

行政院所屬各機關因公出國人員出國報告書

(出國類別： 考 察)

赴歐考察廢棄物處理資源回收
暨廢水處理新技術出國報告書

服務機關：行政院環境保護署
出國人職稱：副署長 研究員
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行政院研考會/省(市)研考會 編號欄
G14 / c09005753

出國地點：義大利及丹麥
出國期間：九十年九月五日至九月十五日
報告日期：九十年十二月五日

公務出國報告審核表

出國報告名稱：赴歐考察廢棄物處理資源回收暨廢水處理新技術出國報告書	
出國計畫主辦機關名稱：行政院環境保護署	
出國人姓名/職稱/服務單位：張祖恩/副署長/環保署，魏盟巽/研究員/環保署	
出國日期：90 年 9 月 5 日至 90 年 9 月 15 日	
出國計畫 主辦機關 審核意見	<input type="checkbox"/> 1. 依限繳交出國報告 <input type="checkbox"/> 2. 格式完整 <input type="checkbox"/> 3. 內容充實完備 <input type="checkbox"/> 4. 建議具參考價值 <input type="checkbox"/> 5. 送本機關參考或研辦 <input type="checkbox"/> 6. 送上級機關參考 <input type="checkbox"/> 7. 退回補正，原因： <input type="checkbox"/> ①不符原核定出國計畫 <input type="checkbox"/> ②以外文撰寫或 僅以所蒐集外文資料為內容 <input type="checkbox"/> ③內容空洞簡略 <input type="checkbox"/> ④未依行政 院所屬各機關出國報告規格辦理 <input type="checkbox"/> ⑤未於資訊網登錄提要資料 及傳送出國報告電子檔 <input type="checkbox"/> 8. 其他處理意見：
層轉機關 審核意見	<input type="checkbox"/> 同意主辦機關意見 <input type="checkbox"/> 全部 <input type="checkbox"/> 部份 (填寫審核意見編號) <input type="checkbox"/> 退回補正，原因： (填寫審核意見編號) <input type="checkbox"/> 其他處理意見：

說明：

一、出國計畫主辦機關即層轉機關時，不須填寫「層轉機關審核意見」。

二、各機關可依需要自行增列審核項目內容，出國報告審核完畢本表請自行保存。

三、審核作業應於出國報告提出後二個月內完成。

赴歐考察廢棄物處理資源回收暨廢水處理新技術報告

一、出國期間

一九九九年九月五日至九月十五日

二、活動內容紀要

本次出國由張副署長率團，成員有本署、經濟部工業局、工研院、臺大、台北醫學大學及產業界等產官學研共十一人，主要是考察義大利及丹麥環保相關政策及處理設施、並拜會丹麥環保署。

(一)義大利染整廢水處理（附件一）

- 1、義大利的紡織皮革業聞名於世，本次至該國訪問主要是實地考察該地染整工業廢水處理情形，並與該地產官學界舉行座談，就環保相關問題交換意見。
- 2、本次實地考察四家染整廠廢水處理設施，此四家染整工廠之廢水主要是利用一改良型超深層曝氣設計，是一種高效率的好氧活性污泥法，利用高壓幫浦，將欲處理水加壓至七大氣壓，大的壓力可獲得高度的溶氧。由於高溶氧、充份的曝氣時間及有效的接觸碰撞等因素，以致達到傳統曝氣方式無法達到的化學氧化效果，藉著強大的氧化力將微粒懸浮物和溶解性物質氧化並轉化為沉降性佳的膠體物質，使得後續處理的浮除效率提高，同時去毒性的氧化特性，大幅提升生物活性及氧化效率。其處理系統為二階段處理，先經前置處理槽，然後至反應槽處理後即可排放。其設備特性為：

- 。 佔地面積小。
- 。 簡化處理流程，節省操作維修成本，每噸廢水處理費用約為新台幣七到十元，比國內目前十五到二十元便宜。
- 。 曝氣時間約二十四至三十八小時，屬長時間曝氣，降低污泥產生。
- 。 與傳統處理方式互容性高，亦即可容入現有的處理設備中，增強處理效果。
- 。 處理效果良好，排水水質穩定。據所參觀之四個廠，其書面資料顯示，其對 COD(mg/L)處理效果，A 廠(廢水量 1600 CMD)由 1600 處理至 100，B 廠(廢水量 1200 CMD)由 2000 處理至 100，C 廠(廢水量 1200 CMD)由 700 處理至 70，D 廠(羊毛洗滌，廢水量 400 CMD)由 25000~35000 處理至 1000(排至污水處理廠)。

(二)拜會丹麥環保署及相關環保單位與設施

1、 拜會丹麥環保署(附件二)

張副署長等人於九月十一日至丹麥環保署拜會，丹麥環保署副署長 Mr. Helge Andreassen 出面接待，且就該國廢棄物管理政策與措施向我方作簡報，並就環保相關議題交換意見。該署並與丹麥工業總會共同設宴款待，歡迎我國環保訪問團到訪。本署為表示該國協助我方訪問行程安排並希望加強與受訪單位進一步的資訊交流，亦宴請該國受訪單位相關人士，Mr. Andreassen 及我國駐丹麥代表處顧代表亦出席我方晚宴。

2、 丹麥廢棄物管理計畫(Waste 21)(附件三)

- (1) 丹麥的國土面積約四萬四千平方公里，比台灣稍大，人口只有五百五十餘萬人，平均每人每天產生七公斤的廢棄物，每年廢棄物產生量約為一千二百萬噸，廢棄物的產生主要是來自建築部門二十四%，家庭部門二十三%，工業部門二十三%，電力部門一二%，廢水處理廠一〇%，商業公司部門八%。一九九七年以前，廢棄物產生量持續增加，直到一九九八年後才穩定下來，主要是能源部門的廢棄物產生量大幅減少所導致。
- (2) 丹麥廢棄物管理特色是其廢棄物最終處理是以回收為主，焚化及掩埋為輔。目前廢棄物有六十四%回收，二十四%焚化，一二%掩埋。在二〇〇四年時，其目標是希望保持六十四%的高回收率，其中營建廢棄物回收目標為九〇%，工業廢棄物六十五%，花園廢棄物九十五%，家庭廢棄物三十五%，大體積廢棄物二十五%。
- (3) 丹麥的廢棄物管理主要權責單為地方機關(local authority)，負責所有廢棄物的管理及處理工作。中央機關主要制定法令，而其廢棄物管理法規大部分與歐聯廢棄物管理法規相結合。地方機關則依法令訂定管理計畫，地方議會(local council)每四年必須完成四年的短期廢棄物管理計畫及十二年的長期計畫，主要是確保有足夠的處理容量。地方議會的權責主要是
- 制定廢棄物管理計畫。

- 地方廢棄物相關管理法規制定。
- 擬定廢棄物處理方案。
- 確保在環保可容許下的廢棄物管理品質。
- 廢棄物產生量統計及資訊登錄。

(4) 丹麥在廢棄物管理方面，利用相當多的執行工具(instruments)，如課稅(Taxes)、收費(charges)、補貼(subsidies)及共同協議(agreements)等，其實徵收廢棄物稅是該國廢棄物回收成功最有利的工具，最主要是為了強化廢棄物回收，所以對廢棄物掩埋課以最高的稅(三七五 DKK／噸)，焚化(三四〇DKK／噸)次之，而回收則免稅。

(5) 該國在廢棄物管理計畫(Waste 21)中指出，在未來該國在廢棄物管理將面臨多方面的挑戰，

- 減少廢棄物產生(To prevent waste)：包括一切能夠減少廢棄物產生的活動以及廢棄物的直接再利用。但不包括回收。
- 增加廢棄物回收：雖然丹麥廢棄物的回收率高達六十四%，但在未來將持續進行廢棄物回收，尤其是在紙類、紙版類包裝、塑膠類、玻璃類、鑄造廠廢棄物(foundry)、廢料(scrap)、電子及電器廢棄物及廢車。
- 改進廢棄物處理的品質：主要著眼於減少於廢棄物對環境產生污染及極盡利用廢棄物中的資源。在Waste 21 中列出有機廢棄物、紙類、紙板、PVC、電

子及電器產品、廢車及電池等進行廢棄物資源回收，不過此部分該國並無先進技術可處理。在發展先進技術方面，還是存在相當多困難，主要是該國廢棄物管理已是地方化，並不是中央統籌主管；廢棄物遍佈各地且量小，收集不易；亦因為這樣，作任何的收集及處理設施的投資都相當冒險。所以基本上，在該國並無很好的誘因來推動新的回收系統及興建新的處理技術。不過，該國還是在二〇〇一年成立丹麥廢棄物中心(Denmark Waste Center)，此中心將收集廢棄物相關管理相關資訊並將加強與相關利益關係者連繫。該國並有計畫成立一個新的廢棄物處理技術發展中心，此中心將協助廢棄物處理業者發展新技術及協助新的廢棄物處理設施之投資。

3、 Kalundborg 生態共生工業區(Industrial Symbiosis) (附件四)

- (1) Kalundborg 生態共生工業區最主要是利用區內個體的廢棄物資源再利用的觀念，達到資源共享及事業共生的目的。該共生系統主要是由五家不同生產型態的私人公司及 Kalundborg 市所組成，有發電廠、煉油廠、製藥廠、石膏灰泥板廠及土壤污染復育公司等。
- (2) 此共生區的特色及益處是衍生物的互相再利用，減少資源的消耗，降低環境衝擊及較佳的能源資源利用等。例

如煉油廠的多餘燃氣可供給發電廠當燃料以減少煤與燃油的使用、發電廠的衍生物石膏可供應石膏灰泥板廠當原料，污水處理廠所產生的污泥可送至土壤污染復育公司當土壤改良劑、養分等。

- (3) 該共生區的運作機制主要是藉著公司間的商業契約，即資源的相互再利用的約定來進行，並無政府的介入或管理。主要是熱心人士資源再利用等環保理念的推動及商業利益下很自然順暢的運作。

4、Kommunekemi 有害廢棄物處理中心

- (1) Kommunekemi 有害廢棄物處理中心成立於一九七二年，主要著眼於工業及家庭有害廢棄物的處理。該中心有廢油處理場、無機物處理場、清桶場、焚化爐等設施，在二〇〇〇年時，總共約處理一一〇、〇〇〇公噸的有害廢棄物。
- (2) 該中心的處理技術亦已移轉至馬來西亞 Kualiti Alam 廢棄物處理中心，該中心目前運轉相當順，其對於我國正在推動中的有害廢棄物處理中心的計畫相當有興趣。

5、哥本哈根回收中心

- (1) 哥本哈根回收中心建於一九九七年，其處理容量約每年一百萬噸，主要是回收營建廢棄物、公園與花園之廢棄物及受油污染之土壤等。目前該中心主要是由哥本哈根市與兩家民營公司共同經營，基於資源再利用的共生觀

念，其運作相當順暢。

- (2) 該中心主要處理設施計有由根本哈根回收中心經營的衛生掩埋場，兩家民營公司分別經營營建廢棄物的回收工廠及污染土壤生物處理設施。公園與花園之廢棄物主要是利用堆肥方式來處理，受油污染之土壤主要是利用生物處理。該回收中心最令人稱奇的是，回收大量的營建廢棄物，在哥本哈根，營建廢棄物回收已達八十九%，在二〇〇四年的目標是九十%。

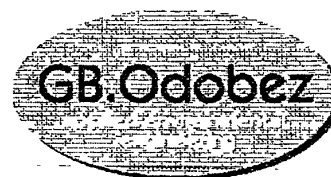
三、結語

- (一) 此次實地參訪義大利染整廠之廢水處理設施發現，其所利用的技術，處理效果甚佳，污泥產生量相當少，而且所需之操作成本相對較低，值得我國參考借鏡。
- (二) 此次丹麥環保署對我國環保訪問團去訪，表示相當重視。在去年本署亦曾拜會丹麥環保署，當時我方曾主動提及簽署環保合作協定之可能性，但為丹方以人力不足及認為應加強實質合作予以婉拒，故本次我方並未直接觸及簽署合作協定議題，而以環保政策與技術資訊交流為主。丹麥土地面積比我國略大，大部份為平原，人口約是我國的四分之一，其環境負荷自然比我國低很多，雖然如此，其在廢棄物管理政策上還是相當積極，未來雙方應可在特殊廢棄物處理、營建廢棄物管理及資源回收等領域加強交流。
- (三) 丹麥為有效達成其廢棄物管理的目標，利用各種執行工具的經濟誘因來達成。例如為達到廢棄物處理以回收為主，

焚化次之，掩埋為後之政策目標，課以掩埋最高的稅率，亦即在丹麥，掩埋費用是非常昂貴的。所以其極力利用經濟誘因的政策工具，以達成政策目標的策略，值得我方借鏡。

- (四) 此次參訪哥本哈根資源回收中心、有害廢棄物處理廠及生態共生工業區，其管理與技術以及積極的作為，應可作為本署正在推動之「資源回收示範專業區」、經濟部工業局正在推動之特殊事業廢棄物處理中心及生態工業區之參考。

附 件 一

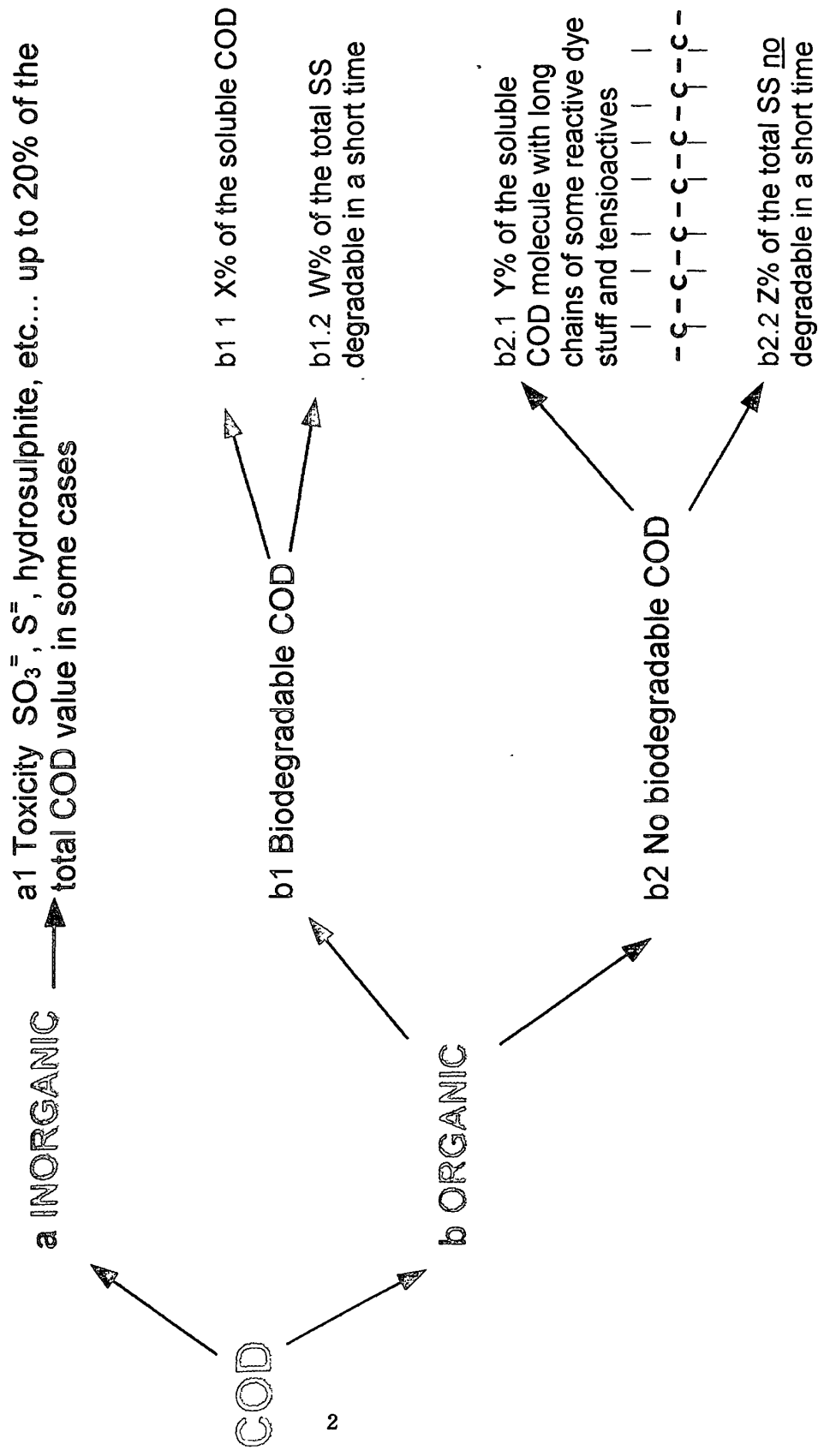
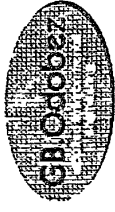


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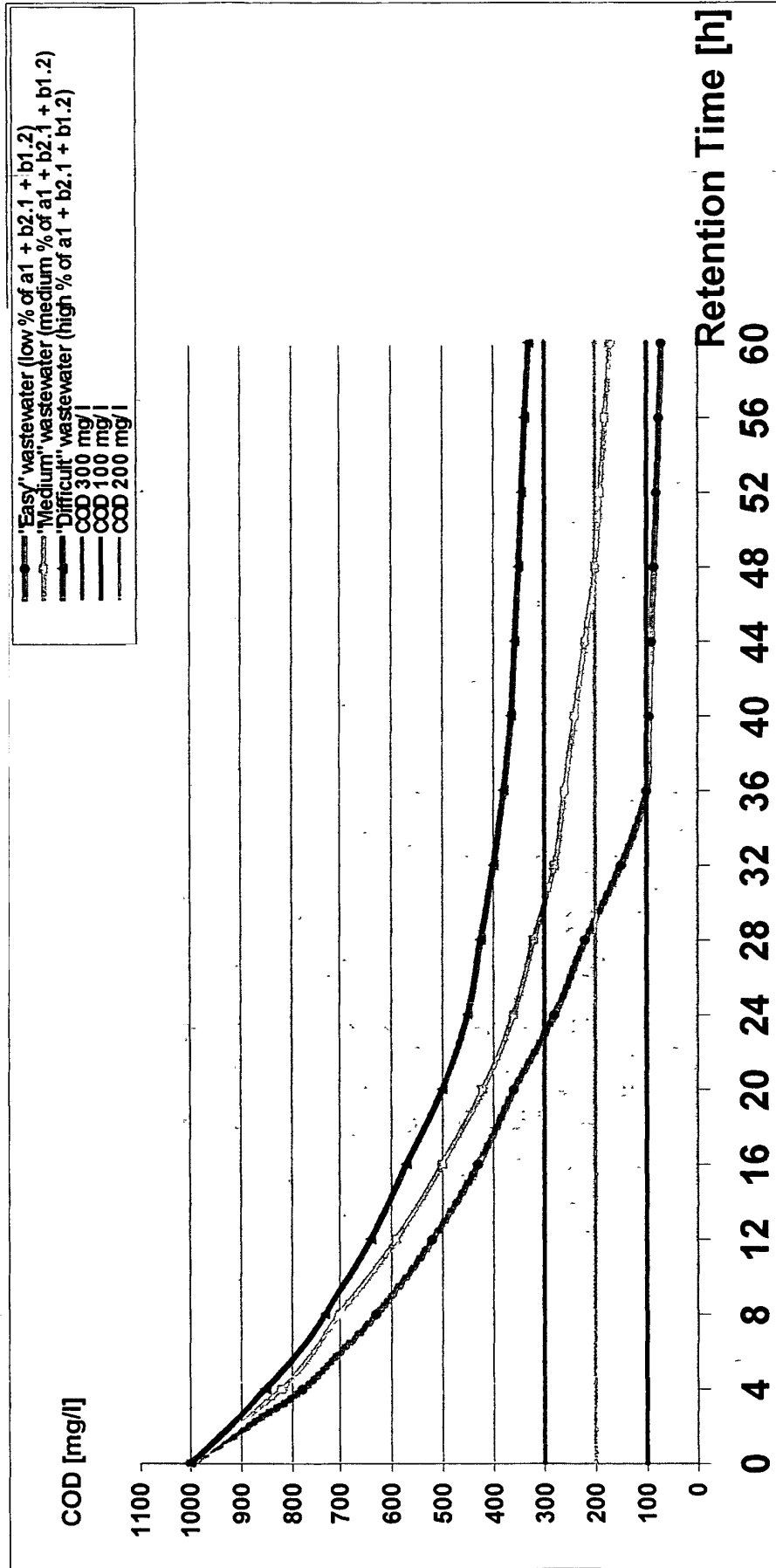
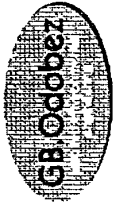
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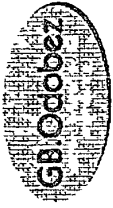
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COD IN TEXTILE WASTE WATER

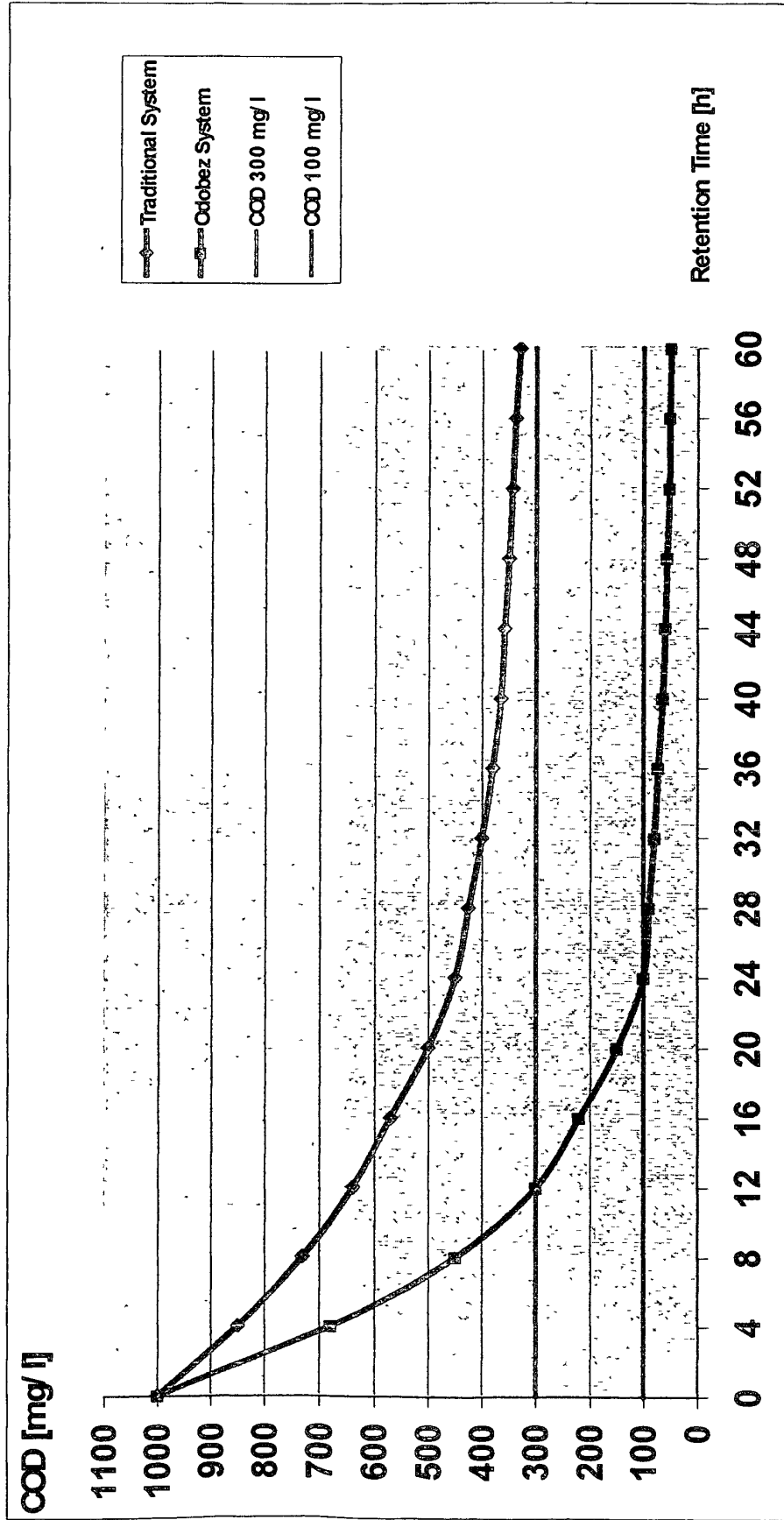


Traditional System





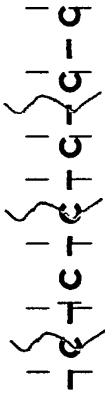
Traditional System vs. Odobez System (Treating "difficult" type of wastewater)





How to reach COD ≤ 100 mg/l with  and
type of waste water?



ODOBEZ SYSTEM

- ✓ Reduce a1 within 15÷30 minutes up to 99%
- ✓ Break b2.1 chains of molecule  c - c - so that the bacteria has an easy "work"
- ✓ Degrade b1.2 by increasing the biomass with sludge recycle up to the quantity required thanks to the high rate of dissolved oxygen available.



 type of waste water is transformed into  type



SLUDGE PRODUCTION WITH BIOFLOTATION "ODOBEZ SYSTEM"

The following calculation formula for the total sludge production coming from bioflotation with ODOBEZ SYSTEM is based on practical data about real sludge production of existing installations.

$$\text{Kg. SS}_{\text{tot.}} = K_1 (\text{Kg. COD}_{\text{sol. deg.}} + K_2 \text{ Kg. SS}_{\text{bio. deg.}}) + \text{Kg. SS}_{\text{no bio.}} + \text{Kg. SS}_{\text{chemicals}}$$

Where

Kg. SS _{tot}	=	Total quantity of dry substance produced
Kg. COD _{sol deg}	=	Kg of soluble COD degraded
Kg. SS _{bio deg}	=	Kg of biodegradable dry substance degrades
Kg. SS _{no bio}	=	Kg. of dry substance no biodegradable
Kg. SS _{chemicals} agents	=	Kg. of dry substances contained in the chemical
K ₁	=	0,04÷0,06 Kg. SS / Kg. COD _{sol deg}
K ₂	=	1,1÷1,2 Kg. COD _{sol} / Kg. SS _{bio.}
Kg COD _{sol}	=	Kg. of soluble COD
Kg. SS _{bio}	=	Kg. of dry substance biodegradable



COMPARISON ODOBEZ SYSTEM VS. TRADITIONAL SYSTEM

Biological Processes on Textile Waste Water Treatment

PARAMETERS	ACTIVATED SLUDGE	BIOFLOTATION ODOBEZ SYSTEM	
Operator and maintenance	By skilled operators (24 h/d)	No skilled operators (1 h/d)	
Tanks necessary for treatment process	Homogenisation + oxidation	Bioflotation	
Area	Big area required	Small area required	
Operating cost	Medium	Low	
Biomass	High (4000-6000 mg/l)	Low (1000-2000 mg/l)	
HRT - hydraulic retention time	24 - 72 h	24 - 36 h	
Kg sludge produced/ Kg COD removed	0,2 - 0,3	0,05 - 0,1	
watt/m ³	20 - 30	15 - 60	
Cracking of substrates at low biodegradability	Low	High	
Kg oxygen required/ Kg COD removed	~ 1	0,4	COD/BOD < 3
Kg oxygen required/ Kg COD removed	~ 1	0,6	COD > 3 BOD < 4
Kg oxygen required/ Kg COD removed	~ 1	0,9	COD/BOD > 4
Efficiency on textile waste water treatment (COD and Surfactants)	High for COD Medium for Surfactants	Very high	≥ 95% COD ≥ 99% Surfactants
Water salinity	Influences performance	Do not influence performance	
Temperature	20 - 28 °C	15 ÷ 38 °C	

WATER RECYCLE

Two Example of Water Recycle

1st Case

We resume (see Table 1) the data referring to a dyeing and printing factory situated in ALBAVILLA – COMO (north Italy) treating, on commission, every kind of textile fibre : cotton, synthetic, acrylics and so on. In this factory has been running for more than 10 years a R.O. plant. The experience coming from the running of this plant guarantees a functional reliability. The membrane life

in this case is about 3÷4 years. The case of ALBAVILLA is unique since the factory, due to its expansion over than 10 years ago, increased its water supply demand up to 5000 cm/d while the municipal aqueduct could supply just 3000 cm/d. The management was, therefore, forced to recover 2000 cm/d to face the fast expansion of the factory.

