Environmental Review No. 7 1999

Waste Statistics 1997

Miljøstyrelsen
Miljø- og Energiministeriet

Contents

1 Introduction

In 1993, the ISAG (Information System for Waste and Recycling) was used for the first time. The results of the fifth ISAG reports for the year 1997 are presented in this publication.

Reports to the ISAG for 1997 cover 424 plants distributed on 317 enterprises. In 1996, reports covered 436 plants distributed on 307 enterprises.

The general picture for 1997 shows that:

- Total waste amounts are almost similar to 1996. This can mainly be attributed to a drop of 24 per cent in waste amounts from coal-fired power plants.
- Overall waste management objectives laid down in the Government's Plan of Action for waste and recycling 1993-97 have been attained. This can mainly be attributed to a high rate of recycling for construction and demolition waste.
- Recycling of domestic waste and bulky waste from households, and waste from institutions, trade and offices remains significantly below the objectives of the Plan of Action.
- Landfilling of waste from industry is still too high.

In 1997, waste generation amounted to 12,857,000 tonnes. Compared to 1996, this is a decrease in waste amounts of 0.5 per cent, corresponding to 55,000 tonnes.

However, this decrease covers large variations in waste arisings in different sectors and can first and foremost be attributed to a decrease of 557,000 tonnes in the generation of residues from coal-fired power plants. This decrease is due to reduced exports of power to Norway and Sweden, as a consequence of a rainy year which meant that these two countries were able to cover more of their power needs by domestic hydropower.

If residues from power plants are not included in statistics, there has been an increase in waste amounts of 502,000 tonnes, which corresponds to some 5 per cent.

70 per cent of this increase of 502,000 tonnes can be attributed to construction and demolition waste arisings which increased by 11 per cent from 3,088,000 tonnes in 1996 to 3,427,000 tonnes in 1997. This increase in construction and demolition waste is explained by high activity in the building and construction sector. The activity in this sector has been on the increase since early 1996 and seems to have peaked early 1998.

Waste amounts from manufacturing industries, institutions, trade and offices, and wastewater treatment plants also increased, though only by between 1 and 4 per cent.

If both slag/fly ash and construction and demolition waste amounts are kept apart, an increase of 2 per cent can be seen.

By contrast, total waste amounts from households were almost similar to 1996: in 1997, 2,776,000 tonnes were generated in this sector against 2,767,000 tonnes in 1996. Of this, domestic waste amounts decreased by 2 per cent from 1,654,500 tonnes in 1996 to 1,620,800 tonnes in 1997. Bulky waste amounts decreased by 8 per cent from 639,100 tonnes in 1996 to 587,700 tonnes in 1997, and garden waste amounts increased by 10 per cent to 442,700 tonnes in 1997.

Total recycling in 1997 attained a rate of 63 per cent against 60 per cent in 1996. 20 per cent of waste was incinerated in 1997 against 19 per cent in 1996. Landfilling decreased to a rate of 16 per cent in 1997 against 20 per cent in 1996. Special treatment still accounted for 1 per cent.

If again residues from coal-fired power plants are kept apart from overall statistics, the rate of recycling in 1997 amounted to 61 per cent, whereas 24 per cent was incinerated and 15 per cent landfilled. If also construction and demolition waste is kept apart - which does account for a high rate of recycling - recycling of all other waste types reached 47 per cent, whereas 34 per cent was incinerated, and 18 per cent landfilled.

2 Waste generation, general

2.1 Generation

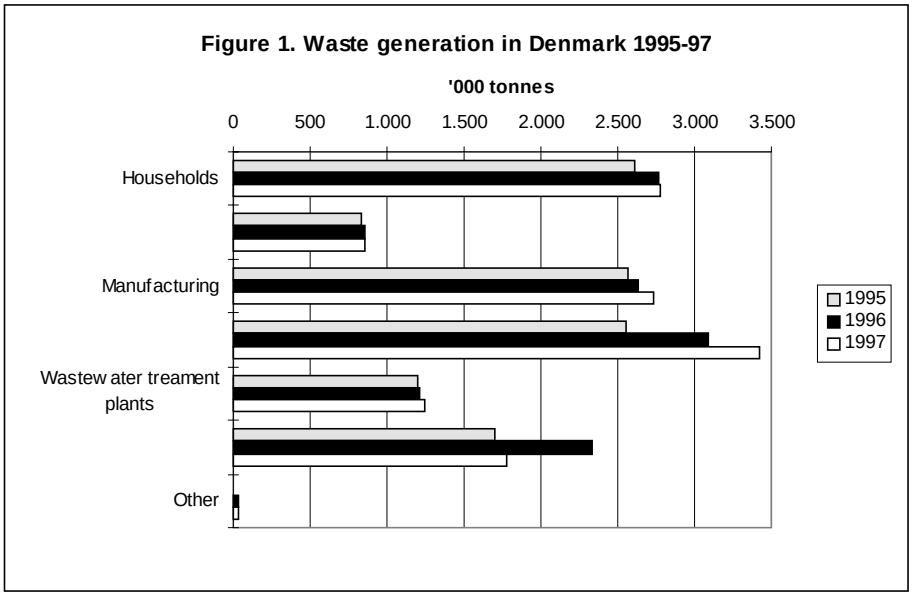
Table 1 and Figure 1 show waste generation within various sectors. These figures are compared to corresponding figures for 1995 and 1996.

Table 1. Total waste generation in Denmark in 1995, 1996 and 1997.	**'000 tonnes**			**Change in %**
Source	**1995**	**1996**	**1997**	**1996-97**
Households	2,610	2,767	2,776	0
Domestic waste	*1,628*	*1,655*	*1,621*	*-2*
Bulky waste	*618*	*639*	*588*	*-8*
Garden waste	*326*	*401*	*443*	*10*
Other	*38*	*72*	*124*	*73*
Institutions, trade and offices	834	851	861	1
Manufacturing etc.	2,563	2,632	2,736	4
Building and construction	2,559	3,088	3,427	11
Wastewater treatment plants	1,195	1,212	1,248	3
Slag, fly ash etc. (coal-fired power plants)	1,699	2,332	1,775	-24
Other	6	30	34	14
Total	11,466	12,912	12,857	0

Sources: ISAG-reports for 1995, 1996 and 1997, Danisco, Association of Danish Recycling Industries and other large scrap dealers, Elsam, Elkraft, and reports to the Danish Environmental Protection Agency on sludge from municipal wastewater treatment plants applied to farmland, and incineration in sludge incineration plants (for 1997, figures from 1996 are used). Figures for sludge are stated in wet weight. A dry matter rate of 13.7 per cent has been used. Figures have been adjusted for imports of waste. The generation of waste in relation to the ISAG reports has been found by stating the quantity of waste delivered to waste treatment plants from primary sources. For this purpose, "primary sources" means waste generators that are not waste treatment plants (reprocessing facilities, incineration plants, composting and biogas plants, and landfills). Waste such as slag, fly ash, and flue gas cleaning products from waste incineration plants is therefore not included in the statement as it would otherwise be counted twice. Furthermore, waste from the source "recycling centres/transfer stations" is distributed on the original source. The principles for distribution are given in Annex 2.

Table 1 and Figure 1 show the following changes in total waste generation from 1996 to 1997:

- Total waste generation in 1997 remained relatively stable compared to 1996. A small decrease of 55,000 tonnes or 0.5 per cent was registered.
- Total waste generation in households was almost identical to 1996: 2,776,000 tonnes in 1997 against 2,767,000 tonnes in 1996. Of this, domestic waste amounts decreased by 2 per cent from 1,654,500 tonnes in 1996 to 1,620,800 tonnes in 1997. Bulky waste amounts decreased by 8 per cent from 639,100 tonnes in 1996 to 587,700 tonnes in 1997, whereas garden waste amounts increased by 10 per cent to 442,700 tonnes in 1997.



Source: See Table 1 above.

- Waste generation in institutions, trade and offices increased by 1 per cent, or 10,000 tonnes.
- Waste generation in manufacturing industries etc. increased by 4 per cent corresponding to 104,000 tonnes.
- Waste generation in the building and construction sector increased by 11 per cent, or 339,000 tonnes.
- Waste generation at wastewater treatment plants increased by 3 per cent to 1,248,000 tonnes.
- Waste generation at coal-fired power plants decreased by 24 per cent, corresponding to a decrease from 2,332,000 tonnes to 1,775,000 tonnes.

The slight decrease in overall waste generation can be attributed to waste generation at coal-fired power plants, which was reduced by around one quarter compared to the previous year. If residues from power plants are kept apart from overall waste amounts, an increase in waste amounts of 502,000 tonnes or around 5 per cent has been registered.

70 per cent of this increase can be attributed to the building and construction sector, where waste amounts increased by 11 per cent from 1996 to 1997. Waste amounts in other sectors such as households, institutions, trade and offices, and the manufacturing industry only increased by between 0 and 4 per cent.

If also waste amounts from building and construction activities are kept apart from total waste amounts, an increase of 2 per cent in waste amounts from 1996 to 1997 has been registered.

In the Government's Plan of Action for waste and recycling 1993-97 it was expected that waste amounts would increase up to 9.8 million tonnes in 1997 and then remain stable up to year 2000. This has not been the

case. With a waste generation in 1997 of 12.8 million tonnes, amounts projected in the Plan of Action were exceeded by 3 million tonnes.

Projections and objectives for waste amount developments stated in the Plan of Action were based on a survey of waste amounts in 1985, carried out by the Danish Environmental Protection Agency and regional councils. This was the first survey of waste amounts, and data were mostly based on estimates and theoretic calculations. Therefore, 1985-figures, and consequently also projections for developments up to year 2000, are subject to uncertainty.

With the implementation of the ISAG in 1993, which is based on reports of actual waste amounts delivered to treatment plants, data on waste generation have become considerably more reliable.

2.2. **Treatment of waste in 1997.**

Developments in waste amounts are shown below and related to objectives laid down in the Government's Plan of Action for waste and recycling 1993-97 for waste treatment in year 2000 (in the following called Target 2000).

2.2.1. **Total waste amounts.**

It can be seen from Table 2 that 63 per cent of total waste amounts was recycled in 1997, whereas 20 per cent was incinerated and 16 per cent landfilled. This means that the Plan of Action's overall objectives for recycling for year 2000 (54 per cent), incineration (maximum 25 per cent) and landfilling (maximum 21 per cent) have been attained.

Table 2. Waste generation in 1995, 1996, 1997, and year 2000 by treatment option.	**'000 tonnes**							
Treatment	**1995**		**1996**		**1997**		**Target 2000**	
	tonnes	%	tonnes	%	tonnes	%	tonnes	%
Recycling	7,046	62	7,787	60	8,046	63	5,300	54
Incineration, of which	2,306	20	2,507	19	2,622	20	2,500	25
Sludge incineration plants	*170*		*170*		*177*			
Incineration plants with energy recovery	*2,136*		*2,337*		*2,445*			
Landfilling	1,969	17	2,524	20	2,103	16	2,000	21
Special treatment	145	1	95	1	86	1		
Total	**11,466**		**12,912**		**12,857**		**9,800**	

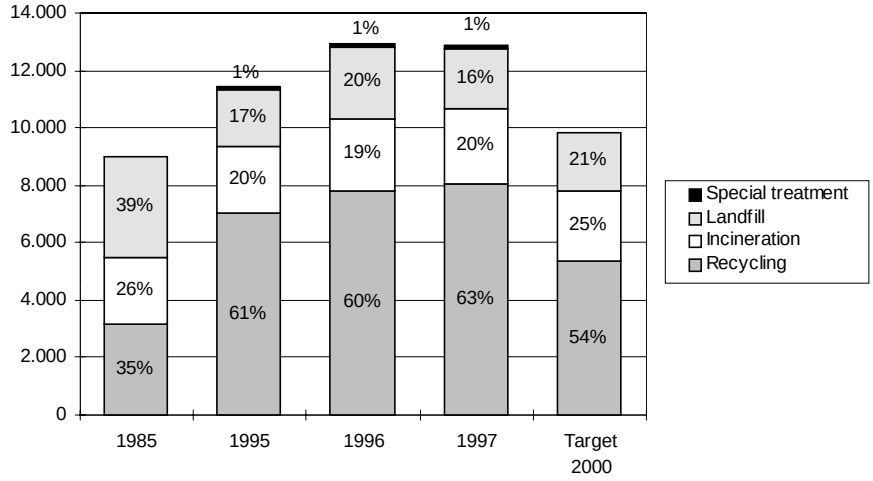
Sources: ISAG reports 1995, 1996 and 1997, the Government's Plan of Action for waste and recycling 1993-97, Danisco, Association of Danish Recycling Industries and other large scrap dealers, Elsam, Elkraft and reports to the Danish Environmental Protection Agency on sludge from municipal wastewater treatment plants applied to farmland, and incineration in sludge incineration plants (for 1997, figures from 1996 are used).

