transport and the changing market share for transport modes;
- International legislation and policy concerning waste management and in particular the movement of wastes; and
- Perspectives on waste transport options in the future.

2. TRENDS IN WASTE TRANSPORT

Statistics on waste generation are undeveloped in most European countries. Historically, reliable estimates of waste arising were difficult to obtain as very little waste was weighed. In consequence, statistics on the transport of waste (in terms of tonne-kilometres by mode) are not available in Europe. For the purpose of this paper, therefore, trends in waste generation and freight transport have to be considered independent of each other. Notwithstanding this, it is generally acknowledged that road traffic provides the primary mode of waste transport across Europe.

2.1. Trends in European freight transport

Transportation in Europe has changed considerably during the last few decades. Developments are determined by two major trends: growing demand for transport and the changing market share for transport modes.

Changes in the volume and structure of economic activity clearly have immediate repercussions on the transport systems. In the European Union, during the period between 1970 and 1996, an average annual rate of Gross Domestic Product of around 2.5 per cent was accompanied by a similar annual growth rate for freight transport generally and almost a 5 per cent increase for road freight in particular.

The choice between different modes of transport is determined by user needs, on the one hand and the services and costs offered by each mode, on the other. In essence, changes that have taken place in recent years have favoured road over less polluting rail and waterway transport. Regarding freight transport, there have been significant changes in the modal split (excluding by sea) over the last few decades. The market share for road freight has increased from 48 per cent in 1970, to over 73 per cent in 1996, whilst rail freight has dropped from 33 to 14 per cent during the same period.

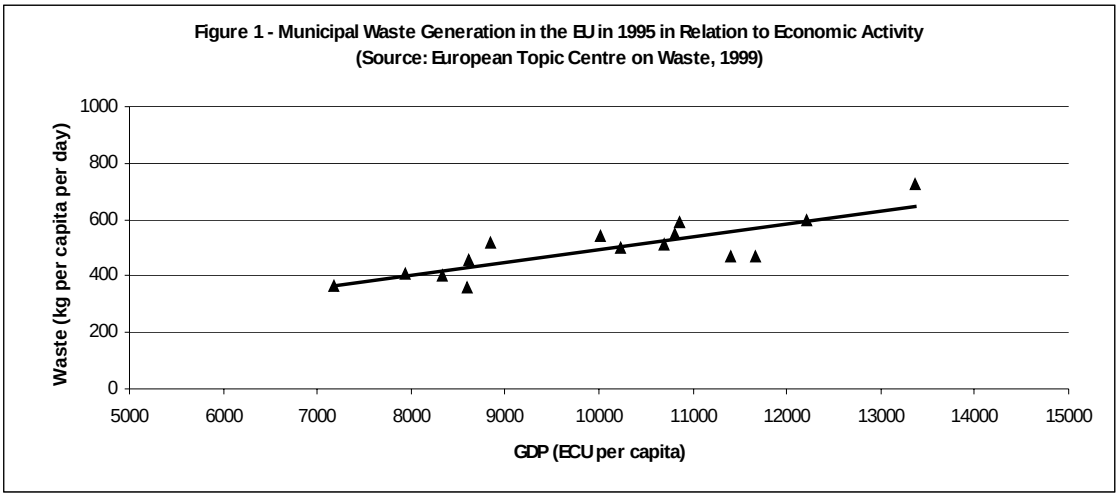
2.2. Trends in waste generation and treatment

Statistics on waste are still not fully developed in most European countries. The lack of reliable data on the quantities and quality of various waste streams, their sources and disposal routes throughout Europe makes it impossible to quantify the overall environmental impact of waste production, management and transport. However, indications of the scale of the situation can be derived from the available data on waste production and management reported in the most up-to-date information provided by national agencies.

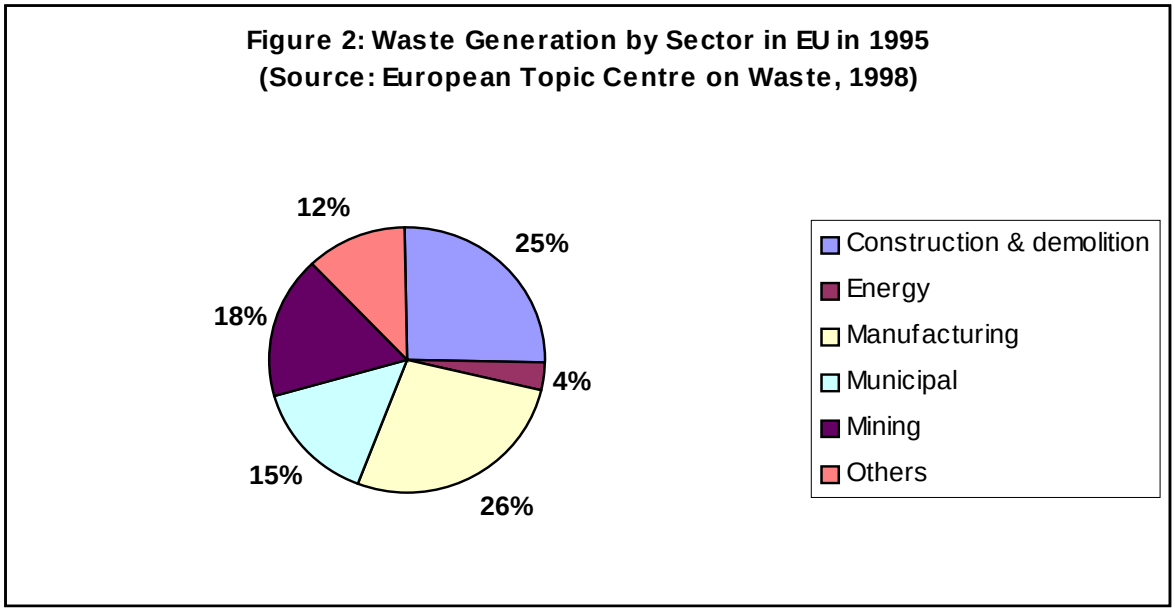
2.2.1. Waste generation

Waste production is important from two points of view: It can give rise to environmental and human health problems and it is a reflection of inefficient use of resources. Economic development involving increased production and consumption of materials has created a worldwide increase in the production of waste. This trend is clearly illustrated by the relationship between economic growth and municipal waste generation in the European Union Member States, as shown in Figure 1. The inference from this is that waste shipment volumes also increase with economic growth.

The total quantity of waste produced by industrial societies is vast, estimated at around 4 billion tonnes a year in OECD Europe alone, which represents about 5 tonnes a year for every man, woman and child. All human activities are potential sources of waste. Wastes can be classified according to their sources, which primarily include the five major sectors of agriculture, mining, manufacturing, municipal and energy production. Given current national statistics on waste, it is not possible to provide an accurate figure of the total produced in Europe. Notwithstanding this, the latest published figure for annual total waste production for OECD Europe excluding radioactive waste, is 2 225 million tonnes[1]. However, for about 40 per cent of the countries covered by the report, the totals exclude agricultural and mining wastes. Estimates of the volumes of such wastes in those countries conservatively suggest that 4 000 million tonnes of solid waste are currently generated in the whole of OECD Europe each year.



Reported waste generation in the European Union in 1995 was 1 287 million tonnes. This total represents almost a ten per cent increase since 1990, which probably reflects both improvements in the reporting of waste generation and year-on-year increases in waste generation. The principal waste producers are the construction and manufacturing sectors, as illustrated in Figure 2. Not all countries consider residues from mining activities as waste and monitoring of agricultural waste is neither consistent nor comparable with that of other types of waste. Furthermore, no comparable data is available for non-EU European countries.



2.2.1.1. Municipal waste

In addition to its source, waste can also be classified according to its various components. Although the composition of municipal waste varies widely from country to country, some general patterns can be detected. Organic waste, for example, accounts for a large share of municipal waste in most European countries. Paper is still a major waste stream despite recycling efforts. Waste plastic especially is found in increasing proportions in western European countries.

Municipal solid waste is the stream for which the most reliable data is available; nevertheless, considerable gaps still remain in determining even a basic picture of trends in generation for Europe as a whole. Furthermore, the OECD definition of municipal solid waste is not systematically applied even within OECD Europe and there are a number of notable deviations. For instance, the German and Swiss interpretations exclude wastes collected separately outside the public sector for recycling, whereas the UK reports data only for household waste and not for municipal waste as a whole.

Municipal wastes in Europe have increased markedly over recent decades. The total reported quantity of municipal waste for OECD Europe increased by almost 5 million tonnes a year from 1980 to 1995, an increase of 56 per cent over the period. More recently, municipal waste generation is estimated to have increased by 11 per cent in OECD European countries between 1990 and 1995. It is estimated that over 200 million tonnes of municipal waste was generated in the OECD European area in 1995, representing around 10 per cent of total waste generation reported.

Municipal waste generation in OECD Europe is thus equivalent to approximately 420 kilograms per person per year. There are, however, marked national variations in this figure with municipal waste production per capita in European countries ranging between 150 and 600 kgs per year. The Netherlands, Norway and the United Kingdom are reported to have the highest municipal waste generation per capita rates of the European Union Member States.

In general, western European countries generate more than 1 kg of municipal waste per person per day, which is higher than that produced per capita in most Central and Eastern European Countries. Comparing waste production in OECD countries, the level of municipal waste production appears to be correlated to the level of industrialisation and the level of income.

Municipal waste generation in European Union Member States is reported to have increased from 135 million tonnes in 1990 to 155 million tonnes in 1995; an increase of approximately 15 per cent over the period.

2.2.1.2. Industrial waste

Wastes from industrial processes include a wide range of materials that may have varied chemical composition and physical state. Depending on the different industrial sectors, industrial wastes may contain varying proportions of organic and inorganic compounds. It is their heterogeneity that makes their treatment and disposal difficult. Clearly, industrial waste comprises many different streams and a number of them are classified as “hazardous”. Major categories of industrial wastes which are considered hazardous include solvents, waste paint, waste containing heavy metals, acids and oily waste.

OECD Europe reported that 410 million tonnes of industrial waste were generated in 1995, compared with approximately 377 million tonnes in 1990, an average increase of 9.4 million tonnes (2.5 per cent) per year. Reporting of industrial waste is less comprehensive than that of municipal waste; the data is generally aggregated and, in many instances, estimated.