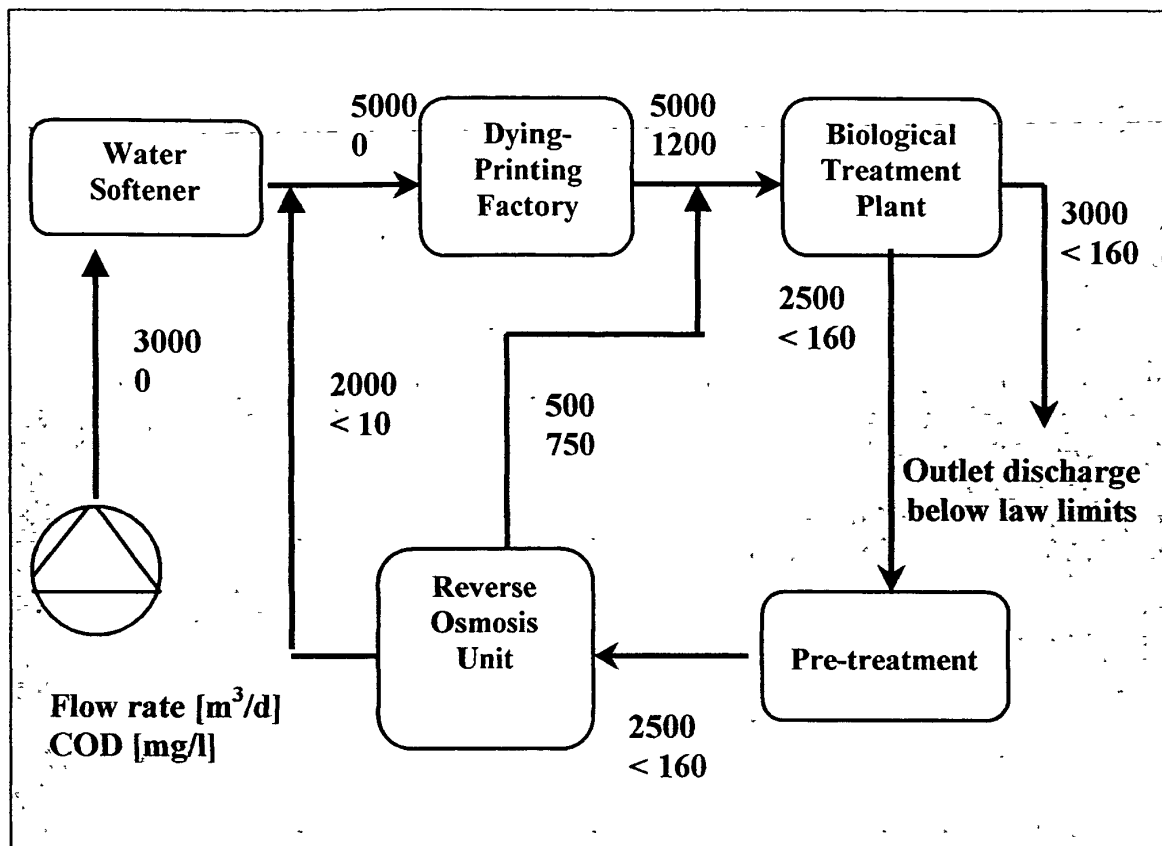
Table 1

Parameter	Measure	Raw water	Outlet biological plant	Water recycled (RO)
Flow rate	cm/d	3000	5500	2000
pH		7.29	7.68	5.58
Conductivity	µS/cm	652	2780	120
Hardness	mgCaCO ₃ /l	370	365	14
Alkalinity	meq/l	6	7.66	0
Susp. Solids	mg/l	5	12	0
COD	mg O ₂ /l	<10	<100	<10
Residue (120°C)	mg/l	470	1850	93
Optical density at 420 nm		0	0.057	0

The total value of Cl⁻ and SO₄⁼ is about 400÷700 mg/l respectively.

The outlet water from biological plant after sand filtration goes to R.O. system

Total operating cost is about 400÷500 Lit/cm.



Flow-sheet for recovering water after a biological treatment

2nd Case.

The second case refers to a dyeing factory situated in LURATE CACCIVIO – COMO (north Italy) which adopts the R.O. regeneration for the direct treatment of just rinse water from dyeing machines. The system eliminates the suspended solids through sand filtration and microfiltration (5µm) passing to R.O. section.

The membrane life is about 4 years

Total operating cost is about 450÷500 Lit/cm

Table 2. input water

Flow rate	13.5 cm/h
pH	7÷10
Conductivity	1000÷2000 µS/cm
Hardness	25÷30 °F
Suspended Solids	25÷40 mg/l
COD	100÷600 mg/l
Optical density at 420 nm	0.085÷0.130

Table 3. recovery water

Flow rate	10 cm/h
pH	7÷8
Conductivity	<100 µS/cm
Hardness	<1 °F
Suspended Solids	0 mg/l
COD	<20 mg/l
Optical density at 420 nm	<0.005



BIOFLOTATION

APPLICATION OF ODOBEZ SYSTEM
TO TEXTILE WASTE WATER
WITH A SHORT EQUALIZATION TIME

Zanolò Spa
Via per Greggio – 13031 ARBORIO (VC)
ITALY



Introduction

In consequence of a series of modifications, in September 1999 it was carried out a study on the wastewater treatment of textile dyeing industry located in Vercelli.

The depuration process consists of a biological treatment with activated sludge, equalization tank, biological reactor and sedimentation tank followed by ozone treatment equipment

This study concerns the improvement of the quality of effluent, in particularly for the COD parameter, and the decrease of sludge production in consequence of a new technology of wastewater treatment directly in equalization tank called bioflotation.

The textile factory works cotton and synthetic fibres six days a week on three shifts (24 hours a day). The daily average flow rate is about 1600 m³/d (65 m³/h with peak flow of 130 m³/h)

The treated effluent is discharged in a river called Sesia. In table 1 are reported some parameters limits of effluents imposed by the current Italian law (D.Ls 152/99).

Tab 1		
COD	mg/l	160
BOD ₅	mg/l	40
BiAS	mg/l	2
SO ₄	mg/l	1000
Cl ⁻	mg/l	1200
TP	mg/l	10
NH ₄	mg/l	15
N-NO ₂	mg/l	0.6
N-NO ₃	mg/l	20

Plant description

In order to achieve requirements for discharge into the river, the textile factory employs some phases of treatment:

- Equalization tank of 600 m³ to control the peak flows,
- Oxidation tanks of 600 and 600 m³,
- Sedimentation tanks 14 m in diameter,
- Ozone equipment of 100kW producing 15÷30 m³/h of oxygen with 2% of ozone.



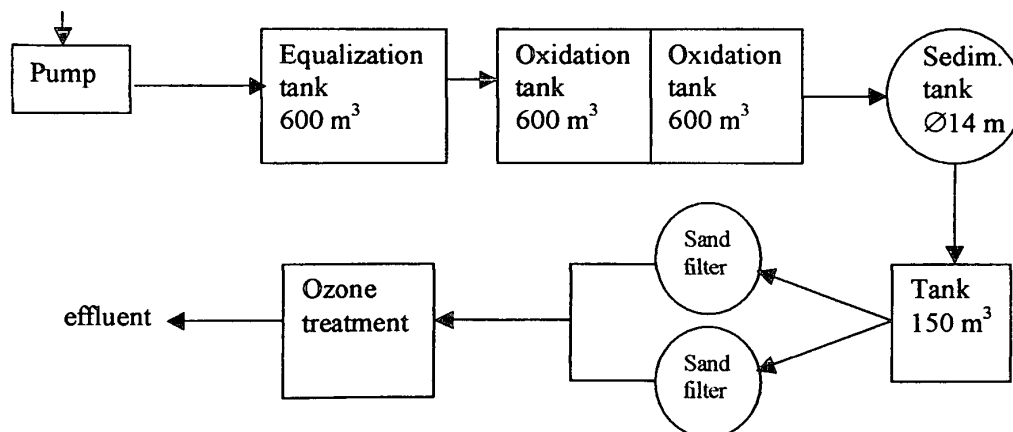
The equalization tank is continuously mixed by 120 Affn-Odobez nozzles instead of steel pipes pumping compressed air that have been removed

The wastewater remains, in this phase, about 6-8 hours undergoing an oxidative pre-treatment
The loading to the next treatment phases is made by pumps provided with an automatic device in order to reveal the flow rate variations and maintain it constant

The pre-treated effluent is putted in two-treatment sections connected in series, consisting of two reactors with a volume of 600 m^3 respectively (in total 1200 m^3 of oxidation tank). The secondary sedimentation tank has a circular shape of 14 m in diameter.

The effluent from the sedimentation tanks is totally (100%) treated by ozone in order to remove colour and tensioactives

Schematic diagram of the waste treatment process



Consideration about the process

The textile wastewater is usually depurated by activated sludge plant to achieve requirements for discharge allowed by law

The use of a large quantity of detergents for cleaning and preparing the materials makes difficult the observance of the values established by law, in this case the use of ozone is certainly useful and advisable taking into account that some dyes are oxidable and with this treatment the colour could be neutralized



In this case it is evident that the plant characteristics are not suitable to support a good depuration because of its low time of mixing (6-8 hours) and biological oxidation (about 16 - 18 hours)

Table 2 shows a typical concentration of some parameters of textile effluent

Tab 2		
COD	mg/l	1540
BiAS	mg/l	51
SO ₄	mg/l	342
Cl ⁻	mg/l	1185
TP	mg/l	6.5
NH ₄	mg/l	0.42
N-NO ₂	mg/l	0.04
N-NO ₃	mg/l	1.8

The observance of the law was not always guaranteed for example in case of some problem to the plant or in case of emergency

The owners of this factory, verifying the poor confidence of system used and worried about the fact that there was no space for doubling the sedimentation tank or biological section, searched a technology that could allow to:

1. Increase the depuration capacity without adding new tanks,
2. Obtain a better efficiency for removing COD and tensioactives and so being sure to regard the law;
3. Produce small amount of sludge and so supporting less costs to dispose them;
4. Removal of thermically destruction of ozone in excess.

In August 1996, the company installed the Affri-Obodez Nozzles in the existing equalization tank and this technology followed by the recovery of ozone through the nozzles has allowed to achieve significant improvements as showed the comparison of parameters values before and after the application (tab 3)



Tab 3				
Comparison of average values before and after the Affri-Odobez Nozzles* application and before and after the recovery of ozone**				
Date	COD mg/l			
	IN	OUT equalization	OUT without O ₃	OUT with recovery of ozone
1995	1600	1550	160	
1996*	1600	1150		130
1997**	1600	550		100

It is interesting to note that the average COD concentration was drastically decreased after the bioflotation application and the recovery of ozone has allowed to obtain an effluent with a COD value of 100 mg/l

The Bioflotation: a new technology of treatment

Textile waste containing large amount of detergents benefits from the process, because these become an active part of the process. Indeed, the detergents are essential to produce the activated foam. This forms the main driver to the process since the foam acts as a supporting structure with a high surface area for bacterial activity. The system is able to make less toxic the wastewater preparing it to a second phase too.

The efficiency of Bioflotation[®] is based on the breathing capability of the bacteria pool working within this activated foam, which transforms organic waste into carbon dioxide and water at a much faster rate than conventional systems with small and restricted production of sludge.

Key to this process is the Affri – Odobez Nozzle, which was first mentioned in technical literature 20 years ago. The Nozzle is capable of mixing (with standard conditions) $3.5 \div 4 \text{ kgO}_2/\text{kWh}$ in water, with an efficiency three or four times higher than traditional systems. It is this air-water mixing that is essential to biological oxidation of waste, since oxygen is essential to the metabolic process involved. As consequence of this it is evident that the Affri-Odobez equipment proved a great advantage to achieve this.



Conclusion

This study has showed the advantages to have installed the bioflotation system in equalization tank and how this technology has permitted to recover the ozone. Specifically

- The COD concentration of the influent to activated sludge plant is decreased from 1150 to 550 mg/l
- Depuration capacity of biological treatment is increased to 40 %
- The biological metabolism after bioflotation is better than before, achieving the total oxidation of organic waste into carbon dioxide and water. As consequence the final COD concentration is decreased from 160 to 100 mg/l

References

- 1 La Bioflottazione® originale processo per l'eliminazione di elevati carichi organici con minima produzione di fanghi - P.Broglio & GB Odobez - Convegno Acque Reflue e Fanghi - febbraio 98 Sala Congressi CNR Milano
- 2 Il trattamento dei reflui di una industria lattiero- casearia con il processo di bioflottazione ® P.Broglio & M.Bonacina, L.Porqueddu, S.Ramponi - Convegno Acque Reflue e Fanghi - Marzo 99 Sala Congressi CNR Milano
- 3 Metodo per la determinazione in tempi brevi della degradabilità di reflui e composti chimici. Applicazioni: E. Scaglia, P. Broglio - Tinctoria, marzo 1991.
- 4 Surfactan Biodegradation - R.D Swischer - M.Dekker Inc. New York 1987
- 5 Il trattamento delle acque residue industriali e agricole - G.Bianucci, E.Ribaldone Bianucci - Hoepli ed. 3a edizione

N.B.: The COD values are measured with the potassium dichromate method.



BIOFLOTATION

APPLICATION OF ODOBEZ SYSTEM
FOR THE WASTE WATER TREATMENT PLANT
OF A DYEING FACTORY IN NORTH OF ITALY.

Martex, Spa
Via Trossi, 9 – 13030 VERRONE (BI)
ITALY



1. INTRODUCTION

The factory Martex is a dyeing factory located in Biella in the North of Italy. The main production of the factory is cotton, polyester and wool. In 1980 the factory built the waste water treatment using Odobez technology because he was obliged to discharge a final water after treatment by far lower than the law limits, since the discharge was in a river whose water was taken for rice fields irrigation in the nearby. The plant was made by a "first phase" V1 tank for the pre-treatment and a "second phase" RF reactor tank for the final discharge to the river. In 1994 the old V1 was substituted by a new V1 with the double capacity (4000 mc) since the factory increased the production.

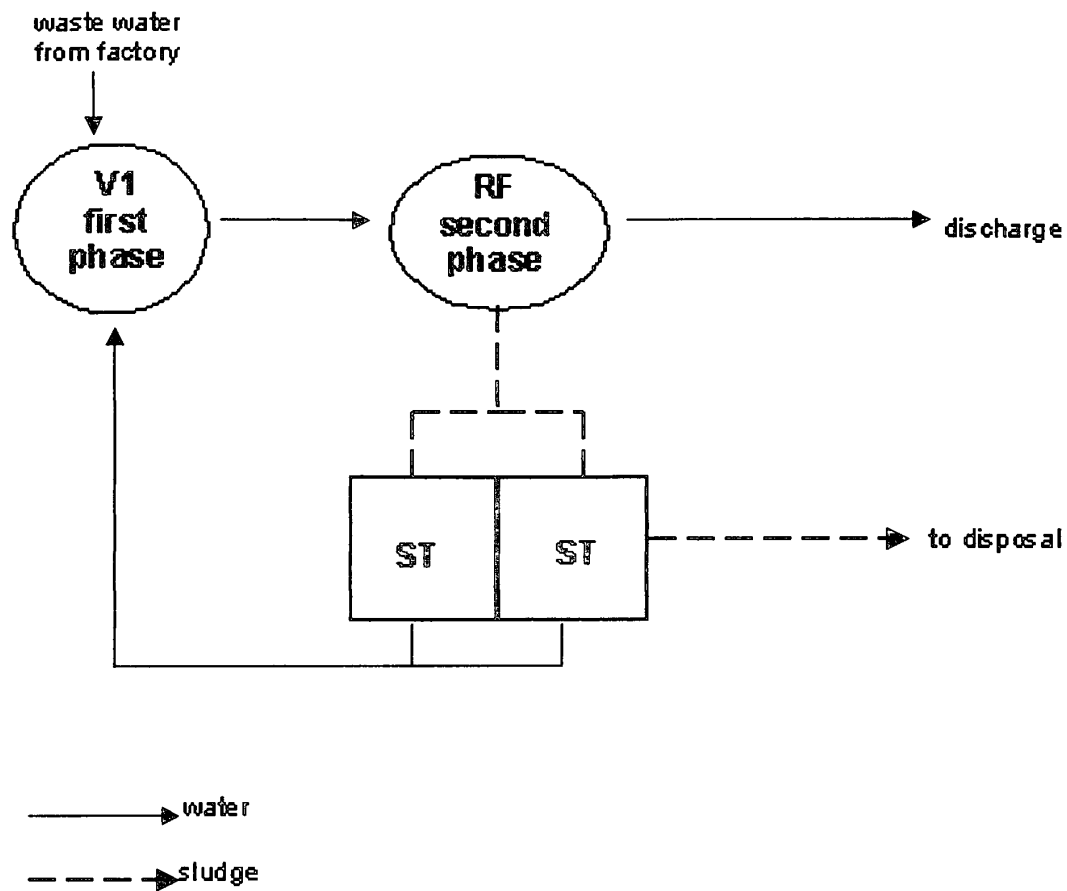
The plant has been running for more than 20 years with excellent results.

2. PLANT DESCRIPTION

The water discharged from the factory is directly fed into V1 (no grating, no pH adjusting). The pretreated water into the "first phase" V1 tank is then pumped to the "second phase" RF reactor tank by adding simply 5 ppm of polymer. The water after second phase is discharged into the river. The sludge production is about 240 kg SS/d.

The sludge discharged from the second phase reactor tank is stored into two sludge tank (80 cm each) and taken away to disposal by a truck 3-4 times per year. The water separated from the sludge in the sludge storage tank is recycled back to V1.

The treatment line is the following:



3. WATER QUALITY

Inlet to WWTP		Outlet from ST
Flow rate	1200mc/d	120 mc/d
COD	2000 mg/l	80 mg/l
BOD	450 mg/l	20 mg/l
SS	150 mg/l	20 mg/l
T-surfactants	80 mg/l	1,5 mg/l

The total sludge production is 240 Kg SS/d.



BIOFLOTATION

APPLICATION OF ODOBEZ SYSTEM FOR THE WASTE WATER TREATMENT PLANT OF A DYEING AND FINISHING FACTORY IN NORTH OF ITALY.

Tintoria Finissaggio 2000 srl
Via 2 Giugno, 18 – 13063 MASSERANO (VC)
ITALY



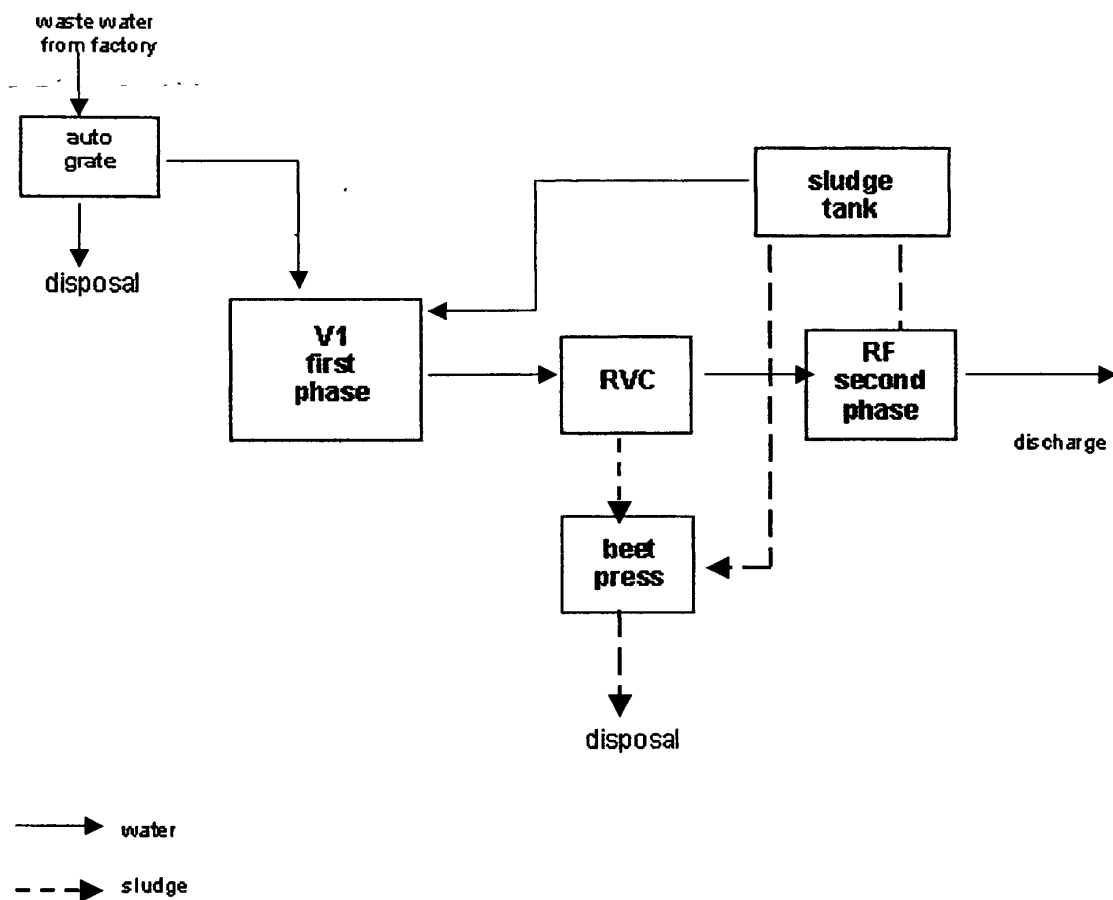
1. INTRODUCTION

The Tintoria e Finissaggio 2000 is a dyeing and finishing factory located in the nearby of Biella in the North of Italy. The production of the factory is the dyeing and finishing of different material on commission for other factories. This factory built in 1981 the reactor RF using Odobez system; so that the water after equalization was directly charged to it. After two years the factory installed a RVC biological system before RF and after equalization. In 1984 the factory installed Odobez nozzles in the equalization tank so that the process is: V1 as a "first phase", RCV system as "middle stage" and RF reactor as "second phase".

2. PLANT DESCRIPTION

The waste water is discharged from the factory into the autograde and then fed to "V1" pre-treatment tank, where the COD reduction is about 40%. After that the water passes through the RVC system where the efficiency is 50% about COD reduction. From the RVC system the water is pumped to reactor RF after adding 15 ppm of polyammina. The final water is discharged directly into the river and the sludge produced is treated in a beet press machine.

The treatment line is the following:



3. WATER QUALITY

Inlet to WWTP		Outlet from ST
Flow rate	1200mc/d	1200 mc/d
COD	700mg/l	70 mg/l
BOD	250 mg/l	10 mg/l
SS	80 mg/l	15 mg/l
T-surfactants	50 mg/l	1 mg/l

The total sludge production is 240 Kg SS/d.



BIOFLOTATION

APPLICATION OF ODOBEZ SYSTEM
FOR THE WASTE WATER TREATMENT PLANT
OF A DYEING FACTORY IN NORTH OF ITALY.

Pettinatura Lane di Romagnano Sesia Spa
Corso Valsesia, 3 – 28078 ROMAGNANO SESIA (NO)
ITALY



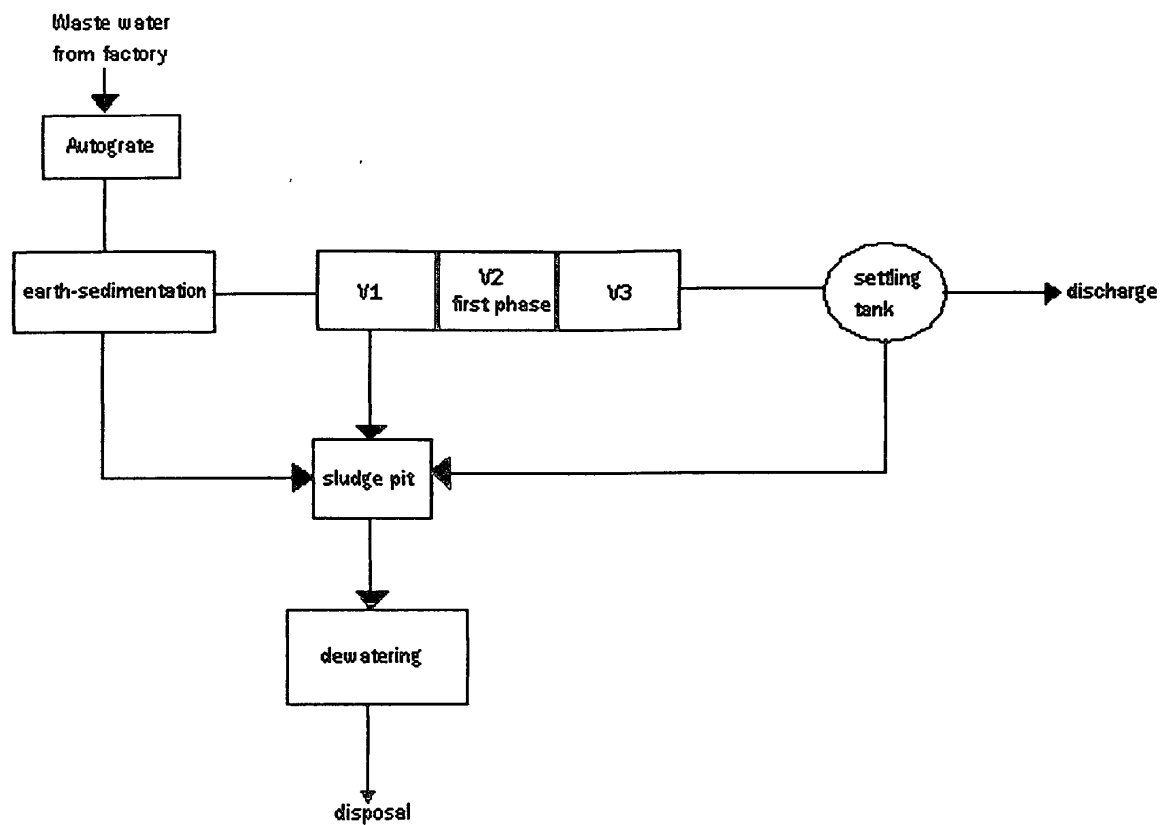
1. INTRODUCTION

The factory Pettinatura Lane di Romagnano Sesia is a wool scouring plant located in Romagnano Sesia in the North of Italy. The main production of the factory is the scouring of the raw and greasy wool scouring coming from the hogget in bailings. In 1994 the factory decided to build a waste water treatment plant since the discharge fee of the waste water to the public treatment plant were too high. The succeeded in making the discharge fee economically acceptable after Odobez System started running. Next step of the factory is a further treatment with Odobez System to reduce the pollutant charge of the waste water down to the limit for river discharge with 0 fee discharge.