Table 2 and Figure 2 show that 8,046,000 tonnes, or 63 per cent of total amounts of waste, were recycled in 1997. This corresponds to an increase of 259,000 tonnes or 3 per cent compared to 1996. Waste incinerated in 1997 amounted to 2,622,000 tonnes, which corresponds to 5 per cent

more than in 1996, whereas amounts of waste landfilled decreased by 17 per cent to 2,103,000 tonnes.

The significant decrease in landfilled waste amounts may be attributed to several different factors: Firstly, a steep drop in amounts of residues from coal-fired power plants was registered in 1997. Secondly, on 1st January 1997 the ban on landfilling of waste suitable for incineration as well as an increase in the tax rate for landfilling took effect. Much waste suitable for incineration that used to be landfilled is now incinerated.

Figure 2. Treatment of waste in Denmark 1985, 1995, 1996, 1997 and 2000



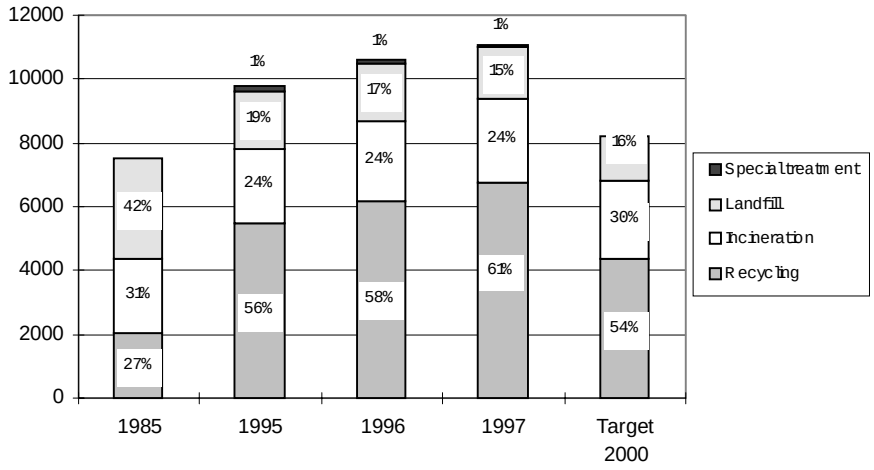
Sources: ISAG reports 1995, 1996 and 1997, the Government's Plan of Action for waste and recycling 1993-97, Danisco, Association of Danish Recycling Industries and other large scrap dealers, Elsam, Elkraft, and reports to the Danish Environmental Protection Agency on sludge from municipal wastewater treatment plants applied to farmland, and incineration in sludge incineration plants (for 1997, figures from 1996 are used). Special treatment means, for example, incineration with energy recovery (Kommunekemi), or pre-treatment for incineration or landfilling of, among others, health-care waste, oil and chemical waste, and other types of hazardous waste.

2.2.2. **Treatment of ordinary waste.**

As mentioned, the decrease in amounts of residues from coal-fired power plants has had a significant impact on the decrease in total waste amounts. It is therefore interesting to keep residues from power plants apart from statistics and take a closer look at general developments in the treatment of ordinary waste.

In Figure 3, slag and fly ash amounts are not included, and it is seen that 61 per cent of ordinary waste was recycled in 1997. This is somewhat more than projected in the Plan of Action. Objectives for maximum incineration and landfilling have also been attained, as 24 per cent of ordinary waste was incinerated and 15 per cent landfilled in 1997.

Figure 3. Treatment of ordinary waste in Denmark 1985, 1995, 1996, 1997 and 2000



Sources: ISAG reports 1995, 1996 and 1997, the Government's Plan of Action for waste and recycling 1993-97, Danisco, Association of Danish Recycling Industries and other large scrap dealers, Elsam, Elkraft, and reports to the Danish Environmental Protection Agency on sludge from municipal wastewater treatment plants applied to farmland, and incineration in sludge incineration plants (for 1997, figures from 1996 are used).

In absolute figures, this means that 11,082,000 tonnes of ordinary waste were generated in 1997. Of this amount, 6,746,000 tonnes were recycled, 2,622,000 tonnes were incinerated, and 1,628,000 tonnes landfilled. 86,000 tonnes were subjected to special treatment.

Due to the high activity in the building and construction sector, it may also be of interest to keep construction and demolition waste apart from statistics.

If both slag and fly ash, and construction and demolition waste are kept apart, it is seen that 47 per cent of waste was recycled in 1997, whereas 34 per cent was incinerated, and 18 per cent landfilled. Because of the large amounts and the high rate of recycling (92 per cent), construction and demolition waste has a significant impact on the achievement of objectives for year 2000 in the Plan of Action for waste and recycling.

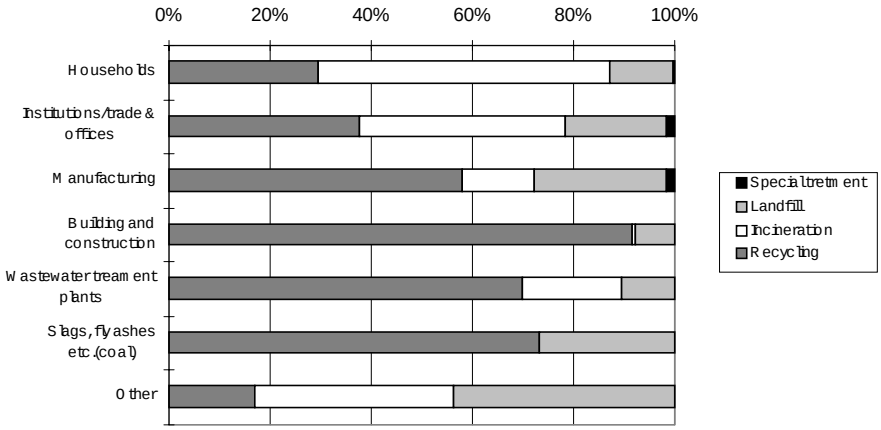
2.2.3. **Treatment by sources and waste types.**

Figure 4 shows total waste generation in Denmark, distributed on sources and treatment option. Figure 5 shows waste generation distributed on waste type and treatment option. Tables with detailed figures are given in Annex 1.

It is seen from Figure 4 that the rate of recycling of waste from manufacturing industries, the building and construction sector, wastewater treatment plants, and coal-fired power plants is high. Objectives for year 2000 in the Plan of Action for waste and recycling for recycling of waste from these sources are attained by a good margin. By contrast, objectives

for recycling of waste from households and institutions, trade and offices are far from being attained.

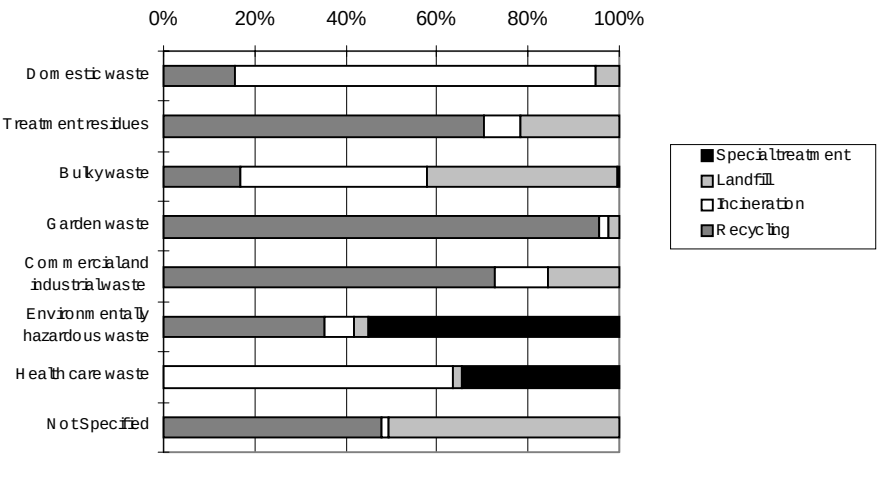
Figure 4. Waste in Denmark in 1997 by source and mode of treatment



Sources: ISAG reports 1995, 1996 and 1997, the Government's Plan of Action for waste and recycling 1993-97, Danisco, Association of Danish Recycling Industries and other large scrap dealers, Elsam, Elkraft, and reports to the Danish Environmental Protection Agency on sludge from municipal wastewater treatment plants applied to farmland, and incineration in sludge incineration plants (for 1997, figures from 1996 are used).

As Figure 5 shows, treatment options also vary much from one waste type to another. 97 per cent of garden waste is recycled, in comparison to a recycling rate of only 15 per cent for domestic waste.

Figure 5. Waste generation in Denmark in 1997 by type of waste and mode of treatment



Sources: ISAG reports 1995, 1996 and 1997, the Government's Plan of Action for waste and recycling 1993-97, Danisco, Association of Danish Recycling Industries and other large scrap dealers, Elsam, Elkraft, and reports to the Danish Environmental Protection Agency on sludge from municipal wastewater treatment plants applied to farmland, and incineration in sludge incineration plants (for 1997, figures from 1996 are used).

3 Recycling

3.1. **Recycling distributed on fractions.**

Table 3 shows waste fractions that are recycled, either by reprocessing, composting, or biogasification. The table expresses quantities sent for reprocessing, composting or biogasification, and is thereby not an outline of actual output of these fractions.

Table 3. Recycling in Denmark in 1995, 1996 and 1997 of waste from primary sources, distributed on waste fractions. In '000 tonnes.

	1995	**1996**	**1997**
Oil and chemical waste	28	53	72
Paper and cardboard	557	548	583
Bottles and glass	92	99	89
Plastic	26	29	28
Food waste / other organic waste	198	193	230
Branches, leaves, grass cuttings etc.	376	452	528
Ferrous metals [1 and 4]	983	899	1,004
Automobile tyres	9	8	20
Concrete	485	942	1,167
Tiles	75	93	125
Other construction and demolition waste	526	532	520
Asphalt	694	737	853
Wood	10	15	21
Soil and stone	344	391	353
Other recyclables	108	166	240
Fly ash and slag from coal-fired power plants[2]	1,276	1,213	911
Fly ash and slag from other sources except waste incineration plants	3	2	2
Flue-gas cleaning products (gypsum, TASP, sulphuric acid) from coal-fired power plants[2]	288	416	394
Sludge from municipal wastewater treatment plants for recovery on farmland, composting and biogasification[3]	918	918	870
Sludge from other sources	50	81	40
Total	**7,046**	**7,787**	**8,050**

Sources: ISAG reports for 1995, 1996 and 1997, (1) Association of Danish Recycling Industries and other large scrap dealers, (2) Elsam, Elkraft, (3) reports to the Environmental Protection Agency on sludge applied to farmland (for 1997, figures from 1996 have been used). (4) Correction for ferrous metals removed from waste incineration plants (15,100 tonnes) has been made to avoid double counting. Some of the collective terms such as “Other recyclable waste, “Other construction and demolition waste” and “Soil and stone” may contribute - after sorting has been completed - to additional quantities of items such as tiles, wood, etc.

The most significant amounts are found for waste fractions relating to industry (ferrous metals), building and construction activities (for example concrete and asphalt), coal-fired power plants (fly ash, gypsum, and slag), and wastewater treatment plants (sludge). However, waste fractions such as glass, paper and cardboard, branches and leaves etc. also account for large amounts. A large proportion of this waste is generated in households.

Amounts of recycled fly ash, slag, and flue gas cleaning products from coal-fired power plants decreased considerably from 1996 to 1997. This is attributable to the decrease in waste amounts from coal-fired power plants as a consequence of reduced exports of power to Norway and Sweden.

Amounts of recycled sludge from municipal wastewater plants also decreased. In 1997, amounts of sludge were 34,000 tonnes larger than in 1996, and incineration and landfilling of sludge increased by 5 and 1 per cent respectively. It seems that sludge recovery by application to farmland has decreased compared to previous years.

3.2. **Paper and cardboard.**

Consumption of virgin paper, paper collected for recycling, and exports of waste paper are shown in Table 4.

Table 4. Consumption and recycling of paper and cardboard in 1995, 1996 and 1997. In '000 tonnes.