2.2.1.3. Hazardous waste

Hazardous wastes form only a small fraction of total wastes generated in Europe, but may present serious threats to human health and the environment if not managed and disposed of safely.

Statistics concerning hazardous waste are still incomplete and existing data may be considered as unreliable. Furthermore, the definition of hazardous waste varies between countries (such as in the Basel Convention, OECD lists, the European Waste Catalogue, etc.), implying that cross-comparisons are misleading. In general, waste containing metallic compounds, halogenated solvents, acids, asbestos, organo-halogen compounds, organo-phosphate compounds, cyanides or phenols is regarded as hazardous waste.

Germany and France were the largest contributors to the approximately 42 million tonnes per year of hazardous waste reported by OECD European countries for the period around 1994.

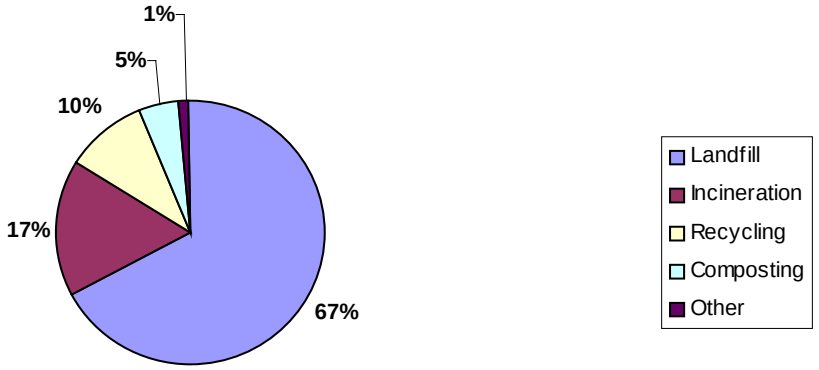
Substantial amounts of hazardous waste (estimated to be about 6 million tonnes per annum) are generated in Central and Eastern Europe, but reliable data based on internationally recognised definitions is largely unavailable. As in the European Union, wastes that are considered hazardous in these countries generally include solvents, waste paints, waste containing heavy metals, acids and oily wastes. In addition, an estimated further 25 to 30 million tonnes of hazardous waste are produced each year in the Russian Federation.

2.2.2. Waste disposal

During the last two decades, European countries have established various control systems for the management of waste, giving increased attention to waste prevention strategies. Since the mid-1970s, OECD countries have adopted a hierarchy of preferred options for waste management. When aiming to minimise the environmental burden associated with waste management, waste prevention is preferred to recycling; recycling is preferred to incineration; while disposal onto and into land is the least preferred option of the accepted methods of disposing of waste. More recently, the European Union has adopted a strategy for waste management in which primary emphasis is laid on waste prevention, recovery of materials and optimisation of final disposal. Despite the increasing emphasis on waste prevention, wastes' production has increased. Landfill and incineration, rather than recycling, are still predominant practices in the management of waste.

Waste management in Europe continues to be dominated by the cheapest available option, landfill (as shown in Figures 3 and 4), despite the accepted principle that waste disposal in or on land should be considered as the least desirable option. The extent of the use of landfill varies between countries. In some countries, which have reached saturation of landfill capacity or have imposed certain restrictions on the landfilling of certain wastes, such as in Austria, Denmark, Germany and the Netherlands, an increasing proportion is now incinerated or submitted to other treatment. In addition, increasing concerns for the emissions of toxic substances from incineration plants have led countries such as Germany and the Netherlands to adopt new programmes for waste prevention and recycling.

Figure 3: Management of Municipal Waste in the EU in 1995 (Source: European Topic Centre on Waste, 1998)



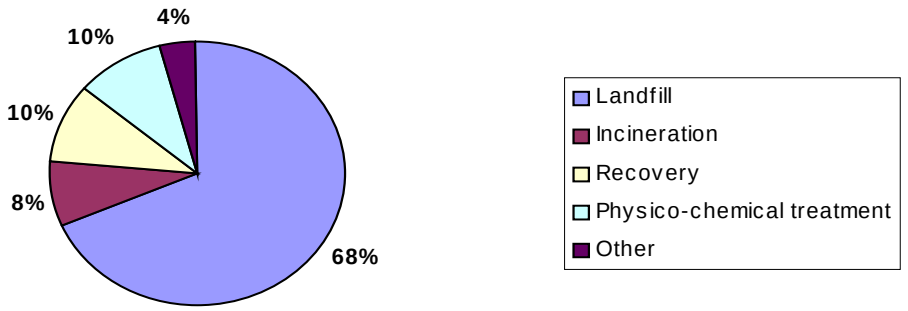
Clearly, the disposal of waste on land is still the major disposal route in Europe. As illustrated in Figure 3, on average, 67 per cent of municipal waste was delivered to landfill sites in European Union Member States in 1995. However, there are major variations between countries. For example, in the UK and Spain, almost 85 per cent of municipal waste is landfilled. In France it is 47 per cent, whereas in the Netherlands it is only 34 per cent.

Incineration is the second main disposal route in Europe; with the average rate of incineration of municipal waste being around 17 per cent. A few northern (Norway and Sweden) and western (Denmark, France, Germany and Switzerland) European countries rely heavily on a significant incineration capacity. Several countries such as the Netherlands, Belgium, the UK, Italy and Sweden have planned to increase their incineration capacity to meet waste treatment needs.

Disposal by means of recycling and composting accounted for less than 15 per cent of municipal waste in the European Union in 1995. Although the contribution of recycling/re-use facilities appears to be insignificant in comparison to landfilling and incineration, it should be recognised that, as a consequence of the European Union's waste management strategy, it is estimated that this figure has increased by around 4 per cent since 1990.

The situation regarding the disposal of hazardous waste is very similar to that of municipal waste, with landfill and incineration being the predominant routes, as illustrated in Figure 4.

Figure 4: Management of Hazardous Waste in EU in 1995 (Source: European Topic Centre on Waste, 1998)

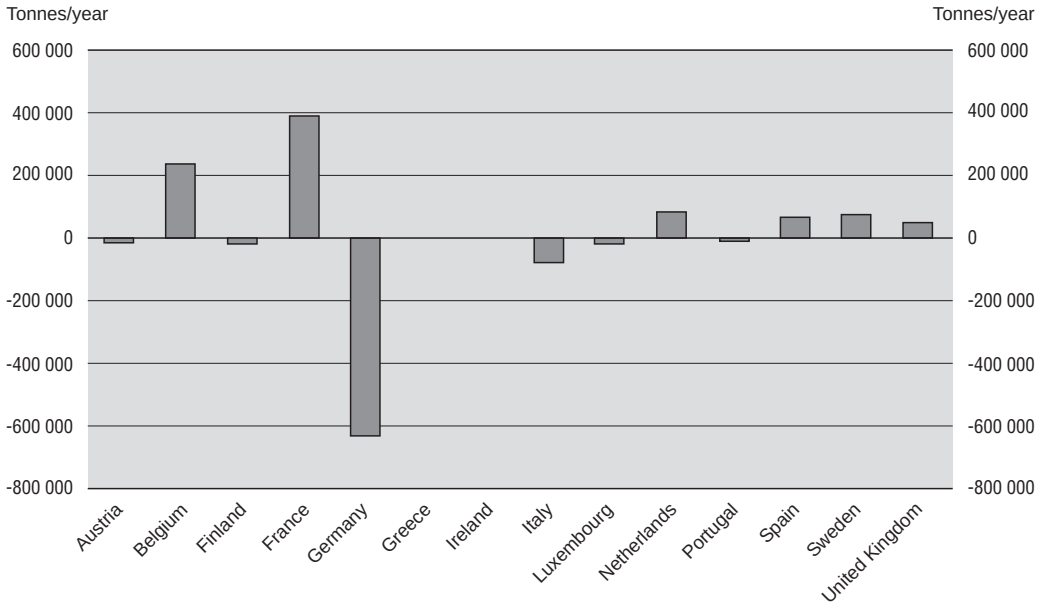


2.3. Waste transport

As mentioned, detailed data on the transportation of waste (in terms of vehicle-kilometres) is not collated within Europe at present. This is an area that the European Commission is considering for the future. At present, the emphasis is towards harmonizing waste production and treatment statistics. Nevertheless, statistics are published concerning the transfrontier movements of hazardous wastes.

The European Commission's report to the Basel Convention reported that over 1.4 million tonnes of hazardous waste was exported from the 15 European Union Member States in 1995, whilst around 1.6 million tonnes of hazardous waste was imported. Germany is consistently the largest net exporter of hazardous waste, whilst Belgium and France continue to be large net importers, as illustrated in Figure 5. Further, France and Belgium are the principal destination countries for exported wastes from Germany and, considering that most EU countries are net importers of waste rather than exporters, this suggests that in general the proximity principle is applied to the movement of hazardous waste within the EU.

Figure 5. **Net import and export of hazardous waste in EU in 1995**



Source: European Topic Centre on Waste, 1998.

Of the 1.4 million tonnes of hazardous waste exported from European Union Member States in 1995, 91 per cent was exported to the other Member States and most of the remaining 9 per cent to OECD countries. A relatively small quantity, around 5 000 tonnes, was exported to non-OECD countries. The majority of waste imports were from other European Union Member States.

Excluding the reported figure for France, which did not provide any information on the treatment of the waste, the returns to the Basel Convention illustrate that 92 per cent of hazardous waste is imported for recycling.

Historically, the patterns of hazardous waste movements have shown two clear directions across Europe, from North to South and from West to East. The transfrontier movements of hazardous waste within Europe have historically been influenced by a number of factors, including waste management capacity, regulatory standards and controls over transfrontier movements. Clearly, improvement in these respects across Europe and particularly the implementation of the Basel Convention, will help to reduce these movements.

3. INTERNATIONAL WASTE MANAGEMENT LEGISLATION

This chapter provides an overview of international waste management legislation, with regard to a large number of binding and non-binding legal instruments that specifically address this issue.

3.1. The Basel Convention

The Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal was adopted in 1989 and entered into force on 5th May 1992. The Convention is the response of the international community to the problems caused by the annual worldwide production of 400 million tonnes of wastes which are considered to be hazardous to people or the environment. It was initiated in response to numerous international incidents regarding hazardous waste trafficking that began to occur in the late 1980s.