2. PLANT DESCRIPTION

The water discharged from the factory is fed to an autograte system. After grating, the water is discharge into an earth-sand sedimentation tank. After earth-sand separation, the waste water is charged to Odobez System (three tank for treatment and compensation since the factory works 13 hours/d). The outlet water is discharged in a sedimentation tank and finally delivered in a piping to the public treatment plant. The foam phase tank (eliminated by a surface scraper given the extremely high COD value of the waste water) together with the sludge of the settler and earth-sand are treated by two dewatering machine decanter type. The sludge production is 5000÷800 KgSS/d.

The treatment line is the following:



3. WATER QUALITY

Inlet to WWTP		Outlet from ST
Flow rate	400 mc/d	
COD	25 000÷35.000mg/l	1000 mg/l
BOD	8.000÷15.000 mg/l	200 mg/l
T-surfactants	350 mg/l	3 mg/l

附 件 二

Program

- **The Danish Waste Model**
- **State of the Art**
- **Waste 21**
- **The Challenges ahead**
 - **to prevent waste**
 - **to increase recycling**
 - **to improve quality of waste treatment**

Legal Framework

- Environmental Protection Act
- Statutory Order on Waste
- Other Statutory Orders
- Cirkulars

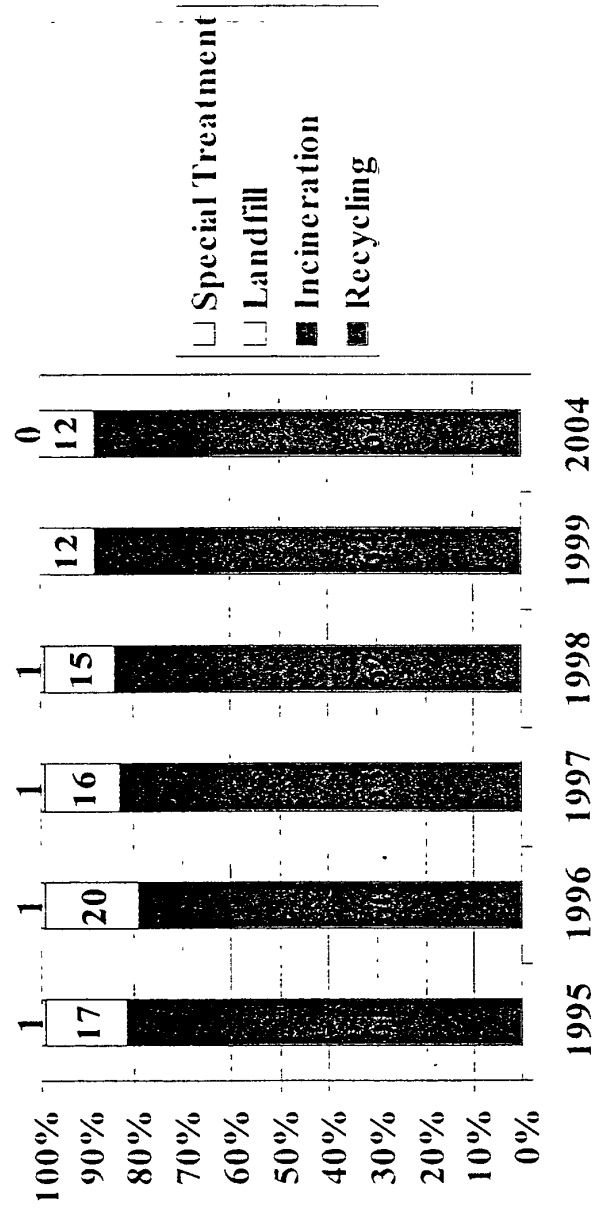
Local Councils have

- Obligation to manage waste
- Responsibility for management of all waste
- Responsibility for waste generated in the municipality

Local Council's duties

- Waste Management Plan
- Local Waste Regulation
- Establishment of Schemes
- Ensure that waste is managed in an environmentally acceptable way
- Collect and register information on waste amounts
- make decisions according to the legal framework

Treatment of Waste



Waste 21

- Is the first national waste management plan
- sets the agenda for future waste management
- is a signal to local council of measures to be taken

Waste 21 will

- *Stabilise waste amounts*
- *increase recycling*
- *utilise the resources in waste by improving the quality of waste treatment*
- *increase the amount of waste assigned to incineration*
- *reduce the need for landfilling*

Challenges ahead

- Stabilise and reduce total waste amounts
- Increase recycling
- Improve quality in waste treatment
 - reduce environmental impact from environmental contaminants in waste
 - ensure better resource recovery

Why waste reduction?

Because:

- Waste represents resources
- Waste treatment causes pollution

Definition of Waste reduction

Waste prevention includes all activities, which can lead to a reduction in generation of waste. Direct reuse, where a substance, material or a product is used again for its original purpose is prevention of waste

Process towards a strategy

- *State of the art report*
- *Workshops*
- *Paper for debate*
- *Conference on waste prevention*
- *Strategy*

Conference - results

- *Waste prevention must have priority in the coming years*
- *Disagreements on instruments*
- *Future initiatives must focus on:*
 - *product's impact on the environment*
 - *reduction of packaging*
 - *a change in production processes*
 - *a change in private consumption*

Increase recycling

- *Paper*
- *Cardboard packaging*
- *Plastic*
- *Glass packaging*
- *Foundry*
- *Scrap*
- *Electric and electronic waste*
- *Cars*

Improve quality of waste treatment

- *Organic waste*
- *Paper*
- *Cardboard*
- *PVC*
- *Impregnated wood*
- *Electrical and electronic waste*
- *End of life vehicles*
- *Batteries*

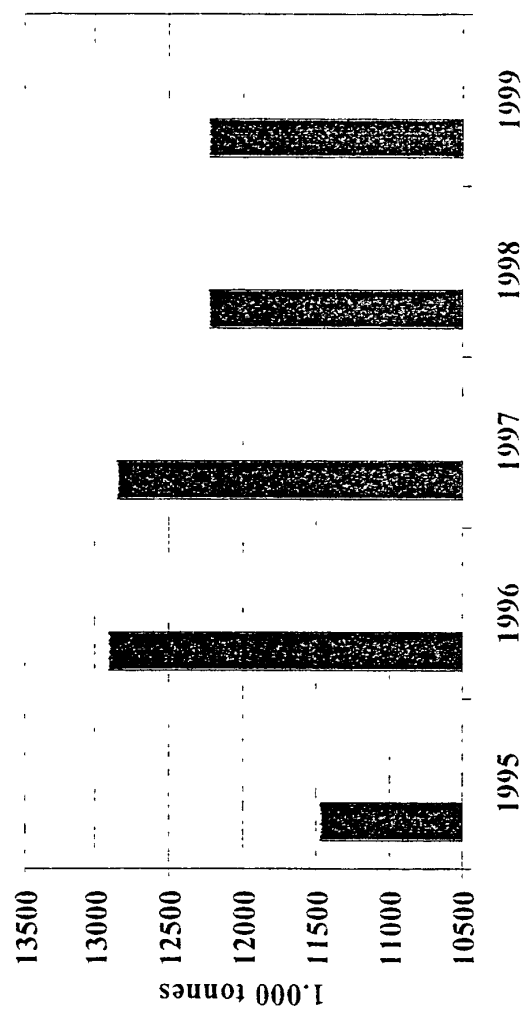
Development af new technology

- Industrial waste consultants
 - advises companies
 - forum for exchange of information and knowledge
- Waste Center Denmark
- Center for Development of new technology

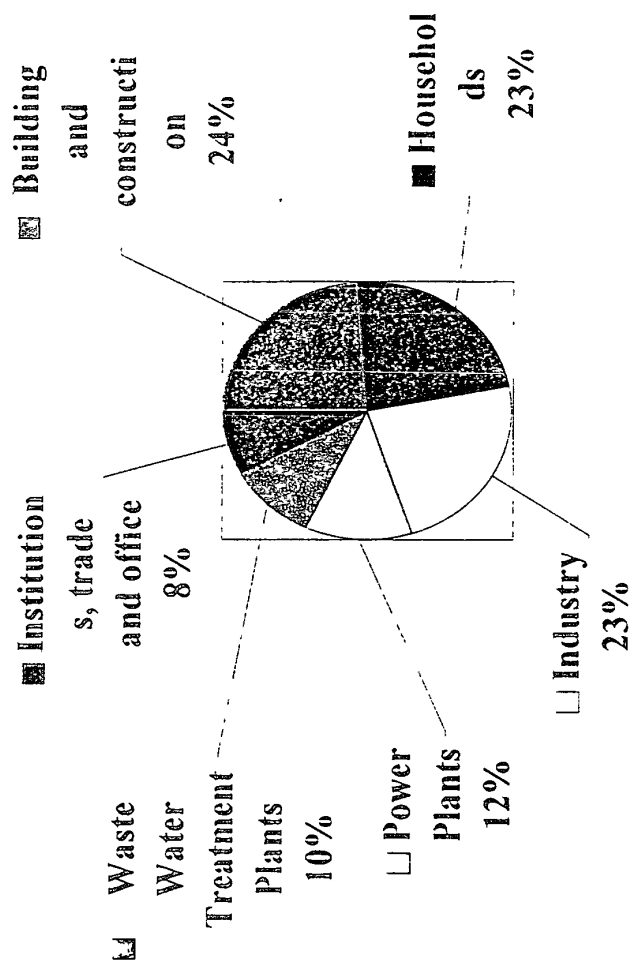
Instruments

- Waste Tax
- Packaging Taxes
- Specific Taxes
- Fees
- Agreements
- Subsidy Schemes

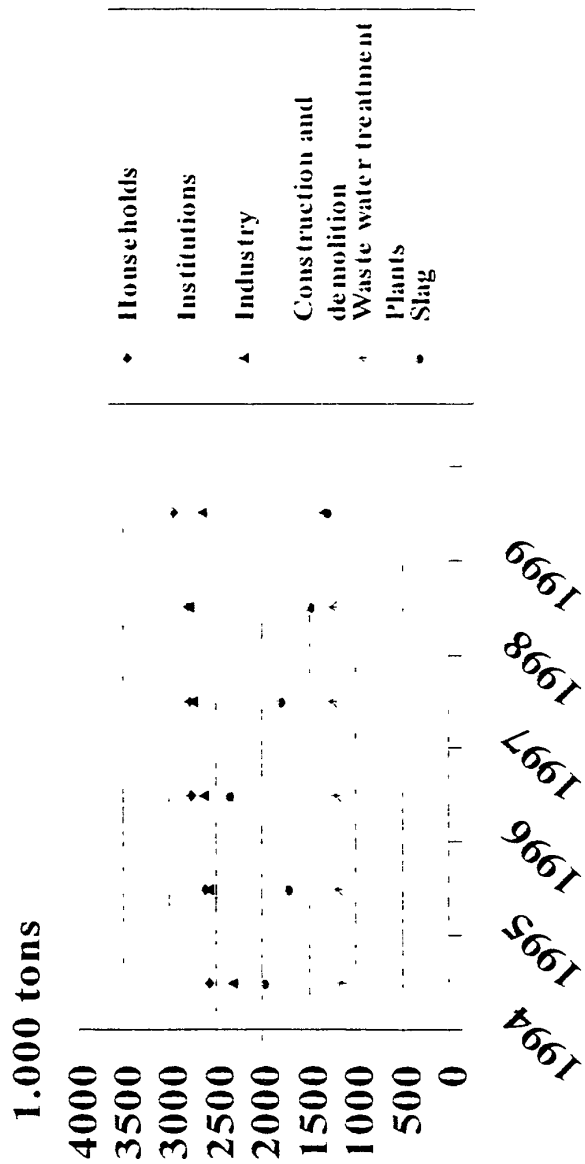
Total Amount of Waste



Waste from primary sources, 1998



Waste amounts from sectors



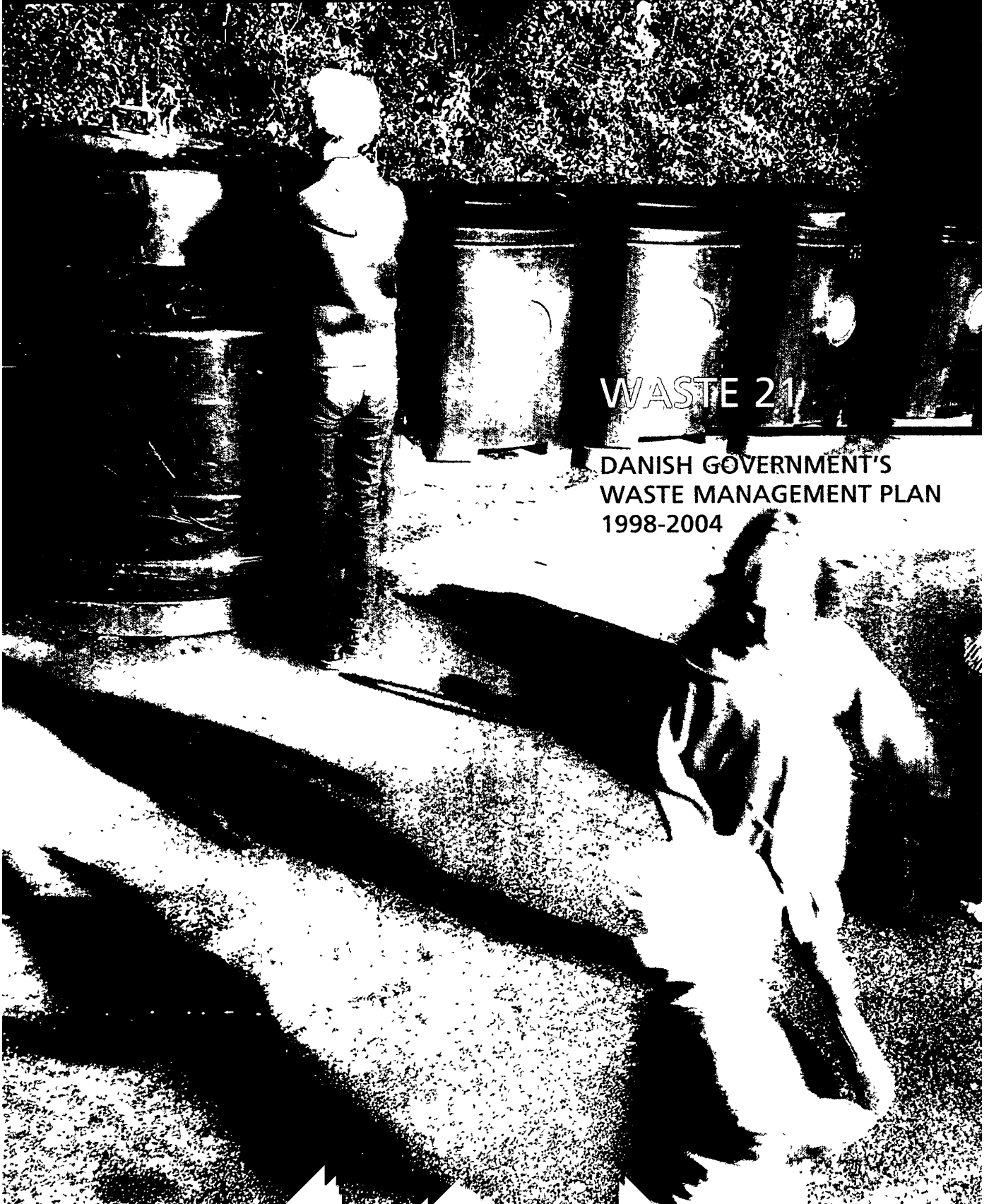
附 件 三

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MILJØ & ENERGI
MINISTERIET

DANISH MINISTRY
OF ENVIRONMENT
AND ENERGY

WASTE 21

DANISH GOVERNMENT'S
WASTE MANAGEMENT PLAN
1998-2004



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Preface

In Denmark, around seven kg waste per capita are generated every day of the year. The task of ensuring collection, correct treatment and largest possible rate of recycling of this waste is heavy, but not impossible.

Experience from waste management in recent years has shown that it does make a difference to make an effort. We have achieved many fine results, but it is no secret that we are still faced with important challenges.

We have reached the overall objectives laid down in the Plan of Action for Waste and Recycling 1993-97. For example, in 1997 total recycling was already 9 per cent above the objective for year 2000, and landfilling was reduced to a level below the objective set for year 2000.

In 1997 the Government introduced a ban on landfilling of waste suitable for incineration. This regulation has been very successful and has meant that more waste has been shifted from landfilling to incineration. When waste that used to be landfilled is incinerated, recovery of the energy contained in waste is ensured, and at the same time much waste is avoided at landfills - waste that takes up space, smells and threatens groundwater resources.

All in all, we have come a long way, but we must go further. An important target for the future is to shift waste from incineration to recycling. Incineration is better than landfilling, but a long term perspective is to recycle even more. For example, paper, cardboard, organic domestic waste, and waste electronic equipment must be recycled. We will also shift waste, for example industrial waste (foundry waste), directly from landfilling to recycling.

Another aspect for the future is the quality of waste treatment. Until now, we have primarily concentrated our efforts on limiting waste arisings, increasing recycling and reducing landfilling. These aspects are still important, but they must be supplemented by more qualitative elements focusing on utilisation of resources in waste, quality in treatment, and greater efforts for environmental contaminants.

Waste 21 was debated on 28th January 1999 in the Danish Folketing. The debate showed broad political agreement on the overall targets of Waste 21. This is a very positive starting point.

Waste 21 sets the agenda for future waste management in Denmark. The plan lays down the overall waste management strategy, and it presents a large number of new initiatives to be launched in the years 1998-2004. The plan will contribute to ensuring better and more efficient waste management than we have today.

Waste 21 is also a signal to local councils of initiatives to be launched in the coming years and to be taken into consideration in the next generation of municipal waste management plans.

Many citizens and enterprises want to contribute to increased recycling. Most people show a keen interest in participating in various waste solutions, and this commitment is central in Waste 21 - favouring both the environment and the economy.

Svend Auken
Minister for Environment and Energy

Guide to the Plan

Chapters 1 to 3 give an account of the strategy and initiatives of Waste 21

Chapter 1 presents the main elements of the waste management plan. In Chapter 2 an account is given of the basic principles of the Danish regulation and organisation of waste management. Chapter 3 summarises the initiatives of the plan for increased recycling, reduced resource consumption, improved quality of recycling/treatment, as well as reduced landfilling. These initiatives will be implemented in the years 1998-2004. Initiatives are presented for all waste sectors, and specific fractions are mentioned in the most relevant sectors.

These chapters are followed by five appendices presenting the issues one by one. The waste management plan - and especially the appendices - has been collated as a reference book, and consequently some issues are stated more than once.

Appendix A on waste regulation summarises instruments used in the Danish waste model. EU waste regulation is also summarised.

Appendix B on waste amounts, technological development and statistical bases presents the status of waste amounts in 1997 and recent years' developments in waste amounts. Furthermore, the need for technological development in waste management is discussed, and new initiatives to improve statistics, including the extension of the ISAG - the Danish Information System for Waste and Recycling - are presented.

In Appendix C on capacity, an outline is given of capacity at waste incineration plants, landfills, and treatment plants for hazardous waste.

In Appendices D and E, sectors and fractions are presented. Status for 1997, objectives for 2004, initiatives to meet targets, present regulation, environmental and economic evaluation of initiatives, as well as implications for national and local waste authorities. Also, treatment capacity for the fractions in question is stated.

1 Waste 21 - Presentation and Objectives

Waste 21 - a national waste management plan

Waste 21 is the Government's national waste management plan covering the years 1998 - 2004. The waste management plan is a follow-up of the Government's Report on Waste¹, presented in early 1998. The plan was debated in the Folketing on 28th January 1999. This debate showed broad political agreement on the overall targets of Waste 21.

Waste 21 sets the agenda for future waste management in Denmark. The plan gives a description of present waste management, initiatives already implemented, as well as new initiatives that ensure better and more efficient waste management than we have today.

The initiatives of Waste 21 are also a signal to local councils of measures to be taken in the coming years which will be considered in the next generation of municipal waste management plans.

Waste 21 meets the requirements of EU legislation with respect to waste management plans, which must be drawn up by all Member States.

Citizens and enterprises must play a more active role

Waste is a resource, and the challenge in future is to limit the loss of this resource as much as possible in an environmentally efficient and economic way. However, this can only be achieved if citizens and enterprises participate actively in waste management solutions.

We know that citizens have a keen interest in such active participation, whether at home or at work. Only by building on citizens' environmental commitment can we achieve good results in the form of efficient collection and recycling schemes.

Need for new waste management solutions

Also in future, local councils will be responsible for the development of waste management solutions, and they must be flexible and open to local, regional and national initiatives that can contribute to improving waste disposal. Local councils must co-operate with citizens, enterprises and the State within waste prevention and development of waste management solutions. It is crucial that local councils base waste management solutions on the waste hierarchy, meaning that recycling has higher priority than incineration and landfilling.

However, when choices are made on forms of treatment, it is important to consider both the environment, energy and resources, as well as economic aspects. This means that the waste hierarchy will not necessarily be followed in all cases.

Municipal initiatives that are not mentioned in this plan will be covered by municipal regulations.

1.1 Challenges ahead

Future efforts in waste management present significant challenges to be taken into consideration in waste management solutions. The challenges are:

¹ The Government's Report on Waste (Danish only) was presented on 29th January 1998 and debated in the Folketing on 17th February 1998.

- to improve quality in waste treatment, i.e. to reduce environmental impact from environmental contaminants

in waste,

to ensure better resource recovery

First, materials in waste must be recovered, then the energy content.

- stabilise total waste amounts

Waste 21

Waste 21 presents a broad range of initiatives for future waste management. Together, these initiatives will ensure that treatment of waste in Denmark will move up the waste treatment hierarchy.

Waste 21 identifies the following main areas of effort:

Separation of waste in more fractions

Source separation

It is important to utilise resources in waste. To that end, waste must be separated into more fractions and treated separately, insofar that it is economically and environmentally beneficial. This will increase recycling and solve the problems caused by environmental contaminants.

Waste 21 presents a number of new initiatives based on citizens' and enterprises' commitment to the environment-friendly treatment of waste².

Waste fractions which used to be incinerated or landfilled must now be recycled thanks to new methods prioritising resource recovery - also of environmental contaminants. This will lead to reduced impacts on the environment.

Another advantage of increased recycling is that the fractions in question will in future no longer take up capacity at incineration plants or landfills.

The following eight fractions will be separated at the source:

- Organic waste

Separate collection of the organic fraction of domestic waste will be extended, once experience with biological treatment is sufficient. Costs of collection and biogasification depend on types of housing and systems chosen, but will not necessarily exceed present costs of disposal.

- Paper and cardboard

Collection from private households and industry and commerce will be extended and made more efficient, and after year 2000, kerbside collection of paper will be established. Local councils will ensure that regulations on separation of paper and cardboard in enterprises are complied with. Kerbside collection will entail additional costs per year of DKK 60-100 per household, depending on types of housing and system chosen.

² A study of "Borgernes adfærd og holdninger på affaldsområdet" (*Citizens' behaviour and attitudes concerning waste management*, Danish only) was published as Environmental Project no. 379, 1998 from the Danish Environmental Protection Agency.

- Cardboard packaging
Recycling of packaging will be increased. Citizens will be able to separate cardboard for recycling.
- PVC
Today, PVC causes problems in traditional waste management. New treatment methods are being developed and are expected to be ready within a few years. Therefore, PVC will be separated. PVC fractions that cannot be recycled will be assigned to landfilling. It is recommended that local councils assign PVC waste to landfilling in special cells so that it may be possible to transfer this waste to alternative treatment later. When new methods have been developed, new requirements will be made for special management.
- Impregnated wood
Impregnated wood also causes problems in traditional waste management. For this fraction also, new treatment methods are being developed. In future, impregnated wood will be separated as waste not suitable for incineration and assigned to landfilling. When better treatment methods have been developed, impregnated wood will be collected separately.
- Waste electrical and electronic equipment
This fraction also causes problems in traditional waste management. Therefore, products will be collected separately, and requirements for their treatment will be made. It is estimated that annual waste collection fees will increase by around DKK 40 per household. For industry and commerce, costs of management of waste electronic equipment will be DKK 5,000 compared to today's costs of DKK 800/tonne.
- End-of-life vehicles
Today, end-of-life vehicles present a considerable environmental problem. In future, collection and reprocessing of vehicles will be ensured. Therefore, end-of-life vehicles will be collected efficiently and reprocessed at enterprises documenting that they are able to reprocess vehicles in an environmentally acceptable way. Future costs of scrapping are expected to amount to DKK 600-700/vehicle against DKK 300-400 today.
- Batteries
When new treatment methods have been developed, all batteries will be collected separately. In a long term perspective, this will increase collection rates for all types of batteries - also for the types collected separately today.

Producer responsibility

Larger focus on products

Producer responsibility - entailing responsibility of producers for the recyclability of products already at the design stage - is a logical concept. Producer responsibility must be introduced internationally if it is to have a high impact on future waste.

The contents of problematic substances in waste must be reduced. Here, the Government's focus on chemicals plays a vital role. The list of undesired substances is a useful tool in identifying substances causing problems for waste management. The list can also be used in connection with the design of new products - and thereby improve waste quality in future.

Focus on waste from enterprises

Enterprises must be more attentive to their waste generation. It is worthwhile knowing the composition of waste, and improving waste management.

saves money and resources. Enterprises in their environmental planning must take waste into consideration with respect to general treatment strategy, and they must be prepared - together with authorities - to propose new waste solutions.

In connection with the extension of the ISAG - the Danish Information System for Waste and Recycling - it is sought to collect more precise information on enterprises' waste, to be used for waste planning and supervision.

For example, information on waste generation, waste composition and possibilities of separating environmental contaminants in waste will in future be important elements in green accounts, environmental permits and environmental management.

The desire of management and staff to make an effort must be exploited, and commitment to waste management must be increased. People closest to the source of waste have good opportunities to improve waste management.

Recycling of waste must be increased, for example by extended use of waste consultants and establishment of waste exchanges.

Improved quality of waste treatment

Treatment methods must be adapted to future requirements for the utilisation of resources in waste - and products must be manufactured that allow for good treatment of subsequent waste.

Both in Denmark and abroad, treatment methods are being developed that ensure utilisation (recovery) of resources in selected waste fractions.

These methods are not fully operational, and experience shows that it takes time for new methods to be fully implemented. New technology will be developed gradually.

In the selection of new methods it is important to consider when and whether to utilise the materials or the energy content of waste: recovery of materials through recycling can be done repeatedly, whereas recovery of energy in waste by incineration can only be done once.

Co-operation on waste solutions

Profitable treatment of waste requires, however, that plants have sufficient supply and financial resources. The need for sufficient supply will, for example, require that small waste fractions are collected from larger areas. Co-operation among regions - also across borders - or among sectors with many small enterprises may be the key to creating the necessary basis for recycling given fractions. It may be necessary to establish few plants for the treatment of certain waste streams. The siting of such plants must be adapted to the supply base and logistics.