	1995	**1996**	**1997**
Consumption of virgin paper[1]	1,208	1,181	1,349
Waste paper collected[2]	557	548	583
Waste paper collected as a percentage of virgin paper consumption	46	46	43
Danish waste paper sent to Danish paper mills[2]	332	318	335
Net exports of waste paper[3]	150	220	204

Sources: (1) Rendan's material stream analysis of waste paper and Statistics Denmark, (2) ISAG reports 1995, 1996, and 1997, (3) Statistics Denmark. The discrepancy between waste paper collected, and Danish waste paper sent to Danish paper mills + net export, may be due to stock enlargement, and it may be a consequence of the use of different statistical sources.

From 1996 to 1997, a significant increase took place in the consumption of virgin paper. In 1997, paper consumption amounted to 259 kg/capita, whereas 112 kg/capita were collected separately. In 1996, corresponding figures were a paper consumption of 224 kg/capita and average collection of 104 kg/capita.

As amounts of waste paper collected did not increase by a similar rate as paper consumption, this means that the rate of collection of waste paper decreased from 46 per cent in 1996 to 43 per cent in 1997.

In 1997, Denmark had a net export of 204,000 tonnes of waste paper, which covers imports of waste paper of 106,000 tonnes and exports of 310,000 tonnes.

Sources of waste paper collected are stated in Table 5. Almost identical amounts of waste paper are collected from the three sources: manufacturing industry, households, and institutions, trade and offices. After a decrease from 1995 to 1996 of 7 per cent, amounts of waste paper from households increased by 14 per cent from 1996 to 1997. Amounts of

waste paper from institutions, trade and offices increased by 3 per cent from 1996 to 1997. However, total amounts collected decreased by 1.5 per cent from 1995 to 1997. Amounts of paper collected for recycling from manufacturing enterprises increased by 3 per cent from 1996 to 1997.

Table 5. Recycling of paper and cardboard by source in 1995, 1996 and 1997. Stated in tonnes.

	1995	1996	1997
Households	173,333	160,469	183,116
Institutions, trade and offices	180,647	173,289	178,158
Manufacturing industry	203,054	214,015	220,935
Building and construction	172	163	234
Wastewater treatment plants		2	1
Not reported		213	731
Total	557,205	548,151	583,174

Source: ISAG reports 1995, 1996 and 1997.

3.3. **Glass**

According to ISAG reports, recycling of bottles and glass from primary sources amounted to 89,000 tonnes in 1997. This is a decrease of 10,000 tonnes compared to 1996. By only including waste from primary sources, however, a complete picture of total material streams is not obtained.

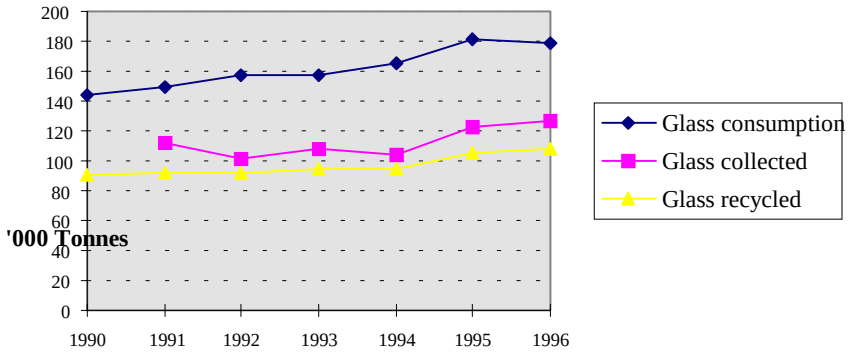
As a consequence, the following description of total recycling of bottles and glass is based on the Rendan material stream analyses for glass, which are more detailed than the ISAG statement of glass recycling.

Consumption of glass packaging has been increasing throughout the 1990s, cf. Figure 6, though with a slight decrease in consumption in 1996 compared to 1995 (1996: 178,348 tonnes and 1995: 181,265 tonnes). The decrease covers a decrease in the consumption of jars of a good 8,000 tonnes, and an increase in the consumption of bottles for wine and spirits of 3,600 tonnes.

Collection and recycling of glass have also been increasing throughout the 1990s. In 1996, 126,109 tonnes of glass were collected, corresponding to 71 per cent of total consumption. Correspondingly, the rate of recycling increased by 3 percentage points from 61 per cent in 1995 to 64 per cent in 1996.

Bottles for beer and soft drinks manufactured for reuse are not included in this statement. Refillable glass bottles, on average, make 35 trips. If these bottles were manufactured as single-use bottles, it would give an increase in waste glass of around 350,000 tonnes.

Figure 6 . The development and consumption of glass in 1990-1996



Source: Rendan material stream analysis for glass, bottles, and cullets, 1996.

3.4. **Ferrous metals**

Table 6 shows amounts of collected ferrous scrap, distributed on receivers. Total potential of ferrous scrap is not known precisely. Recycling industries normally estimate a recycling rate in excess of 90 per cent for ferrous scrap.

According to ISAG reports, Danish foundries and the Danish Steel Works imported 210,000 tonnes in 1997, whereas scrap dealers imported 78,000 tonnes. This adds up to total imports of 288,000 tonnes in 1997, or 10,000 tonnes less than in 1996.

Table 6. Recycling of ferrous scrap in 1996 and 1997. In '000 tonnes.

		1996	1997
I	Danish ferrous scrap sent to foundries and the Danish Steel Works[1]	356	406
II	Ferrous scrap exported by scrap dealers[2]	612	684
III	Ferrous scrap imported by scrap dealers [2]	35	78
Total recycling of Danish ferrous scrap (I+II-III)		**933**	**1012**
Ferrous scrap imported by foundries and the Danish Steel Works[1]		263	210

Sources: (1) ISAG reports 1996 and 1997, (2) Information from the Association of Danish Recycling Industries and other large scrap dealers. The statement used in table 5 for recycling of ferrous scrap is slightly different from the one used in Table 3. For example, the correction for ferrous scrap removed from waste incineration plants (1996: 15,100, 1997: 19,774) has not been made in Table 5, as this table shows the total balance for ferrous metals.

3.5. **Organic waste for composting, wood chipping, and biogasification.**

Organic waste amounts delivered to composting, wood chipping, and biogasification are shown in Table 7.

The table shows, similar to developments from 1995 to 1996, that there was a significant increase from 1996 to 1997 in garden waste amounts

(branches, leaves etc.) for composting. This indicates that municipal collection and bring schemes for garden waste are becoming more widespread and extensively used.

Table 7. Amounts of organic waste 1995-97 delivered to composting, wood chipping, and biogasification, and removal from the plants of compost, wood chips, and screenings. Stated in '000 tonnes

Material	1995	1996	1997
Branches, leaves etc. for composting/wood chipping	376	452	528
Organic domestic waste for composting	34	36	46
Organic domestic waste for biogasification	5	10	1
Other organic waste for composting	6	2	1
Other organic waste for biogasificaiton	120	111	139
Other organic waste for fodder production	32	34	42
Sludge for composting	7	6	7
Sludge for biogasification	59	92	52
Total	**639**	**743**	**817**
Removal from plants of bark/wood chips	49	34	44
Removal from plants of compost	102	162	214
Removal from plants of screenings	5	19	13

Source: Calculations and estimates based on ISAG reports 1995, 1996 and 1997. ISAG reports do not include information on the quantity of biogas generated.

Amounts of organic domestic waste for composting, and other organic waste for biogasification also increased from 1996 to 1997. By contrast, there was a drop in amounts of organic domestic waste treated by biogasification. This is mainly attributable to the closing-down of the biogas plant Nordsjællands Biogasanlæg located in Elsinore.

Quantities of bark/wood chips and compost removed from the plants do not reflect the quantities generated. However, this quantity should be considered as reflecting the quantity sold or delivered free.

Amounts of compost removed from the plant increased significantly: from 162,000 tonnes in 1996 to 214,000 tonnes in 1997.

3.6. **Tyres**

In 1995, the Minister for Environment and Energy entered an agreement with a number of organisations, on a take-back scheme for used tyres from cars, vans, and motorcycles. The purpose of the agreement is to ensure collection and recovery of used tyres in Denmark. Landfilling is avoided and resource recovery ensured, whereby material recovery is prioritised to energy recovery.

The scheme started 1st April 1995 and is financed by a fee on tyres comprised by the agreement and marketed in Denmark. The fee amounts to DKK 8 per tyre.

According to the agreement, the objective was a take-back rate of 60 per cent in 1995. The objective for 1997 onwards is 80 per cent. Objectives have been more than attained in 1997.

Table 8. Take-back of car, van, and motorcycle tyres in 2nd half of 1995, and in 1996 and 1997	2nd half 1995	1996	1997
	Tonnes	Tonnes	Tonnes
Used tyres covered by the take-back scheme	8,725	16,705	18,405
Collected tyres	7,600	12,670	17,229
Of which for			
Retreading or continued use	3,300	5,477	4,581
Temporary storage	955	1.133	0
Rubber powder production	3,345	6,060	12,648
Collection in % of tyres covered by the scheme	87.1	75.8	93.6

Source: Reports from the Danish Tyre Trade Environmental Foundation for 1995, 1996, and 1997. 2nd half of 1995 includes 1,000 tonnes collected in the first half of 1995, thereby increasing the collection rate.

4 Hazardous waste

Table 9 on hazardous waste amounts, includes waste from primary and secondary sources distributed on treatment options. Waste from secondary sources, such as waste from incineration plants, is not included in total waste generation, cf. Table 1. However, it is reasonable when assessing the total generation of hazardous waste to include waste from both primary and secondary sources.

Table 9. Hazardous waste generation in 1996 and 1997. Tonnes.	Recycling		Incineration		Special treatment		Landfilling		Total	
	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997
Primary sources										
Lead batteries[1]	14,200	14,895							14,200	14,895
Hermetically closed nickel-cadmium batteries[8]	33.5	95							120	120
Waste oil delivered to district heating plants[2]			20,734	22,576					20,734	22,576
Oil and chemical waste delivered to Kommunekemi[3 and 7], of which					82,509	74,215			82,509	74,215
Detergent and soap waste					1,468	1,457			1,468	1,457
Organic aromatic solvents					5,290	6,878			5,290	6,878
Other organic solvents					2,701	5,132			2,701	5,132
Wastes of printing ink, paints, varnish etc. with organic solvents					6,535	8,793			6,535	8,793
Liquid organic residues from distillation					2,346	1,184			2,346	1,184
Anti-freeze liquid					868	828			868	828
Acidic aqueous solutions					4,820	4,867			4,820	4,867
Photographic developer					5,407	2,509			5,407	2,509
Alkaline aqueous solutions					2,498	2,654			2,498	2,654
Sludge of metal hydroxide and metal oxide					4,796	4,816			4,796	4,816
Sludge from flue gas washing and flue gas filter dust					1,641	2,803			1,641	2,803
Waste from production of chemical pesticides					519	700			519	700
Medical waste					961	779			961	779
Chemical waste from laboratories etc.					2,342	2,049			2,342	2,049
Waste oil					14,612	13,217			14,612	13,217
PCB and PCT waste					-	34			-	34
Waste mercury					-	185			-	185
Other waste received at Kommunekemi					25,705	15,328			25,705	15,328
Dust emitting asbestos[3 and 9]							7,800	7,000	7,800	7,000
Health-care waste[3]			5,700	5,900	3,000	2,900			8,700	8,800
Sulphuric acid (coal-fired power plants)[5]	2,2000	8,000							22,000	8,000
Oil and chemical waste from other primary sources[3]	12,200	28,600	10,100	9,500	2,600	5,400	5,800	3,000	30,700	46,500
Total, primary sources	48,400	51,590	36,534	37,976	87,900	82,515	13,600	10,000	186,763	182,106
Secondary sources										
Flue gas filter dust[1]	10,487	10,137							10,487	10,137
Fly ash and flue gas cleaning products from waste incineration[3 and 6]					26,500	24,600	45,400	36,700	71,900	61,300
Total secondary sources	10,487	10,137			26,500	24,600	45,400	36,700	82,387	71,437
Total	58,887	61,727	36,534	37,976	114,400	107,115	59,000	46,700	269,150	253,543

Sources: (1) Registrations according to EU Regulation 259/93 on shipments of waste, (2) Payment of subsidies for recovery of waste oil, (3) ISAG reports 1996 and 1997, (5) Elsam, (6) The figure for special treatment covers that the quantity is in storage. (7) Kommunekemi A/S, (8) Calculations by the Danish Environmental Protection Agency. The difference between total quantity of waste hermetically closed nickel-cadmium batteries (120 tonnes) and the amount collected for recycling (95 tonnes) is due to the fact that the batteries are not collected separately, but comprised by the general collection of waste, (9) Under the terms of Statutory Order no. 660 of 24th September 1986 on asbestos from the Ministry of Labour, asbestos is divided into three categories: I) dust emitting asbestos, II) asbestos that may emit dust, and III) non-dust emitting asbestos. Only asbestos of the first category is hazardous waste, but reports to the ISAG comprise asbestos of both categories I and II.