This global environmental treaty strictly regulates the transboundary movements of hazardous wastes and provides obligations to its parties to ensure that such wastes are managed and disposed of in an environmentally sound manner. The fundamental principles of the Basel Convention are as follows:

- The generation of hazardous wastes should be reduced to a minimum (the "waste minimisation" principle);
- Where it is unavoidable, the wastes should be disposed of as close as possible to the source of generation (the "proximity" principle);
- In a number of instances, the export of hazardous wastes is prohibited absolutely;
- In all other cases, transboundary hazardous waste movements must conform to the provisions of the Convention: they are permissible only if they present the best solution from an environmental viewpoint; if the principles of environmentally sound management and non-discrimination are observed; and if they take place in conformity with the regulatory system established by the Convention;
- The cornerstone of this regulatory system is the prior informed consent of the prospective states of export, import and transit; and
- Hazardous wastes that have been exported illegally must be re-imported into the State of origin.

Supporting the implementation of these principles, the Secretariat to the Basel Convention controls the transboundary movement of wastes, monitors and prevents illegal traffic, provides assistance for the environmentally sound management of hazardous wastes, promotes co-operation between parties in this field and develops technical guidelines for the management of hazardous wastes.

Since the transboundary movements of waste within Europe and worldwide for that matter, are strongly influenced by the different regulatory requirements between countries for disposing of waste, it became evident that the harmonization of waste management standards across the globe was a critical step towards reducing the risk of transfrontier hazardous waste movements. In recognition of this, in March 1994, the sixty-five Member countries of the Basel Convention agreed by consensus to ban all exports of hazardous wastes (for both disposal and recovery) from OECD to non-OECD countries by the year 1998. However, the ban has still to be ratified by most States. The Basel ban was called "Decision II/12". The Convention subsequently agreed lists of wastes that are covered by the ban (List A) and those which are not (List B).

The Basel Convention supports the major concepts upon which a future global waste management regime should be based. The Convention's fundamental principles of waste minimisation, proximity of disposal, environmentally sound waste management and "cradle-to-grave" monitoring by means of an international control system, indicate a tendency towards an integrated

approach to pollution control. By addressing the necessity of protecting the global environment against the adverse effects of the hazardous wastes, establishing global standards for waste management and calling for the exchange of information between States and mutual assistance in technical fields, the Basel Convention contains most elements of a holistic approach towards environmental protection.

Clearly the Basel Convention serves as an umbrella for the waste management systems of the OECD and the European Union. Each of these systems is now discussed in further detail.

3.2. OECD Waste Management System

Trade in recoverable wastes in the OECD area involves about 200 million tonnes of materials valued at about 20 billion pounds sterling per year. In 1992, the OECD Council adopted a decision (legally binding on those who agreed to it), setting up a comprehensive regime for managing this trade. Existing OECD rules are now discussed in detail.

The OECD's work in the field of waste management is extensive. In 1976, the OECD outlined a comprehensive waste management policy, which advocated an integrated and holistic approach to the problem. It emphasized the importance of both the reduction of wastes at source and the promotion of recycling or re-use of wastes.

Subsequent legal instruments adopted by the OECD adhered to the principles of the earlier policy. In 1984, the Council adopted a decision and a recommendation addressing in particular the issue of the movements of hazardous wastes. It imposed a binding obligation on OECD Member States to control transfrontier movement of hazardous wastes and recommended a set of principles to be applied by States in implementing this requirement. These principles included the environmentally sound management of hazardous wastes and the imposition of duties on the waste producer in this context; the principle of non-discrimination; full co-operation between all countries involved, including notification of competent authorities and the right of the importing State to oppose any waste movement; and the duty to re-import. It also introduced the concept of "cradle-to-grave" monitoring of hazardous wastes.

The 1984 decision ultimately formed the basis of the Basel Convention. As a consequence, the OECD later concentrated on the issue of the transfrontier traffic in recyclable wastes and in 1992 elaborated a Council Decision Concerning the Control of Transfrontier Movements of Wastes Destined for Recovery Operations. The decision governs the transfrontier movements of recyclable wastes exclusively among OECD Member States, encompassing both hazardous and non-hazardous wastes. The 1992 Decision establishes a "three-tier system": in accordance with their nature and hazard potential. Wastes are allocated to one of three lists to which different levels of control apply. The Decision establishes a procedure and a set of criteria to be used in the allocation of a waste to one of these lists.

The "green list" of recyclable wastes is perceived as comparatively harmless and includes certain metals and metal alloys, plastic, paper, glass, textiles, etc. It is subject only to controls "normally applied in commercial transactions" provided that the wastes do not have any hazardous characteristics.

Recyclable wastes contained in the "amber list" are subject to a control system, which requires a written contract between the parties involved. This must include provisions for financial security and

allocation of responsibility for shipment, prior notification to and tacit consent of, the competent authorities of the States concerned, a movement document accompanying the shipment and the duty of the producer to arrange for the safe disposal or return of the waste if the shipment cannot be carried out in accordance with the arrangements. The "amber list" is quite extensive and includes wastes such as ashes and residues of various metals, waste oil and petrol, sewage sludge and household waste.

The "red list" of wastes is subject to the same controls as those in the "amber list", but requires compulsory, prior informed consent in every case. This list, comprising recyclable materials considered intrinsically hazardous, includes substances such as PCBs, tarry residues and asbestos and similar fibres.

The 1992 decision also requires wastes subject to its provisions to be shipped to an authorised recovery facility and transport to be carried out in accordance with relevant international transport agreements.

In summary, all exports of wastes for recovery, from the European Community or OECD Europe, are prohibited unless the parties are signatories to the Basel Convention or are OECD Members, and bilateral or regional agreements have been concluded. Similarly, imports of waste for recovery into the European Community can only be made by Members of the OECD providing that they comply with the OECD control system, which has also been implemented by the European Community Waste Shipment Regulation (259/93/EEC) and which is discussed in the preceding section. Indeed, as a result of the close involvement of the European Commission and the European Union Member States in the OECD's work, the EU policy and legislation on hazardous wastes has developed largely in parallel with that of the OECD.

3.3. European Union waste management legislation

The European Union's waste management policy evolved in the 1970s. Since 1973, five Action Programmes on the Environment have been adopted, each constituting the fundamental reference character for EU environmental policy for a given period of time. The second and third Action Programmes established three main objectives for waste management, which were confirmed and elaborated in subsequent programmes:

- The prevention and reduction of non-recoverable waste;
- The recycling or re-use of waste wherever possible; and
- The proper management and safe disposal of non-recoverable waste.

The Fifth Action Programme on the Environment identified as one of the key tasks for the 1990s the need to halt and to reverse the current trends in waste generation, in terms of both volume increase and in environmental hazard and damage. On the basis of the European Union strategy for waste, actions have subsequently focused on the waste management hierarchy of prevention, recycling and re-use and optimisation of final disposal. The legislation that implements these stated aims is now discussed.

The overall structure for an effective waste management regime in the European Union is set out in the Waste Framework Directive and the complementary Hazardous Waste Directive. These directives establish the framework for waste management structures, which has been elaborated by

two types of "daughter" directives: one group sets down requirements for the permitting and operation of waste disposal facilities; the other group deals with specific types of waste.

3.3.1. Waste Framework Directives (1975 and 1991)

The Waste Framework Directive of 1975, as amended in 1991, elaborates the general principles of waste management in the European Union. The amendment considerably extends the range of waste products and operations covered by the original Directive in 1975. It is not limited to wastes with hazardous characteristics and applies to wastes destined for both final disposal and for recycling and recovery operations. The new framework also provided a common terminology and definitions of waste based on work carried out by the OECD.

The Waste Framework Directive requires Member States to promote measures for waste minimisation and for the recycling and reprocessing of wastes, the generation of which is unavoidable. Furthermore, in accordance with the principle of proximity and the aim of achieving self-sufficiency in waste disposal in the European Union (and as far as possible within each Member State), Member States are required to establish, in co-operation with each other as appropriate, a network of authorised waste disposal installations. This network must guarantee the disposal of each type of waste in the nearest appropriate disposal facility, to be determined on the basis of high environmental and human health standards. The nearest facility need not be located within the national boundaries of the generating State. Transfrontier transport of wastes to neighbouring States will therefore not necessarily be reduced. The disposal network should, however, lead to a minimisation of long-distance transport of wastes.

To further this aim, the Waste Framework Directive also requires Member States to draw up detailed waste management plans covering the wastes to be recovered or disposed of, technical requirements, special arrangements for particular wastes and suitable disposal sites or installations. Members must also introduce permit systems for disposal operations and installations. In addition, establishments that collect or transport waste on a professional basis must also be registered. Inspection and record-keeping requirements are also laid down.

In accordance with the "polluter pays" principle, the cost of waste disposal must be borne by the holder or the previous holder of the waste.

The initiative to create a general nomenclature for waste has been undertaken by the European Commission through the development of its European Waste Catalogue. The EWC has been developed in compliance with the Waste Framework Directives, which require a common reference list of waste to be established across the EU Member States. Its implementation will provide a common basis for cross-referencing national lists and facilitate the implementation of EU waste management policies. The EU and UNECE are co-operating towards extending the catalogue to all European countries.

3.3.2. Hazardous waste

The principal aim of the Council Directive 91/689/EEC is to formulate a common definition of hazardous waste and introduce greater harmonization of the management of such waste. It lists hazardous wastes, constituents and properties that render waste hazardous. Establishments that carry out their own waste disposal will need a licence.

Hazardous waste management plans have to be published by the competent authorities, either as part of the general waste management plan (according to 75/442/EEC) or separately. Member States must require:

- Registration and identification of every site where hazardous waste is delivered; and
- Packaging and labelling according to Community and international standards when such waste is collected, transported and temporarily stored.

The competent authorities must inspect installations producing and receiving hazardous waste as well as means of transporting the waste.