Increased involvement of importers, suppliers and traders, as well as development of collection equipment, will enhance the collection of waste.

Requirements of treatment methods

With new treatment methods, a new certification scheme for treatment plants has been introduced, according to which enterprises must document that they are able to reprocess a given waste fraction in an environmentally correct manner.

Waste prevention

In 1997, 12.9 million tonnes waste were generated in Denmark. The total amount of waste is similar to that of 1996, but covers different develop-

ments in different sectors. There was a decrease in waste amounts from coal-fired power plants, an increase in construction and demolition waste amounts, and unchanged waste generation in households. The increase within other sectors (industry, institutions, trade and offices as well as wastewater treatment plants) was moderate - between 1 and 4 per cent per year.

Economic growth has a large impact on waste generation. Other factors also influence waste arisings. In some cases, initiatives for waste prevention will be adapted to the sector, in other cases to the waste fraction. There is therefore a need to study each sector and fraction in order to determine factors influencing waste generation.

We know that different strategies to prevent waste have to be implemented depending on the origin of waste: waste may be generated in production (process waste), it may originate from discarded products, or waste may be residues, for example from coal-fired power plants.

Environmental management and clean technologies can limit the amounts of waste generated in enterprises. The integrated product policy will lead to increased lifetime of products, improved recyclability of discarded products, and it will ensure that product design also considers the waste perspective of products. For residues, completely different factors influence waste arisings. For example, the amount of residues generated in coal-fired power plants is directly linked to energy policy.

The implementation of integrated product policy will have an impact on waste management, but some years will pass before products of the future become waste. For a long period, waste will be made up of "old" products. In addition, there are considerable imports of goods, and such goods are expected to be manufactured according to the integrated product policy later abroad than in Denmark.

Waste composition is a result of different activities in our society; daily activities in households, at work and in industrial production. Activities change as a consequence of many different impacts.

Responsibility for solving the problem of increasing waste amounts is shared by all citizens. In 1999, a conference will be organised, allowing parties involved to meet and commit themselves to co-operation on waste prevention.

Interplay between the Danish waste model and the EU

The Danish waste model is the result of an interplay between EU regulation and national regulation.

EU regulation lays down overall frameworks and principles for waste management. The organisation of waste structures and the incorporation of EU regulation in Danish legislation is a national task.

Denmark, with a number of other EU countries, has come far in waste management. Together with these other countries we have succeeded in incorporating key elements of the Danish waste model in EU regulation, for example the waste hierarchy, source separation, licencing requirements for treatment plants, and the establishment of data collection. On one point, Denmark has chosen another path than other European countries - we incinerate a very large part of our waste and landfill very little.

Environmental design of industrial products will in the long term have a significant impact on waste composition. Danish product design must be supplemented by an international effort due to the large amounts of imported goods. The integrated product policy therefore also has an international aspect.

We will continue to develop the Danish waste model. There are still many environmental problems related to our way of managing waste. In co-operation with other countries we will find new waste solutions minimising the impacts of waste management as they are today, and we will pass on experience gained to the EU and other Member States just as we will also be inspired by solutions in other countries. By co-operating for better waste management within the EU we can achieve considerable results.

Transboundary movements of waste

Today, transboundary movements of waste are controlled. The possibilities of controlling waste depend on the destination: recovery or disposal. Special requirements for waste treatment, for example, may be used to control movements. The purpose of this control is to ensure that waste receives environmentally sound treatment.

Waste destined for recovery

In cases where we have a superior recovery method in Denmark, we must make use of it. We can control movements of waste for recovery through specific treatment requirements in national legislation or municipal regulations. Today, we have laid down special treatment requirements for refrigeration equipment and electronic waste. It is planned to make treatment requirements for vehicles, and requirements for batteries, PVC, shredder waste and waste suitable for incineration are being considered (see Appendix A). Transboundary movements of waste for recovery will only be permitted on the basis of a specific evaluation of compliance with treatment requirements. If no such requirements are laid down, transboundary movements can only be prevented through environmental considerations, or with a view to protecting public safety or health.

Waste destined for disposal

If suitable plants are available for the disposal of waste in Denmark, transboundary movements of waste destined for disposal will not be permitted. The background for this ban is the proximity principle, the priority for recovery and self-sufficiency at national and Community levels. The ban will be incorporated in legislation.

Imports of waste for disposal in Denmark are not permitted. One exception is waste which is generated in such a small quantity in another Member State that the provision of new specialised disposal plants in that State would be uneconomic. This ban will be incorporated in legislation. The Commission will be notified of these measures in accordance with Council Regulation³

³ Article 4, section 3 a) i) in Council Regulation (EEC) no. 259/93 on the supervision and control of shipments of waste within, into and out of the European Community

1.2 Objectives

New focus

- *quality in waste treatment*
- *reduced environmental impact*
- *utilisation of resources in waste*

Waste 21 envisages a change in focus

Focus used to be on *quantities* - and it will now be supplemented by *qualitative* elements such as utilisation of resources in waste, quality in waste treatment, and mitigation of problems caused by environmental contaminants

With Waste 21, Danish waste management will be improved, entailing reduced loss of resources and better quality in waste treatment. The plan reflects the principles of ecological space and allows for larger participation of citizens and enterprises in waste solutions.

Waste management year 2004

- *64 % recycling*
- *24 % incineration*
- *12 % landfilling*

New national objectives⁴ for waste management means increased recycling and reduced landfilling. Objectives have been drawn up on the basis of an evaluation of impacts of initiatives and an assessment of waste arisings year 2004.

Need for landfilling decreases

The objective is that the total need for landfilling in year 2004 will be reduced by some 500,000 tonnes against the quantity landfilled in 1997. This will be achieved through increased recycling and incineration. This is a decrease of 25 per cent against 1997. Waste from industry and residues from coal-fired power plants in particular contribute to this decrease.

The ban on landfilling of waste suitable for incineration means that resources in waste are better utilised through incineration - but at the same time this has led to new challenges in waste management. Now, the objective is to shift a larger part of waste suitable for incineration to recycling - and at the same time to shift non-combustible waste directly from landfilling to recycling.

Capacity

Up to year 2004, landfill capacity at national level is sufficient, but there are large differences among the regions.

Increased recycling

Recycling can be improved compared to today. The initiatives in Waste 21 will lead to increased recycling of 270,000 tonnes. This is an increase of 1 per cent against 1997. The increase will be distributed over all sectors - except for municipal wastewater treatment plants and the building and construction sector.

Figures may give the impression that recycling targets have been met, but construction and demolition waste counts much in the overall calculation. Many new initiatives are not directed at heavy waste fractions, but rather at light, important fractions such as plastic and paper and fractions containing environmental contaminants.

As a consequence of waste prevention initiatives in the Government's plan of action for energy, Energy 21, amounts of residues from coal-fired power plants, which are recycled extensively, will decrease considerably.

More incineration

⁴ Objectives in Plan of Action for Waste and Recycling 1993-1997 were: Recycling 54%, incineration 25 %, landfilling 21 % by year 2000.

Total amounts of waste going to incineration in 2004 will increase compared to 1997⁵. Initiatives in Waste 21 for increased recycling will shift waste from incineration, but other factors will have the opposite impact. Firstly, the ban on landfilling of waste suitable for incineration is expected to shift large amounts of waste from landfilling to incineration. Secondly, an increase in waste arisings up to year 2004 will mean more waste to be incinerated

Capacity

New challenges are ahead due to increased capacity needs and enhanced environmental requirements⁶. These challenges will be solved in close co-operation between local, regional and national authorities. The aim is to adapt capacity to needs and site capacity in a way that allows for best possible energy utilisation and largest possible CO₂ mitigation based on the principle of regional self-sufficiency. Co-ordination of incineration capacity will be enhanced or rules will be introduced ensuring overall planning nationally and regionally and that environmental and economic considerations are respected.

Better quality in waste treatment

New treatment methods are being developed for a number of waste fractions, but there is still a long way to go before all methods have reached full-scale operation. Therefore, the effect of new treatment methods cannot be measured today; developments have to be seen over time. When processes are operational, separate collection will be introduced for environmentally harmful and recyclable fractions.

A review of the effects of initiatives for electronics, end-of-life vehicles, batteries and impregnated wood based on today's data shows the following

40% of copper is recycled

For electronics it is expected that around 25,000 tonnes of waste electrical and electronic equipment will be shifted from landfilling and incineration to recycling. The copper content of this waste corresponds to 40 per cent of the amounts incinerated or landfilled today.

25 tonnes of lead to be recycled

Reprocessing of end-of-life vehicles will ensure that 25 tonnes of lead are separated for recycling.

6 tonnes of cadmium

Collection and treatment of all NiCd batteries will remove 6 tonnes of cadmium from waste streams.

25 tonnes of arsenic 75 tonnes of chromium

It is assessed that separate treatment of impregnated wood in year 2004 will entail a reduction of around 25 tonnes of arsenic and 75 tonnes of chromium in conventional waste treatment.

Waste prevention

Waste prevention is one of the key elements of Waste 21. Already now, waste prevention may be introduced for fractions where factors significant to waste generation are known. Today we know that new energy generation will lead to a considerable reduction of residues from coal-fired power plants within the next 30 years.

Consumption patterns are decisive to developments in waste arisings from households. It is therefore planned to launch information campaigns focusing on the connection between material consumption and waste arisings.

Results within sectors

⁵ 2.6 million tonnes were incinerated in 1997.

⁶ New EU directive on waste incineration is in the pipeline.

Prerequisites for meeting targets for year 2004 are that national and local authorities issue the necessary rules and regulations, and that citizens and enterprises participate in waste solutions

Development and information activities stated in Waste 21 require substantial subsidies from the Environmental Council for Cleaner Products. Studies will show which additional financing schemes may be established to strengthen certain areas in order to ensure a systematic improvement in waste management all over Denmark.

Initiatives for various sectors can be summarised as follows

<p><i>Waste incineration plants year 2004</i></p> <ul style="list-style-type: none"> • 70% recycling 	<p>A number of environmentally harmful fractions may no longer be assigned to disposal at conventional <i>waste incineration plants</i>. These fractions are, for example, waste electronic equipment, impregnated wood, and PVC. Stabilised flue gas cleaning waste will be landfilled at three sites receiving waste from the whole country. Recycling of residues from waste incineration plants is to reach at least 70 per cent in year 2004 (77 per cent in 1997).</p>
<p><i>Construction and demolition waste year 2004</i></p> <ul style="list-style-type: none"> • 90% recycling 	<p>Recycling of <i>construction and demolition waste</i> is to be kept at the present high level, and environmental contaminants from the building sector are to be collected and treated separately. Such materials are PVC, waste electrical and electronic equipment, as well as impregnated wood. In year 2004, recycling is to be at 90 per cent (92 per cent in 1997).</p> <p>Recycling of <i>household waste</i> will increase up to year 2004. Recycling of domestic waste and bulky waste will increase, and garden waste will be kept at the present high recycling rate.</p>
<p><i>Domestic waste year 2004</i></p> <ul style="list-style-type: none"> • 30 % recycling 	<p>Increased recycling of <i>domestic waste</i> will be ensured by the introduction of kerbside collection schemes for paper, and increased information on glass collection. Recycling of organic domestic waste will be increased as biogas technology is developed and capacity installed. In a longer term perspective, separate collection schemes will be introduced all over the country. The recycling objective for domestic waste is 30 per cent in year 2004. The long term objective of 40 to 50 per cent is to be maintained (15 per cent in 1997).</p>
<p><i>Bulky waste year 2004</i></p> <ul style="list-style-type: none"> • 25 % recycling 	<p>Recycling of <i>bulky waste</i> will be increased by further source separation of recyclable fractions such as cardboard. Requirements for the establishment of recycling possibilities for source-separated waste at recycling centres will be considered. Recycling is to reach 25 per cent in year 2004 (17 per cent in 1997).</p>
<p><i>Industry year 2004</i></p> <ul style="list-style-type: none"> • 65 % recycling 	<p>Waste from <i>industry</i> will be shifted from landfilling to recycling, and environmental contaminants in waste are to be managed through better treatment methods. Fractions in focus are, for example, foundry waste, shredder waste, and waste electrical and electronic equipment. Recycling will be increased, for example, through the establishment of waste exchanges. Recycling in year 2004 is to reach 65 per cent (58 per cent in 1997).</p>
<p><i>Institutions, trade and offices year 2004</i></p> <ul style="list-style-type: none"> • 50 % recycling 	<p>Recycling from <i>institutions, trade and offices</i> will be increased by enhanced collection of recyclable materials. This can be achieved through improved information, guidance from special waste consultants, and enhanced supervision by local authorities. The effort is especially directed towards fractions such as batteries, vehicles, tyres, refrigeration equipment, PVC, waste electrical and electronic equipment, cardboard and paper, as well as waste oil. Recycling is to reach 50 per cent in year 2004 (38 per cent in 1997).</p>

*Wastewater treatment plants
year 2004*

- 50% recycling

Both fertiliser and energy resources in *municipal sewage* sludge are to be utilised, but due to stricter requirements for the contents of certain organic chemical substances in sludge, it is expected that the present high level of application of sludge to farmland cannot be maintained. The objective is therefore to have 50 per cent recycling in year 2004 (70 per cent in 1997)

Residues from coal-fired

power plants year-2004

- 90% recycling of bottom
ash and fly ash

Amounts of residues from coal-fired power plants are expected to drop as a consequence of Energy 21. Recycling of residues can therefore be increased to 90 per cent in year 2004 (73 per cent in 1997). Furthermore, it will be ensured that increasing amounts of bioash are recycled in environmentally appropriate ways.

2 The Danish Waste Model

The Danish waste model is a comprehensive system covering waste prevention, collection and treatment. The fundamental principle of the model is that co-ordination of waste management is a public sector task.

Responsibility lies with local councils

In Denmark, responsibility for management of all waste lies with the local councils⁷.

In Denmark, in contrast to many other countries, we have chosen to manage household waste, and industrial and commercial waste, in a comprehensive waste management system, covering both packaging waste and hazardous waste.

Source separation

For some recyclable fractions, collection systems with source separation have been established, enjoying widespread acceptance and used extensively by citizens and enterprises. The principle of source separation of waste is one of the key elements in the Danish waste model.

It is a municipal task to ensure that the waste hierarchy is followed, ensuring that some types of waste are recycled in compliance with specific requirements.

In general, it is attempted to solve the waste problem at the source by introducing cleaner technology. In recent years, environmental management, green accounting and similar concepts have also gained ground. This has meant that waste is not only perceived as an environmental problem, but also as a resource.

Organisation

The local council may choose to be in charge of waste management itself, or it may contract the task to an intermunicipal waste company.

The local council may also choose to contract waste management operations to private companies.

Intermunicipal companies

The practical organisation of waste management is different from one local authority to another. Large local authorities such as Copenhagen, Aarhus and Odense choose to manage waste themselves. Most of Denmark's other (small) local authorities have chosen - mostly for practical reasons - to co-operate with other local authorities with a view to solving central parts of the task jointly. This is done by establishing intermunicipal waste companies. Such companies are normally based on Art. 60 in the Local Government Act⁸.

Management of hazardous waste is also organised differently from one local authority to another. A network of intermunicipal transfer stations has been set up, servicing most local authorities in Denmark. A few local authorities handle hazardous waste themselves.

⁷ Agricultural waste and residues from coal-fired power plants are not managed by local councils.

⁸ Local Government Act no. 1092 of 29th December 1997, Art. 60.

On 1st January 1998, 35 intermunicipal waste companies and 18 intermunicipal transfer stations existed, all approved under Art 60 of the Local Government Act.

Other types of companies have also been established to operate within waste management. Some of these companies are owned by local authorities.

collection/transportation

Operation of municipal schemes

Municipal schemes for household waste are normally operated by local councils, municipal companies and private waste companies, whereas the management of industrial and commercial waste is normally contracted to private companies.

The collection of both household and industrial and commercial waste is typically contracted to private companies.

- recycling

Waste recycling is mostly carried out by private companies. However, several intermunicipal companies also operate within waste recycling, as a means to ensure environmentally correct recycling of waste independent of, for example, fluctuating market demand for recyclates.

- incineration

Waste incineration is in practice a public sector task, and incineration plants are typically operated by municipal or intermunicipal companies. In addition, several incineration plants exist that are not run by intermunicipal companies. Ownership forms vary much and, for example, several plants are owned by power distribution companies.

- landfilling

As a general rule, waste disposal sites may only be owned by public authorities.

To support the Danish waste model, a broad range of instruments are applied that are characteristic to this model. These instruments are described in Appendix A. Both EU and Danish legislation on waste set up objectives and requirements for waste management in relation to the preparation of waste management plans. Appendix A describes the interplay between Danish and EU legislation.

Transboundary movements of waste

Transboundary movements of waste follow a specific procedure based on previous notification, authorisation and financial guarantees.

*Competent authority is
Danish Environmental
Protection Agency*

The Danish Environmental Protection Agency is the competent authority, and the scheme is administered in extensive co-operation with regional and local councils.

Monitoring

Assisted by the police, local councils monitor that regulations on transboundary movements of waste are complied with. However, regional councils are responsible for monitoring waste imports to Danish enterprises which operate under regional supervision under the Danish Environmental Protection Act Art. 66. Regional councils also carry out monitoring on the roads.

2.1 New focus for waste management

Waste 21 introduces a change of focus in Danish waste management

New focus - qualitative objectives

- quality in treatment

- reduced environmental impact

- increased resource utilisation

Until now, focus has been on quantities - i.e. waste minimisation and increased recycling. From now on, focus will also be on qualitative objectives - better quality in waste treatment is to be achieved. This means reduced environmental impact and increased resource utilisation in an economically acceptable way

Utilisation of resources in waste is to be understood very broadly. Resources mean both energy resources used to generate "waste", raw material resources making up waste, and energy that can be recovered by waste incineration.

Products may be reused directly. Reuse preserves both raw materials and the energy used to manufacture the product. The Danish bottle return system is a good example of reuse.

It is also possible to process waste, using its raw materials to manufacture new goods (recycling). Recycling ensures utilisation of raw materials several times. Virgin raw materials are saved, as is the energy used to produce them. At the same time, the energy content of waste is saved which as a last resort can be recovered, for example by incineration.

Another kind of recycling is the extraction of raw materials from waste, for example copper or lead. This has many advantages: virgin raw materials are saved, spreading of substances is reduced (a hazard to the environment), and raw materials can instead be utilised in new products.

The energy content of waste covers both the energy used to manufacture the product and the energy reserve which may be recovered by incineration of the product. Biogasification of organic domestic waste ensures recovery of both fertilising contents and energy contents, making this form of treatment superior to incineration. These and other factors are important to take into consideration in the choice of future treatment methods.

Factors to be considered differ from one waste fraction to another, and the choice of method depends on treatment methods available and logistics at any given time. However, we have to face the fact that technological development does not happen automatically in the waste area. The reasons for this are that waste management competence is decentralised and that sources of several waste fractions are dispersed unevenly over the country. For example, one waste fraction may be generated in small quantities in many municipalities. Other waste fractions may arise in large quantities in few municipalities. Therefore, supply is not secured. This constitutes a barrier to innovation and development of profitable collection schemes and treatment methods.

In addition, market prices fluctuate widely, and consequently initial investments in the sector are risky. There is no incentive to invest in the development of new plant and turn it into commercial use.

In future, local councils will continue to be responsible for developing waste solutions, but they must be flexible and open to involvement of professional competence from other local authorities, private companies and to look at national solutions.

Under Waste 21, this will be even more important as more fractions are to be collected and treated separately, and new methods must be developed to treat these fractions. New treatment methods must be adapted to waste of the future. Local councils must be prepared to adapt to alternative management of given waste fractions.

Today, local authorities co-operate on the recycling of, for example, paper and cardboard, and batteries are collected separately and reprocessed abroad. It may be necessary to extend this co-operation to cover more operators in the choice of new waste solutions in order to improve quality in waste treatment.

- As a consequence, local councils must be prepared to co-operate - also - across borders - when they develop new waste management solutions.

Report on Waste

Focus on qualitative elements in waste management is also one of the main messages in the Danish Government's "Report on Waste - Waste 21" dated January 1998 (Danish only).

Better quality in treatment is a prerequisite to ensure that targets for reduced spreading of environmental contaminants and optimisation of resource utilisation are met.

Environmental contaminants came in focus with the "1995 Nature and Environment Policy Report", adopted by the Folketing in November 1995. According to this report, one of the four most important areas of effort in environmental policy is the phase-out of xenobiotic substances.

The Government is also focusing on chemicals.

In connection with this new focus, two other strategies play a key role for the environment.

In the Government's report on future initiatives for chemicals from May 1997 and the Danish Environmental Protection Agency's report on integrated product policy, tools for preventive efforts are identified in which source tracking and limited use of undesired substances are important elements.

List of undesired substances

Furthermore, the Danish Environmental Protection Agency has drawn up a list of substances that are undesired in products. The list is based on knowledge of substances' harmful effects on human health and/or the environment. In the selection, consideration has been given to problems arising in manufacture, use, and disposal of waste.

The list is a useful tool in the identification of substances that cause problems in waste management, and therefore it is to be used in the development of cleaner technology and the substitution of environmental contaminants with less harmful substances.

However, it will take time before the integrated product policy has an effect on waste, and undesired substances are substituted. Durability of goods is an important factor when the nature of waste is to be changed.

In parallel with this preventive effort a modern waste treatment system is therefore to be established that can handle waste as it is today - both originating from domestic and imported goods - and which will be affected by "old" products on the market for some years ahead.

3 Initiatives

Up to now, Danish waste strategy has focused on waste prevention, increased recycling and reduced landfilling. These concepts will still be in focus, but now the quality of waste treatment is also to be improved. Environmental impacts from chemical substances will be reduced and resources in waste utilised.

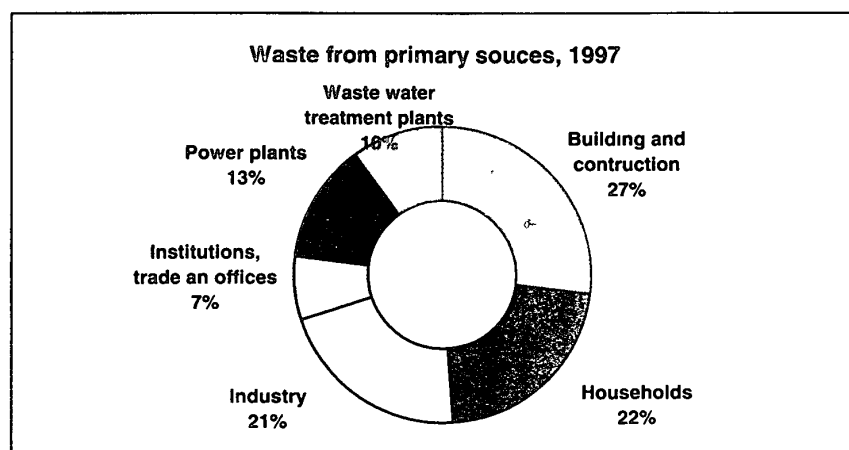
For Waste 21 to succeed, a number of initiatives must be launched at different levels. Some initiatives are of more general nature, others will be adapted to different sectors or directed at the waste fraction in question.

This requires that national and local authorities live up to their obligations, including the preparation of necessary rules and regulations, and that citizens and enterprises contribute to good waste solutions.

Development and information activities stated in the plan require a substantial subsidy from the Environmental Council for Cleaner Products, but there is also a need to study additional financing possibilities which may be established in order to promote technological development.

Waste can be divided according to the source (sector) generating it. Sectors are waste incineration plants, building and construction, households, industry, institutions, trade and offices, power plants, and wastewater treatment plants. Total amounts of waste are distributed as follows: building and construction 27 per cent, households 22 per cent, industry 21 per cent, institutions/trade and offices 7 per cent, power plants 13 per cent. Wastewater treatment plants account for 10 per cent (see also figure)⁹.

Residues from waste incineration plants are not included in total waste amounts in the figure, as they would otherwise be counted twice.



The initiatives of Waste 21 are described below. The first initiatives are of more general nature, followed by a number of initiatives divided into sectors.

⁹ The figure "Waste from primary sources" only includes waste from primary sources, i.e. residues from waste incineration plants are not included in total amounts.

generating the waste. A more detailed description of initiatives is given in Appendices A to E.

3.1 General areas of effort

In Denmark, 12.9 million tonnes¹⁰ waste were generated in 1997. Of total amounts less than 2 per cent was hazardous waste and 7 per cent packaging-waste.

Developments in waste amounts

In general, waste amounts have increased over the past 10 years up to 1996. Within the building and construction sector and coal-fired power plants especially, increasing amounts of waste have been registered. From 1996 to 1997 total waste amounts remained stable. Amounts of residues from coal-fired power plants dropped steeply from 1996 to 1997.

Despite increasing waste amounts, past objectives for recycling in year 2000 have been reached¹¹. The building and construction sector especially has contributed to the high rate of recycling.

Waste prevention

The Folketing has decided that total waste amounts must be kept stable. Waste prevention is a very hard task to solve. The Government will do their part, but all members of society have a responsibility.

Studies have shown that the economy is the decisive factor for 80 per cent of the increase in waste generation, but it does not play the same role for all fractions. The remaining part of the increase is caused by other factors such as amendment of legislation and citizens' behaviour.

In order to break the generally increasing trend in waste generation it is necessary to identify mechanisms behind waste generation in different sectors, and on this basis adapt initiatives (see Appendix B on waste amounts).

Responsibility for solving the problem of increasing waste amounts is shared by all citizens. In 1999 a conference will be organised, allowing all parties involved to meet and commit themselves to co-operation on waste prevention.

Waste data

Knowledge on waste must form the basis for planning, regulation and supervision by local authorities to a greater extent. Initiatives to improve the statistical basis in the waste sector are described in Appendix B on waste data.

It is a prerequisite for improved quality in waste treatment that good statistics are available. Reliable data must be used for identifying new areas of effort and for monitoring whether initiatives which have been launched lead to the expected results (see Appendix B on waste data).

Technological development

Improved quality in waste treatment requires development of new technology. There are several barriers to automatic development, for example decentralised competence in waste management, fluctuating prices, as well as

¹⁰ Waste Statistics 1997, Environmental Review no. xx, 1999 from the Danish Environmental Protection Agency.

¹¹ Cf. Action Plan for Waste and Recycling 1993-97, the objective for year 2000 was 54% recycling, 25% incineration and 21% landfilling. Actual 1997 figures show recycling of 63%, incineration 20%, landfilling 16% and special treatment 1%.

the fact that waste is generated unevenly over the country (see Appendix B on technological development)

Denmark has been at the forefront of technology in waste treatment. If technologies suitable for waste of the future are to be developed at general level, it is necessary to ensure an intensive effort solving the task systematically throughout the country. In co-operation with operators in the area, the Government will evaluate areas in which an enhanced effort is needed and how best to support this effort.

Taxes

Waste tax

The waste tax is a good financial incentive to ensure that waste is subjected to the form of treatment to be promoted; this means increased recycling and reduced landfilling. It will be ensured regularly that the waste tax supports overall priorities in waste management. In this connection it will be evaluated whether waste tax should also comprise hazardous waste and contaminated soil, promoting more suitable treatment (a detailed description of the Danish waste tax is given in Appendix A).

Packaging fee

The weight-based packaging fee gives producers an incentive to reduce the weight of packaging and thereby also waste generated. If the packaging fee is later to be fixed on the basis of environmental impact of packaging, in addition to being waste preventive, the fee will also give an incentive to reducing environmental impact of packaging waste (see Appendix A on regulation).