Table 9 shows a slight decrease from 1996 to 1997 of 15,600 tonnes in hazardous waste arisings. This decrease covers different developments for different fractions. For example, an increase of 7,500 tonnes in total generation of oil and chemical waste from primary sources has been registered, whereas there has been a decrease of 10,600 tonnes in the generation of fly ash and flue gas cleaning products from waste incineration plants.

In 1996, Kommunekemi received 82,500 tonnes of oil and chemical waste, or 10 per cent less than amounts received in 1995, and the lowest amount since 1984. This trend continued in 1997, with 74,200 tonnes of oil and chemical waste delivered to Kommunekemi, corresponding to around 10 per cent less than in 1996.

This result shall be seen in connection with the fact that amounts of oil and chemical waste subjected to special treatment at other treatment plants than Kommunekemi more than doubled in 1997 compared to 1996. As mentioned above, total generation of oil and chemical waste increased by 7,500 tonnes or almost 7 per cent.

Amounts of nickel-cadmium batteries collected in 1997 were 95 tonnes against only 33.5 tonnes in 1996. This increase can be attributed to Statutory Order no. 93 of 22nd February 1996 on Collection of Hermetically Sealed Nickel-Cadmium Accumulators (Closed Nickel-Cadmium Batteries) and Remuneration for Collection and Disposal for Recycling. Under the terms of this Statutory Order, a remuneration was introduced amounting to DKK 120/kg of nickel-cadmium batteries collected for recycling.

Since subsidies were introduced in 1993 for incineration of waste oil at district heating plants, amounts of waste oil delivered to such plants have increased steadily. In 1994 and 1995, around 19,000 tonnes were delivered, and in 1996 a delivery of 20,734 tonnes was registered, whereas 22,500 tonnes of waste oil were delivered to district heating plants in 1997.

5 Imports and exports of waste

5.1. **Imports**

Table 10 shows imported amounts of waste for 1996 and 1997 distributed on waste fractions and treatment options. Imported amounts of waste increased from 1996 to 1997 by 6 per cent, and account for 4 per cent of total waste generated in Denmark.

Table 10. Imports of waste in 1996 and 1997 stated by fraction and in tonnes.

Fraction	Recycling		Incineration		Landfilling		Special treatment		Total	
	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997
Glass[1]	2,200	1,500							2,200	1,500
Paper and cardboard[2]	84,526	105,857							84,526	105,857
Plastic[1]	16,700	18,500							16,700	18,500
Ferrous metals[1 and 3]	298,663	299,312							298,663	299,312
Other burnable[1]			13,108[4]	23,693					13,108	23,693
Special health-care waste[4]							375	29	375	29
Soil[3]					4	0			4	0
Food waste/ other organic[1]	6,600	8,900							6,600	8,900
Other recyclables[1]	2,300	2,600							2,300	2,600
Sludge[4]	7,772	12,013							7,772	12,013
Other notified waste[4]	28,614	21,164					14,715	6,837	34,329	28,001
Total	**447,374**	**469,846**	**13,108**	**23,693**	**4**	**0**	**15,090**	**6,866**	**475,576**	**500,405**

Sources: (1) ISAG reports 1996 and 1997, (2) Statistics Denmark, (3) Association of Danish Recycling Industries and other large scrap dealers, (4) Registrations according to EU Regulation 259/93 on shipments of waste.

89 per cent of waste imported is categorised as green waste for recovery according to the EU Regulation on shipments of waste, and it covers glass, paper, cardboard and carton, plastic, ferrous metals, as well as organic waste. Waste imported is destined for recycling or incineration with energy recovery.

The remaining 11 per cent of waste imported is listed on the OECD amber and red lists and is subject to mandatory notification under the EU Regulation on shipments of waste, cf. Table 12. Waste of this type is destined for disposal (landfilling and incineration without energy recovery) or recovery (recycling and incineration with energy recovery).

5.2. **Exports**

Table 11 shows amounts of waste exported in 1996 and 1997. It is seen that amounts exported account for 9 per cent of total waste generation in Denmark. In 1997, amounts exported increased by 56,000 tonnes or 5 per cent compared to 1996. This increase is mainly attributable to an increase in exports of residues from waste incineration plants, whereas there has been a decrease in exports of residues from coal-fired power plants and iron manufacture.

Table 11. Exports of waste in 1996 and 1997 stated by fraction. In tonnes.		
	1996	**1997**
Glass[1]	9,875	1,168
Paper and cardboard[1]	304,812	309,658
Plastic[1]	8,589	12,718
Ferrous metals[2 and 6]	611,508	699,473
Other burnable[6)]	0	9100
Fly ash from coal-fired power plants[3]	170,000	113,000
Sulphuric acid from coal-fired power plants[3]	2000	0
Slag and flue gas cleaning products from iron and steel manufacture [4 and 6]	32,800	25,900
Lead batteries[4 and 5]	14,200	14,895
Hermetically closed nickel-cadmium batteries[4 and 5.]	34	95
Flue-gas cleaning products from waste incineration plants[4]	21,103	26,510
Ferrous metals from waste incineration plants[4)]	8,008	26,692
Other notified waste[4]	22,161[7]	22,145
Total	**1,205,090**	**1,261,354**

Sources: (1) Statistics Denmark, (2) Association of Danish Recycling Industries and other large scrap dealers, (3) Elsam and Elkraft, (4) Registrations according to EU Regulation on shipments of waste, (5) Collection of nickel-cadmium batteries registered by the Danish Environmental Protection Agency, (6) ISAG reports 1996 and 1997, (7) Figure changed compared to 1996 statistics.

91 per cent of amounts exported is classified as green waste destined for recovery, and covers primarily the fractions paper and cardboard, and ferrous metals, which alone account for 80 per cent of amounts exported.

Exports of waste destined for disposal and waste destined for recovery, which are listed on the OECD red and amber waste lists, are subject to mandatory notification in accordance with the EU Regulation on shipments of waste. These exports amounted to about 114,000 tonnes, corresponding to 9 per cent of amounts exported, cf. Table 12.

5.3. **Imports and exports of waste subject to mandatory notification, distributed on countries and waste fractions.**

Table 12 shows countries of export and import of waste subject to mandatory notification.

The table shows that imports of waste destined for recovery come almost exclusively from Germany. Norway, Spain, Sweden and Germany receive most of what Denmark exports for recovery.

The major proportion of imported waste subject to mandatory notification and destined for disposal comes from Norway. Similarly, Norway is also the main country of destination for waste for disposal exported from Denmark (flue gas cleaning products from waste incineration plants).

The geographical structure of countries with which Denmark co-operates in the treatment of hazardous waste is identical to that of 1996. In return, from 1996 to 1997, a remarkable increase in amounts of exported waste subject to mandatory notification has been registered.

In 1997, Denmark exported 113,800 tonnes against 65,200 tonnes in 1996. This is an increase of 75 per cent. Especially, there was an increase

in exported amounts of slag and ash from the manufacture of iron and steel, and ash from zinc processing plants to Norway; in household hazardous waste and waste from paper mills to Sweden, and in residues from waste incineration plants, waste oil, household hazardous waste, and waste from surface treatment of ferrous metals to Germany.

By contrast, amounts of imported waste subject to mandatory notification decreased from 65,000 tonnes in 1996 to 55,000 tonnes in 1997.

Table 12. Imports and exports of waste subject to mandatory notification in 1997. Stated in tonnes

Country	Disposal		Recovery	
	Exports from DK to:	Imports to DK from:	Exports from DK to:	Imports to DK from:
Belgium				
AC220	0	0	225.8	0
AA020	0	0	17.89	0
AA040	0	0	3.6	0
AA130	0	0	779.17	0
Total:	**0**	**0**	**1,026.46**	**0**
Great Britain				
AD090	0	0	21.69	0
AA060	0	0	493.25	0
AA100	0	0	8.57	0
AA120	0	0	297.65	0
Total:	**0**	**0**	**821.17**	**0**
Finland				
AA050	0	0	260.07	0
Total:	**0**	**0**	**260.07**	**0**
France				
AA180	0	0	74.9	0
Total:	**0**	**0**	**74.9**	**0**
The Netherlands				
AB010	0	0	0	1,665.05
AB080	0	0	169.77	0
AD060	1,656.17	0	0	1,737.55
RX100	0	0	0	40.66
Total:	**1,656.17**	**0**	**169.77**	**3,443.26**
Ireland				
AC210	0	0	0	1,570.86
AC220	0	0	0	123.07
AD010	0	744.56	0	72.29
AD070	0	0	0	311.53
AD140	0	42	0	0
Total:	**0**	**786.56**	**0**	**2,077.75**

Iceland				
AC220	0	117.74	0	0
RX100	0	47.1	0	0
Total:	**0**	**164.84**	**0**	**0**
Norway				
AB020	20,092.61	0	2,044.78	0
AB110	0	67.54	275	0
AC030	0	0	0	190.03
AC090	0	16.36	0	0
AD010	0	0	0.4	0
AD090	0	1,146.24	0	59.39
RA010	0	23.88	0	0
RX100	0	4,527.40	0	24.98
AA010	0	0	9,905.30	0
AA020	0	0	2,218.58	0
Total:	**20,092.61**	**5,781.42**	**14,444.06**	**274.39**
Poland				
AA070	0	0	0	3.21
Total:	**0**	**0**	**0**	**3.21**
Spain				
AA010	0	0	10,136.50	0
Total:	**0**	**0**	**10,136.50**	**0**
Sweden				
AC150	0	7.37	0	0
AD020	0	97.3	0	0
AD070	0	0	0	121.71
AD160	0	0	4,168.66	0
RX100	0	0	4,300.03	641.55
AA030	0	0	107.05	0
AA100	0	9.54	0	0
AA170	0	0	15,076.04	0
AA180	0	0	49.07	0
Total:	**0**	**114.21**	**23,700.86**	**763.26**
Germany				
AB010	0	0	0	338.43
AB020	6,417.15	0	24,647.41	0
AB030	0	0	81.92	0
AB080	0	0	30.36	0
AC030	0	0	3,272.24	7,277.46
AC040	0	0	0	886.72
AC090	0	0	6.5	0
AC170	0	0	0	7,563.63
AC220	0	0	0	180.68
AC270	0	0	0	12,012.62
AD010	0	0	0	13,44
AD030	0	0	0	583.92
AD040	50.81	0	0	0
AD060	0	0	0	6,907.32

AD070	0	0	0	233.18
AD090	0	0	50.14	0
AD160	0	0	1,699.47	0
RA010	3.35	0	0	529.38
RX100	0	0	0.55	3,088.46
AA010	0	0	2,985.00	1,577.73
AA020	0	0	71.18	0
AA040	0	0	119.08	0
AA070	68.44	0	8.8	0
AA100	168.27	0	52.02	0
AA130	0	0	1,626.64	0
AA160	0	0	17.01	0
Total:	**6,708.01**	**0**	**34,668.33**	**41,192.97**
United States				
AB080	0	0	50.24	0
Total:	**0**	**0**	**50.24**	**0**
Total all countries:	**28,456.79**	**6,847.03**	**85,352.36**	**47,754.84**

Sources: Danish Environmental Protection Agency, database of shipments. The registration is made on the background of completed consignment notes under EU Regulation 259/93 on shipments of waste. The consignee must send a copy of the filled-in consignment note to the competent authorities within three working days after receipt of the waste. OECD-codes are defined in Commission Decision of 21st October 1994 (no. L 288/36, Official Journal of the European Communities of 9th November 1994).