3.3.3. Shipment of waste

Regulation 259/93/EEC, on the supervision and control of shipments of waste within, into and out of the European Community, establishes a system for controlling the movement of waste which implements the Basel Convention, the OECD Council Decisions on transfrontier movements of waste and the fourth ACP-EEC (Lomé) Convention. Whilst the Basel Convention deals only with hazardous waste, the Regulation also covers shipments of non-hazardous waste. The Regulation sets up separate regimes governing shipments within the EU, imports, exports and transit shipments and the different requirements depend on whether the waste is destined for recovery or disposal and whether it is listed in the annexes on the green, amber or red list. In general terms, it can be said that the amber and red lists consist of hazardous waste and the green list of non-hazardous waste. These three lists resulted from workings of the OECD.

In 1998, the list of wastes banned for export from the European Community to non-OECD countries was agreed by the European Commission. The new list, amending the original annex to the 1993 Regulation on waste shipments, implements the international rules agreed earlier in the year under the Basel Convention (the "Basel Ban"). The new EU list imposes the export ban on a wider range of wastes than those agreed under the Basel Convention.

In addition to the Basel Convention's List A, wastes on the EU's hazardous waste list or the OECD's red and amber list may also be banned. It should also be noted, however, that the new EC instrument is structured so that any material appearing on List B can continue to be exported even if it appears on the EU hazardous waste list or on the red or amber lists.

3.3.4. Waste disposal installations

This section of the paper reviews the legislation that governs waste disposal installations in the European Union. This legislation includes the Hazardous Waste Incineration Directive, the Municipal Waste Incineration Directive and the Commission's Proposal on Landfill.

3.3.4.1. Hazardous Waste Incineration

The Hazardous Waste Incineration Directive (94/67/EEC) is a daughter directive to the Waste Framework Directive. Member States must set and enforce operating conditions and emission limit values for hazardous waste incineration plants through permits.

A permit under the Waste Framework Directive may only be granted if the incineration plant is designed, equipped and operated in such a manner that environmental pollution prevention requirements in the form of emission limits and management controls have been met. Hazardous waste incineration plants must be operated in order to achieve the maximum level of incineration possible. Permits must list the types and quantities of hazardous waste being incinerated. Incinerator operators must receive a comprehensive description of any waste before they can accept it. Exceeding of the emission limit value must be notified to the competent authority without delay and can result in reduction of incineration outputs or closure of the plant.

3.3.4.2. Waste Incineration from New and Existing Installations

Directives 89/369/EEC and 89/429/EEC apply parallel sets of permitting requirements and operating restrictions to new and existing municipal waste incineration plants. They are daughter directives to the Framework Directive 84/360/EEC on the combating of air pollution from industrial plants.

These directives regulate the permitting, design, equipment, operation and reporting of municipal waste incineration plants. New plants are those for which an authorisation to operate was granted on or after 1 December 1990. They exclude plants used specifically for the incineration of sewage sludge, chemical, toxic and dangerous waste, medical waste from hospitals or other types of special waste, even if these plants burn municipal waste as well, because such incinerators are more stringently regulated under the Directive on Hazardous Waste Incineration.

Three levels of emission limit values for dust, certain combinations of heavy metals, hydrochloric acid, hydrofluoric acid and $S0_2$ are established, depending on the nominal capacity of the incineration plant. Limit values and a programme of phased improvement of existing municipal waste incineration plants within certain time limits are laid down.

The directives also establish extensive requirements for monitoring, inspection and reporting by the operators of these plants. Information concerning the application for operating permits and the results of the monitoring must be made available to the public.

3.3.4.3. Proposed Directive on Landfill

A proposal for a directive on Landfill is now before Parliament and the Council of the European Union. The objectives of the new proposal are to prevent and reduce the adverse effects of existing and new landfills on the environment, in particular the pollution of surface water, ground water, soil and air, as well as the resulting risks to human health. The proposal also seeks to harmonize the environmental and technical standards for the landfilling of waste.

To achieve these objectives, procedures are provided for controlling the opening, management, closure and monitoring of a site and the acceptability of the waste in the landfill. The proposal recommends that landfills should be subject to permits and should meet technical requirements relating to siting, water control and leachate management, protection of soil and water (surface and groundwater), gas control nuisances and hazards. In addition, charges for landfilling would be required to reflect the costs of setting up and operating the site and the estimated costs of closure and aftercare for a period of at least fifty years.

In particular, with the aim of reducing the "global greenhouse effect", the proposal includes provisions to reduce the landfilling of biodegradable municipal waste as well as provisions to ensure that the gases produced in new as well as existing landfills are collected, treated and used. To reduce the volume or hazardous nature of the waste, the proposal requires all waste to be treated before landfilling. To ensure high environmental protection during handling and control of waste going to landfills, the proposal identifies waste-specific landfills. Thereby, the proposal ensures that landfills for non-hazardous waste are used only for non-hazardous waste, landfills for hazardous waste are used only for hazardous waste and landfills for inert waste are used only for inert waste. Therefore, the current practice of co-disposal (the mixing of hazardous waste with municipal waste in the same landfill) would be phased out.

3.3.5. Horizontal environmental directives

In addition to vertical directives relating to waste management, there are also horizontal directives, which also impact upon the production, transport and disposal of wastes. The most important horizontal directives are those concerning environmental impact assessment and integrated pollution prevention and control.

3.3.5.1. Environmental Impact Assessment

Directive 85/337/EEC on the assessment of the effect of certain public and private projects on the environment has recently been amended by Directive 97/11/EC. These directives embody the preventive approach to environmental protection by requiring that, before consent is given by a governmental body, development projects likely to have significant effects on the environment are subjected to an assessment of possible environmental impacts.

Some categories of projects listed in Annex I to the directive are always subject to the environmental impact assessment requirement. Others, listed in Annex II, which may have significant effects on the environment, are subject to assessment when certain criteria determined by the Member State are met. In the United Kingdom, environmental assessments are normally carried out on waste disposal installations (incinerators, landfills, transfer stations, etc.) with capacities of over 75 000 tonnes per year.

The promoter must supply the competent authority with detailed relevant information about the project in the impact statement. Environmental authorities must be given an opportunity to comment before a decision on the project is taken. The public must be informed of the request for development and the impact statement and allowed to express its opinion. Decisions by the competent authority have to take the assessment results into account.

3.3.5.2. Integrated Pollution Prevention and Control

The goal of the Directive is to achieve integrated prevention and control of pollution arising from a wide range of industrial activities by means of measures to prevent or, where that is not practicable, to reduce emissions of specified substances from industrial facilities to air, water and land, including measures concerning waste, in order to achieve a high level of protection of the environment as a whole.

All activities covered by the Directive require a permit. Member States may issue a single permit for releases to air, water and waste from an industrial facility, or issue multiple permits, which

are integrated through a co-operation procedure involving several permitting authorities. As well as imposing emission limits in environmental permits, Member States must ensure that the permits contain measures designed to ensure that the following basic requirements are met:

- All appropriate preventive measures are taken against pollution, in particular through the application of Best Available Techniques (BAT);
- No significant pollution is caused;
- Waste production is avoided; where waste is produced it should be recovered or, where that is technically and economically impossible, disposed of while avoiding or reducing any impact on the environment;
- Energy is used efficiently;
- The necessary measures are taken to prevent accidents and limit their consequences; and
- The necessary measures are taken, upon definite cessation of activities, to avoid any pollution risk and return the site of operation to a satisfactory state.

Permits must, in particular, include emission limit values based on BAT, taking into consideration the potential for transfer of pollution from one medium to another. Other requirements to protect soil and groundwater and concerning waste management must be laid down if necessary. In addition, permits must contain the supplementary requirements necessary to prevent breaches of any environmental quality standard.

4. OVERVIEW OF RELEVANT INTERNATIONAL TRANSPORT LEGISLATION

European Legislation on the transportation of waste has thus far focussed on recording the movement of the waste material from "cradle to grave". Certain risks arise in the transportation of waste and in particular the transport of hazardous waste; these risks, which can normally be assimilated to those caused by the carriage of dangerous goods, come within the context of matters relating to transport safety.

The European Commission reacted to this point of view in the communication entitled "Transport of Goods and Hazardous Wastes" which responded specifically to resolutions adopted by the European Parliament following the Mont-Louis cargo accident. This communication called for the effective application of the rules already adopted at international level with regard to the carriage of dangerous goods. These rules are now discussed.

There exists a large body of non-binding international rules, e.g. guidelines and codes of conduct, that establish safety standards and uniform procedures for the international transport of dangerous substances. A comprehensive set of rules is provided by the Recommendations of the United Nations Committee of Experts on the Transport of Dangerous Goods (UNCTDG Recommendations, commonly referred to as the Orange Book). These recommendations are addressed to governments and international organisations and are widely used. They are updated biennially to take account of new developments. Covering all modes of transport, they set out a classification system for dangerous goods (such as hazardous wastes) and general standards on packaging, testing, labelling and placarding and shipping documents. These recommendations have mainly been integrated into various conventions.

Under the auspices of the United Nations, a number of regional agreements covering the modes of transport of dangerous goods were elaborated:

- The 1957 European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR);
- The 1985 International Regulations Concerning the Carriage of Dangerous Goods by Rail (RID) which forms Annex I to the International Convention on the Transport of Goods by Rail (CIM);
- The European Agreement Concerning Transport of Dangerous Goods by Inland Navigation (IDN);
- The International Maritime Dangerous Goods Code (IMDG);
- The Convention on International Civil Aviation (Chicago Convention).

As mentioned, these agreements provide classification systems and establish safety standards for the transport of dangerous goods. They are harmonized with each other and updated at regular intervals and have been applied by most States.

The rules on the transport of dangerous goods are, for the major part, highly technical and detailed. Whereas they primarily address substances other than wastes, many of them were amended to include hazardous wastes subsequent to the adoption of the Basel Convention. The rules thus provide technical standards for the management of hazardous wastes subject to transport. Like the sectoral pollution control treaties, they therefore offset one of the principal weaknesses of customary law and may play a role in the emergence of internationally recognised "ecostandards". Like sectoral pollution control treaties, however, these agreements address only one stage of the hazardous waste cycle, namely, transport. In addition, they focus on the establishment of safety standards and therefore do not provide any guidance with respect to the permissibility of waste shipments, or the mutual rights and obligations of the States.