Capacity to be adjusted

Capacity at waste incineration plants

Increased need for capacity, overall energy policy and enhanced environmental requirements¹² create a number of challenges to be solved in close co-operation between local, regional and national authorities.

The objective is to adjust incineration capacity to actual needs and locate it in areas where best possible energy utilisation and largest possible CO₂ mitigation are obtained, taking into consideration principles of regional self-sufficiency. In future, establishment of new plants, closing-down of operation, or conversion to combined power and heating generation will be co-ordinated better.

Today, a large number of incineration furnaces generate only heating without co-generation. It is estimated that after year 2000 there will still be a need to exploit capacity in several of these furnaces. The use of these furnaces will be evaluated regularly, taking special consideration of the largest possible energy utilisation and stricter environmental requirements.

Co-ordination will be enhanced and rules will be laid down to ensure a comprehensive planning nationally and regionally and optimum respect of environmental and economic aspects.

Landfill capacity

Up to year 2004 landfill capacity is sufficient at national level, but at the same time there are large differences among the regions due to different availabilities of suitable sites for the landfills. In addition, practice shows that planning must be carried out with a 12-year horizon. Considerations on capacity must therefore go further than the four years which are often practice in planning.

¹² An EU directive on waste incineration plants is in the pipeline, comprising requirements for emissions.

3.2 Sectors and fractions

In waste planning, it is expedient to divide waste according to its source. Within a given sector, waste of a similar type is normally generated, and collection schemes are adapted to this type.

Initiatives for each sector are described below. Under each sector it is discussed how to achieve objectives, including for which fractions initiatives will be launched, and which efforts work well today (see also Appendix D on sectors and Appendix E on fractions).

3.3 Waste incineration plants

Objectives year 2004

- 70 % recycling of total waste amounts from incineration plants

In 1997, around 550,000 tonnes of residues (slag and flue gas cleaning waste) were generated at waste incineration plants.¹³ It is expected that increasing amounts of waste will be incinerated in the coming years, and thereby increasing amounts of residues will be generated.

Fractions are incinerated today which are no longer considered suitable for incineration. These fractions include PVC, impregnated wood and waste electrical and electronic equipment. In future, as far as possible these fractions will not be incinerated. In a coming EU directive on waste incineration, Denmark will seek to include principles for incineration of certain fractions.

The quality of residues must be improved, and both recycling and landfilling of residues must be managed with largest possible respect of groundwater resources. To this end, new treatment methods for, e.g. flue gas cleaning waste, will have to be developed.

Waste incineration plants, initiatives

<i>Waste electrical and electronic equipment</i>	<i>A special scheme will be established for these products. Requirements for the scheme to be laid down in a Statutory Order.</i>
<i>Impregnated wood</i>	<i>Impregnated wood will be considered as waste not suitable for incineration. This fraction will be landfilled. When better treatment methods have been developed, impregnated wood will be collected separately.</i>
<i>PVC</i>	<i>PVC will be separated. The part which cannot be recycled must be landfilled. When better treatment methods have been developed, new requirements will be made to special management of this waste fraction.</i>
<i>Flue gas cleaning waste</i>	<i>Three disposal sites will be established, receiving waste from the whole country. Stabilisation methods for flue gas cleaning waste are being developed.</i>
<i>Slag</i>	<i>Recycling of slag must be managed with largest possible respect of groundwater resources. A Statutory Order will be issued regulating recycling of residues and soil in building and construction works.</i>

Initiatives to reduce loss of resources

Studies have shown that waste electrical and electronic equipment contributes with 60 per cent of copper and 20-40 per cent of lead going to either incineration or landfilling. As a consequence, waste electrical and electronic equipment will be collected separately and managed in a more environment-friendly way. This will reduce loss of resources considerably. Requirements for management were laid down in a Statutory Order issued in 1998.

¹³ Residues from waste incineration plants are not included in statements of total waste amounts, as they would otherwise be counted twice.

Similarly, *impregnated wood* contains a number of heavy metals. The incineration of such wood leads to pollution of residues with heavy metals. In future, impregnated wood will be managed as waste not suitable for incineration, and landfilled. When better treatment methods have been developed, impregnated wood will be collected separately for treatment.

The incineration of *PVC* entails generation of larger amounts of waste (flue gas cleaning waste) than amounts incinerated. Furthermore, PVC often contains heavy metals which pollute residues. PVC will therefore be separated. If PVC waste cannot be recycled, it will be landfilled. It is recommended that local councils assign PVC waste to landfilling in special cells so that it will be possible subsequently to transfer this waste to alternative treatment. When better treatment methods have been developed, new requirements for special management will be made. A large proportion of hard PVC construction waste can be recycled today, and this will be reflected in municipal assignments.

Flue gas cleaning waste is classified as hazardous waste¹⁴. It used to be landfilled temporarily, as no suitable methods to stabilise it were available. Suitable disposal sites have formally been selected, and the sites are now to be established. The work of developing stabilisation methods for flue gas cleaning waste will be continued. When disposal sites come into operation, exports of flue gas cleaning waste will not longer be permitted.

In 1997, 82 per cent of *slag*¹⁵ was recycled. In future, recycling of slag will also take place with largest possible respect of groundwater resources. In 1999, a Statutory Order on rules for recycling will be submitted to hearing.

In the development of recycling possibilities and treatment methods for residues and flue gas cleaning waste it is expected that closer co-operation among operators in the area will be established. A new centre for research on residues is planned.

3.4 Building and construction sector

Objectives year 2004

- 90% recycling of construction and demolition waste
- sorting and separate collection of environmentally harmful fractions
- increased use of environmentally correct design

The building and construction sector is characterised by a very high recycling rate of waste generated. This high rate will be maintained, as waste recycling saves important resources.

The objective for year 2004 is to increase recycling further¹⁶. This will be achieved primarily by continued separation of construction and demolition waste such as asphalt, stone and concrete in clean fractions, separation of PVC, impregnated wood and waste electrical and electronic equipment, as well as extended use of environmentally correct design.

In 1997, construction and demolition waste amounted to some 3.4 million tonnes. The amount of PVC, impregnated wood, and waste electrical and electronic equipment is estimated at around 2 per cent of total construction and demolition waste amounts.

¹⁴ In 1997, 61,300 tonnes flue gas cleaning waste were generated.

¹⁵ In 1997, slag generation amounted to 493,800 tonnes.

¹⁶ The objective of Plan of Action for waste and recycling 1993-97 was 60% recycling of construction and demolition waste in year 2000. This objective was revised in 1993 to 85% recycling before year 2000.

However, it is expected that amounts of PVC and impregnated wood will increase considerably in the coming years. It is assessed that PVC and impregnated wood in year 2004 will amount to some 60,000-70,000 tonnes.

The need for separating other environmentally harmful fractions will be examined.

Building and construction sector, initiatives

<i>Waste electrical and electronic equipment</i>	<i>A special scheme to be established. Requirements for treatment laid down in a Statutory Order.</i>
<i>Impregnated wood</i>	<i>Impregnated wood will be considered as waste not suitable for incineration. This fraction will be landfilled. When better treatment methods have been developed, impregnated wood will be collected separately.</i>
<i>Environmentally correct design</i>	<i>Possibility of laying down requirements for use of environmentally correct design.</i>
<i>PVC</i>	<i>Separation for recycling or landfilling.</i>
<i>Residues and soil</i>	<i>Requirements for recycling of residues and soil for building and construction purposes to be laid down in a Statutory Order.</i>

Initiatives to improve quality in waste treatment and reduce loss of resources

A separate scheme for *waste electrical and electronic equipment* will be established, and in 1998 a Statutory Order was issued¹⁷. The purpose of the Statutory Order is to ensure environmentally correct treatment of waste.

Impregnated wood will be managed as waste not suitable for incineration and landfilled. So far, no suitable treatment method has been found, but methods are being developed. When better treatment methods have been developed, separate collection of impregnated wood will be established.

The concept of *environmentally correct design* takes waste prevention and recycling into consideration in the design. The use of environmentally correct design is voluntary today, but possibilities of making it compulsory will be investigated in co-operation with the Ministry of Housing and Urban Affairs.

PVC waste will be separated. PVC construction waste contains a large fraction of hard PVC which can be recycled today. Recyclable hard PVC construction waste will therefore be assigned to recycling. Other non-recyclable PVC waste will be landfilled. It is recommended that local councils assign PVC waste to landfilling in separate cells, allowing subsequent alternative treatment of the waste. When suitable treatment methods have been developed, new requirements for special management of the waste will be made.

In 1999, a Statutory Order on *residues and soil* for building and construction purposes will be submitted to hearing. The purpose is to ensure that recycling is managed with largest possible respect of groundwater resources.

As a result of above initiatives, the objective for recycling of construction and demolition waste is set at 90 per cent in year 2004.

¹⁷ Order no. 1067 of 22nd December 1998 on management of waste from electrical and electronic products.

Objectives year 2004

- *increased focus on link between material consumption and waste amounts*
- *maintenance of return bottle system*
- *increased collection of household hazardous waste*

Objectives year 2004

- *30% recycling of domestic waste*
- *70% incineration*

Objectives in longer term perspective

- *40-50% recycling of domestic waste*

3.5 Households

Household waste covers domestic waste, bulky waste and garden waste. A small proportion of household waste is hazardous

There has been an increase in household waste arisings, and the major part of this increase can be attributed to garden waste. The increase should also be seen in connection with increased purchasing power and private consumption.

No specific objectives for recycling, incineration and landfilling have been set up for the sector as a whole. Material consumption and resulting waste arisings will come in focus. Also, the Danish return bottle system will be maintained.

Weight-based packaging fees to some extent give producers an incentive to reduce packaging weight and thereby waste arisings. If the packaging fees later to be fixed on the basis of environmental impact of packages, the fee - in addition to being waste preventive - will give an incentive to reduce environmental impacts from packaging waste.

In order for objectives for domestic waste, garden waste and bulky waste to be met, it is necessary to activate citizens into participating in various collection schemes. This implies that information efforts in local authorities will be increased in order to provide the best possible knowledge of waste collection schemes.

Furthermore, citizens will have better opportunities to deliver fractions containing environmental contaminants for separate treatment.

Another purpose of this information effort in local authorities is to enhance the interest of citizens in purchasing products that after use have the least possible environmental impact as waste.

Collection of household waste is financed in many municipalities through a general waste collection fee. It will be studied whether a differentiated fee will increase citizens' incentives to contribute to increased recycling and waste minimisation.

3.5.1 Domestic waste

Recycling of domestic waste can be increased considerably, and in forthcoming years focus will be put on increased separation and collection of glass, paper, plastic and the organic fraction of domestic waste¹⁸.

A rough estimate shows that these four fractions cover around 84 per cent of total domestic waste amounts¹⁹.

Domestic waste, initiatives

<i>Batteries</i>	<i>When suitable treatment methods have been developed, all batteries will be collected</i>
<i>Waste electrical and electronic equipment</i>	<i>Products to be collected and treated separately</i>
<i>Hazardous waste (paint residues, medicine resi-</i>	<i>Information to householders on hazardous waste to increase collection</i>

¹⁸ Cf. Plan of Action for waste and recycling 1993-97, the objective was 40-50% recycling. This objective has not been met as a recycling rate of 15% was registered in 1997. Existing schemes will therefore be extended and rendered more efficient.

¹⁹ Domestic waste amounted to 1,621,000 tonnes in 1997.

<i>dues, hazardous chemical substances and products)</i>	
<i>Glass</i>	<i>Efficiency of existing scheme to be improved. An information campaign will be launched to increase collection of glass. Evaluation of market for reuse of wine bottles, and possibility of reducing rate of cullets by improved collection equipment. System for return bottles to be maintained.</i>
<i>Organic domestic waste</i>	<i>Experience with biogas plants to be evaluated. Subsequently, introduction of requirements for collection of organic domestic waste. Elaboration of status of recycling of organic domestic waste.</i>
<i>Cardboard packaging</i>	<i>Separation and recycling possibilities for cardboard to be established.</i>
<i>Paper</i>	<i>Kerbside collection schemes for paper to be established from private households. Evaluation of factors deteriorating recycling of paper, such as glue.</i>
<i>Plastic packaging</i>	<i>Evaluation of possibilities for recycling of plastic packaging to be carried out.</i>

Initiatives to increase recycling

When suitable treatment methods have been developed, all *batteries* will be collected.

A separate scheme will be established for *waste electrical and electronic equipment*. In 1998, a Statutory Order was issued with the purpose of ensuring environmentally correct treatment of this waste fraction.

Citizens play an important role in the separation of *household hazardous waste*. Often, due to lack of knowledge, hazardous waste will end up in domestic waste. Local councils must therefore increase information to citizens on existing schemes. As a support to local authorities, a guideline on hazardous waste will be issued in 1999.

Collection of *waste glass* can be increased through better information to citizens. Information campaigns will be launched to increase collection of packaging glass and reduce incorrect separation. The possibility of reducing the rate of cullets of collected glass through better collection equipment will be evaluated. Furthermore, the market for reuse of wine bottles and environmental impacts of bottle export will be evaluated.

The Danish return bottle system ensures a high reuse rate of packaging and thereby a considerable reduction of both waste arisings and resource consumption.

Work is being undertaken to gain better experience with biogas plants for the treatment of *organic domestic waste*. Once the basis is sufficient, requirements for the collection of organic domestic waste will be introduced. A status for recycling of organic domestic waste and sewage sludge will be drawn up to be used as a basis for a possible plan of action for recycling of organic waste.

Separation and recycling schemes will be established for *cardboard packaging* from households. It will also be studied whether and how *plastic drums* can be collected and sold for recycling. The schemes may be established in conjunction with bulky waste schemes.

The collection of *paper* from households will be increased by using more efficient collection systems and collecting more types of paper. An exten-

sion of the scheme from year 2000 with kerbside collection is expected to double collection. In parallel, barriers hampering increased recycling will be evaluated. Solutions may be to use alternative glues or inks.

Altogether, the above initiatives will result in domestic waste recycling of 30 per cent in year 2004 (15 per cent in 1997). Especially, increased collection of paper and organic domestic waste will contribute to this result.

3.5.2 Bulky waste

Recycling of bulky waste may be increased by converting/improving existing schemes, and by activating citizens in the process by requiring increased separation of a number of fractions²⁰.

Focus will especially be on separation of waste electrical and electronic equipment, impregnated wood, refrigeration equipment and PVC. A rough estimate shows that these fractions account for around 12 per cent of total amounts of bulky waste²¹.

In recent years, staffed recycling stations have been established in many municipalities, often supplemented by collection schemes.

Bulky waste, initiatives

<i>Batteries and accumulators</i>	<i>When suitable treatment methods have been developed, all batteries will be collected</i>
<i>Waste electrical and electronic equipment</i>	<i>Special scheme to be established for the collection of waste electrical and electronic equipment. Requirements have been laid down in a Statutory Order</i>
<i>Impregnated wood</i>	<i>Impregnated wood will be managed as waste not suitable for incineration. When better treatment methods have been developed, a special scheme for impregnated wood will be established</i>
<i>Refrigeration equipment</i>	<i>Refrigeration equipment will be collected separately to increase recycling and separation of environmentally harmful fractions</i>
<i>PVC</i>	<i>PVC will be separated. Fractions that cannot be recycled will be landfilled. When better treatment methods have been developed, new requirements for special management of the waste will be made</i>

Initiatives to increase recycling and ensure better quality in waste treatment

The possibility of increasing recycling through requirements for bulky waste schemes will be evaluated.

Today, special schemes for *Ni-Cd batteries and lead accumulators* exist. The scheme for lead accumulators works well. When better treatment methods for *batteries* have been developed, all batteries will be collected.

A special scheme will be established for *waste electrical and electronic equipment*. In 1998, a Statutory Order to this effect was issued²². The purpose is to ensure an environmentally correct treatment of this waste fraction.

The Statutory Order will be supplemented with a nation-wide information campaign, and a number of environmental guidelines will be prepared. Finally, eco-labelling criteria will be set up for several products. In 1998, a product panel will be established for electronics.

²⁰ Cf. Plan of Action for waste and recycling 1993-97, the objective was 25% recycling, 37.5% incineration and 37.5% landfilling. Recycling in 1997 was 17%, 41% was incinerated and 41% landfilled. Previous objectives are thus not met.

²¹ Bulky waste amounted to 588,000 tonnes in 1997.

²² Order no. 1067 of 22nd December 1998 on management of waste from electrical and electronic products.

In future, *impregnated wood* will be managed as waste not suitable for incineration. This waste will be landfilled. When better treatment methods have been developed, impregnated wood will be collected separately.

In future, *refrigeration equipment* will also be collected for an environmentally acceptable treatment. CFC will be extracted and collected, and resource recovery will be ensured for recyclable fractions.

PVC will be separated. What cannot be recycled will be assigned to landfilling. It is recommended that *PVC* waste is assigned to landfilling in special cells, allowing to bring it to alternative treatment at a later stage. When better treatment methods have been developed, new requirements will be made for special management of *PVC* waste.

Altogether, the above initiatives will lead to an increase in recycling of bulky waste to 25 per cent in 2004 (17 per cent in 1997). Initiatives for waste electrical and electronic equipment and refrigeration equipment ensure that the quality of waste treatment will be improved.

Around 50,000 tonnes, corresponding to half the waste electrical and electronic equipment collected, have generally ended up in bulky waste. New initiatives in the area result in these amounts advancing into the best category of the waste treatment hierarchy: from incineration and landfilling to recycling.

3.5.3 Garden waste

Objective year 2004

- 95% recycling

For many years, home composting of garden waste has been promoted in information campaigns. Local councils have established schemes and plants for the composting of garden waste on a voluntary basis.

It is not considered that recycling of garden waste can be increased further²³.

Today's efforts will be maintained, and no new initiatives are envisaged.

3.6 Industry

The objectives for recycling industrial waste for year 2000 have already been fulfilled, but the amount of waste landfilled is still too high. Therefore, concerted efforts will be made to reduce amounts of waste for landfilling and increase the recycling rate to 65 per cent.

Objectives year 2004

- 65% recycling
- 15 % landfilling
- improved collection of hazardous waste

The objective for year 2004 is to reduce amounts for landfilling to a maximum of 15 per cent. A study has shown that shredder waste and foundry waste account for 27 per cent of industrial waste landfilled in 1997, corresponding to some 190,000 tonnes²⁴.

Other fractions will be separated in order to increase recycling. Fractions are described below. Amounts from these fractions account for an estimated 22 per cent of total amounts of industrial waste. The fractions in question are primarily waste electrical and electronic equipment, paper and cardboard, PCB/PCT, end-of-life vehicles, including shredder waste, as well as foundry

²³ Recycling amounted in 1997 to 97 per cent, and only 1 per cent of garden waste was landfilled. In 1997, garden waste arisings amounted to 443,000 tonnes.

²⁴ Total amounts of industrial waste were 2,736,000 tonnes in 1997. Around 26% of this waste was landfilled and 58% recycled.

waste. These fractions are the most important in relation to amounts and environmental impacts.

Waste from enterprises will come in focus. Information on waste will be prioritised. These points will be taken into consideration when evaluating green accounts and in the implementation of the IPPC directive. A workshop will be organised discussing how to increase recycling, including a discussion of waste exchanges. Experience with consultants on industrial and commercial waste will be evaluated.

Industry, initiatives

Batteries and accumulators	When suitable treatment methods have been developed, all batteries will be collected.
End-of-life vehicles	A special scheme for end-of-life vehicles will be established. Requirements for the scheme will be laid down in a Statutory Order.
Waste electrical and electronic equipment	A special scheme will be established for waste electrical and electronic equipment. Requirements have been laid down in a Statutory Order.
Hazardous waste	A guideline will be issued for hazardous waste.
Refrigeration equipment	Refrigeration equipment will be collected separately to increase recycling and to separate environmentally harmful fractions.
Cardboard and paper	A guideline will be issued to local councils, clarifying existing rules.
PCB/PCT	A Statutory Order on PCB/PCT was issued in 1998.
Plastic transport packaging	Scheme is being implemented.
PVC	PVC will be separated. What cannot be recycled will be landfilled. When new treatment methods have been developed, new requirements will be made for special management of PVC waste.
Shredder waste	When suitable treatment methods have been developed, new requirements will be made for special management of the waste.
Waste oil	Subsidy scheme will be re-evaluated.
Foundry waste	Development of new treatment methods will be promoted.

Initiatives to reduce loss of resources and amounts of waste landfilled

A separate scheme for *end-of-life vehicles* will be established. A Statutory Order including requirements for the management of waste will be submitted to hearing in 1999. Recyclable and environmentally harmful fractions will be separated for recycling or environmentally appropriate disposal. Furthermore, a certification scheme will be introduced for enterprises undertaking reprocessing of end-of-life vehicles. The introduction of a certification scheme requires an amendment to the Danish Environmental Protection Act.

No technology for the treatment of *shredder waste* is available in Denmark. A method is being developed, but has not yet been fully tested. When a treatment technology has been developed, special requirements for management of shredder waste will be made.

Technically, large parts of *waste sand from foundries* can be recycled today. It will therefore be ensured that all foundries in Denmark recycle waste sand. The possibility of recycling other waste fractions from foundries will be studied. Initiatives to this end will be promoted.

Initiatives to increase recycling and quality in waste treatment

Today, special schemes for *Ni-Cd batteries* and *lead accumulators* exist. The scheme for lead accumulators works well. When better treatment methods have been developed, all batteries will be collected.

A special scheme for *waste electrical and electronic equipment* will be established. In 1998, a Statutory Order on such equipment was issued with the purpose of ensuring correct management of this fraction. The Statutory Order will be supplemented by a national information campaign, and a number of guidelines will be issued. Also, eco-labelling criteria will be established for several products.

Enterprises are under a responsibility to notify the local council of their *hazardous waste* generation. In 1999, a guideline will be issued on hazardous waste. The purpose is to enhance the understanding of how to apply hazardous waste criteria. Hazardous waste is exempt from the Danish waste tax, and the basis for this exemption will be re-evaluated.

Refrigeration equipment will in future also be collected for environmentally correct treatment of waste. CFC will be extracted and collected, and recyclable fractions will be recovered.

Paper and cardboard collection will be considerably extended. A guideline will be issued to local councils in order to extend responsibility for establishment of recycling schemes for paper and cardboard as well as supervision of schemes.

In 1998, a Statutory Order on *PCB/PCT*²⁵ was issued, including requirements for the registration of certain PCB/PCT-bearing products.

PVC will be separated, and the fraction that cannot be recycled will be assigned to landfilling. It is recommended that local councils assign PVC waste to landfilling in special cells, allowing subsequent alternative treatment of PVC waste. When better treatment methods have been developed, new requirements will be made for special management of this waste.

Today, *waste oil* is treated by incineration with energy recovery. The subsidy scheme for waste oil will be re-evaluated and legislation amended as necessary.

On 1st July 1998 a requirement came into effect on recycling of *plastic transport packaging* from enterprises. The scheme is being implemented in municipalities.

Altogether, above initiatives will result in increased recycling of industrial waste to 65 per cent in 2004 (58 per cent in 1997). Most important fractions contributing to increased recycling are paper, cardboard, shredder waste, waste electrical and electronic equipment, and foundry waste.

The initiatives for end-of-life vehicles, shredder waste, waste electrical and electronic equipment, and foundry waste will all contribute to a reduction of waste for landfilling.

Several of the initiatives will contribute to improved waste treatment. One example is the treatment of waste electrical and electronic equipment, which is described above.

²⁵ Bekendtgørelse nr 925 af 13. december 1998 om PCB, PCT og erstattningsskoffer herfor (*Statutory Order no. 925 of 13th December 1998 on PCB, PCT and substitute substances*, Danish only)

3.7 Institutions, trade and offices

Objectives year 2004

- 50% recycling
- 45% incineration
- 5% landfilling

Recycling of waste from institutions, trade and offices²⁶ is far below the objective for year 2000. Therefore, focus in the coming years will be put on separation of a number of waste fractions for recycling or special treatment

The objective for year 2004 is a recycling rate of 50 per cent. This objective will be fulfilled primarily through source separation of a number of fractions for recycling. Initiatives are described below. The most important fractions are tyres, waste electrical and electronic equipment, glass, organic waste (food waste from catering centres), cardboard, paper, and plastic.

A rough estimate shows that these fractions account for some 87 per cent of total waste amounts generated in the sector²⁷.

Experience with consultants on industrial and commercial waste will be evaluated, and a survey of waste composition in the sector will be carried out.

Institutions, trade and offices, initiatives

<i>Batteries</i>	<i>When new treatment methods have been developed, all batteries will be collected</i>
<i>End-of-life vehicles</i>	<i>End-of-life vehicles will be collected and treated in an environmentally appropriate way</i>
<i>Tyres</i>	<i>The existing scheme will be extended</i>
<i>Waste electrical and electronic equipment</i>	<i>A special scheme will be established. Requirements to the scheme have been laid down in a Statutory Order</i>
<i>Health-care risk waste</i>	<i>Status quo</i>
<i>Refrigeration equipment</i>	<i>The existing scheme will be maintained</i>
<i>Organic waste (food waste from catering centres)</i>	<i>The existing scheme will be re-evaluated</i>
<i>Paper and cardboard</i>	<i>A guideline will be issued to local councils, clarifying existing rules</i>
<i>Plastic transport packaging</i>	<i>A scheme is being implemented</i>
<i>PVC</i>	<i>PVC will be separated. What cannot be recycled will be landfilled. When better treatment methods have been developed, new requirements will be made for special management of PVC waste</i>
<i>Waste oil</i>	<i>Subsidy scheme will be re-evaluated</i>

Initiatives to increase recycling and ensure better quality in waste treatment

When new treatment methods for batteries have been developed, all batteries will be collected separately. So far, only Ni-Cd batteries and lead accumulators have been collected. The scheme for lead accumulators works well.

End-of-life vehicles will be collected in an efficient way and environmentally appropriate treatment ensured. A Statutory Order will be submitted to hearing in 1999 on requirements for management of this waste fraction. Recyclable and environmentally harmful fractions will be separated for recycling or environmentally appropriate disposal. A certification scheme will be introduced for enterprises reprocessing end-of-life vehicles. The introduction of a certification scheme requires an amendment of the Danish Environmental Protection Act.

²⁶ Recycling in 1997 amounted to 38%

²⁷ Total waste amounts in 1997 were 851,000 tonnes

The existing scheme for *tyres* will be extended to comprise large tyres that will be collected for recycling or energy recovery through incineration

A special scheme for *waste electrical and electronic equipment* will be established, and a Statutory Order was issued in 1998, making requirements for the management of this waste. The Statutory Order will be supplemented by a nation-wide information campaign, and a number of environmental guidelines will be issued. Finally, eco-labelling criteria for several products will be established.

Refrigeration equipment will in future be collected for environmentally correct treatment. CFC from refrigeration equipment will be extracted and collected, and recyclable fractions will be recovered

Organic waste (food waste from catering centres) is currently reprocessed for animal fodder. The collection scheme has been in effect since 1986, and an evaluation is called for to clarify whether other forms of recycling than reprocessing for animal fodder may be of relevance. Rules for the schemes will therefore be studied and adjusted as necessary

Paper and cardboard collection will be increased considerably. Today, local councils shall assign paper and cardboard from industry and commerce to recycling. As a consequence, public and private institutions and enterprises are under an obligation to separate these fractions for recycling. A guideline will be issued to local councils to extend responsibility for establishing recycling schemes for paper and cardboard, as well as supervision of these schemes

PVC will be separated. The fraction which cannot be recycled will be assigned to landfilling. It is recommended that local councils assign PVC waste to landfilling in special cells, allowing subsequent alternative treatment of the waste. When better treatment methods have been developed, new requirements for special management of PVC waste will be made.