5.3.1. OECD-codes.

AA010	Dross, scalings and other wastes from the manufacture of iron and steel.
AA020	Zinc ashes and residues.
AA030	Lead ashes and residues.
AA040	Copper ashes and residues.
AA050	Aluminium ashes and residues.
AA060	Vanadium ashes and residues
AA070	Ashes and residues containing metals or metal compounds not elsewhere specified or included.
AA130	Liquors from the pickling of metals.
AA100	Mercury waste and residues.
AA120	Galvanic sludges.
AA160	Ash from incineration of printed circuit boards
AA162	Photographic film ash.
AA170	Lead-acid batteries, whole or crushed.
AA180	Used batteries or accumulators, whole or crushed, other than lead-acid batteries and
waste	and scrap arising from the production of batteries and accumulators, not otherwise
speci-	fied or included.
AB010	Slag, ash and residues, not elsewhere specified or included.
AB020	Residues arising from the combustion of municipal/household wastes.
AB030	Waste from non-cyanide based systems which arise from surface treatment of metals.
AB070	Sands used in foundry operations.
AB080	Waste catalysts not on the green list.
AB100	Waste alumina.
AB110	Basic solutions.
AC030	Waste oils unfit for their originally intended use.
AC040	Leaded petrol (gasoline) sludges
AC070	Brake fluids.
AC090	Waste from production, formulation and use of resins, latex, plasticisers, glues and adhesives.
AC170	Treated cork and wood wastes.
AC210	Non-halogenated solvents.
AC220	Halogenated solvents.
AC260	Liquid pig manure; faeces.
AC270	Sewage sludge.
AD010	Waste from the production and preparation of pharmaceutical products.
AD030	Waste from the manufacture, formulation and use of wood preserving chemicals.

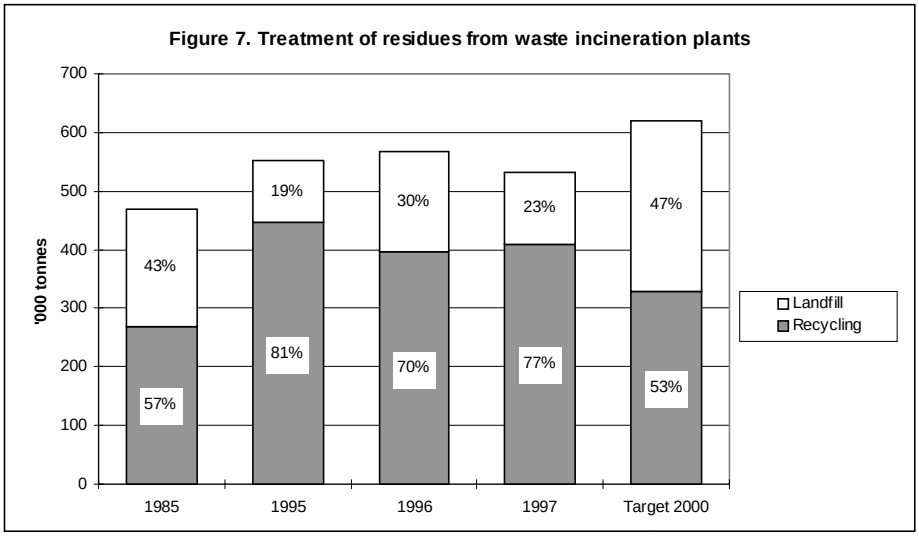
AD040	Inorganic cyanides, excepting precious metal-bearing residues in solid form containing traces of inorganic cyanides.
AD060	Waste oils/water, hydrocarbons/water mixtures, emulsions.
AD070	Waste from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish.
AD080	Wastes of an explosive nature, when not subject to specific other legislation
AD090	Waste from production, formulation and use of reprographic and photographic chemi-
cals	and materials, not elsewhere specified or included.
AD140	Wastes from industrial pollution control devices for cleaning of industrial offgases, not elsewhere specified or included.
RA010	Waste, substances and articles containing consisting of or contaminated with polychlorinated biphenyl (PCB) and/or polychlorinated terphenyl (PCT) and/or polybrominated biphenyl (PBB), including any other polybrominated analogues of these compounds at a concentration level of 50 mg/kg or more.
RC030	Leaded anti-knock compounds sludges
RX100	Other wastes not specified with an OECD-code

6 Waste fractions and status compared to objectives for year 2000

6.1. **Residues from waste incineration plants.**

Residues from waste incineration plants are not included in statements of total waste generation presented so far, as waste would otherwise be counted twice.

Figure 7 shows amounts of residues (slag, fly ash, and flue gas cleaning products) from waste incineration in 1997, stated in tonnes, as well as treatment option.



Sources: ISAG reports 1995, 1996 and 1997, and the Government's Plan of Action for waste and recycling 1993-97.

In Table 13, amounts of residues removed from waste incineration plants are detailed further. Amounts of residues from waste incineration naturally depend on amounts of waste incinerated. The table shows that amounts removed from waste incineration plants decreased by 26,000 tonnes from 1996 to 1997. 150,000 tonnes were landfilled in 1997, which is 42,000 tonnes less than in 1996. Recycling of residues from waste incineration plants in 1997 amounted to some 407,000 tonnes, which is almost 24,000 tonnes more than in 1996.

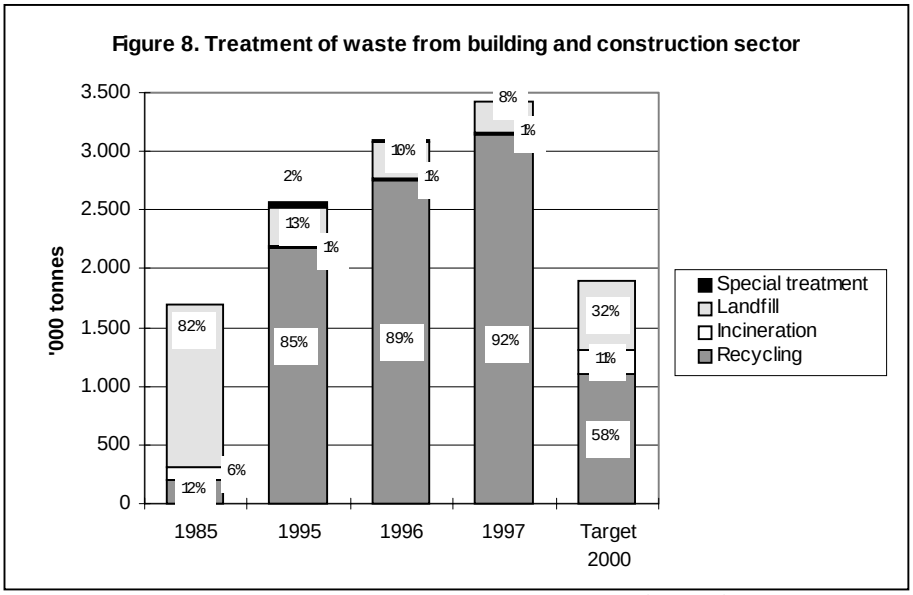
Table 13. Slag, fly ash and flue gas cleaning products removed from waste incineration plants in 1995, 1996 and 1997 related to treatment option. Tonnes			
	1995	**1996**	**1997**
Slag removed from waste incineration plants	491,300	509,200	493,800
Fly ash and flue gas cleaning products removed from waste incineration plants	63,300	71,900	61,300
Total removed from waste incineration plants	*554,600*	*581,100*	*555,100*
Landfilled slag from waste incineration plants	64,500	126,300	87,100
Landfilled fly ash and flue gas cleaning products from waste incineration plants	44,400	45,300	36,600
Fly ash and flue gas cleaning products exported for landfilling	2,564	21,103	26,510
Total landfilled from incineration plants	*111,464*	*192,703*	*150,210*
Slag from waste incineration plants registered as delivered to reprocessing plants	121,900	101,800	106,100
Slag from waste incineration plants estimated as delivered directly to recycling	304,900	281,100	300,600
Total recycling from waste incineration plants	*426,800*	*382,900*	*406,700*
Fly ash and flue gas cleaning products removed from waste incineration plants and estimated as in storage.	16,336	5,497	- 1,810

Source: Calculations based on ISAG reports 1995, 1996, and 1997 and registrations according to EU Regulation on shipments of waste.

6.2. **Waste from building and construction activities.**

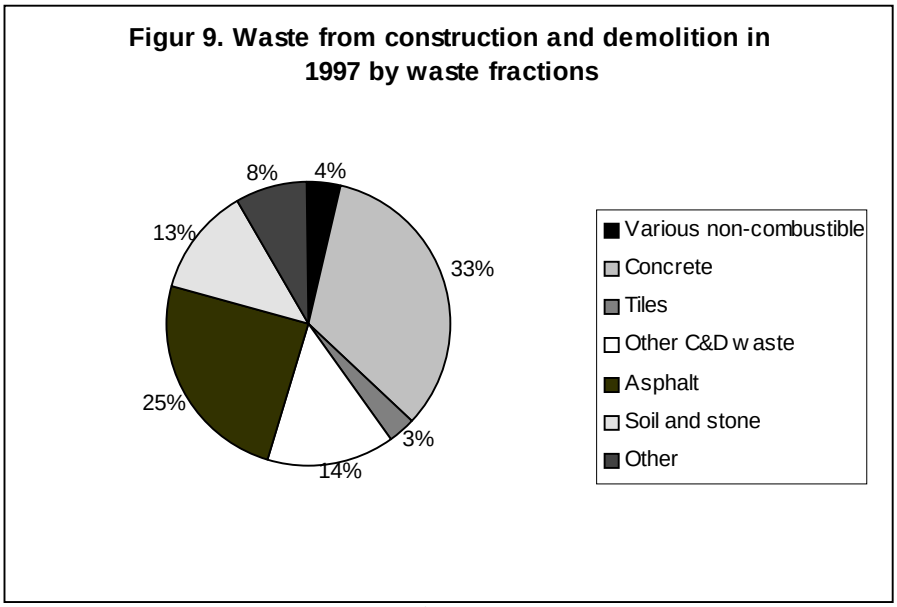
In 1997, waste from the building and construction sector amounted to a total of 3,427,000 tonnes, which is an increase of 11 per cent or 339,000 tonnes compared to 1996-amounts. Such an increase is not surprising, as activities in the building and construction sector have been increasing since the beginning of 1996 and seem to have peaked in early 1998. It is therefore to be expected that waste arisings from this sector will also be considerable in next year's statistics, though perhaps not quite as large as in 1997.

As it can be seen from Figure 8, by far the largest proportion of waste from the building and construction sector is recycled - only 1 per cent of waste is incinerated, whereas 8 per cent is landfilled. This adds up to a rate of recycling in 1997 of 92 per cent, which is an increase by 3 per cent compared to 1996. The figure also shows that objectives for year 2000 have been more than attained for construction and demolition waste, both for recycling, incineration, and landfilling.



Sources: ISAG reports 1995, 1996 and 1997, and the Government's Plan of Action for waste and recycling 1993-97.

Figure 9 shows composition of construction and demolition waste. More than half the waste is concrete and asphalt.



Source: ISAG reports 1997. Legend: clock-wise from top.

A large proportion of construction and demolition waste is reprocessed in mobile crushing plants moved around the country for various assignments. In some cases, both the owner of the crushing plant and his client report to the ISAG. The Danish Environmental Protection Agency is aware of this possible source of double counting, and great efforts are made in co-operation with reporting enterprises to subject data to quality assurance in order to avoid double counting.

6.3. **Households.**

It can be seen from Tables 1 and 14 that total waste generation in households in 1997 amounted to some 2,776,000 tonnes, which is almost identical to 1996.

Waste from households covers primarily the waste types domestic waste, bulky waste, and garden waste, which again can be divided into waste fractions such as paper and cardboard, bottles and glass, and food waste/other organic waste. See also Table 14 where fractions are stated, in so far as it has been possible to register them separately.

Table 14. Waste generation in households by fraction. Stated in tonnes	**1994**	**1995**	**1996**	**1997**
Various burnable	1,794,717	1,769,445	1,800,752	1,784,342
Various non-burnable	203,430	189,443	164,356	155,590
Paper and cardboard	142,668	173,330	160,469	183,116
Bottles and glass	69,064	46,157	64,903	67,771
Food waste/other organic	32,907	38,913	45,905	47,085
Branches, leaves, grass cuttings etc.	248,574	298,090	386,874	426,309
Oil and chemical waste	9,576	16,300	16,214	12,668
Other	73,880	78,098	127,479	99,181
Total	**2,574,816**	**2,609,776**	**2,766,952**	**2,776,061**

Sources: ISAG reports 1994, 1995, 1996, and 1997.

Amounts of "various non-burnable" from households have decreased for the third consecutive year. The decrease was almost 24 per cent in the period from 1994 to 1997. As this fraction is normally landfilled, this is an expression of waste from households being separated better, resulting in smaller amounts of waste for landfilling.

Amounts of separately collected paper and cardboard from households increased by 14 per cent from 1996 to 1997, whereas amounts of separately collected bottles and glass increased by around 4 per cent.