In addition to the international agreements on the transport of dangerous goods, such as hazardous wastes, there are a number of European Community Acts aimed specifically at the safety of transport of (dangerous goods and) hazardous waste. Among the measures provided for in the EEC Action Programme, which have already been adopted, is the Directive on the Professional Training of Drivers of Vehicles Carrying Hazardous Goods by Road (89/684/EEC). This directive refers to cargoes of hazardous goods and all drivers effecting such transport must have a professional training certificate declaring that they have successfully carried out a specific training course. Furthermore, by virtue of the Safety Advisers Directive (96/35/EEC), each "undertaking" whose activities include the transport of dangerous goods by road, rail, or inland waterway must appoint, before 31 December 1999, one or more safety advisers. The principal mandate of those safety advisers is to seek and promote, by all appropriate means and by all appropriate action, the safety of shipments of hazardous goods.

There is also a number of non-specific European Community Acts that deal with the safe transport of waste. For instance, the revised Waste Framework Directive (91/156/EEC) provides for obligatory registration of all establishments or undertakings whose object of business is the transport of waste, as well as the periodic checking of these establishments or undertakings. Furthermore, the Transfrontier Shipments Regulation (259/93/EEC) refers to all the conventions on international transport (listed in its Annex I) which "shall be complied with insofar as they cover the waste to which this Regulation refers."

5. DISCUSSION AND CONCLUSIONS

European Union Member States are increasingly addressing waste disposal problems by focussing on ways to decrease disposal in landfill and incineration through economic measures, for example, taxes and duties. The effects of the concurrent move towards encouraging reduction, recycling and recovery, in preference to disposal, are not currently visible in the global waste statistics, as the quantity of waste for final disposal continues to increase. However, one consequence may be an increase in waste transportation, as the need for greater segregation results in multiple handling of the waste components prior to reprocessing or disposal.

This point is further illustrated in the context of the proposed landfill directive. The separation and pre-treatment of putrescible waste before landfilling and a ban on the co-disposal of hazardous and non-hazardous wastes, may lead to the establishment of fewer and larger landfills across Europe. This, in turn, might mean that, for certain large, strategic facilities, alternative forms of transport might be favoured in order to extend the spatial zone of waste collection. However, the segregation and separate treatment of wastes could give rise to a greater demand on transportation as certain components undergo multiple handling.

On the other hand, the Council regulation concerning the supervision and control of shipments of waste within, into and out of the European Union takes into account the objective to minimise waste movements destined for final disposal on the basis of the principles of self-sufficiency and proximity. It also regulates the control of shipments of waste destined for recovery operations in such a way that recovery is promoted, while at the same time preventing such waste from being transported to recovery operations which are unacceptable from an environmental point of view.

Further, it could be considered that the encouragement of regional self-sufficiency in the provision of waste disposal facilities favours road transport, as the economics of alternative modes over shorter distances are not normally attractive. Indeed, although specific data (in terms of tonne-kilometres by mode) on the transport of wastes is not available, it is generally acknowledged that road traffic provides the primary mode of waste transport across Europe. The flexibility of this mode of transport will ensure its role in the collection of waste, but other modes should come into contention for the movement of bulk waste from central transfer stations to a recycling centre or central disposal outlet.

The European Commission recently set out its Common Transport Policy, entitled *Sustainable Mobility: Perspectives for the Future*. The underlying principles of this policy are liberalising market access in transport and ensuring integrated transport systems. The intended aim of the integrated transport policy is to encourage the transfer of freight from road to less environmentally damaging means of transport.

The nature of the Commission's proposals to promote intermodal transport is yet to fully emerge. If there is a case for the redistribution of waste shipment from road to rail and waterways, then this should be demonstrated through the application of reliable models used to predict the total cost of each alternative. This form of assessment must accurately reflect practical integrated transport networks, internalise all costs associated with environmental impact and take account of the social impacts of a restructured industry.

Waste installations may well be candidates for environmental assessment. Although road transport may be the mode preferred by the developer, alternative forms of transport may need to be evaluated on both economic and environmental grounds and with reference to the long-term "security" or "availability" of the different options. Clearly, incorporating the philosophy of the best practicable environmental option (BPEO) into the environmental impact assessment will play an important role in identifying both the location of waste treatment facilities and the waste transport patterns to the facility.

In certain circumstances, the transportation of waste by alternative modes will offer both economic and environmental advantages; helping to remove both bulky and hazardous loads from Europe's already congested roads. Indeed, intermodal waste transport networks are currently deployed in some of Europe's largest cities. In London, for example, both rail and river modes are used to transport wastes to out-of-town disposal facilities. Household and commercial wastes are transported via refuse collection vehicles to a number of strategic waste transfer stations. At these sites, the wastes are containerised and then transported by a combination of road, rail and river to rural landfill sites. It is estimated that over 600 000 tonnes of waste are moved from the city centre by river, whilst another 750 000 tonnes per year from the north and west of the city are transported by rail. In total, the movement of waste from London by rail and river saves in excess of 1 000 heavy goods vehicle journeys per day from the capital's congested roads.

In conclusion, waste management including the transport of wastes is a major issue which needs to be addressed in a comprehensive way at all stages of economic activity. Whilst a significant volume of legislation and guidance is growing on the management of waste, little of this is related to the transport function itself. As a result, there are no direct instruments available to guide the development of sustainable waste transportation strategies. The following actions are therefore recommended:

- Ensure comparable data is collected on all aspects of waste management including, for the first time, information relating to the transport of wastes (in terms of tonne-kilometres) by mode;
- Examine the application of full cost pricing on waste in order to encourage shipment by the most sustainable mode;
- Review the effectiveness of the present waste strategies, with particular regard to the application of self-sufficiency and the proximity principle;
- Document proven best practice and encourage widespread take-up through effective information transfer and supported pilot schemes.

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OTHER CONTRIBUTIONS

During the Round Table, several participants submitted written contributions. These contributions are reproduced below as complementary information.

SPAIN

Anton AZKONA
Rapporteur for
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TRANSPORT OF WASTE IN AN INTEGRATED GLOBAL CONTEXT

1. WASTE IS A COMPLEX ISSUE

Waste has become a complex issue in the modern world, as may clearly be seen in the number of instruments put in place by environmental authorities at the local, regional, national, EU and world level:

- The EU has issued [DOCE L5/15OF 7/1/94] an official list of wastes (EWC) arising from over 650 types of waste streams together with a list of hazardous wastes (HWL) covering over 200 waste streams [DOCE L 356 OF 31/12/94];

- The EU also has an official strategy towards waste management [Com(96) 399Final];

- Legislation has been drawn up at the EU level (Directives, Regulations and Decisions) to regulate waste management within the European Union;

- Transport of waste is regulated at the global level by the Basel Convention, at the level of developed countries by the OECD Decision of the Council [C(92)39 Final] and at the EU level by Regulation (EEC) 259/93 on the Shipment of Waste;

- Innumerable regulatory measures have been introduced to control and promote environmentally sound management of wastes at the local, regional and national levels.

Environmental management has changed within a few decades from a *command and control* activity into an integral component of other types of policy. Waste has also been part of this integration process and is primarily incorporated into policy in one of two ways:

- Waste prevention/minimisation at the production level through the introduction of cleaner technologies, including internal recycling, and the light-weighting of goods produced by the economic activity in order to reduce the amount of waste arising from end-of-life streams;

– Dramatically increasing the recycling of waste/secondary materials. To this end, design for recycling, substitution of dangerous substances, separate collection, identification and sorting technologies, etc., represent a variety of activities undertaken in nearly all types of manufacturing and production process in order to boost recycling. Waste management at the local, regional and national levels is also increasingly focused on enhanced recycling.

The reality nowadays is that 50 per cent of the steel, paper and glass produced in Europe is made from waste/secondary raw materials which therefore compete directly with virgin materials; the same is true for non-ferrous metals, and all of these materials have very well-established recycling chains that mine in the corresponding waste streams and most of them are traded in global markets.

Other sectors such as rubber (used tyres), plastics, granulates from construction and demolition wastes, used oils, batteries, textiles, etc., may be considered as emerging recycling sectors that are currently focused on securing larger quotas for the recycling rates of their respective materials.

The Work Programme for RTD actions in support of "Competitive and sustainable growth" 1998-2002 (DGXII) specifies an overall goal of 50 per cent of recycling/recovery for the year 2010 and a desirable target of 70 per cent re-use/recycling for the year 2020.

In conclusion, waste management has become an issue which is as complex as the economic activity itself and which can no longer be addressed without taking account of the dimension it has acquired as an integrated activity.

2. FRAMEWORK OF ANALYSIS FOR WASTE TRANSPORT

Although a full and detailed analysis has yet to be made of the distinctive characteristics of waste transport, it is clearly an issue that needs to be approached from several directions, namely:

– The environmental impact of waste transportation;
– The distinctive nature of waste transport;
– Waste transport as a factor of competitiveness in the recycling industry.

Examining waste transport from these standpoints can provide the broad approach needed to assess the current and future environmental impacts of such transport and its economic relevance.

2.1. Environmental impact of waste transport

Transport in general generates a number of local environmental impacts such as noise pollution, air pollution in urban areas and accidental spills resulting in soil and water pollution; but possibly the most severe environmental impact attributable to transport is that it is one of the main sources of greenhouse gas emissions.

Municipal waste collection and transportation, either for recycling or final disposal, is responsible for most of the noise and urban air quality problems associated with waste transportation. Movements of hazardous waste can also cause environmental pollution through accidental spills, and the transport of all kinds of waste produces greenhouse gas emissions.

While reliable initial estimates indicate that the transport of waste accounts for around 15 per cent of total freight shipments by weight in France, energy consumption for waste transport accounts for merely 5 per cent of the total energy consumption by the transport sector. At the global level, the transport sector is the second highest contributor to CO2 emissions, generating 24 per cent of total emissions; if the figures for France were to be extrapolated to the rest of the world, therefore, waste transport would appear to account for 1.2 per cent of total CO2 emissions worldwide.

Further work on the contribution of waste transport to greenhouse gas emissions will undoubtedly provide estimates for other countries and improve the accuracy of the figures available. However, unless the assessment of these figures takes proper account of the complexity of the waste transport issue, as outlined above, the conclusions eventually drawn may prove to be erroneous.