Waste oil is today incinerated with energy recovery. A subsidy to disposal of waste oil by incineration at district heating plants is granted. The subsidy scheme will be re-evaluated and legislation amended as necessary.

On 1st July 1998 a requirement came into effect on recycling of *plastic transport packaging* from enterprises. The scheme is being implemented in municipalities

Altogether, the above initiatives in this sector will result in increased recycling up to 50 per cent in 2004 (38 per cent in 1997). Initiatives for paper and cardboard and electronic equipment contribute most.

Several of these initiatives will also contribute to improved treatment. For example, around 20 per cent of total waste electronics is generated in the sector "institutions, trade and offices". The initiative for this fraction will result in 20,000 tonnes of waste being shifted from landfilling or incineration to recycling.

3.8 Power plants

Objectives year 2004

- *reduction of coal-based energy generation*
- *recycling of 90% of residues from coal-fired power plants*
- *environmentally acceptable recycling of bioash*

The Government's Plan of Action for Energy - Energy 21 - will result in coal-based energy generation being almost completely phased out within 30 years. This will have a decisive impact on the amount of residues from coal-fired power plants that will drop steeply. The amounts still being generated in future will also be recycled with greatest possible respect of groundwater resources.

According to Energy 21, wood and energy crops will in future constitute an increasing part of fuel, and recycling of the ash generated will have high priority.

Power plants, initiatives

<i>Residues from coal-fired power plants</i>	<i>A Statutory Order will be issued regulating recycling of residues from coal-fired power plants</i>
<i>Residues from biofuel</i>	<i>A Statutory Order will be issued regulating recycling of bioash Methods will be developed to increase recycling of residues from biofuel</i>

Initiatives to improve quality in recycling

In the next 30 years, there will still be generation of residues from coal-fired power plants²⁸. The high recycling rate of residues will be maintained²⁹. In 1999, a Statutory Order will be submitted to hearing on the management of residues and soil which regulates recycling of residues from coal-fired power plants.

With the increased use of biofuel it will be necessary to separate fly ash from bottom ash in order to ensure a high rate of recycling. Methods will be developed ensuring that the cadmium-bearing fly ash can be removed separately for special treatment. There is also a need for initiatives to develop new methods of recycling of residues from biomass. Requirements for the use of bioash as a fertiliser will be laid down in a Statutory Order which will be submitted to hearing in 1999.

3.9 Wastewater treatment plants

Objective year 2004

- *50% recycling of sludge on farmland*

In 1997, the recycling rate of waste from municipal wastewater treatment plants amounted to 70 per cent of total amounts (wet weight), and thereby the objective for year 2000 has been fulfilled³⁰.

Requirements for the content of certain chemical substances in sludge will become stricter in year 2000, and this means that in a transitional period local councils must find alternatives to the application to farmland.

²⁸ In 1996, 2,300,000 tonnes residues were generated. This amount is the highest ever due to large electricity exports to Norway and Sweden. Amounts of residues are expected to decrease, and in year 2004 they are expected to be below 1,000,000 tonnes.

²⁹ In 1997, 1,775,000 tonnes residues were generated. Of this, 73 % was recycled.

³⁰ In 1997, a total of 1,248,000 tonnes sludge, sand and screenings were generated at wastewater treatment plants. According to the Plan of Action for waste and recycling 1993-97 the objective was to recycle 50 % of sludge. In 1997, 72 % of sludge was recycled.

Both fertiliser and energy contents in sewage sludge are to be utilised, but due to stricter requirements the extensive application of sludge to farmland is expected to decrease. The objective is therefore a recycling rate of 50 per cent in year 2004 (See Appendix E on the sludge fraction)

Wastewater treatment plants, initiatives

<i>General</i>	<i>Reduced use of xenobiotic substances</i>
<i>Sludge</i>	<i>Re-evaluation of existing rules</i>
	<i>Preparation of a status for recycling of organic domestic waste and sewage sludge</i>
	<i>Study of biogasification of sludge before application to farmland</i>

Initiatives to improve quality of sludge for recycling

Today work is being undertaken to improve the quality of sludge and the possibilities of increased recycling, and this work will continue in future through the general policy of phasing-out of xenobiotic substances.

Furthermore, evaluations are being made of the decomposition of xenobiotic substances in sludge at different treatment forms, long term effects of the application of sludge to farmland, as well as assimilation of xenobiotic substances in plants.

Regulations on agricultural use of sewage sludge will be re-evaluated, if results of the studies indicate the need for amendments.

In 1999, a status for recycling of organic domestic waste and sewage sludge will be prepared. This status may form the basis for a plan of action for recycling of organic waste.

Initiatives to increase energy recovery from sludge

In the study program for biogas, funds will be provided for detailed studies of biogasification of sludge prior to application to farmland

Waste 21: Rough estimate of distribution of selected waste fractions in each sector

Fractions	Waste amounts ('000 tonnes)	Construction and demolition %	Domestic waste %	Bulky waste %	Garden waste %	Industry %	Institutions trade and offices %	Coal-fired power plants %	Wastewater treatment plants %
Batteries and accumulators	17		10	2		2	86		
End-of-life vehicles*	130*					5*	95*		
Tyres	40						100		
Waste electronic equipment	103	2	15	48		15	20		
Glass	190		60				40		
Impregnated wood	50	95		5					
Health-care risk waste	9						100		
Refrigeration equipment	15			80		5	15		
Food waste from catering centres	26						100		
Organic domestic waste	700		100						
Paper and cardboard	1349		32			28	40		
PCB/PCT	7					100			
Plastic (PVC and shredder plastic)	240	10	50	10		10	20		
PVC	34	33	11	22		17	17		
Residues: coal-fired power plants	1775							100	
Shredder waste	95					100			
Sludge etc.	1209								100
Waste oil	36					10	90		
Foundry waste	95					100			
Fractions total in '000 tonnes		83	1,387	98		725	814	1,775	1,209
Total waste amount 1997 in '000 tonnes ³¹	12,857	3,427	1,621	588	443	2,736	861	1,775	1,248

³¹Waste fractions do not make up total waste amounts for each sector. * End-of-life vehicles are not included in the calculations, as for example tyres, accumulators and shredder waste are sub-fractions of end-of-life vehicles and would otherwise be counted twice

APPENDIX A

Regulation

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A 1 Instruments of the Danish model

Legal basis

Danish waste legislation is characterised by a close interplay between EU regulation and national regulations

EU regulation lays down overall frameworks and principles for waste management. The organisation of waste structures and the implementation of EU regulation in Danish legislation is a national task.

The Danish waste model is based on a combination of traditional administrative instruments (Acts, Statutory Orders, Circulars), and various other instruments such as taxes and charges, subsidy schemes and agreements. These instruments are described below.

EU waste regulation is summarised in Appendix A2 together with a description of the interplay between EU regulation and Danish legislation.

A 1.1 Administrative instruments

The legal framework laying down the obligation of local authorities to manage waste is given in the Danish Environmental Protection Act and subsequent Statutory Orders and Circulars. The most important Statutory Order is the Statutory Order on Waste no. 299 of 30th April 1997.

Local authorities are competent authority in waste management issues

The Danish Environmental Protection Act lays down regulations on waste in Part 6 (Sections 43-50). Under these provisions, local authorities are responsible for the management of all waste in Denmark.

The Act states that the local council is in charge of waste management. Thus, the local authority is responsible for waste generated in its municipality.

Duties of local authorities

Under the terms of the Danish Environmental Protection Act and the Statutory Order on Waste, local councils have a number of duties in connection with waste management.

Every four years, the local council must prepare a short-term waste management plan covering four years, and a long-term plan covering 12 years.

Furthermore, the local council must prepare waste regulations detailing the schemes established in its municipality.

In this context, the local council must ensure compliance with the waste hierarchy, including recycling of certain types of waste in accordance with specific requirements laid down in the Statutory Order on Waste and various Circulars.

The local council must establish schemes ensuring that waste generated in its municipality is managed in an environmentally acceptable way. Such schemes may be assignment schemes or collection schemes.

Characteristic features of assignment schemes are that the local council lays down in a waste regulation that given waste types must be assigned to a

given form of management. The waste producer is responsible for waste management in compliance with provisions in the regulation

By contrast, characteristic features of collection schemes are that the local council is responsible for ensuring that collection, transportation and management of a given waste fraction is in compliance with the regulation

For domestic waste including glass and paper from private households as well as for hazardous waste, the Statutory Order on Waste lays down requirements to the effect that the local council must establish a collection scheme. In addition, a Circular gives requirements for the establishment of collection schemes for construction and demolition waste

The local authority collects and registers information on waste amounts, waste treatment plants etc.

Finally, the local council makes decisions according to the Danish Environmental Protection Act and the Statutory Order on Waste, for example concerning classification of waste and notification of orders and prohibitions, and it is in charge of supervision of compliance with regulations

Duty to use schemes

When a municipal scheme has been established, citizens, freeholders and enterprises are, as a rule, under an obligation to use the scheme. There are, however, various possibilities of exemption from this obligation

According to the Danish Environmental Protection Act, it is furthermore prohibited to establish competing collection, where a municipal collection scheme has been established.

Organisation

The local council is not allowed to delegate responsibility for waste management, but it can choose either to assume the task itself, to confer the task to an intermunicipal waste company (i.e. a co-operation between municipalities) or to contract operation to private companies.

The operation of collection schemes for household waste is assumed both by municipal companies and private waste companies, whereas management of industrial and commercial waste is normally assumed by private companies alone

Environmental approvals

Enterprises and plants carrying out treatment, reprocessing or crushing etc. of waste must have environmental approval. As of 1st January 1992 landfills may as a general rule only be owned by public authorities.

A 1.2 Other instruments

In addition to the above traditional regulation by Acts, Statutory Orders and Circulars, waste management is regulated by a number of different instruments such as taxes and charges, subsidies and agreements

Waste tax

The waste tax, which came into effect on 1st January 1987, is one of the instruments established to achieve the targets of the Plan of Action for waste and recycling. The waste tax is differentiated so that it is most expensive to landfill waste, cheaper to incinerate it, and tax exempt to recycle it. Hazardous waste and contaminated soil are exempt from the Danish waste tax.

The objective is that the waste tax rate and the differentiation shall create an incentive to lead generated waste directly to recycling or to recover it by incineration with energy recovery instead of leading it to landfilling

The waste tax is described in more detail in A 1.3

Packaging taxes

Packaging taxes are levied on a number of products. Since 1978 a volume-based tax on packaging for most beverages has been in effect. The tax is divided into six volume categories and two material-based rates. The tax is levied on new packaging and thereby gives an incentive to use refillable packaging.

Furthermore, with effect from 1st April 1998 a volume-based tax is levied on bottles and drums. From 1st January 1999, this tax is converted into a weight-based tax divided into 13 material and packaging types. The tax is levied on packaging for a number of products, including soap and detergents, lubricants, perfume and margarine. Non-carbonated soft drinks, vinegar and edible oils also fall under the weight-based tax as from 1st January 1999.

The weight-based tax promotes the reduction of packaging consumption and thereby waste arisings. The objective is that the tax reflects the environmental impact of materials in question. Therefore, a number of environmental indices will be prepared on the basis of cradle-to-grave analyses.

Furthermore, as from 1st January 1999 a weight-based tax is levied on plastic foil foodstuff-packaging manufactured from soft PVC. The purpose of this tax is to promote the use of more environment-friendly packaging foil.

Finally, since 1994 a weight-based tax on paper and plastic carrier bags has been in effect, and since 1988 a value tax on disposable tableware. Both taxes give an incentive to increase reuse and reduce waste amounts.

Specific taxes

As a supplement to the general waste tax, more specific taxes have been introduced aimed at products that either demand special treatment after use or where consumption should be limited or shifted to more environment-friendly products. For example, a fee has been introduced for Ni-Cd batteries, in the form of a remuneration scheme¹.

General fee or tax financing of municipal schemes

Costs of waste management may be financed by fees or taxes at the discretion of local councils.

Fees may cover costs for establishment, operation, administration, investment, planning, and collection of information etc.

In compliance with general local government rules, fees must be fixed on a cost-coverage principle, i.e. the rate of fees must be fixed so that over time there is a balance between revenues (fees) and costs of schemes in the waste management system. Schemes must therefore be based on the non-profit cost-coverage principle.

The local council may fix an overall fee for schemes established in the municipality. The fee must correspond to the service delivered to citizens.

¹ Act no. 414 of 14th January 1995 amended by Act no. 397 of 22nd May 1996 on taxes on nickel-cadmium batteries.

In municipal waste regulations, the local council may lay down provisions on waste management fees, including rate and levy system.

Specific taxes and charges

In addition to the waste management fee financing municipal waste management schemes, taxes, charges and fees are increasingly used to finance, for example, take-back schemes for certain waste fractions (tyres and lead accumulators). Here, fees are used to finance collection and recycling.

Agreements

Agreements are another instrument used to achieve environmental objectives in waste management. For example, an agreement has been entered with the Danish Contractors' Association on selective demolition of building materials. Other examples of agreements are: an agreement with local councils on CFC-containing refrigerators, an agreement on recycling of transport packaging with the Confederation of Danish Industries, the Danish Plastics Federation and the Packaging Industry, an agreement with industry on collection of discarded lead accumulators, and an agreement with the Danish Motor Trade Association, the Association of Danish Recycling Industries and municipal associations on a take-back scheme for discarded tyres.

Subsidy schemes to promote cleaner products and recycling

In the subsidy programme "Programme for cleaner products etc." funds have been allocated to projects on recycling, cleaner technology, and waste. The Environmental Council for Cleaner Products is in charge of overall prioritisation of funds, whereas the Danish Environmental Protection Agency is in charge of the administration of funds for specific projects.

Subsidies are granted to activities that reduce environmental impacts in connection with development, manufacture, sale or use of products or in connection with management of waste generated in the entire life cycle of the product, either in the form of promotion of cleaner products or recycling. Subsidies may also be granted to projects aiming at mitigating problems related to waste disposal. This may be in the form of projects of demonstration, surveying, and information etc. or development of processes, methods, production equipment or products within waste management. Investments in plant cannot be subsidised today.

A 1.3 The Danish Waste Tax

Objective year 2004

- *ensure that the waste tax leads to waste prevention and increased recycling*

A 1.3.1 Status

The Danish waste tax was introduced in 1987. The purpose of the waste tax is to shift waste from landfilling and incineration to recycling, and the tax is differentiated so that it is most expensive to landfill waste, cheaper to incinerate it with energy recovery, and tax exempt to recycle it.

The waste tax gives a financial incentive to shift waste from incineration and landfilling to recycling. It has worked well for large, homogeneous waste fractions, but up to 1997 the tax rate has not been high enough to ensure satisfactory recycling of the types of industrial waste which traditionally are not transferred to recycling.

A 1.3.2 Future initiatives

In co-operation with the Danish Ministry of Taxation, the Act will be revised in 1999. In this context, an assessment will be carried out to clarify whether the exemption of hazardous waste and contaminated soil is to be upheld.

Measures

- *revision of the waste tax*

Hazardous waste has so far been exempt from the waste tax, and assessments will be made on whether the assumptions for this exemption have changed. The costs of disposal of hazardous waste vary depending on the type of waste. For certain types of waste, costs are similar to those for non-hazardous waste. Finally, it will be assessed whether the waste tax can be used to control contaminated soil streams.

An evaluation of the effects of the increase in the waste tax rate which took effect on 1.1.97 will be finalised in spring 1999. It will be supplemented by an analysis of the latest increase once the analytical basis is adequate.

A 1.3.3 Regulation

The waste tax is authorised by the Act on taxes on waste and raw materials. The yield of the tax is a general revenue in the Finance Act. The tax is administered by local customs and tax regions, and it is levied at registered treatment plants. This ensures that all waste treated is taxed and that the tax is passed on fully to the producer of the waste.

The waste tax is differentiated, and rates today are DKK 375/tonne waste for landfilling (also for landfilling of residues from power plants based on fossil fuel or biomass), DKK 330/tonne waste incinerated and DKK 280/tonne waste incinerated at plants with a minimum of 10 per cent power generation. Recycled waste is not taxed.

A refund is granted to local authorities for costs of cleaning beach sand contaminated with oil and chemicals.

A 1.3.4 Environmental impact assessment

An adjusted waste tax will lead to reduced loss of resources and improved waste treatment, both contributing to reduced environmental impact.

A 1.3.5 Implications for national authorities

It may be necessary to amend the Act on taxes, depending on the results of ongoing studies.

A 1.3.6 Implications for local authorities

At any time, local authorities must take account of the effects of the waste tax (in their choice between incineration or landfilling).

A 2 EU waste regulation

Close interplay between EU and national regulations

Danish legislation on waste management is characterised by a close interplay between EU regulation and national regulations

EU regulation lays down overall frameworks and principles for waste management. The organisation of waste management and the implementation of EU regulation in Danish legislation is a national task.

The formulation of EU waste strategy and legislation takes place in close co-operation between EU institutions and Member States.

Denmark as front-runner

Denmark's impact on EU legislation has been significant, and together with a number of other EU Member States, Denmark has often taken the lead in solving new tasks in waste management. Many of the central elements of the Danish waste model have been - and still are - a source of inspiration to EU regulation. One example is the waste hierarchy, especially in connection with the introduction of waste prevention. Another example is the principle of source separation, permit requirements for waste treatment plants, and the establishment of data collection.

EU objectives

EU objectives for waste management are primarily concentrated on prevention, promotion of recycling and other forms of recovery, and minimisation of final disposal

The present Community strategy for waste management, in particular objectives and measures, is described in Communication from the Commission on the Community strategy for waste management, adopted on 30th July 1996.

The waste management policy has resulted in the adoption of a number of legal instruments setting up obligations for Member States in waste management.

Member States are under an obligation to draw up one or several plans for the management of waste in order to achieve the objectives for waste management laid down in Directives.

The central legislative instrument is the Council Directive 75/442/EEC as amended by Council Directive 91/156/EEC, also known as the "framework" Directive on waste. This Directive is supplemented by a number of Directives regulating particular types of waste. In addition, regulations have been issued in the form of a number of Directives on the treatment of waste, incineration of waste, and incineration of hazardous waste. Finally, a proposal for a Directive on the landfill of waste has been tabled and is expected to be adopted in mid-1999

Objectives and requirements for waste management laid down in waste-related Directives are described below, including the requirements to draw up waste management plans

Regulations on transboundary movements of waste are also described

A 2.1 General requirements of the framework Directive on waste

The Directive on waste² provides a number of basic definitions and principles for environmentally sound management of waste. The scope of the Directive covers all waste that is not regulated separately

Waste hierarchy

- waste prevention
- recycling
- incineration with energy recovery
- landfilling

The Directive defines forms of treatment of relevance in waste management. It distinguishes between recovery (forms of treatment ensuring resource utilisation of waste, such as recycling and incineration with energy recovery) and disposal, i.e. forms of treatment where resources in waste are not utilised (including landfilling)

The Directive lays down the waste hierarchy described above in which waste prevention has the highest priority, followed by recycling and other types of recovery, including incineration with energy recovery. Waste which cannot be treated in these forms is landfilled

Principles for proximity and self-sufficiency

Under the terms of the Directive, Member States are required to establish an integrated and adequate network of disposal installations enabling both the Community as a whole as well as Member States individually to dispose of waste generated on their territory.

Environmentally sound management of waste

Member States are required to ensure that waste is managed without endangering human health and the environment. The Directive prohibits the abandonment, dumping or uncontrolled disposal of waste and lays down requirements to the effect that all treatment plants must obtain a permit, and that they are subject to periodic inspections.

Further to this requirement, the Directive lays down requirements for establishments or undertakings that carry out waste treatment to keep a record of various information on waste treated.

Finally, the Directive lays down the "polluter-pays principle", i.e. the cost of disposing of waste must be borne by the holders and/or the previous holders or the producer of the product from which the waste came.

Drawing up plans to attain the objectives

In order to attain the objectives of the Directive, Member States are required to draw up waste management plans. Member States may prevent movements of waste which are not in accordance with their waste management plans.

The Directive gives a list of specific requirements for the contents of such plans relating to the type, quantity and origin of waste, technical requirements, management of particular wastes and suitable disposal sites or installations.

Implementation in Denmark

The framework Directive on waste has been implemented in Denmark in, for example, the Danish Environmental Protection Act and the Statutory Order on Waste

² Council Directive 75/442/EEC as amended by Council Directive 91/156/EEC

A 2.2 Special requirements for hazardous waste

A 2.2.1 Directive on hazardous waste

The Council Directive on hazardous waste³ covers all hazardous waste as defined in Annexes I, II and III of the Directive and the list of hazardous wastes⁴

Waste is categorised as hazardous if it features on the list of hazardous waste and/or displays the properties listed in Annexes II and III to the Directive which render them hazardous

Permits

Requirements of the Directive correspond to requirements laid down in the framework Directive on waste. permits for establishments or undertakings carrying out storage, treatment or disposal of hazardous waste, and periodic inspections of establishments or undertakings transporting such waste.

Inspection

Prohibition to mix waste

The Directive also prohibits mixing of hazardous waste of different categories or mixing hazardous waste with non-hazardous waste.

The Directive requires Member States to ensure that hazardous waste is labelled and packaged in connection with collection, transportation and temporary storage

The Directive lays down requirements that producers, carriers and disposal plants for hazardous waste keep a record of various information on waste treated

Plans

This Directive also establishes the requirement to draw up management plans for hazardous waste.

Implementation in Denmark

The implementation of the Directive in Danish legislation is ensured through a number of provisions in the Statutory Order on Waste.

The Directive on hazardous waste is supplemented by a number of individual Directives regulating particular types of hazardous waste. Basic principles contained in the framework Directive on waste and the Directive on hazardous waste on, for example, permits for enterprises storing, treating or disposing of hazardous waste, periodic inspections of enterprises transporting such waste, as well as plans for management of hazardous waste also apply to these individual Directives.

Requirements for special management

A 2.2.2 Directive on waste oils

The Council Directive on the disposal of waste oils⁵ prohibits any discharge or treatment of waste oils causing a risk of pollution. If such discharges and treatment forms cannot be avoided, Member States must take the necessary measures to ensure safe collection and disposal of waste oils.

The Directive lays down requirements to the effect that waste oils are primarily treated by regeneration and/or incineration with energy recovery.

The Directive gives emission values in connection with incineration of waste oils.

³ Council Directive 91/689/EEC

⁴ Council Decision (94/904/EC) of 22nd December 1994 establishing a list of hazardous waste pursuant to Article 1 (4) of Council Directive 91/689/EEC on hazardous waste

⁵ Council Directive 75/439/EEC as amended by Council Directive 87/101/EEC

In addition, the Directive requires that establishments or undertakings collecting waste oils are registered and inspected by competent authorities. Establishments or undertakings carrying out disposal of waste oils are also requested to obtain a permit.

The implementation of the Directive in Danish legislation is ensured through a number of provisions in the Statutory Order on Waste.

A 2 2.3 Directive on batteries and accumulators

The Council Directive on batteries and accumulators containing certain dangerous substances⁶ aims at harmonising national measures on the management of spent batteries and accumulators containing mercury, cadmium or lead.

Requirements for collection

The Directive orders Member States to establish collection schemes for spent batteries and accumulators containing mercury, cadmium or lead, as well as to ensure separate treatment and disposal.

The Directive prohibits the marketing of alkaline manganese batteries and the incorporation of accumulators in appliances, if batteries or accumulators exceed limits fixed in the Directive.

The Directive is supplemented by a Commission Directive on a marking system for batteries and accumulators⁷. The marking must support the provisions of the Directive on batteries and accumulators on collection and recovery of batteries and accumulators.

The Directive also lays down provisions on the use of economic instruments such as deposit and return systems, charges or taxes.

Plans

The Directive orders Member States to draw up plans for attaining the objectives of the Directive. Plans must comprise initiatives to promote marketing of "green" batteries and ensure that heavy metal-containing batteries are separated from household waste.

The Directive has been implemented by the Statutory Order on certain batteries and accumulators containing dangerous substances, the Statutory Order on Waste, the Statutory Order on a fee on lead accumulators and the Act on Remuneration for the collection of lead accumulators etc.

A 2 2.4 Directive on PCBs and PCTs

Special requirements for disposal

The Council Directive on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT)⁸ regulates the disposal of PCBs/PCTs and the replacement or disposal of equipment containing PCBs as well as the disposal of used PCBs. The Directive prohibits reuse of PCBs.

The purpose of the Directive is to ensure environmentally safe disposal of PCBs and PCTs. For large PCB volumes (more than 5 dm³), decontamination and/or disposal must be effected at the latest by the end of 2010. For equipment with contents of less than 5 dm³, disposal must be ensured at the latest at the end of the product's useful life.

⁶ Council Directive 91/157/EEC

⁷ Commission Directive 93/86/EEC

⁸ Council Directive 96/59/EC

Member States must ensure that inventories are compiled of equipment with PCB volumes of more than 5 dm³.

The Directive must be seen in connection with the Directive on reduced marketing and use of certain dangerous substances and preparations, partly prohibiting the use of PCBs/PCTs, the Directive on waste oils and the Directive on the incineration of hazardous waste

Plans

Plans for the replacement, collection and safe disposal of PCBs must be drawn up.

The Directive on PCB/PCT was implemented in Danish legislation in December 1998⁹

A 2.3 Special requirements for packaging and packaging waste

The Directive on packaging and packaging waste¹⁰ should be seen in connection with the framework Directive on waste and the Community strategy for waste management. The Directive on packaging and packaging waste is the first example of a Directive fully based on the waste hierarchy.

The Directive includes provisions on prevention of packaging waste, including the promotion of reuse systems for packaging. It also sets up a number of quantitative objectives for the recycling of packaging waste.

Quantitative treatment requirements

The Directive sets up requirements to the effect that between 50 per cent and 65 per cent of total packaging waste must be recovered no later than year 2001. Of this, between 25 per cent and 45 per cent of total packaging waste must be material recycled

In addition to overall objectives for material recycling, the Directive also sets up specific requirements for recycling of each packaging material. As a minimum 15 per cent of each packaging material must be recycled no later than year 2001. These requirements are directed at glass, paper and cardboard, metal and plastic. In Appendix E, Section E5, it is described how Denmark ensures compliance with these requirements.

In Denmark, it is expected to attain a recycling rate of around 45 per cent of packaging waste by year 2001. The major part of the remaining packaging waste is incinerated with energy recovery. On the basis of implemented and planned initiatives in packaging waste management and in waste management in general - including the ban on landfilling of waste suitable for incineration, it is expected that total recovery of packaging waste will be above 80 per cent and thereby go beyond the targets stated in the Directive on packaging and packaging waste. Denmark must inform the Commission of this in compliance with Article 6 (6) of the Directive.

Requirements for packaging

To support the objectives of the Directive for treatment of packaging waste, the Directive sets up requirements for design of packaging. These requirements are directed at manufacturers (or importers) of packaging. The purpose of these requirements is to reduce amounts of and environmental impact from packaging and packaging waste. The Directive sets up concentra-

⁹ Statutory Order no. 925 of 13th December 1998 on PCBs, PCTs and substitute substances

¹⁰ European Parliament and Council Directive 94/62/EC

tion levels of heavy metals in packaging and so-called essential requirements on the composition and nature of packaging

Once a year, starting from mid-1999, Denmark must submit documentation to the Commission on recycling and recovery of packaging waste.