There has been a minor increase of around 3 per cent in amounts of separately collected food waste/other organic waste from households from 1996 to 1997.

Amounts of garden waste from households continued to increase. From 1996 to 1997 amounts of garden waste increased by 10 per cent. In the period from 1994 to 1997, the total increase was just above 70 per cent.

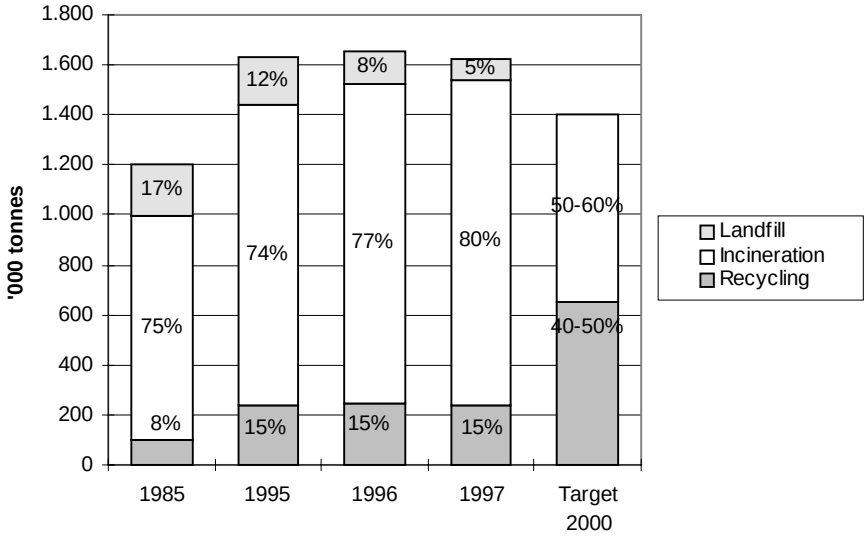
Developments and treatment of different waste types are detailed below.

6.3.1. **Domestic waste**

Domestic waste from households covers waste that results from normal consumption in private households, i.e. paper, bottles and glass, organic

food waste, and residual waste, which is collected at regular intervals, normally weekly or every second week.

Figure 10. Treatment of domestic waste from households



Sources: ISAG reports 1995, 1996 and 1997, and the Government's Plan of Action for waste and recycling 1993-97.

Table 1 shows that amounts of domestic waste from households decreased from 1,654,500 tonnes in 1996 to 1,620,800 tonnes in 1997, corresponding to a decrease of 2 per cent.

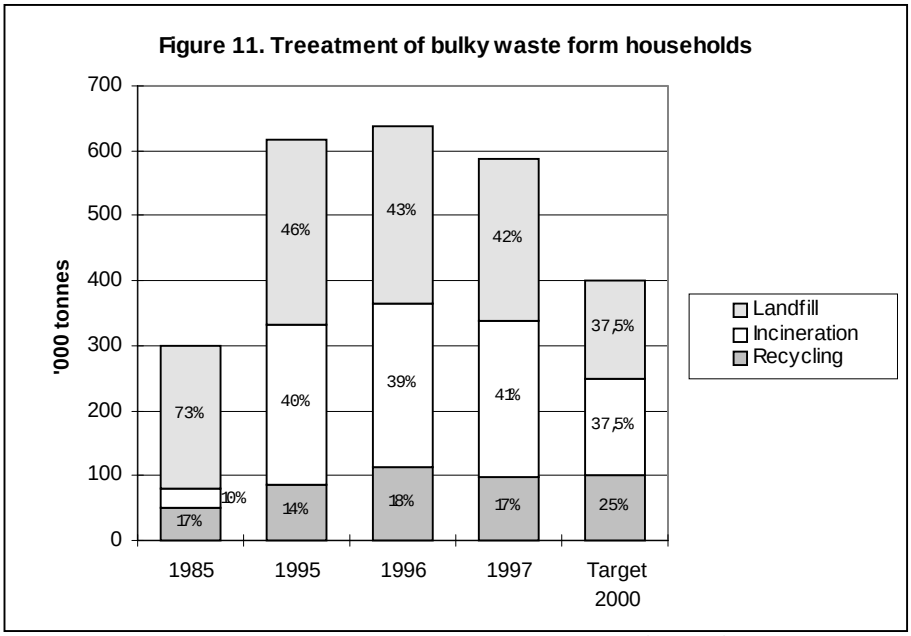
Domestic waste recycling remained at a level of 15 per cent of total amounts, whereas 80 per cent was incinerated in 1997 against 77 per cent in 1996. Landfilling decreased from 8 per cent to 5 per cent in 1997, see also Figure 10.

Figure 10 also shows that the objective for year 2000 of 40 to 50 per cent recycling of domestic waste is far from being attained. By contrast, the objective for year 2000 of 0 per cent landfilling of domestic waste is closer to being attained. Domestic waste is incinerated to an increasing extent instead of being landfilled.

6.3.2. **Bulky waste**

In 1997, 587,700 tonnes of bulky waste were generated in Danish households, which is a decrease of 8 per cent compared to 1996, cf. Table 1. Amounts of bulky waste have doubled since 1985. This is due to a real increase in bulky waste amounts, but for a major part also to the introduction of collection schemes and bring schemes at recycling centres.

It can be seen from Figure 11 that the rate of recycling of bulky waste from households has been relatively stable since 1985.



Sources: ISAG reports 1995, 1996 and 1997, and the Government's Plan of Action for waste and recycling 1993-97.

In 1997, 17 per cent of bulky waste was recycled which is actually less that the previous year. This means that the objective of 25 per cent recycling in year 2000 is still far ahead.

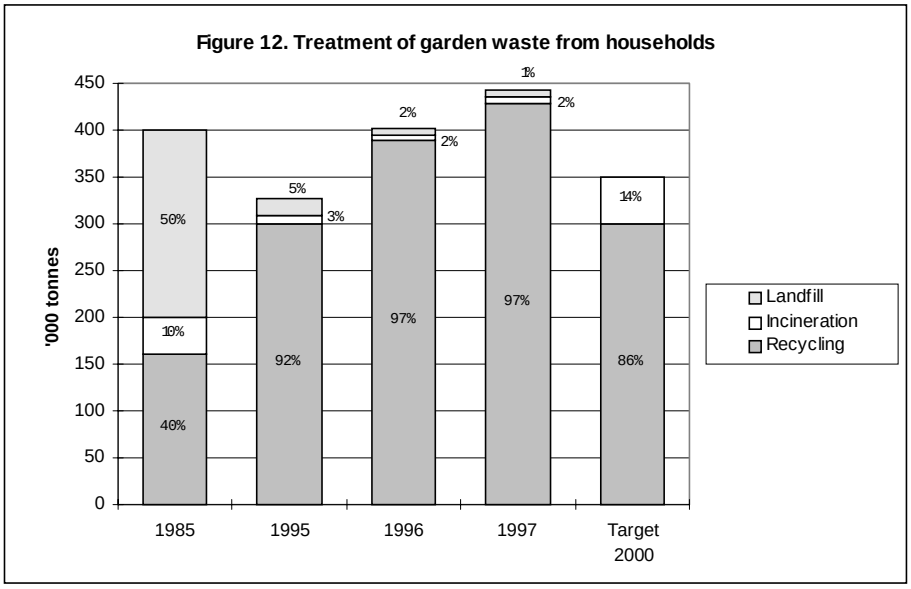
As in previous years, too much bulky waste was delivered to landfilling, but landfilled amounts expressed in per cent have been reduced significantly from 73 per cent in 1985 to 42 per cent in 1997.

6.3.3. **Garden waste**

Garden waste amounts collected from households reached 442,700 tonnes in 1997. This is an increase of 10 per cent compared to 1996, cf. Table 1.

Figure 12 shows treatment of garden waste. It can be seen that 97 per cent of garden waste was recycled in 1997, which is far more than stated in the Plan of Action for waste and recycling 1993-1997. Only 2 per cent was incinerated - the objective of the Plan of Action states a maximum of 15 per cent - and only 1 per cent was landfilled. Compared to 1985, garden waste has been diverted from incineration and landfilling, so that almost all garden waste is recycled today.

The remarkable increase from 1995 to 1997 of 75,000 tonnes of garden waste from households is not only attributable to actual increases. Around 20,000 tonnes derive from plants that should have reported in 1994 and 1995, but only did so as from 1996. The rest of the increase may be seen as an expression of increased use of municipal schemes for garden waste.



Sources: ISAG reports 1995, 1996 and 1997, and the Government's Plan of Action for waste and recycling 1993-97.

6.3.4. **Household waste per capita.**

Table 15 states the generation of household waste per capita and per household. The table covers both waste type and waste fraction.

As the table shows, waste generation in households stated per capita and household remained relatively stable compared to 1996, as only a minor increase of 1 and 4 kg respectively has been registered.

Table 15. Waste generation in households in 1996 and 1997 per capita and household. Stated in kg.	**1996**		**1997**	
	Per capita	Per household	Per capita	Per household
Households total	525	1,157	526	1,161
Of which				
Mixed domestic waste	266	588	316	698
Separately collected				
Domestic waste/paper	27	59	31	68
Domestic waste/glass	12	25	12	27
Domestic waste/food waste	9	19	9	20
Hazardous waste	3	7	2	6
Garden waste	76	168	84	185
Bulky waste	121	267	111	246
Of which				
Paper	4	8	4	9
Glass	1	2	1	2

Source: ISAG reports 1996 and 1997. Population figures and number of households per 1st January 1997 have been used.

A good half of households' waste generation is collected in separate collection schemes for paper/cardboard, bottles/glass, food waste/other organic, hazardous waste, bulky waste, and garden waste. This shows that households separate their waste extensively.

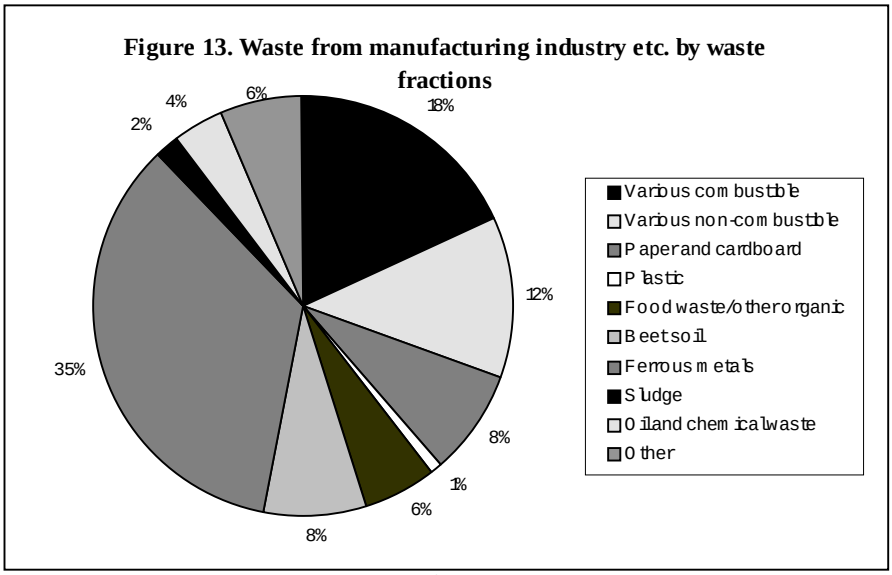
Both measured per capita and per household there has been an increase from 1996 to 1997 in separate collection of paper/cardboard and garden waste, whereas amounts of separately collected bulky waste decreased.

In an evaluation of waste generation from households it is worthwhile to notice that garden waste and bulky waste make up a significant proportion of total amounts.

6.4. **Waste from manufacturing industry.**

The composition of waste from manufacturing industries is presented in Figure 13. It can be seen that ferrous metals, various burnable, and various non-burnable account for the largest single fractions in industrial waste.

Figure 13. Waste from manufacturing industry etc. by waste fractions



Source: ISAG reports 1997. Legend: clock-wise from top.

Total waste generated in manufacturing enterprises in 1997 amounted to 2,736,000 tonnes, corresponding to 104,000 tonnes or 4 per cent more than in 1996.