While there is no dispute over the figures for total greenhouse emissions from waste transport activities, the net contribution needs to be calculated by subtracting from this total the share accounted for by the transport of waste/secondary materials which have been substituted for raw virgin materials.

Furthermore, less energy is needed to process waste/secondary materials compared with virgin materials, as is the case for steel, non-ferrous metals, glass, rubber and even paper. These energy savings should also be taken into account in an integrated assessment in which waste transport is treated as one of the components of the entire recycling process.

2.2. Distinctive characteristics of waste transport

Waste transport has a number of distinctive attributes in terms of:

- type of waste transported, e.g. hazardous/non hazardous, municipal waste, etc.;
- physical characteristics or biological properties;
- constraints in terms of collection and disposal systems;
- shipping routes;
- mode of transport, e.g. road, sea, rail, etc.

These characteristics have an impact on technological development, investment and costs, waste management strategies, etc., and make waste transport a distinctive component of the general transport sector.

2.3. A factor in the competitiveness of the recycling industry

Waste transport has both a positive and a negative impact on the competitiveness of the recycling industry, costs and legal aspects being the two main areas where this influence is usually felt.

2.3.1. Waste transportation costs

Waste transport is an additional cost and as such represents a factor in the competitiveness of not only the recycling industry but also companies and local authorities involved in waste management in general.

The more traditional recycling sectors, such as those for steel and non-ferrous metals, can accommodate the transportation costs for waste/secondary raw materials equally as well as, if not better than, they do for virgin materials, due amongst other things to the high market value of residues.

Even paper waste can move from country to country, in that recycled paper no longer has to compete with paper made from virgin fibre.

Heavier materials, although they can compete with low virgin material prices, are more expensive to transport, which limits the distance over which they can be traded. In the case of construction and demolition waste aggregates, the cost of transport is a crucial positive/negative factor in terms of their ability to compete with virgin raw materials. Locating granulation plants at sites in urban areas which are closer to the product destination than the quarries from which virgin material is extracted will give a competitive advantage to granulates in terms of transportation costs.

In the case of used tyres, the density, bulk and weight of the material (in whole, shredded, granulated or premixed form as well as the final product) are such that transport and storage prior to recycling constitute major costs. In view of this, "raw" materials are in many cases used within relatively close proximity to the production site.

Long distances in countries such as Norway can hamper the recycling of glass cullet because the transportation costs involved give a competitive disadvantage to the use of glass waste compared with that of virgin materials.

2.3.2. Legal aspects

Transboundary movements of waste are subject to Regulation 239(91) EC at the EU level, OECD Decision C(92)39 at the level of the developed countries and the Basel Convention at global level.

The recycling industry claims that these regulatory instruments, by penalising the movement of waste, are a major barrier to the recycling of waste materials. Complicated and time-consuming administrative procedures with regard to the acceptance of waste by the parties involved, together with added border controls, are an impediment to the rapid response times needed in healthy business transactions. They also add a cost, as yet unquantified, to the recycling business.

The environmental authorities and environmentalists both argue that controls on waste movements are necessary in order to protect the environment against the risks that such movements pose, particularly in the case of hazardous waste. They argue that the laws have been enacted in order to protect the weak, or in this case, the environment.

The positions of actors with regard to this issue range from the complete deregulation proposed by industry, at one extreme, to the maintenance and strict application of the regulations already in place demanded by environmentalists at the other. It is very difficult to frame realistic, workable proposals for the intermediate position, which would consist in simplifying the legislation and adopting a more flexible approach to its implementation.

2.3.3. Definition of waste

The official definitions of waste used at the level of the EU and OECD are very general and rather vague and are based on the owner's intention/obligation to discard/dispose or on the actual act of discarding. Consequently, they cover *de facto* a very broad range of materials and combinations of materials that are involuntarily generated in the course of production, transport, handling and consumption.

Industry in general, believes that many of the materials currently classified as waste, either as they arise or after sorting, have both a market value and obvious utility in the economy and are traded in the same way as other materials and goods. These materials should not be considered as waste and should therefore be withdrawn from official waste lists, thus removing the trade barrier created by regulations relating to waste shipments.

An alternative or complementary position is currently starting to emerge as a result of ongoing discussions over the point in the recycling chain at which a waste undergoing recycling ceases to be waste. That point could be located after separate collection, sorting , pre-treatment or full integration into a marketable product. Depending upon the point in the recycling chain at which a material ceases to be considered as waste, a number of administrative barriers imposed by regulations will cease to have effect.

3. CONCLUSIONS

Waste transport can and should be tackled from different standpoints without losing the necessary global vision of the issue. The developed world will soon reach the target of recycling 50 per cent of the waste generated in manufacturing processes and, in particular, the waste arising from goods produced in the economy as the latter reach their end of life. The economies of the developed countries will therefore find themselves *mining* their own waste streams and the transport of waste, with all its distinctive attributes, will be integrated in the production function.

This integration will require changes and adjustments to many of the policies pursued by the EU and the developed world. Loosening the controls on waste movements will require placing greater trust in the actors and companies transporting and processing waste. Specific certification systems, proper *ad hoc* standards and similar instruments could help to secure a high level of environmental protection at lower cost, together with the smooth and transparent performance of recycling activities in the market.

Developing countries face a two-fold problem in their efforts to achieve economic growth. Some of the materials they need can be acquired at reasonable prices by importing waste/secondary raw materials and they also need access to the used equipment discarded by developed countries which they can reuse. At the same time, the environmental protection systems in these countries are usually very fragile and are often not robust enough to be able to manage wastes properly. Developing countries can therefore be seen as a convenient outlet for troublesome wastes which the developed countries produce and which can pose serious risks to the latter's environment.

The Basel Convention affords protection against such risks but, at the same time, may represent a barrier to a buoyant and healthy trade in waste/secondary raw materials.

There is much to be discussed with regard to waste transport, and much that needs to be improved in the management of wastes. We should therefore treat this issue seriously and examine both sides of the argument while maintaining the necessary degree of detachment.

Jean-Pierre LEHOUX
Bureau of International Recycling (BIR)
Brussels

Bureau of International Recycling (BIR) comments

1. The Bureau of International Recycling (BIR) is a world trade organization which was created in 1948 with members in more than 50 countries. It represents the interests of national federations and commercial firms which are directly or indirectly involved in the collection, processing, recycling and final consumption/reuse of materials (secondary raw materials) which have been diverted from the waste stream for further recycling.

   A third of the 600 million tons of materials processed by the recycling industry annually is traded internationally. Our yearly turnover is 160 billion US dollars and our yearly investments amount to 20 billion US dollars.

   More than 1.5 million people are directly employed by the recycling industry worldwide.

   Detailed figures on trade in SRM may be obtained from the European Commission, particularly in the annexes of the recent report issued by the Forum on the Competitiveness of the Recycling Industry.

2. BIR members are not involved in waste disposal/landfilling or in waste incineration. They are all operating legally and fully licensed under the control of the competent national and international authorities.

   They fulfill all the necessary requirements requested by the environmental, industrial and transportation authorities.

3. The materials are collected, processed and transported from one site to another (within the country of origin, throughout the EU or throughout the world) in order to supply the end-users with secondary raw materials.

   These secondary raw materials are, for instance, iron and steel scrap for further use by steelworks, non-ferrous scrap for foundries and smelters, recovered paper for the paper and cardboard mills.

   Of the 280 million tons of paper and cardboard which are produced in the world each year, 45 per cent is produced from recovered paper. Almost 45 per cent of the world's production of stainless steel comes from recycled materials.

   Out of the 750 million tons of steel which are annually produced in the world, 350 million are made from recycled metal.

All these materials have a positive economic value and they meet a series of criteria which make them different from *waste material*:

- They have a use and a market;
- They are traceable from collection/production through their ultimate recovery/reuse/ recycling stage;
- They have commonly recognized characteristics and meet users' commercial requirements;
- They are part of a contract at the different stages of the recovery cycle involving recognized (licensed, permitted) economic operators;
- They present no potential risk greater than the comparable primary material.

The EU Commission DG XI (Environment-Waste Unit) is currently working on these criteria, together with a small group of trade organisations such a BIR, in order to facilitate this distinction between waste and non-waste.

4. The **proximity principle** is not to be applied to our secondary raw materials but to waste destined for disposal, as has been confirmed by Decisions from the European Court of Justice and Position Statements from the EU Commission DG XI.

5. Using secondary raw materials involves substantial energy savings when compared with primary production.

	Energy saving (%)
Steel	74
Aluminium	95
Copper	85
Paper	64
Plastics	80

Producing from recycled paper means 35 per cent less water pollution and 74 per cent less air pollution.

Producing from recycled steel means 86 per cent less air pollution.

6. The above-mentioned figures clearly support the need for the transportation of our recycled materials anywhere in the world in order to meet demand.

7. BIR vigorously supports the control (and, if justified, the ban) of any waste intended for further disposal, particularly when hazardous.

BIR has been (and still is) a full participant in the UNEP Basel Convention on the controls of shipments of waste intended for disposal and in the OECD work on the controls of shipments of waste intended for further recovery.

As a responsible organisation, BIR strongly defends this position.

SUMMARY OF DISCUSSIONS

SUMMARY

The first aspect of waste transport that needs to be understood is the direction in which it is evolving, that is to say, the major trends currently prevailing in this sector of activity. To do this requires a knowledge of how much waste is transported at both the national and international levels. Assessing the overall size of waste flows provides an insight into levels of activity. In the case of waste transport, together with other segments of the transport sector, it needs to be borne in mind that the statistical data are either missing or incomplete. That said, we do know that most waste consignments are transported by road. This makes the modal split a central issue which merits close examination. The predominance of road is, to a large extent, an outcome of the regulatory provisions and notably the proximity principle set out in Directive 91/156/EEC. It is essential to have a proper understanding of the regulations and the impact of those regulations, particularly in view of the fact that proposals can be drawn up to amend them and establish distinctions between wastes according to how dangerous they are. A case can also be made for the introduction of multi-factor balances (environment, energy, the economy) which can inform the decisions made by politicians, who sometimes have to make difficult choices between several waste treatment options.

Discussions at the Round Table can therefore be summarised under five headings:

- first, major trends;
- second, statistics;
- third, the modal split;
- fourth, regulations;
- fifth, the balance between the environment, energy and the economy.