In common with other Directives relating to waste, this Directive gives various provisions for marking systems, return, collection and recovery systems, management plans, information systems and economic instruments

National programmes for prevention and reuse

Finally, the Directive opens the possibility for Member States to launch specific national programmes or actions to ensure prevention and reuse of packaging waste. Danish initiatives are described below

In addition to ensuring that specific requirements of the Directive are complied with, each Member State must implement other measures to prevent packaging waste (Article 4).

In 1998, the Folketing adopted an amendment of the packaging tax in effect at that time so that from 1999 taxes are levied on packaging for certain products on the basis of packaging material and weight. It is expected that the weight-based tax will give an incentive to reduce the weight of packaging and thereby have a waste-preventive effect on packaging waste arisings

In addition, Denmark has introduced a subsidy scheme for cleaner products etc. which in a long term perspective is expected to have a waste preventive-effect. This scheme is described in more detail in the Section A1 on instruments

Apart from the possibility of creating incentives for manufacturers to develop new, material-saving or other environment-friendly technologies through economic instruments such as taxes, Member States do not have much room to implement waste-preventive measures at manufacturing level. The Directive sets up requirements for composition and nature of packaging, and thus packaging must be optimised in relation to prevention as far as possible.

As a consequence, Denmark has chosen to primarily focus on waste management in relation to national initiatives for prevention. The reuse of packaging is a logical and efficient way of preventing waste arisings

Special effort for beverage packaging

Denmark has selected beverage packaging as a special area for initiatives, as this packaging type potentially represents a very significant amount of packaging waste due to the large volumes.

Under the Danish scheme, beer and carbonated soft drinks may only be marketed in approved refillable packages¹¹.

The bottle return system means that each year we avoid the disposal of around 390,000 tonnes of waste (total weight of the corresponding volume of single-use bottles of glass or plastic)

¹¹ The scheme is based on the Statutory Order from the Ministry of Environment and Energy on Packaging for Beer and Soft Drinks, no. 124 of 27th February 1989, with subsequent amendments

Imported beverage may be marketed in packages that are not approved, provided that they are covered by a deposit and return system ensuring refilling or material recovery

Bottles for wine and spirits are collected in municipal collection schemes (see also Appendix E, Section E7), by retailers, and from restaurants.

Whole bottles are washed and sent for refilling either in Denmark or abroad. Cullets are sent for material recovery. A reimbursement of the packaging tax through export of bottles for refilling contributes to supporting reuse of wine bottles

The scheme for bottles for wine and spirits means that each year we avoid around 50,000 tonnes of waste.

Reuse of transport packaging

Finally, large quantities of plastic transport packaging - especially crates for beer and soft drinks, transport boxes for foodstuffs in the retail trade, and pallets - are reused

The Directive has been implemented in Danish legislation by, for example, the Statutory Order on Waste, the Statutory Order on certain requirements for packaging, and the Statutory Order on Packaging for Beer and Soft Drinks

A 2.4 Directives on treatment plants

The future Directive on the landfill of waste will be one of the most important legal instruments for installations for the treatment of waste. A number of other Directives lay down requirements to plants treating waste, for example the Directives on waste incineration.

Directive on the landfill of waste

A 2.4.1 Draft Directive on the landfill of waste

The draft Directive on the landfill of waste is drawn up under the framework Directive on waste. The purpose of the Directive is to introduce measures, procedures and guidelines to prevent or, as far as possible, reduce environmental impacts from landfills. This means especially contamination of surface water, groundwater, soil and air, load on global environment, including the greenhouse effect, as well as risks from landfilling of waste to human health.

The Directive will cover all new landfills, but existing landfill sites must also comply with requirements of the Directive before a specific date.

Landfill sites serving islands or landfills located in isolated settlements may be exempt from provisions of the Directive in certain situations.

The Directive will introduce common procedures for permits for all classes of landfill (for hazardous, non-hazardous and inert waste), and it will introduce procedures for reception of waste for landfilling. Reception procedures will be based on waste classification

Phasing-out and requirements for treatment

In order to reduce amounts of biodegradable waste going to landfills, the draft Directive lays down targets for amounts of this type of waste that Member States may landfill.

These targets must primarily be met by composting, biogasification or material/energy recovery.

Furthermore, it is required that - with some exceptions - all waste is pre-treated before landfilling.

Economic instruments

The draft Directive requires that the price of landfilling must reflect all costs of establishment and operation of the landfill site. As far as possible, this also covers costs of financial security, costs of closure and aftercare for a period of minimum 30 years

Implementation in Denmark

The Directive must be implemented in Danish legislation no later than two years after its publication in the Official Journal.

A 2.4.2 Directives on incineration

Council Directive 89/369/EEC on the prevention of air pollution from new waste incineration plants and Council Directive 89/429/EEC on the prevention of air pollution from existing waste incineration plants are both adopted under the framework Directive 84/360/EEC on the combating of air pollution from industrial plants. At the same time, the two Directives relate to the framework Directive on waste.

Authorisation etc

The Directives on incineration regulate authorisation, design, equipment and operation of new and existing municipal incineration plants

Emission limit values

The Directives lay down emission limit values for dust, certain combinations of heavy metals, hydrochloric acid, hydrofluoric acid and SO₂.

The Directives give requirements for measurements, inspection and reporting from plants.

The Directives do not apply to plants that are specially designed for incineration of sludge from wastewater treatment plants, chemical, toxic or hazardous waste as well as medical waste, even if such plants may also incinerate domestic waste.

The Council has adopted the Council Directive 94/67/EEC on the incineration of hazardous waste. This Directive lays down rules on design, operation and control of plants incinerating hazardous waste, as well as plants co-incinerating hazardous waste

A 2.5 Transboundary movements of waste

Council Regulation on shipment of waste

The Council Regulation on shipments of waste¹² was adopted, among others, to implement the Basel Convention of 22nd March 1989 on the control of transboundary movements of hazardous wastes and their disposal, as well as an OECD Council Decision on the control of transfrontier movements of waste destined for recovery operations.

A 2.5 1 Regulation on shipments of waste

¹² Council Regulation No 259/93 on the supervision and control of shipments of waste within, into and out of the European Community, as amended by Council Regulation No. 120/97 of 20th January 1997

Regulations apply directly and are thereby binding for authorities and citizens. Contrary to Directives, Regulations do not have to be implemented in national legislation.

However, the Regulation on shipments of waste is supplemented in Danish legislation by a Statutory Order on import and export of waste¹³, giving, for example, provisions on sanctions and inspection.

Basic principles

The Regulation lays down a number of procedures to be followed in connection with transboundary movements of waste, building on the principle of prior notification and authorisation as well as provision of financial guarantees. The Regulation also regulates in which cases competent authorities may prohibit shipments of waste.

The Regulation distinguishes between waste destined for disposal and waste destined for recovery. Waste for recovery is divided into three main categories - green, amber and red.

Reasoned objections for competent authorities to prohibit shipments of waste vary depending on the destiny of waste: disposal or recovery.

The Regulation requires that all shipments of waste for disposal are notified and authorised.

Shipments of waste for disposal

The Regulation lists a number of reasoned objections to shipments of waste for disposal. A Member State may, partially or generally, prohibit shipments of waste into and out of its territory. Such a partial or general ban must be justified by the fact that the waste in question may be disposed of in a plant closer to its origin (proximity principle), or that the waste in question should be subject to recovery instead of disposal (priority for recovery), or that the Community as a whole should become self-sufficient in waste disposal and that Member States should move towards that aim individually, so that the waste problem is not solved by exportation of waste (principle of self-sufficiency).

There is also a possibility to make objections to separate shipments of waste for disposal, if such shipments oppose to the principle of self-sufficiency, the proximity principle, waste management plans or national environmental legislation.

Shipments of waste for recovery

Waste for recovery is divided into three main categories: green, amber and red waste, and different rules apply to transboundary movements of waste depending on the category. Waste which does not feature on any of the lists must follow the procedure for red waste.

Green waste is not covered by the provisions of the Regulation as to notification, but in order to assist the tracking of waste, the shipment must be accompanied by various information on, for example, the identity of the consignee of the waste and the holder of the waste.

Amber waste is covered by the requirement for notification. If no objections to the shipment have been raised within a given period of time, the shipment may take place without written authorisation.

¹³ Statutory Order no. 971 of 19th November 1996

Red waste follows the same procedure of notification as amber waste, but shipment can only take place after receipt of written authorisation from the competent authorities

Possibilities of objection to shipments of waste for recovery are more limited than for waste for disposal. As green waste is exempt from the provisions of notification, the Regulation gives no direct possibility of raising objections to shipments. For amber and red waste the most important objections are waste management plans and/or national legislation.

There is also a possibility of raising objections if the ratio of the recoverable and non-recoverable waste does not justify the recovery under economic and environmental considerations (fictive recovery).

In addition, the Regulation lists a number of specific reasoned objections.

A 2.5.2 The Basel Convention

As from 1st January 1998, it is prohibited to export hazardous waste from OECD countries to non-OECD countries. This so-called export ban is the implementation of a ban adopted under the Basel Convention.

The Basel Convention on the control of transboundary movements of hazardous wastes and their disposal was adopted in the UNEP in Basel in 1989 and took effect in May 1992.

One of the main purposes of the Convention is to reduce the number of movements of hazardous waste. The Convention also defines a number of procedures in connection with movements, for example, requirements for notification and authorisation of movements.

Together with the other EU Member States, Denmark has implemented the Basel Convention in the so-called Regulation on shipments of waste, regulating transboundary movements of waste, including hazardous waste.

In March 1994, at the initiative of, among others, Denmark, the parties to the Convention adopted, an immediate ban on the movement of hazardous waste destined for final disposal and a ban on exports from OECD countries to non-OECD countries of waste for recycling, taking effect no later than 1st January 1998.

Due to non-ratification, the ban has not yet taken effect formally. Despite this, the EU has amended the Regulation on shipments of waste to the effect that the ban covers all EU Member States.

In order to ensure an operational ban, two lists have been prepared and adopted in parallel to the ban: a list of hazardous waste and a list of non-hazardous waste. These two lists provide the technical basis for determining whether waste is hazardous or non-hazardous and thereby whether a given movement is covered by the ban. The two lists have been incorporated in Annex V to the Regulation.

APPENDIX B

Waste amounts and statistical basis

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B 1 Developments in waste amounts

Objectives year 2004

- stabilise total waste amounts
- utilise energy and raw material resources in waste

B 1.1 Status

Total waste amounts increased from 1995 to 1996 by 10 per cent, but decreased by 0.5 per cent from 1996 to 1997. Overall objectives for waste treatment year 2000 have been met¹

Total waste generation was relatively stable from 1996 to 1997. This is mainly due to a decrease of 24 per cent in amounts of residues from coal-fired power plants, and an increase in construction and demolition waste of 11 per cent. Waste amounts from industry, the service sector and wastewater treatment plants only increased by 1 to 4 per cent, and household waste arisings were stable.

In Denmark, 12.9 million tons of waste were generated in 1997 (see Table 1). Of this, 2 per cent was hazardous waste² and 7 per cent packaging waste³.

Table 1. Total waste generation in Denmark, 1994 to 1997.	'000 tonnes			
	1994	1995	1996	1997
Source				
Households	2,575	2,610	2,767	2,776
Domestic waste	1,662	1,628	1,655	1,621
Bulky waste	606	618	639	588
Garden waste	286	326	401	443
Other	21	38	72	124
Institutions/trade and offices	656	834	851	861
Manufacturing etc	2,309	2,563	2,632	2,736
Building and construction	2,433	2,559	3,088	3,427
Wastewater treatment plants	1,156	1,195	1,212	1,248
Slag, fly ash etc (coal-fired power plants)	1,962	1,699	2,332	1,775
Other	14	6	30	34
Total	11,105	11,466	12,912	12,857

Table 1 states distribution of waste generation 1994-1997 by source. Source: Waste statistics 1997, Environmental Review from the Danish Environmental Protection Agency No. xx, 1999

Targets for recycling have been met, as 63 per cent of waste was recycled. The target of reducing waste for landfilling has also been met; 16 per cent of waste is landfilled today. Incineration accounts for 19 per cent, and special treatment for 1 per cent.

The high recycling rate of construction and demolition waste has especially contributed to the high overall recycling rate.

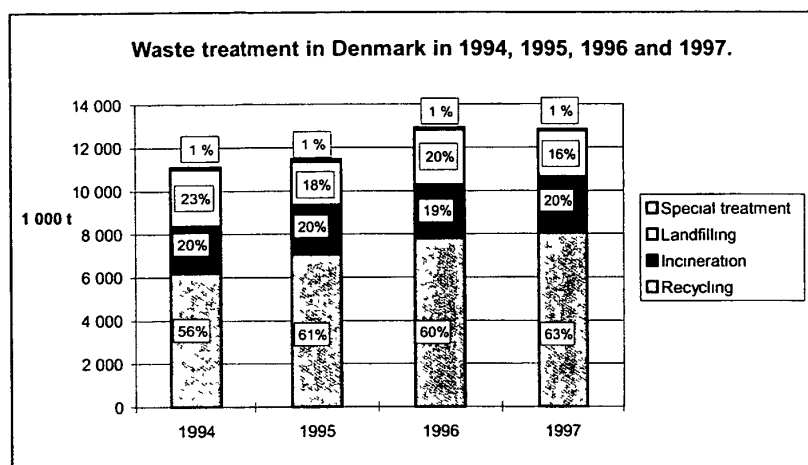
¹ According to Plan of Action for waste and recycling 1993-97, overall targets for waste treatment were: recycling 54 per cent and landfilling 21 per cent

² In 1997, some 250,000 tonnes hazardous waste were generated in Denmark. Of this some 70,000 tonnes derived from so-called secondary sources such as waste incineration plants. A minor decrease of 16,000 tonnes from 1996 to 1997 was registered

³ 900,000 tonnes packaging waste were generated in 1996

B 1.2 Developments in waste amounts

Waste generation is the result of all activities in society. Total waste generation related to gross national product shows a trend of increasing amounts of waste per DKK GNP in the period from 1985 to 1996. Waste generation is not similar within different sectors or waste fractions. The ratio between waste amounts and GNP is relatively stable for household waste, whereas a certain increase in the ratio is seen within the service sector.



Source: Waste Statistics 1997, Environmental Review from the Danish Environmental Protection Agency No. 1, 1999

The Risø National Laboratory has developed a scenario model for the Danish Environmental Protection Agency in which amounts of waste from primary sources are linked to waste generating economic activity in ADAM⁴.

The model assumes that there is a direct correlation between waste amounts and waste generating economic activity, and the model can be used for scenario analyses of impacts of changes in level and composition of economic activities on amounts of waste generated.

Another important assumption of the model is that mechanisms of waste generation remain the same. This means that the relationship between waste amounts and the relevant economic activity (waste coefficient) is always constant. This assumption is a simplification of real life, but since waste data are only available for the period 1994 to 1996, it is not yet possible to determine future developments in the rate of waste coefficients more precisely.

The assumption of constant waste coefficients means that the model cannot take into consideration the impact of behavioural changes, new technology or political measures within waste generation. Once waste data for a longer period than 1994 to 1996 are available it will be possible to determine more precisely how behavioural changes in the population influence developments in waste coefficients. In any case, it will be necessary to supplement the model with assessments of impacts of new technology and political measures within waste generation.

⁴ Economic projection model from the Ministry of Finance

A comparison of the model with actual developments in waste amounts in the period 1994-1996 shows that the model can account for around 80 per cent of the increase in waste amounts from 1994 to 1996. This means, as assumed, that a considerable part of the increase in total waste amounts can be attributed to economic development, whereas the remaining part of the increase in waste amounts must be attributed to other factors such as new legislation or behavioural changes

Stricter requirements for emissions into the atmosphere or the aquatic environment will, for example, lead to more waste in the form of cleaning products. The development of energy-saving products and subsequent political pressure to use these (refrigeration equipment, double-glazed windows etc.) will in certain periods also lead to increased shift to new products, and thereby to more waste. By contrast, new energy policy targets of phasing out coal-based energy production will lead to a decrease in amounts of residues from coal-fired power plants within the next 30 years

The impact of economic development and other waste generating mechanisms will also differ from one sector to another and from one fraction to another

For example, economic development has a smaller impact on amounts of domestic waste from households than on production waste from industry. Correspondingly, stricter environmental requirements for air and wastewater emissions will primarily lead to increasing waste amounts from industry, whereas the shift to more energy-saving products will have the largest impact on bulky waste amounts from households.

In order to decelerate the general increase in waste generation, it is necessary to clarify mechanisms behind waste generation within different sectors, fractions and waste streams. On the basis of this knowledge, waste preventive initiatives will be adapted to the different sectors or waste fractions in focus.

The scenario model will be a useful tool in identifying which sectors and fractions should be in focus in order to decelerate developments in waste amounts. It will, however, be necessary to supplement the model with assessments of impacts from behavioural changes, technological developments and political measures.

B 1.3 Waste - a resource

Waste contains energy and raw material resources that may be utilised. In Denmark, the energy resource in waste suitable for incineration is recovered. Waste may also contain raw material resources such as heavy metals.

The challenge ahead is to utilise all resources in waste, to recover raw materials in waste, and to bring them back into circulation. Efforts in future will therefore also focus on raw material resources, including the development of treatment methods allowing the recovery of raw material resources in waste.

B 2 Technological development in waste management

Objectives year 2004

- ensure development of treatment technologies for PVC, impregnated wood, batteries, and shredder waste
- ensure continuous and systematic technological development

B 2.1 Status

The quality of waste treatment must be improved. Better-quality waste treatment requires development of new technology

Denmark has always been at the forefront of waste treatment technology. If technologies suitable for waste of the future are to be developed at an overall level, an intensive effort is called for, allowing us to solve the task systematically in the entire country. It will be necessary for the State to get involved in this work.

Local councils are responsible for waste management. This makes them important operators in the identification of new waste types for separate treatment, the establishment of new logistic systems, and the choice of technologies for the treatment of waste.

Profitable treatment of waste requires, however, that plants have sufficient supply and sound financial basis. The need for sufficient supply will, for example, require that small waste fractions are collected from larger areas. Co-operation among regions - also across borders - or among sectors with many small enterprises may be the key to creating the necessary basis for recycling specific fractions. It may be necessary to establish a small number of plants for the treatment of certain waste streams. The siting of such plants must be adapted to supply and logistics. Kommunekemi A/S is a good example of an enterprise receiving waste fractions and having a collection network that covers all municipalities in the country.

Technological development does not happen automatically in the waste area. The reasons for this are that waste management competence is decentralised and that sources of several waste fractions are dispersed unevenly over the country. For example, one waste fraction may be generated in small quantities in all municipalities. Other waste fractions may arise in large quantities in few municipalities. Therefore, supply is not secured. This constitutes a barrier to innovation and development of profitable collection schemes and treatment methods.

In addition, market prices fluctuate greatly, and consequently initial investments in the sector are risky. There is no incentive to invest in the development of new plants and put them to commercial use.

Both local authorities and enterprises need an incentive to take the lead in developing solutions which are necessary to meet objectives in society.

Today, we have identified a need for technological development for certain fractions, such as plastic (including PVC), impregnated wood, shredder waste, and batteries. The Council for Recycling and Cleaner Technology has in the past five years granted subsidies to a number of projects. Subsidy funds available in the new Environmental Council for Cleaner Products are also important when pilot projects for different waste fractions are launched. However, funds are not sufficient to ensure the necessary improvement.

It is necessary, at an overall level, systematically to develop methods adapted to waste of the future. The State must therefore assume its part of responsibility and become actively involved.

There is a need for intensive efforts to lift the level in waste management. A lift to ensure that waste management in the entire country is improved. This effort will also contribute to ensuring that Denmark in future is also in the forefront with environmentally high-quality waste treatment. Efforts may also have a positive impact on employment. New ways of thinking are required, both in terms of technology and organisation, and it is necessary that improvements are nation-wide.

Measures

- *support technological development*
- *seek additional financing possibilities*

B 2.2 Future initiatives

Technological development within waste management will be supported. In co-operation with operators, the Government will evaluate areas where there is a need for enhanced efforts and how best to support these efforts.

B 2.3 Economy

The need for financing is to a certain extent covered by funds in the Environmental Council for Cleaner Products. However, the Council is not at present able to grant subsidies for plant investment. There is a need to examine which additional financing possibilities should be established in order to secure development.

B 3 Statistical basis

Objectives year 2004

- *collect knowledge on waste at detailed level to be used by*
 - *enterprises*
 - *local and national authorities*
- *measure effects of future efforts in waste management*

B 3.1 Status

There is a need for a registration system allowing the monitoring of waste in a simple way "from cradle to grave", in detail. Data collected will be used by, for example, waste generating enterprises and national and local authorities (local and regional authorities and the Danish Environmental Protection Agency). Data must be used in planning by local authorities to form the basis for decision-making for regulation as well as supervision work.

Data are also needed to monitor whether initiatives have had the desired effect

A central data reporting system has been established (Information System for Waste and Recycling - the ISAG) which each year gives a good picture of waste generated in Denmark as well as treatment of this waste

The ISAG gives a good general picture, but it cannot be used to follow different waste streams in detail. For example, the ISAG cannot provide information on origin of waste in terms of industrial sectors.

The ISAG is extended regularly, and the latest modification of the system implied an extension with more detailed information on generation and treatment of hazardous waste. The modification came into effect with reports for 1998

In parallel to the ISAG, data are collected regularly on different waste fractions in the form of, for example, material stream and mass flow analyses.⁵⁻⁶

In addition, several local authorities have developed individual data systems on waste, and consequently waste generating enterprises report information on their waste at different times and to several different authorities.

There is therefore a need to ensure systematic collection of comparable data on waste at a detailed level and in a way that both enterprises and local and national authorities can use data. This need will increase in future, as more and more waste fractions become subject to special treatment.

A proposal is being drafted on a simplified system for registration of data on waste - for waste planning and supervision of waste disposal in Denmark. This will lead to a proposal for a further extension of ISAG data so that it is possible for local authorities and the Danish Environmental Protection Agency to act on the basis of comparable data at a more detailed level than today.

⁵ Material stream analyses have been made regularly for paper, cardboard, glass, organic waste and construction and demolition waste.

⁶ Mass flow analyses follow groups of substances and products "from cradle to grave" and also comprise information on waste. Such analyses have been made for PVC, impregnated wood etc.

A concrete proposal for the extension of the ISAG has not yet been finalised, but one of the ideas being discussed is a system where present ISAG reports are supplemented by information on, for example, waste carrier, plant capacity, operating data, treatment prices, detailed information on hazardous waste, and geographical source of recycling

As a tool in municipal waste management planning, the annual reports to the ISAG might be supplemented every four years by detailed information on waste generation directly from enterprises to local authorities or waste companies using such information

Environmental indicators have been developed in waste management, covering information on waste amounts in general, and especially glass and paper. Indicators are not designed to follow new efforts in waste management, such as efforts that aim at reducing contents of environmental contaminants in waste. With increased focus on environmental contaminants in waste, new indicators are to be developed.

There is also a need to survey the composition of waste from institutions, trade and offices with a view to identifying new areas of effort aimed at increased recycling and reduced landfilling of waste generated in this sector

In future, there will also be a need to carry out material stream and mass flow analyses for selected waste fractions, especially in areas where the overall data registration (the ISAG) is not sufficient. Such an area is for example bulky waste. Registration of bulky waste is complicated as in some regions it is registered as household waste and in other regions as industrial and commercial waste

Measures:

- *extension of waste data registration*
- *development of indicators for measuring environmental impact of waste*
- *survey of waste from institutions, trade and offices*

B 3.2 Future initiatives

Development of methods that can measure the effect of initiatives on reducing environmental impacts in waste management, for example by measuring heavy metals in residues, must be promoted.

When results are available, new indicators will be included in the annual indicator report from the Ministry of Environment and Energy.

A survey will be carried out of waste from institutions, trade and offices.

Material stream and mass flow analyses will be prepared in areas where ISAG registrations are not sufficient.

B 3.3 Regulation

General information on waste is collected under the Information System for Waste and Recycling (the ISAG) which took effect in 1993. The ISAG is administered by the Danish Environmental Protection Agency. According to the Statutory Order on Waste, enterprises carrying out collection and treatment of waste must report information on waste managed to the Danish Environmental Protection Agency.

B 3.4 Environmental impact assessment

An extended data system allowing the monitoring of separate waste fractions will facilitate the assessment of impacts of concrete measures for different waste fractions.

B 3.5 Implications for national authorities

The envisaged modifications to the ISAG system are intended to take effect in connection with reporting as per 31st January 2001. The Statutory Order on Waste will be amended accordingly

B 3.6 Implications for local authorities

Local authorities will use the data system to provide the basis for municipal waste management planning, and to carry out supervision of waste management in the municipality.

APPENDIX C

Capacity

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C 1 Capacity - incineration plants

C 1.1 Waste amounts, capacity, and catchment areas

In 1997, 2.4 million tonnes of waste were treated at Danish incineration plants. A further 180,000 tonnes municipal sewage sludge were incinerated at specific sludge incineration plants.

In 1995, incineration capacity and needs balanced. The ban on landfilling of waste suitable for incineration in effect since 1st January 1997, increasing waste amounts, and delays in the conversion to co-generation (combined power and heating generation), however, are all factors that have led to a deficiency in capacity today.

On 1st January 1997, 31 waste incineration plants were in operation in Denmark. Since 1991, six old incineration plants have been phased out, and the oldest incineration plant in operation today was built in 1968.

Total number of oven lines in 1997 was 70, divided into 25 co-generation (CPH) and 45 hot water generating (HW) oven lines. The policy has been to ensure maximum energy utilisation and to shift as much waste as possible to CPH plants. HW capacity has not been established since 1992. Incineration capacity of plants varied in 1995 between 14,000 tonnes and 315,000 tonnes per year. Of total amounts of waste incinerated, 57 per cent was treated at CPH plants and 43 per cent at HW plants.

Aim: regional balance

In Waste 21, a number of waste regions have been defined. A waste region is a well-defined geographical area within which co-operation on exploitation of incineration capacity etc. is logical and expedient.

Danish waste management policy aims at ensuring sufficient capacity within each waste region to treat waste suitable for incineration generated in the region. This policy is in accordance with the principle of self-sufficiency in the waste regions and the proximity principle entailing that waste suitable for incineration is treated at nearby incineration plants to the largest possible extent.

Incineration capacity and waste amounts in Denmark in 1995 and year 2000¹ are shown below.

1995 figures reflect actual amounts of waste suitable for incineration delivered to Danish incineration plants. Amounts of waste suitable for incineration landfilled or stored temporarily are not included. The amounts of waste suitable for incineration in year 2000² are projections based on data reported to the ISAG (the Danish Information System for Waste and Recycling) combined with anticipated economic development from the Danish Ministry of Finance.

Waste amounts and capacity in '000 tonnes, Denmark

¹ Information on waste amounts and capacity in Denmark year 1995 and 2000 stated in this appendix is taken from the report "Affaldsmængder til forbrænding år 2000" (*Waste amounts for incineration year 2000, Danish only*), published in October 1997 by the Danish Environmental Protection Agency and the Danish Energy Agency.