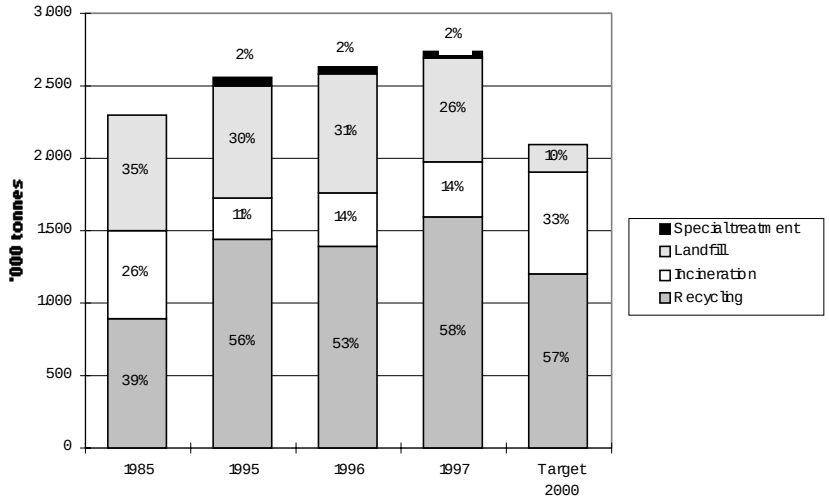
This increase is mainly attributable to an increase in amounts of various burnable waste and ferrous metals of 60,000 tonnes and 135,000 tonnes respectively. This increase is outweighed, however, by a decrease in amounts of beet soil and sludge of 101,000 and 85,000 tonnes respectively.

The decrease in amounts of beet soil from the harvesting of sugar beets is attributed to better weather conditions in 1997 compared to 1996.

However, efforts made in the sector to reduce soil sticking to beets in harvesting have also played a significant role.

58 per cent of waste from industry was recycled in 1997, corresponding to some 193,000 tonnes more than in 1996, cf. Figure 14. Amounts incinerated in 1997 remained at the same level as in 1996, whereas 26 per cent was landfilled. This means that 115,000 tonnes less waste were landfilled in 1997 compared to 1996. This is certainly the right direction, but there is still some way to go before the objective of the Plan of Action for waste and recycling of maximum of 10 per cent landfilling will have been achieved.

Figure 14. Treatment of waste from manufacturing industries etc.



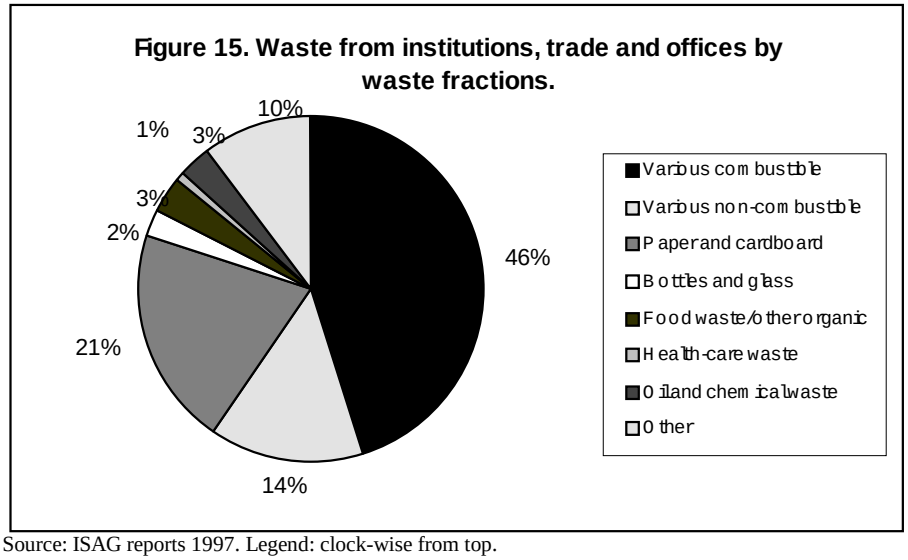
Sources: ISAG reports 1995, 1996 and 1997, and the Government's Plan of Action for waste and recycling 1993-97.

6.5. **Waste from institutions, trade and offices.**

The composition of waste from institutions, trade and offices is presented in Figure 15. It is seen that the major proportion of waste falls within the fractions various burnable, various non-burnable, and separately collected paper and cardboard.

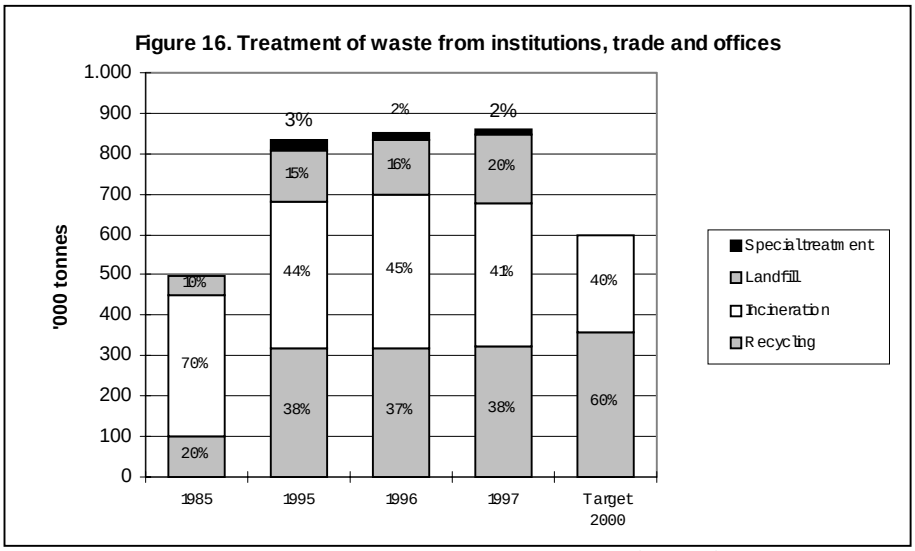
In 1997, waste generation in institutions, trade and offices amounted to 861,000 tonnes, corresponding to a minor increase of 10,000 tonnes compared to 1996.

This modest increase covers an increase in amounts of various non-burnable waste of 47,000 tonnes, whereas amounts of various burnable waste decreased by 37,000, and separately collected bottles and glass decreased by 14,000 tonnes. Other fractions were more or less identical to 1996.



Source: ISAG reports 1997. Legend: clock-wise from top.

The increase in amounts of various non-burnable waste, which is mainly landfilled, also means that compared to 1996 there was an increase of 4 percentage points in landfilled waste from institutions, trade and offices. This means that objectives of the Plan of Action for waste and recycling for no landfilling are further away from being attained than before, cf. Figure 16.

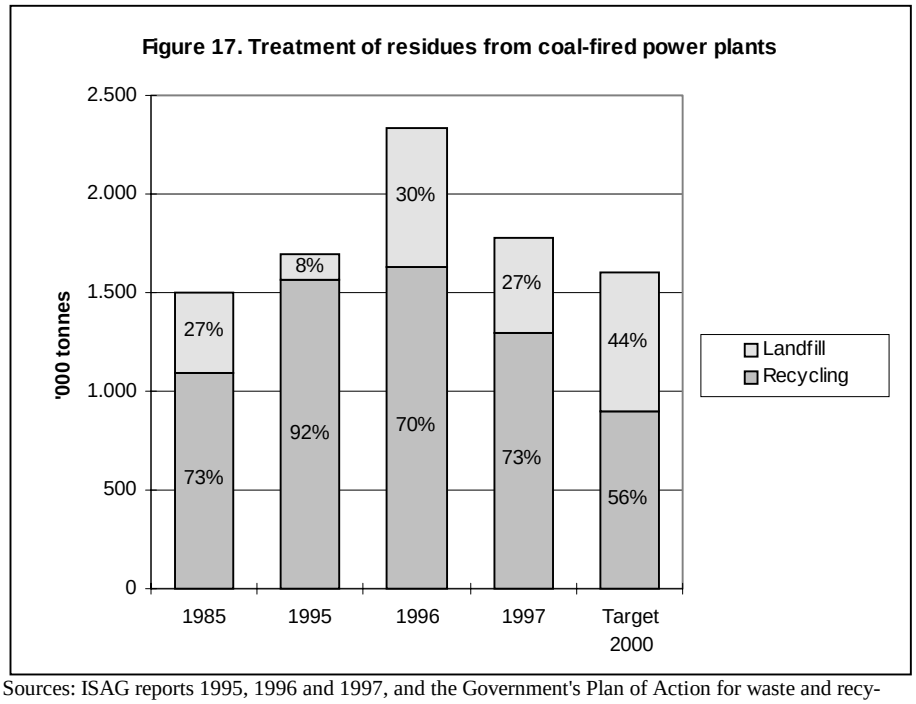


Sources: ISAG reports 1995, 1996 and 1997, and the Government's Plan of Action for waste and recycling 1993-97.

6.6. **Residues from coal-fired power plants.**

Amounts of residues from coal-fired power plants vary somewhat from one year to another due to variations in exports of power to Sweden and Norway. In 1996, the generation of residues was particularly large due to large exports of power. In 1997, amounts of residues decreased again to a level of 1,775,000 tonnes.

In 1997, recycling of residues from coal-fired power plants attained 73 per cent, corresponding to 1,300,000 tonnes, whereas landfilling decreased from 30 per cent in 1996 to 27 per cent in 1997. See also Figure 17.



Sources: ISAG reports 1995, 1996 and 1997, and the Government's Plan of Action for waste and recycling 1993-97.

Table 16 shows recycling options for residues from coal-fired power plants.

Table 16. Recovery in 1997 of residues from coal-fired power plants. In '000 tonnes.	Fly ash	Slag/bottom ash	Gypsum	TASP	Sulphuric acid	Total
Cement	311					311
Concrete	220					220
Porous concrete	7					7
Asphalt	49					49
Roofing felt	5					5
Backfilling cf. Statutory Order 568	34	111				145
Backfilling cf. Part 5 approvals (Env. Protection Act)	169	5				174
Granulates				4		4
Fertiliser					8	8
Backfilling				36		36
Plaster board			306			306
Total	**795**	**116**	**306**	**40**	**8**	**1,265**

Source: Reports from Elsam and Elkraft

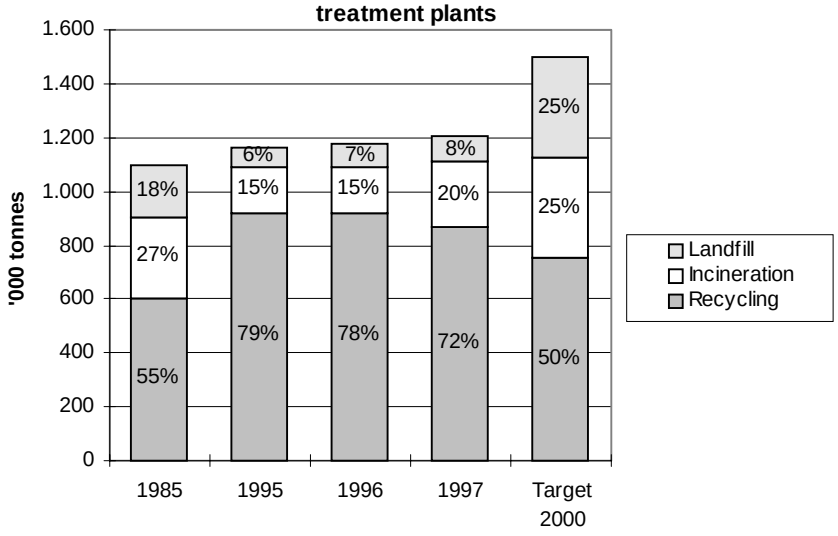
75 per cent of recycled residues was used as secondary raw materials in industrial manufacture of, for example, cement, concrete, and plaster board.

The remaining 25 per cent of recycled residues was recovered either under the terms of Statutory Order no. 586 of 6th December 1983 from the Ministry of Environment and Energy, or as backfilling with special approval under the Danish Environmental Protection Act.

This means that these residues are either used in building and construction works as backfilling below buildings, roads and squares, backfilling of cable conduits and trenches, for noise barriers, or as backfilling in land reclamation works or harbour fillings.

6.7. **Sludge from municipal wastewater treatment plants.**
Figure 18 shows treatment of sludge from municipal wastewater treatment plants. The statement only includes sludge, excluding sand and screenings.

Figure 18. Treatment of waste from municipal wastewater treatment plants



Sources: ISAG reports 1995, 1996 and 1997, and the Government's Plan of Action for waste and recycling 1993-97. Reports to the Danish Environmental Protection Agency on sludge applied to farmland etc. Figures for 1997 are based on data from 1996.

In 1997, amounts of sludge stated in wet weight were 1,209,000 tonnes, which is 34,000 tonnes more than in 1996.