1. MAJOR TRENDS

1.1. A new approach

Despite the efforts made to reduce waste output (cf. the chemicals industry), it is hard to avoid increases in the volume of wastes transported, given the close link that exists between growth in GDP and growth in waste. In this respect, we are currently witnessing a gradual shift away from a purely "environmental" to a "logistical" approach to waste and the emergence of two major trends, namely, to minimise the production of wastes and to recycle those which are produced in order to create secondary raw materials.

Landfills, other than those used for final wastes, are gradually being phased out and new waste recycling requirements are currently being introduced. This development is changing logistics chains and producing transport procedures of far greater complexity. It is worth considering the fact that 50 per cent of all waste materials will be recycled by 2010 and 70 per cent by the year 2020.

1.2. Concentration/specialisation

While recycling was previously ensured by a large number of small enterprises, we are now seeing concentration in the sector and the attendant risks of dominant positions. The reduction in the number of landfills, the increased size of those remaining and their increasing specialisation will generate a greater number of transport movements. Landfills are usually further away than incinerator plants, although it is worth noting that the high costs of incineration as a means of reducing residues and gas are more than offset by the lower transport costs. In addition, account must also be taken, in any "transport" balance drawn up for incinerators, of the downstream transport of ash. In contrast, the need to ensure that under-used incinerator plants remain profitable -- and they must be kept in service because there is a limit to how much waste can be recycled -- may generate substantial flows of long-distance traffic.

The way in which wastes are treated has a direct impact on transport. Recycling wastes increases the number of transport movements, in that the need to sort wastes more thoroughly means that wastes are handled several times before their recycling or disposal. Each intermediate stage adds another transport leg. Changes to treatment methods will modify the entire waste disposal logistics chain. The trend is now towards increasingly specialised and sophisticated treatment plants. It should be noted that the emergence of specialised treatment plants runs counter to the proximity principle advocated by the "Greens". Furthermore, the need to separate consignments of hazardous and non-hazardous materials will also induce more traffic flows.

1.3. The players

Waste transport is becoming an increasingly specific activity with a tendency towards concentration and the use of specialised vehicles comparable to those used for controlled temperature transport. Integrators only use sub-contractors for non-hazardous wastes. Carriers are offering an increasingly wide array of services which, in some cases, even extend to pre-treatment.

The transport of urban waste is managed and integrated by recycling firms. The arrangements for industrial waste are far looser.

Waste products can be classified into six categories, according to the sector of origin and who the main actors are. These categories are household waste, municipal waste, industrial waste, building and construction waste and waste from the agro-food industry and agriculture. Two sectors account for the bulk of the waste products generated, namely: the building and construction industry, i.e. in-fill and rubble, and the agro-food industry.

1.4. Broader geographical coverage

Waste transport takes on a new dimension with the CEECs, which are major users of secondary raw materials. The CEECs also generate household waste, whose collection is now starting to be organised. It is also worth nothing that waste disposal and recycling is less expensive in the CEECs, whose environmental standards are less stringent than those in force in the European Union and whose waste disposal practices very probably do not make use of the best available technology.

2. STATISTICS

2.1. Available data and gaps

As a general rule, there is a reasonable amount of data available on urban waste, although the volume of the latter is not particularly significant. In contrast, far less information is available on industrial waste and building and construction waste, which are far more voluminous. The reason for this lack of data is that the actors in this sector have nothing to gain from compiling very costly statistics.

There is also a significant lack of statistics regarding waste collection, and there is a similar lack of coverage of international movements. As a general rule, few recent data are available because they are expensive to produce, and while there are gaps in the data on the volumes of waste transported there are virtually no data available on waste production.

2.2. The statistics needed

There is no point in having statistics that are too detailed because they are very difficult to interpret. In this respect, some of the experts at the Round Table felt that it was better to be more or less right than to be sure of being wrong. What is needed above all are statistics that are useful in terms of policy, that is to say, statistics capable of showing major trends and, in this respect, there are a number of under-exploited sources.

2.3. The need for satisfactory classifications

The basic problem with statistics is the definition of wastes. In order to have good statistics, we need to have a clearly-defined classification system which will not be modified in the future. Classifications are useful instruments which can help in the decisionmaking process, but if they are to be of use they must first be harmonized and simplified. In this respect, it should be noted that:

- Classifications vary substantially from one country to another;
- They have far too many categories, which results in overly complex regulations;
- There are differences which should be removed between the classifications relating to hazardous wastes (OECD, Basle Convention);
- Classifications change too frequently over time.

What is needed is a European definition of waste. It is essential for classifications to clearly distinguish secondary raw materials that current classification systems are unable to identify, which is not easy in that recycling blurs the distinction between wastes and secondary products. More work is therefore needed to determine the precise point at which recycled waste ceases to be a waste product.

Given that classifications evolve over time, methodological guides need to be drawn up to enable users to distinguish between waste and non-waste products.

3. MODAL SPLIT

3.1. An integrated but differentiated approach

To ensure that each mode of transport has its place in the modal split, properly structured logistic and organisational schemes need to be developed in which the railways and inland waterways can regain their rightful place. The alternative modes to road cannot have a role to play unless organisational systems are completely overhauled.

There are several types of waste transport chain; similarly, there are several different sources of waste and several types of waste. High-value wastes or secondary raw materials require a different form of organisation, as do low-value wastes. In addition, in such cases, subsidy issues can disrupt transport organisation.

3.2. Scope for modal transfer

The scope for transfer from one mode to another varies according to the stage of the transport process. The collection of urban wastes, for example, can be transferred to another mode (pneumatic system, light railways, etc.). As a general rule, modal transfer requires the creation of transfer centres where flows can be consolidated. In the case of combined transport, a suitable system of collection in *caissons* needs to be developed from the outset, given that transferring waste skips to containers is very expensive.

Modal transfer downstream of the incineration stage offers scope for rail in that flows can be consolidated by storing residual ash products. The development of rail and inland waterways is contingent on the development of intermodal techniques, but the latter reduce shipment sizes and thus lead to diseconomies.

Rail can be a competitive alternative for recycling industries which have their own branch lines. Costs are prohibitively high when railway operators are obliged to base their operations at transfer centres without rail links where new infrastructure needs to be built. When new plant must be put in place to capitalise on the value of waste, however, it is important to perform an impact study so that each mode can set out its conditions.

3.3. Drawbacks of rail/Determinants of the current modal split

Consolidating flows is a fundamental issue:

- Even if the firms involved in waste management were to be concentrated, they still remain for the most part small and thus constitute a barrier to the consolidation of flows. Many of the activities relating to recycling are highly dispersed, which makes the use of rail relatively inefficient.
- The argument advanced and defended by the “Greens” that the volume of wastes and the distances they are transported should be reduced is diametrically opposed to the need to consolidate flows in order to rationalise their transport. The concept of proximity and the

organisation of waste processing on too local a basis leads to an excessive number of dispersed transport movements and a loss of efficiency due to insufficient consolidation. There is a fundamental contradiction between the desire to restrict waste movements and the need to consolidate flows in order to rationalise transport. The narrowness of vision in this respect must be decried. Any requirement which restricts the movement of non-hazardous waste products over long distances (notably international movements) limits the scope for efficient transport.

- Due to the lack of sufficiently high volume flows and because of the proximity principle, waste movements are currently restricted to very short distances (less than 45 kilometres in France) which precludes any opportunity for rail to compete. As a result, the issue of waste transport way well remain a regional issue, thus ensuring that road continues to dominate.
- The main obstacle to the use of combined road-rail transport is not a problem of cost but of quality of service and, in particular, consistency of supply. This is a significant constraint in the case of household waste because of the risk that treatment plants may remain idle. Rail must be capable of providing a swift alternative in the event of dysfunctions.

4. REGULATIONS

4.1. Current shortcomings

Much of the legislation relating to waste only refers very obliquely to transport. In far too many instances waste regulations have neglected the "transport" component. An overall approach is therefore needed to the entire chain.

There is clearly too much regulation at the international level, with a very large number of regulatory texts that are mutually inconsistent. Monitoring systems vary substantially from one country to another and there are wide divergences between procedures for their implementation.

Current regulations are aimed solely at ensuring the traceability of wastes and not at organising their transport on a rational basis. The outcome of this has been such a proliferation of paperwork that it is difficult to exploit all the data generated and properly monitor products. As a result, the control of movements is ineffective because it consists in producing documentation.

It is also worth noting that regulations tend to focus on the vehicle.

In many cases, the regulations tend to organise treatment on a local basis by using administrative area units with rigid boundaries. Applying the principle of proximity, which underpins much of the legislation, carries the twofold risk of precluding:

- the creation of efficient treatment sites capable of disposing of sufficient volumes of waste;
- rational transport chains, due to a failure to consolidate flows.

This principle is too rigid (greater account needs to be taken of geographical realities), is not always relevant, is inefficient and overly biased to road, as mentioned earlier.

Current regulations are far too constraining for recycled and non-hazardous wastes. However, metallurgical, non-ferrous and paper wastes account for 80 per cent of the cross-border movements of such materials. Such movements, which are particularly useful for less developed economies, are frequently hampered by regulations whose real aim is to protect markets.

Regulations applicable to the division of responsibility require close scrutiny because they can often have unwanted effects. The concept of responsibility plays a major role in the choice of transport chain and in the decision to use a given supplier of services. In some countries, the waste producer always retains responsibility or joint responsibility for its disposal.

The subsidies awarded to certain types of transport (paper, cardboard) can affect the organisation of recycling operations at the international level and can interfere with the flows of waste products.

4.2. Desirable changes: standardization, simplification, a global approach

The regulations need to focus on hazardous wastes and remedy the lack of traceability. They need to be consistent with the regulations relating to hazardous materials. The movement of secondary raw materials or inert waste, in contrast, needs to be liberalised as much as possible. This underlines the importance of revising classification systems. One of the problems with establishing a concordance between hazardous wastes and hazardous materials, however, lies in the hybrid nature of certain waste products.

In the case of hazardous wastes, one of the main problems at the international level is that permits for the transport of such wastes vary substantially from one country to another.