Recycling of sludge decreased from 78 per cent in 1996 to 72 per cent in 1997, and amounts incinerated increased by 5 percentage points to 20 per cent, whereas amounts delivered to landfilling increased by one percentage point to 8 per cent.

7 Incineration plants and landfills

7.1. Incineration plants

In 1996, total waste incineration capacity was 2,474,000 tonnes, distributed on 31 plants, cf. Table 17. In the beginning of the nineties, an extensive conversion of waste incineration plants from heating generation to combined power and heating generation took place. In this connection, capacity adjustments were effected in relation to expected waste amounts for incineration in future. As a result of the ban on landfilling of waste suitable for incineration that took effect on 1st January 1997, increased pressure on incineration capacity is expected. Amounts of non-recyclable waste suitable for incineration will be surveyed regularly in order to ensure necessary incineration capacity.

Table 17. Number of incineration plants and available incineration capacity in 1989, 1993, 1994/95 and 1996.	**1989**	**1993**	**1994/95**	**1996**
Number of incineration plants	38	31	31	31
Theoretic capacity, '000 tonnes	2,164	2,329	DH: 1,217 CPH: 1,315	DH: 1,061 CPH: 1,413
Nominal capacity, tonnes/hour	313	335	DH: 174 CPH: 188	DH: 171 CPH: 194

Sources: Rambøll & Hannemann 1990: Analysis of data for energy plants based on waste, for the Danish Environmental Protection Agency and the Danish Energy Agency, October 1990. The Danish Environmental Protection Agency and the Danish Energy Agency 1994: Waste resources for waste incineration 1993 and year 2000 (*)The Danish Environmental Protection Agency and the Danish Energy Agency 1997: Waste amounts for incineration year 2000. Figures for 1989 and 1995 are calculated on the basis of nominal capacity at 7,000 hours/year. Figures for 1996 are based on actual hours of operation of plants. District heating capacity (DH) may be subject to restrictions under the Act on heating supply. CPH = combined power and heating.

7.2. Landfills

Total remaining capacity at landfills in 1994 amounted to 24.7 million tonnes distributed on 64 sites. Remaining capacity at landfills for inert waste in 1994 was 6.4 million tonnes distributed on 49 sites. Remaining capacity at separately located mono-landfills amounted to 6.2 million tonnes in 1994, distributed on 63 sites.

A landfill is defined as a site receiving waste which, immediately or over time, presents a risk of pollution of groundwater, surface water and/or air. A landfill for inert waste is a site receiving waste which does not, or only to a very limited extent, present a risk of pollution of groundwater,

surface water and/or air. A mono-landfill is a site receiving only one or a limited range of waste types with known composition.

As a consequence of the above-mentioned ban on landfilling of waste suitable for incineration, in combination with an increased and further differentiated waste tax, a drop in landfill capacity needs is expected. Thus, at the national level, it is not expected that there will be a need for large extensions of landfill capacity in future.

Table 18. Number of landfills, inert waste landfills, and separately located mono-landfills, and available landfill capacity in 1992 and 1994.

	Landfills		Inert waste land-fills		Separately located mono-landfills
	1992	1994	1992	1994	1994
Number of sites	60	64	70	49	63
Remaining capacity, million tonnes	30.9	24.7	14.3	6.7	6.2
Annual filling rate, million tonnes	2.1	1.7	0.9	0.12	0.8

Sources: Danish Environmental Protection Agency. Working report no. 54, Landfill capacity 1992, Danish Environmental Protection Agency 1997: Landfill sites in Denmark, and internal calculations

Annex 1. Tables outlining waste generation

Table 1. Waste generation in Denmark in 1995, 1996, 1997 and year 2000 by source and treatment option. Stated in '000 tonnes and in per cent.

Entire country	Recycling								Incineration								Landfill								Special treatment								Total							
	1995		1996		1997		T-2000		1995		1996		1997		T-2000		1995		1996		1997		T-2000		1995		1996		1997		T-2000		1995		1996		1997		T-2000	
Source	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%
Households	628	22	777	28	818	29	1.050	49	1.466	58	1.545	56	1.602	58	950	44	501	20	428	15	343	12	150	7	15	0	16	1	14	0	0	0	2.610	23	2.767	21	2.776	22	2.150	22
Domestic waste	237	15	249	15	239	15	650	40-50	1.201	74	1.274	77	1.298	80	750	50-60	190	12	132	8	83	5	0	0	0	0	0	0	0	0	0	0	1.628	14	1.655	13	1.621	13	1.400	14
Bulky waste	85	14	114	18	98	17	100	25	247	50	250	39	241	41	150	38	286	46	275	43	248	42	150	38	0	0	1	0	1	0	0	0	618	5	639	5	588	5	400	4
Garden waste	300	92	388	97	428	97	300	85	9	3	6	2	8	2	50	15	17	5	6	2	6	1	0	0	0	0	0	0	0	0	0	0	326	3	401	3	443	3	350	4
Other	6	15	26	36	52	42	0	0	8	22	15	21	55	44	0	0	9	24	16	22	5	4	0	0	15	39	16	22	12	10	0	0	38	0	72	1	125	1	0	0
Institutions/trade/offices	317	31	317	37	324	38	360	60	365	43	380	45	352	41	240	40	128	23	135	16	170	20	0	0	24	3	19	2	16	2	0	0	834	7	851	7	861	7	600	6
Manufacturing etc.	1.446	49	1.397	53	1.590	58	1.200	57	278	12	361	14	389	14	700	33	779	36	822	31	707	26	200	10	59	3	52	2	51	2	0	0	2.563	22	2.632	20	2.736	21	2.100	21
Building and construction	2.173	84	2.748	89	3.136	92	1.100	58	18	1	17	1	21	1	200	11	321	15	317	10	264	8	600	32	46	0	6	0	5	0	0	0	2.559	22	3.088	24	3.427	27	1.900	19
Wastewater treatment plants	918	78	918	76	872	70	750	50	175	13	176	15	245	20	375	0-50	101	9	117	10	130	10	375	0-50	1	0	1	0	0	0	0	0	1.195	10	1.212	9	1.248	10	1.500	15
Slag, fly ash etc. (coal)	1.564	67	1.629	70	1.300	73	900	56	0	0	0	0	0	0	0	0	135	33	703	30	475	27	700	44	0	0	0	0	0	0	0	0	1.699	15	2.332	18	1.775	14	1.600	16
Other	0	2	1	3	6	17	0	0	4	73	27	91	13	39	0	0	2	26	2	6	15	44	0	0	0	0	0	0	0	0	0	0	6	0	30	0	34	0	0	0
Total	7.046	56	7.787	60	8.046	63	5.360	54	2.306	20	2.507	19	2.622	20	2.465	25	1.969	24	2.524	20	2.103	16	2.025	21	145	1	95	1	86	1	0	0	11.466	100	12.912	100	12.857	100	9.850	100

Source: ISAG reports 1995, 1996 and 1997, Government's Plan of Action for waste and recycling 1993-97, Danisco, Association of Danish Recycling Industries and other large scrap dealers, reports to the Danish Environmental Protection Agency on sludge applied to farmland etc. (for 1997, figures from 1996 have been used) and incineration of sludge at waste incineration plants (for 1997, figures from 1996 have been used). Waste amounts from wastewater treatment plants include sand and screenings and are therefore slightly higher than stated in Figure 17.

Table 2. Waste in Denmark in 1995, 1996 and 1997 by waste type and treatment option. Stated in tonnes and in per cent.

Entire country	**Recycling**						**Incineration**						**Landfilling**						**Special treatment**						**Total**	**Total**	**Total**
Waste type	1995		1996		1997		1995		1996		1997		1995		1996		1997		1995		1996		1997		1995	1996	1997
	tonnes	%	tonnes	%	tonnes	%	tonnes	%	tonnes	%	tonnes	%	tonnes	%	tonnes	%	tonnes	%	tonnes	%	tonnes	%	tonnes	%	tonnes	tonnes	tonnes
Domestic waste	282.134	16	284.940	16	263.907	16	1.225.916	70	1.311.750	76	1.331.666	79	238.327	14	140.307	8	89.031	5	0	0	0	0	0	0	1.746.376	1.736.997	1684604
Bulky waste	85.528	14	114.973	18	98.253	17	247.126	40	249.806	39	240.511	41	292.255	47	281.704	44	247.778	42	0	0	637	0	1.243	0	624.909	647.120	587784
Garden waste	378.736	91	453.539	95	530.159	96	11.606	3	8.216	2	9.654	2	25.839	6	18.152	4	14.126	3	0	0	0	0	0	0	416.182	479.908	553940
Industrial/ commercial waste	3.794.340	69	4.334.406	70	4.909.762	73	632.209	11	710.881	11	766.597	11	1.072.445	19	1.146.153	18	1.061.182	16	11.260	0	5.485	0	2.968	0	5.510.254	6.196.925	6740509
Hazardous waste	18.699	12	45.308	31	50.679	35	2.127	1	6.364	4	9.387	7	4.281	3	10.252	7	4.359	3	130.955	84	85.490	58	78.731	55	156.061	147.413	143156
Health-care waste	0	0	0	0	0	0	6.226	69	5.780	66	5.345	63	0	0	0	0	173	2	2.784	31	2.996	34	2.923	35	9.010	8.776	8441
Treatment residues	2.486.497	83	2.551.344	69	2.177.586	70	178.854	6	213.595	6	258.746	8	321.217	11	919.417	25	669.305	22	0	0	0	0	0	0	2.986.568	3.684.357	3105637
Not reported	498	15	2.726	26	15.903	48	519	15	227	2	444	1	2.366	70	7.645	72	16.805	51	0	0	0	0	0	0	3.383	10.598	33152
Total	7.046.433	62	7.787.236	60	8.046.249	63	2.304.582	20	2.506.618	19	2.622.351	20	1.956.730	17	2.523.632	20	2.102.758	16	144.998	1	94.607	1	85.865	1	11.452.744	12.912.093	12857223

Source: ISAG reports 1995, 1996 and 1997, Danisco, Association of Danish Recycling Industries and other large scrap dealers, reports to the Danish Environmental Protection Agency on sludge applied to farmland etc. (for 1997, figures from 1996 have been used) and incineration of sludge at waste incineration plants (for 1997, figures from 1996 have been used).

Annex 2. Conversion of ISAG data

Recycling centres/transfer stations

The ISAG covers a commercial source "recycling centres/transfer stations". This means that waste, for example from households, delivered via transfer stations is not recorded as waste from "households".

The source "recycling centres/transfer stations" is therefore distributed on the original sources. This distribution is obviously based on estimates.

- All domestic waste from "recycling centres/transfer stations" is converted into domestic waste from the source "households".

- All bulky waste, apart from the fractions "paper and cardboard" and "bottles and glass", from "recycling centres/transfer stations" is converted into bulky waste from the source "households".

- All bulky waste covering the fractions "paper and cardboard" and "bottles and glass" is converted into "domestic waste" and transferred from the source "recycling centres/transfer stations" to the source "households".

- All garden waste from "recycling centres/transfer stations" is converted into garden waste from the source "households".

- All industrial and commercial waste from "recycling centres/transfer stations", apart from the fractions "concrete", "tiles", "other construction and demolition waste", "asphalt", "wood", and "asbestos", is converted into industrial and commercial waste from the source "institutions, trade and offices".

- All industrial and commercial waste from "recycling centres/transfer stations", covering the fractions "concrete", "tiles", "other construction and demolition waste", "asphalt", "wood", and "asbestos", is converted into industrial and commercial waste from the source "building and construction sector".

- All hazardous waste from "recycling centres/transfer stations" is converted into hazardous waste from the source "households".

- All waste of the type "treatment residues" and "not registered" from "recycling centres/transfer stations" is converted into a new source: "other".

Bulky waste

- All waste of the type "bulky waste" from the sources "institutions, trade and offices", "manufacturing industries", and "building and construction sector" is converted into "industrial and commercial waste", although deriving from the same sources.

Ferrous metals

- Reports to the ISAG of ferrous metals are made according to the Statutory Order on waste by enterprises, including smelting works, that reprocess collected and separated ferrous metals through remelting. Scrap dealers that collect ferrous metals are not subject to mandatory reporting to the ISAG, but are requested to uphold a register in accordance with ISAG regulations.

- The Danish Environmental Protection Agency receives information from scrap dealers directly from the Association of Danish Recycling Industries and other large scrap dealers. In waste statistics, such ferrous scrap has been attributed to the source "manufacturing industry".

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