The vehicle stickers used to indicate the type of waste transport need to be harmonized and not restricted solely to hazardous wastes. There is also a need to review inspection procedures (the current use of "A" stickers is not a safeguard since inspections can be avoided simply by not displaying the sticker).

The many regulations at the international levels need to be harmonized and simplified. Regulations must be consistent at all levels (local, national, international) and harmonized world-wide. The approach towards regulation must therefore be global and integrated. There should be no contradictions between rules on transport and those relating specifically to waste between regulations at the national and international level.

In terms of regulations, many of the questions that arise with regard to transport are the outcome of decisions taken at other levels, hence the necessity, once again, for a global approach. There are strong interactions between other regulations (notably those relating specifically to waste processing) and transport regulations. All regulations need to be implemented coherently.

Inspection regimes need to be reviewed and greater use made of on-the-spot inspections during transport operations, i.e. spot checks on vehicles. This is far more effective than filling out papers and documents. Moreover, it is not enough to harmonize regulations, the procedures for implementing those regulations also need to be harmonized. This is clearly more effective than simply increasing the number of regulations.

There needs to be greater flexibility in application of the proximity principle and other divisions should be used in place of the existing administrative units to ensure that waste transport is organised on a more rational basis. If consideration is given to introducing measures to promote application of the proximity principle, such as taxes levied specifically on long-distance transport, they should at least be differentiated according to the mode of transport used and should be lower for the more environmentally-friendly modes. Steps must be taken to ensure that these taxes are not a barrier to the consolidation of flows. In this respect, the Round Table was not opposed to use of a carbon tax to contain pollutant emissions and the consumption of transport services. It simply noted that this was a controversial issue in that it seemed to be an established belief that road transport should pay for the cost of its infrastructure, which was not the case with other modes of transport. The solution would therefore lie in taxing the consumption of carbon while, at the same time, reducing the taxation of the labour factor, of which there was an excess -- as shown by unemployment rates in Europe -- and which was over-taxed. Here again, a consensus can readily be achieved.

Some experts felt, on the other hand, that not enough was known about environmental costs to be able to levy appropriate taxes on polluting modes. This view was fiercely criticised at the Round Table. It was pointed out that there were many studies available, issued by a variety of institutions, including the ECMT and the European Commission, and that it could not fairly be claimed that nothing was known about the cost to the environment, particularly given the general agreement between viewpoints.

At the same time, the subsidies given to the transport of certain goods needs careful scrutiny to avoid any unwanted impacts on the organisation of international recycling operations.

5. THE BALANCE BETWEEN THE ENVIRONMENT, ENERGY AND THE ECONOMY

5.1. Current situation

The transport of waste accounts for 5 per cent of energy consumption in the transport sector. The collection of waste is an aspect that is frequently overlooked and it needs to be borne in mind that refuse collection vehicles consume vast amounts of fuel, approximately 70 to 100 litres per 100 kilometres. Since wastes are primarily transported by road, the accompanying emissions are those relating to the use of diesel (soot particle, NOx, etc.).

5.2. Need for a global approach in which transport is simply one component

A global approach is needed to waste management systems in which transport is integrated into an overall structure. What is needed is to seek an overall optimum rather than an optimum for each link in the chain (solely at the level of transport, for example). The role played by transport needs to be examined in the context of each branch chosen.

Studies need to be made of the genuine costs, including the environmental cost, of all the alternative systems, notably recycling or disposal, by integrating the "transport" component. Policymakers need to be advised of the existence of such an approach to ensure that they are properly aware of all the implications (notably with regard to transport) of their decisions concerning the

treatment of wastes. The Round Table was astonished that comparisons such as cost-benefit studies were not used on a more routine basis -- even if assessing the financial cost of environmental impacts can sometimes be difficult -- when reviewing the various options open for the recycling and disposal of waste. Recycling can be a misplaced "good intention" which simply assuages the conscience of the "Greens". Recycling needs to be properly assessed to determine how effective it actually is and how it functions. Such a global approach has several implications:

- When establishing an environment/energy balance, a comparison must be made of the energy savings associated with recycling with the energy consumption relating to transport (recycling induces transport). This type of balance makes it possible to establish a clearer dividing line between wastes which should be incinerated and those which should be recycled.
- Environmental balances for a recycling/incineration plant must integrate the various transport options. Any decision regarding plans to install recycling facilities must integrate the transport aspect very far upstream in the process.
- Environmental balances must take account of pollution. Pollution in the city does not have the same impact that it does in the country.
- If a large incinerator plant in the vicinity of a town has a major impact due to direct pollution, it should be recalled that, in return, the plant provides heating for the city and thus avoids the need to have a large number of individual boilers that are less efficient, less monitored and more polluting. It should also be noted, on the other hand, that ash from incinerator plants is the source of growing controversy due to its high Dioxin levels. The outcome is that the environmental balance is not as much in favour of incineration as might be thought.
- The advantage to recycling is that wastes can be recycled several times, but this is not a panacea. The benefits of recycling depend upon the materials in question and the conditions that apply to the technology currently in vogue, which can rapidly change.
- A secondary raw material generates fewer wastes or useless products than a virgin raw material. Here too there are important economic considerations.

An integrated environmental approach is required. From this standpoint, the legislation must be perfectly consistent with regard to different sources of emissions. Transport and incineration vie with each other in this respect and should therefore be considered or assessed on the same basis.

It is essential to take account of the energy/environmental impacts of transport in that the direct costs of transport are frequently low and consequently play merely a marginal role in the choice of mode of disposal, as in the case, for example, of a choice between incineration and recycling. Taking account of transport in an overall ecological balance can be decisive and can significantly influence a choice in favour of one or another mode of disposal. To be more precise, the role played by transport costs varies according to the type of product:

- The cost of transport plays merely a marginal role in the organisation of transport movements and the modes of disposing of high-value wastes destined for recycling;
- In contrast, with regard to waste from public works (building aggregates), transport is an important factor in competitiveness; proximity to a waste treatment plant is therefore essential. The same applies to used tyres, which are very bulky both to transport and to store;

- In the case of paper, everything depends upon the quality of the product; transport is only a factor in competitiveness in the case of poor-quality paper;
- Transport is a factor in the competitiveness of the collection of waste glass.

Assessing the cost calls for an overall approach to the entire operation, including taxes on CO_2 emissions and not simply the cost of the transport. When the cost of transport in percentage terms is low, subsidies and the comparative costs of recycling and disposal can encourage long-distance transport. The low cost of incineration (particularly if the plant is old) can generate more long-distance trips.

From an economic standpoint, the issue of waste illustrates all of the problems associated with the transport of low-value goods. Furthermore, the low prices prevailing in the waste transport sector are a barrier to modernisation of this sector. Empty return legs and overcapacity are driving prices down.

5.3. Scope for action regarding the environment

Measures can first be introduced with regard to the vehicles used for collection. Investing in electrically- or gas-powered vehicles that meet Euro3 and Euro4 standards will produce a more satisfactory environmental balance. However, vehicles which are less polluting still use as much fuel, if not more, than ordinary vehicles, thus leading to a problem with CO2 emissions. In any case, from an environmental standpoint, older vehicles need to be retired.

Organisational approaches can then be developed by using alternative modes to road.

Firms can be encouraged to use their own wastes. There is undoubtedly much to be gained from this but it will first require analyses of product life cycles which take the transport component into account, a difficult task given the lack of data. Large industrial firms such as car manufacturers, however, are capable of predicting the future life cycle of their products and introducing measures to ensure that they are recycled.

Lastly, it should be noted that the problem in "reverse logistics" is the use of dual-purpose vehicles which can both deliver and collect wastes. It would appear that returning wastes throughout the entire initial logistical chain, i.e. reverse logistics, costs four times as much as a transport operation organised for a specific waste product.

6. CONCLUSIONS

The volume of waste can logically be expected **to grow,** given the links between waste and growth in GDP and the economy in general. The tendency, too, is to increase the proportion of recycling and to eliminate the use of landfill other than for final wastes. Structural changes are therefore taking place which have recently been confirmed with the opening-up of the CEECs. However, the environmental balance of waste transport is not as positive as it might be because too much use is made of road transport.

In order to take action we first need to have operational data available, which will require changes to be made because current **statistical systems** are not capable of monitoring waste movements. The production of data for use in policymaking requires simplified and harmonized classification systems, based on a clear distinction between hazardous waste, non-hazardous waste and secondary raw materials. In order to be able to monitor these categories, classification systems need to remain stable. But rather than classifications, what in fact is needed are methodological guides to ensure that a distinction is drawn between waste and recycled raw materials. Classification systems can always evolve, but they need to remain fixed for a certain time to provide benchmarks.

Regulations need to be simplified and harmonized. Firstly, legislation must not be matched to administrative districts. Secondly, a segmented approach should be chosen. Regulations must focus on hazardous wastes, in regard to which they must be made more stringent. The transport of other types of waste, and notably secondary raw materials, must be liberalised. What is shocking is that wastes are routinely assumed to be hazardous. The traceability of hazardous wastes also needs to be ensured by other means than the use of forms. EDI can play a major role in this area. All of the above can make it easier to apply rules uniformly and not simply harmonize legislation.

The transportation of hazardous wastes requires:

- Harmonized authorisations;
- Improved signing on vehicles, which also needs to be harmonized;
- Development of road checks and not simply regulatory checks based on "paper" documentation.

Lastly, the uniform application of regulations needs to be promoted.

A segmented approach is also needed with regard to **economic considerations,** in that transport costs do not have the same impact for all forms of waste. Further work is needed, too, on transfer centres in order to increase the efficiency of transport. Lastly, it is uncertain whether reverse logistics is a feasible proposition.

The **environmental balance** shows the need for an overall approach and not one based solely on transport. It must thus be possible to establish environmental balances by branch. It is also important to have cradle-to-grave tracking of special wastes in accordance with the precautionary principle. Lastly, we need to be wary of specious good ideas such as "waste transport must be restricted" or "recycling is the best solution".

It would be useful to develop certain research tools, for example, the application at the European level of an approach such as the one developed by France with regard to the quantification of waste movements. Experiments need to be carried out into methods which might increase the efficiency of waste movements and, more generally, the various forms of organisation possible (incineration, recycling). Models of waste generation and waste transport could be developed. Analyses could be made of the links between administrative and waste collection organisation.

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