² Waste amounts year 2000 do not include amounts in temporary storage.

Catchment areas 34				
Waste incineration plants 31				
Incineration capacity	Co-generation	Hot water	Total capacity	Waste amounts
1995	1,175	1,125	2,299	2,135
2000	2,071	0,885	2,956	2,890

Waste amounts and capacity are stated below for six waste regions in Denmark year 1995 and year 2000 ('000 tonnes)

Waste region Sealand³

Excess

9 catchment areas Amagerforbrænding, Vestforbrænding, Nordforbrænding VEGA, KARA, KAVO, FASAN, REFA, Novoren				
Incineration capacity	Co-generation	Hot water	Total capacity	Waste amounts
1995	430	681	1,111	1,035
2000	930	645	1,575	1,296

Waste region Bornholm

Balance

1 catchment area All municipalities in Bornholm organised in Bofa				
Incineration capacity	Co-generation	Hot water	Total capacity	Waste amounts
1995	-	21	21	20
2000	-	21	21	21

Waste region Funen

Lack of capacity

4 catchment areas Nyborg, Svendborg, Fynsværket, Vestfyn				
Incineration capacity	Co-generation	Hot water	Total capacity	Waste amounts
1995	-	69	69	59
2000	208	-	208	279

Waste region Southern Jutland

Lack of capacity

5 catchment areas Haderslev, Sønderborg, Vejle, Kolding, Horsens				
Incineration capacity	Co-generation	Hot water	Total capacity	Waste amounts
1995	311	15	326	309
2000	312	15	326	389

Waste region Central Jutland

Lack of capacity

8 catchment areas Måbjergværket, Knudmoseværket, Reno Syd, Hammel, Århus Nord, Grenå, Fællesforbrænding, 4-S Skive				
Incineration capacity	Co-generation	Hot water	Total capacity	Waste amounts
1995	223	200	423	401
2000	361	116	477	573

Waste region Northern Jutland

Balance

7 catchment areas Thisted, Aars, Hadsund, Reno Nord, AVV, FredenksHAVN, Skagen				
Incineration capacity	Co-generation	Hot water	Total capacity	Waste amounts
1995	210	139	349	310
2000	260	89	349	331

³ Since the report "Affaldsmængder til forbrænding år 2000" (Waste amounts for incineration year 2000) was published, the waste companies KAVO and NOVOREN in the County of Western Sealand have entered an agreement on delivery of waste suitable for incineration to the incineration plant Fynsværket. The division into waste regions and the list of catchment areas in different waste regions are revised regularly.

Waste suitable for incineration is generally led to nearest waste incineration plant

It does happen that waste suitable for incineration is transported from one waste region to another. Based on available data⁴ from 1995, it has been calculated that amounts of waste suitable for incineration treated outside the region of generation on an average were below 2 per cent of total amounts incinerated in 1995.

It is thereby ensured to a large extent that waste suitable for incineration is incinerated in the region of generation.

Capacity utilisation in 1996 close to maximum

C 1.2 Capacity utilisation

In 1996, around 2.3 million tonnes of waste were delivered to waste incineration plants, corresponding to utilisation of a little below 80 per cent of maximum theoretic capacity at that time. In other words, capacity was utilised close to maximum.

There are a number of limitations to maximum utilisation of capacity. One limitation is seasonal variations in heating needs, meaning that some oven lines cannot be in operation during summer months. As a consequence, it is necessary in some periods to cool off heat. Another limitation consists of old hot water generating waste furnaces that, for environmental reasons, can only be used in transitional periods or only in certain periods of the year. There may also be limitations due to operation or design.

Objectives

- *incineration capacity adapted to actual needs*
- *optimum energy utilisation, largest possible CO₂ mitigation*
- *regional self-sufficiency*

C 1.3 Objectives and future initiatives

Total amounts of waste to be incinerated in year 2004 will be larger than in 1997. Waste 21 launches initiatives for increased recycling which will shift waste from incineration, but other factors have the opposite effect. First and foremost, the ban on landfilling of waste suitable for incineration is expected to shift large amounts of waste from landfilling to incineration. An increase in waste arisings up to 2004 will also mean more waste for incineration. In addition to present projects on extension of capacity, it is expected up to 2004 that a further 5 to 10 per cent incineration capacity will be established.

Measures

- *enhanced co-ordination or establishment of rules on incineration capacity*

New challenges are ahead due to increased capacity needs, overall energy policy, and stricter environmental requirements⁵. These challenges will be solved in close co-operation between local, regional and national authorities.

The aim is to adapt capacity to needs and locate capacity in a way that allows for best possible energy utilisation and largest possible CO₂ mitigation based on the principle of regional self-sufficiency. In future, the establishment of new plants, closing-down of operations, or conversion to co-generation will be better co-ordinated.

Much incineration capacity is today based purely on hot water generating oven lines. It is estimated that after year 2000 there will still be a need for utilising capacity in several of these ovens. The use of such ovens will be assessed regularly, especially in respect of largest possible energy utilisation and stricter environmental requirements.

⁴ Data can be seen in the report "Affaldsmængder til forbrænding år 2000" (*Waste amounts for incineration year 2000*)

⁵ A new EU directive on waste incineration is in the pipeline, comprising requirements for emissions.

Co-ordination will be enhanced or rules will be issued ensuring overall planning nationally and regionally and that environmental and economic aspects are respected

C 1.4 Regulation

Under the terms of the Statutory Order on Waste⁶ local councils are under an obligation to ensure that waste suitable for incineration which is not recycled is assigned to incineration at approved incineration plants, and that sufficient incineration capacity is available for waste suitable for incineration

Exemptions from this rule may be granted with a view to temporary storage of waste suitable for incineration, if incineration capacity is insufficient for a period of time.

New waste incineration plants are approved today under Part 5 of the Danish Environmental Protection Act. Prior to approval, regional authorities must carry out an EIA (Environmental Impact Assessment)⁷ Authorities must also respect the terms of the Electricity Supply Act⁸ and the Heating Supply Act⁹ in their approval

EU directive on waste incineration is expected to lead to stricter emission limit values

It is expected that a proposal for a new/revised EU directive on waste incineration will be adopted in the near future. If the proposal is adopted in its present form, emission limit values for Danish incineration plants will become stricter. In connection with new approvals, authorities are trying to ensure that waste incineration plants can comply with future requirements

C 1.5 Implications for national authorities

Developments in amounts of non-recyclable waste suitable for incineration will be monitored nationally and regionally with regard to ensuring sufficient incineration capacity.

C 1.6 Implications for local authorities

In municipal waste management plans, local councils must state amounts of waste for incineration in relation to capacity available. In this context, local councils must give an account of plans to bring down amounts of waste suitable for incineration in temporary storage, including statements of the need for additional incineration capacity.

⁶ Statutory Order of the Ministry of Environment and Energy No. 299 of 30th April 1997

⁷ In accordance with Statutory Order No. 849 of 30th September 1994 on the assessment of the effects of certain public and private projects on the environment

⁸ Electricity Supply Act, Statutory Order No. 632 of 1st July 1996 on electricity supply, amended by Act No. 486 of 12th June 1996, Act No. 189 of 12th March 1997 and Act No. 89 of 10th February 1998

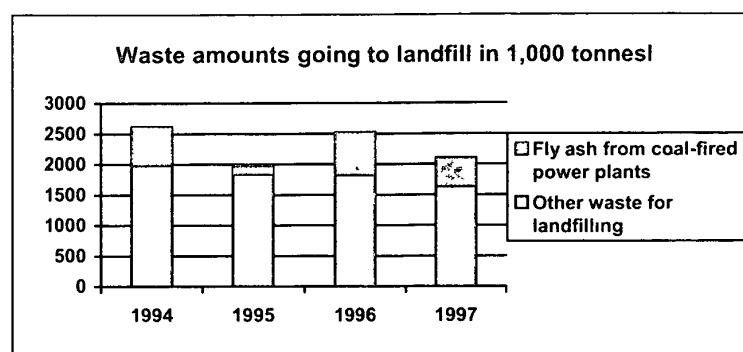
⁹ Heating Supply Act No. 382 of 13th June 1990, amended by Act No. 327 of 14th May 1992, Act No. 96 of 9th February 1994, Act No. 213 of 29th March 1995 and Act No. 436 of 10th June 1997

C 2 Landfill capacity

C 2.1 Waste amounts going to landfill

In 1997, 2.1 million tonnes of waste were landfilled in Denmark. Fluctuations in landfilled amounts reflect changes in amounts of landfilled fly ash from coal-fired power plants and landfilled industrial waste.

A general decrease in landfilling of household waste has been registered from 1994 to 1997.



Source: Waste Statistics 1997, Environmental Review No. 1 1999 from the Danish Environmental Protection Agency

Energy 21 envisages a decrease in coal-based power generation, and consequently amounts of fly ash from coal-fired power plants will decrease.

C 2.2 Regional planning

Based on information delivered by local authorities, who are responsible for waste planning, regional authorities in their regional planning must ensure that areas are set aside for the necessary treatment capacity in the entire planning period - both concerning landfills and waste incineration plants. Export and import of waste must be taken into consideration.

In connection with the 1997 revision of regional plans, it became clear that, in many counties, increased capacity needs are to be expected in the period covered by the plans. Changes are to be incorporated in subsequent supplementary regional plans. In order to ensure a balance between expected amounts of waste and existing and/or planned capacity, regional plans must provide an overall statement of waste treatment capacity and considerations of possible siting of waste treatment plants.

In the siting of new waste treatment plants, a number of criteria must be respected. These criteria are:

Guidelines from the Ministry of Environment and Energy on coastal landfills, memorandum of 27th December 1991, and Statutory Order from the Ministry of Environment and Energy No. 921 of 8th October on quality standards for the aquatic environment and requirements for discharge of certain

dangerous substances into inland waters or the marine environment¹⁰ This Statutory Order bans location of landfills in areas where discharges of leachate may cause pollution of inland waters and the marine environment Landfills must therefore not be located near sensitive aquatic environments.

In the planning of large building and construction works, possibilities for utilising inorganic residues must also be considered Many construction works are planned and completed today without consideration of utilising such residues, leading to a loss of resources and increased need for landfill sites

Finally, Guidelines no 9 of 1997 from the Danish Environmental Protection Agency for waste landfills must be respected

On 1st January 1997, a ban on landfilling of waste suitable for incineration took effect As a consequence, there may be a need in some regions for temporary storage of waste suitable for incineration

Landfills are in general covered by regulations on EIA in the Planning Act (assessment of the effect of certain public and private projects on the environment) This is always the case for landfilling of hazardous waste

Temporary storage of waste suitable for incineration

C 2.3 Future capacity at Danish landfills

There is a need for a detailed study of projections of waste arisings with a view to ensuring that sufficient landfill capacity is available In this connection it is also necessary to ensure that sufficient capacity for temporary storage of waste suitable for incineration is available

Amounts of *residues from coal-fired co-generation plants* vary from one year to another due to varying electricity demand Recycling of residues depends partly on a few large construction works It must be ensured that sufficient capacity for landfilling of residues is available, and regional councils should assume this task in co-operation with power companies.

Amounts of *residues from waste incineration* (slag and flue gas cleaning products) are expected to increase slightly In a letter of 24th August 1998 from the Ministry of Environment and Energy, three local councils and the relevant regional councils have been requested to keep relevant sites available for the establishment of landfills for flue gas cleaning waste.

Amounts of *bioash* (from straw and wood chips) are also rising Analyses of ash show that cadmium contents are relatively high Limit values for cadmium and mercury will become stricter in year 2000 for application to farmland, and it is therefore expected that there will be an increasing need for landfill capacity for this fraction.

As a consequence of new techniques using *mixed fuels* (biomass and coal), a new type of residue will be generated which must probably be landfilled

In addition, there is a need for landfilling of *contaminated soil* which cannot be cleaned The amount of contaminated soil for landfilling is expected to

¹⁰ Danish only Danish title Kvalitetskrav for vandområder og krav til udledninger af visse farlige stoffer til vandløb, søer eller havet Implementing EU directive 74/464/EEC on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community

increase due to enhanced efforts for contaminated site clean-up. As to ordinary *surplus soil*, this fraction may no longer be landfilled in raw material pits due to new legislation banning landfilling of soil in raw material pits. In future, if surplus soil causes disposal problems due to the ban, it may be necessary for regional authorities to establish alternative sites of disposal.

Amounts of soil will vary with increasing or decreasing activity in the building and construction sector.

Finally, increasing amounts of *contaminated harbour sludge* are expected, which must be disposed of in other ways than by dredging. Here, special attention must be paid to coastal zones near harbours. It shall also be considered whether it would be expedient to select one or several sites in the county with a view to subsequent recovery possibilities.

Conclusion

Up to 2004, landfill capacity is sufficient at national level, but there are large differences among the regions due to possibilities of identifying suitable sites for landfills. In addition, practice shows that planning must be carried out with a 12 years' horizon. Considerations on capacity must therefore go further than the four years which are often practice in planning.

C 3 Capacity - hazardous waste

C 3.1 Hazardous waste - primary sources

In 1997, a total of 182,000 tonnes of hazardous waste were treated in Denmark. An outline of various hazardous waste fractions and treatment is given in Table C 3.1 below.

In addition, hazardous waste is generated at waste incineration plants and other so-called secondary sources.¹¹ An outline of waste from secondary sources is given in Table C 3.2.

Table C 3.1 Hazardous waste by form of treatment

Hazardous waste 1997 (tonnes)	Recycling	Incineration	Special treatment	Landfilling	Total
-Lead batteries ¹	14,448	447			14,895
-Hermetically sealed Ni-Cd accumulators ²	95				120
-Waste oil led to district heating plants ³		22,576			22,576
-Oil/chemical waste led to Kommunekemi ^{4 and 5}			74,215		74,215
-Dust emitting asbestos ¹				7,000	7,000
-Hospital waste ¹		5,900	2,900		8,800
-Sulphuric acid (coal-fired power plants) ¹	8,000				8,000
-Oil and chemical waste from other primary sources ¹	28,600	9,500	5,400	3,000	46,500
Total	51,143	38,423	82,515	10,000	182,106

Sources: (1) Registrations under EU regulation on shipment of waste, (2) Subsidies granted for disposal of waste oil, (3) ISAG reporting 1996, (4) Elsam, (5) Kommunekemi A/S, (6) Calculations from Danish Environmental Protection Agency. Differences between total amounts of waste hermetically sealed Ni-Cd accumulators (120 tonnes) and amounts collected for recycling reflect the fact that batteries are not collected separately, but are included in general waste collection.

28 per cent of hazardous waste is recycled today.

- lead accumulators and Ni-Cd batteries are collected and sent for reprocessing in Sweden or France
- sulphuric acid is exported for recycling
- waste from the photographic industry is recycled in Great Britain

21 per cent is incinerated.

- waste oil: In 1997, around 35,000 tonnes waste oil were treated. Just below 60 per cent was treated at district heating plants, and around 40 per cent was destroyed at Kommunekemi A/S
- health-care risk waste: Health-care risk waste amounts to 8,800 tonnes. Around 35 per cent is treated at SWS (Special Waste System). The rest is treated at seven conventional waste incineration plants (Affaldsselskabet Vendsyssel Vest I/S, I/S Amagerforbrænding, BOFA I/S, I/S KARA, I/S Vestforbrænding, Forbrændingsanlægget Århus Nord, Vejen Kraftvarmeværk)
- oil sludges are treated at Ålborg Portland

45 per cent is subject to special treatment.

- oil and chemical waste is primarily treated at Kommunekemi A/S (around 95 per cent), and a small fraction of laboratory waste is treated at Special Waste System

6 per cent is landfilled

- asbestos and contaminated soil is deposited at special landfills

¹¹ Waste from secondary sources is not included in total waste generation, as it would otherwise be counted twice.

In recent years, Kommunekemi A/S has received decreasing amounts of oil and chemical waste for treatment. Waste oil amounts have been decreasing since 1988 and account today for only one quarter of amounts in 1988. Chemical waste amounts have been generally decreasing from 1991 to 1996. From 1996 to 1997, amounts increased by 9 per cent.

It seems that a number of enterprises have emerged, pre-treating hazardous waste, for example by separating non-hazardous fractions from hazardous waste (for example oil filters, paint drums, water components in waste oil). Hazardous fractions are mainly delivered to Kommunekemi A/S, or to district heating plants (waste oil). Non-hazardous fractions are delivered to incineration or recycling.

For a few waste fractions (silver from the photographic industry, organic solvents) recycling enterprises exist (recovery of silver, cooling liquids), but generally only few treatment methods have been developed for, for example, recovery or recycling of hazardous waste fractions.

Conclusion

At present, no need for extension of treatment capacity for hazardous waste is envisaged.

C 3.2 Hazardous waste - secondary sources

Some residues from waste incineration plants are classified as hazardous waste, for example flue gas filter dust, fly ash, and flue gas cleaning products from waste incineration. An outline of amounts and treatment is given in Table C 3.2.

Table C 3.2 Hazardous waste from secondary sources

Hazardous waste, 1997 (secondary sources) (tonnes)	Special treatment	Landfilling	Reprocessing	Total
-Flue gas filter dust ¹			10,137	10,137
-Fly ash and flue gas cleaning products from waste incineration plants	24,600	36,700		61,300
Total	24,600	36,700	10,137	71,437

(1) Registrations under the EU regulation on shipments of waste, (2) ISAG reports for 1997, (3) Figure under special treatment means that waste is in storage.

Flue gas filter dust and flue gas cleaning products from waste incineration plants account for around 30 per cent of total hazardous waste amounts.

Some of these residues are landfilled abroad today, and some are stored temporarily in Denmark. Flue gas filter dust from the Danish Steel Works is sent for reprocessing in Spain.

Apart from residues from waste incineration plants, Kommunekemi also generates residues. These residues are also classified as hazardous waste, see also Table C 3.3.

Table C 3.3. Hazardous waste from Kommunekemi

Hazardous waste	1997 tonnes	1998 tonnes
Ash ¹⁾	8 380 (30)	5 910 (80)
Slag ²⁾	10,910	11,040
Gypsum ³⁾	970	1 150
Total	20,260	18,100

(1) Reduction in amounts of ash from 1997 to 1998 is due to reduced operation in 1998 because of renovation of flue gas system in F4. Figures in brackets state the calculated part of thermal treatment of soil etc. in F1. (2) Only part from treatment of hazardous waste in F3 and F4. (3) Gypsum is generated only in the thermal treatment of contaminated soil etc. in F1

Initiatives have been launched to establish three landfills receiving stabilised flue gas cleaning products from the whole country. When the sites have been established and stabilisation methods are operational, residues will be deposited at these landfills.

In respect of the principles of proximity and self-sufficiency, exports of flue gas cleaning products will no longer be permitted when these landfills have been established and start operation. In connection with the preparation of Waste 21, the Commission has been notified of these measures in accordance with regulations in Article 4, section 3 a) i) in Council Regulation (EEC) No. 259/93.

Conclusion

The above-mentioned three landfills are expected to ensure sufficient capacity for landfilling of residues for the next 10 to 15 years.

APPENDIX D

Sectors

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D Sectors

Waste can be divided according to the sector generating it. Such a division is useful as each sector is characterised by generation of specific waste fractions and collection systems adapted to this waste.

D 1 Waste incineration plants

<i>Environmental problem</i>	<i>Contents of heavy metals in residues may limit possibilities of recycling</i> <i>Flue gas cleaning waste from waste incineration plants accounts for large quantities of hazardous waste</i>
<i>Initiatives</i>	<i>Stop incineration of environmentally harmful fractions</i>

D 1.1 Status

Objective year 2004

- 70% recycling of residues in due respect of ground-water

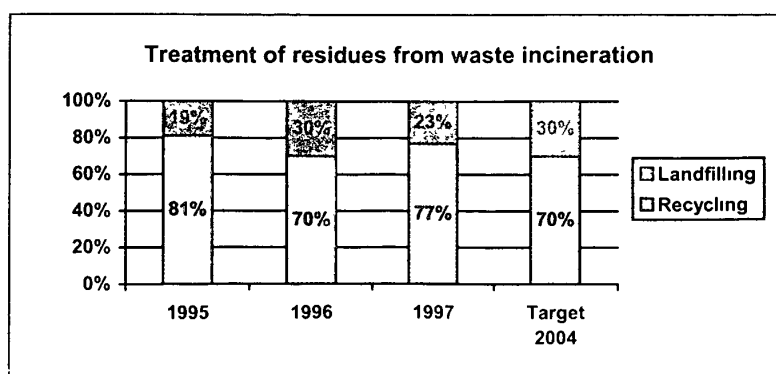
Waste incineration plants treat waste, but also generate waste. On 1st January 1997, 31 incineration plants were in operation in Denmark (see also Appendix C on capacity at incineration plants).

In 1997, 2.4 million tonnes waste were incinerated.

Residues from waste incineration plants consist of slag and flue gas cleaning waste, accounting for 20 and 3 per cent respectively of waste amounts treated.

Slag is separated, and 70-80 per cent is recycled whereas the remaining amounts are landfilled, primarily due to low quality (too high content of heavy metals).

The composition of waste treated is essential to the amounts and quality of residues. Especially, contents of heavy metals and PVC are of importance in this connection.



Source: Waste Statistics 1997, Environmental Review no. 1 1999 from the Danish Environmental Protection Agency.

Measures

- *requirements that environmentally harmful waste fractions such as PVC, impregnated wood, and waste electrical and electronic equipment must not be assigned to incineration*
- *seek to include principles of incineration of certain fractions in future EU Directive on waste incineration*

D. 1.2 Regulation

According to the Statutory Order on waste, local authorities must assign waste suitable for incineration - which is not recyclable - to incineration at a plant with energy recovery. Certain types of waste are defined as waste not suitable for incineration, as treatment may cause environmental problems. Examples of such waste are oil contaminated soil, PVC waste, and waste containing heavy metals.

D 1.3 Future initiatives

In future it will be ensured that environmentally harmful fractions such as PVC, impregnated wood, and waste electrical and electronic equipment are separated from waste streams. It will also be ensured that these fractions are not incinerated, but recycled or landfilled until suitable treatment methods have been developed.

In the coming EU Directive on waste incineration, Denmark will seek to include clauses on incineration of heavy metal containing waste fractions and waste causing excessive amounts of residues from incineration (for example PVC), ensuring that such fractions are incinerated according to specific principles.

D 1.3 Environmental assessment

By keeping environmentally harmful fractions, such as PVC, impregnated wood, and waste electrical and electronic equipment, away from waste incineration plants, amounts of heavy metals in slag and flue gas cleaning products will be reduced.

Amounts of flue gas cleaning waste will decrease due to the reduction of PVC incinerated.

D 1.4 Implications for national authorities

The Statutory Order on waste will be revised to state that PVC-containing waste, impregnated wood, and waste electrical and electronic equipment are no longer to be considered as waste suitable for incineration.

In order to protect groundwater, requirements for recycling of residues will be made stricter.

Heavy metal contamination of residues will drop considerably leading to improved quality of slag. However, the present target of 70 per cent recycling of residues by year 2004 is maintained.

D. 1.5 Implications for local authorities

In their future planning, local authorities will ensure that impregnated wood is separated as waste not suitable for incineration. Non-recyclable PVC waste will be landfilled. It is recommended that local authorities assign PVC waste to landfilling in separate cells, allowing subsequent alternative treatment of such waste. When suitable treatment methods have been developed for impregnated wood and PVC waste, new requirements for management of these waste fractions will be made. For waste electrical and electronic equipment, separate collection schemes will be established in order to increase recycling.

D 2 Building and construction sector

<i>Environmental problem</i>	<i>Construction and demolition waste accounts for 27 per cent of total waste amounts and would take up excessive landfill capacity if not recycled</i>
<i>Initiatives</i>	<i>Statutory Order on requirements for recycling of residues and soil for building and construction purposes to be issued</i> <i>Establishment of separate scheme for PVC</i> <i>Separation of impregnated wood as waste not suitable for incineration</i> <i>Study the need for separation of other environmentally harmful fractions</i> <i>Increased use of environmentally correct design</i>

Objective year 2004

- *90% recycling of construction and demolition waste*
- *separation of environmentally harmful waste fractions (PVC, impregnated wood, and waste electrical and electronic equipment)*
- *increased use of environmentally correct design*

D 2.1 Status

Construction and demolition waste covers primarily concrete, asphalt, stone, and other construction and demolition waste. Amounts in 1997 were 3.4 million tonnes. Construction and demolition waste amounts have been increasing in recent years.

The high rate of recycling of construction and demolition waste will be maintained, as recycling of waste saves resources. It is important that recycling takes place with the highest possible respect for groundwater resources. In future, the "cradle-to-grave" concept is to gain wider use in building and construction works, and the use of environmentally correct design will play a more important role so that waste management is taken into consideration already in the design phase

In 1997, the recycling rate of construction and demolition waste was almost 91 per cent. 8 per cent of total amounts was landfilled, and 1 per cent sent to special treatment¹. All in all, efforts for this waste fraction must be considered a success, and past objectives of 85 per cent recycling before year 2000 have been achieved. Parallel to increased recycling, a decrease in amounts for landfilling has been registered, leading to reduced need for new landfill capacity in future.

D 2.2 Future initiatives

In 1999, a Statutory Order on recycling of residues and soil for building and construction purposes will be sent to hearing. The purpose of the Statutory Order is to ensure that recycling takes place with largest possible respect for groundwater resources

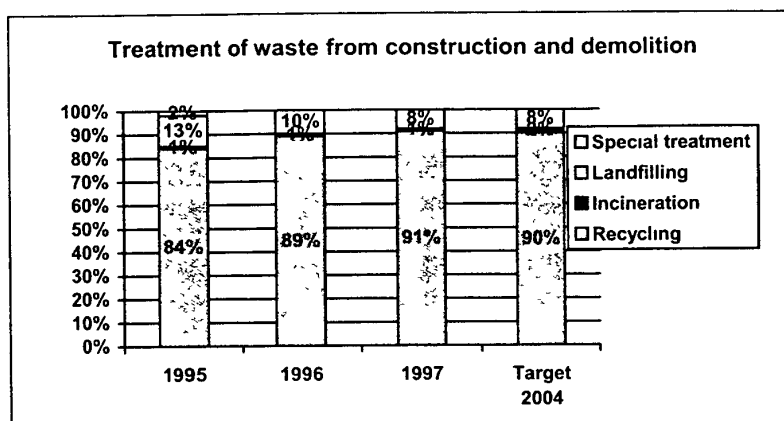
¹ According to the Plan of Action for waste and recycling 1993-97, objectives for year 2000 were a recycling rate of 60 per cent. Objectives were revised in 1993 and set to 85 per cent recycling before year 2000. In the Plan of Action, construction and demolition waste was selected as an important area of effort, and a "Plan of Action for cleaner technology and recycling efforts in the building and construction sector 1993-97" was prepared (Danish only, title: Delhandlingsplan for renere teknologi og genanvendelsesindsatsen i bygge- og anlægssektoren 1993-1997)

Measures

- requirements for recycling of residues and soil in building and construction works
- requirements for separation of environmentally harmful substances, materials and components (waste electrical and electronic equipment, PVC, and impregnated wood)
- study the possibility of making requirements for use of environmentally correct design
- study the need for separation of other environmentally harmful fractions

A large range of materials and components in the building and construction sector containing environmental contaminants are to be separated. In a first step, requirements will be made for separation of following fractions PVC, impregnated wood, and waste electrical and electronic equipment

A study will be launched to examine the need for separation of other environmentally harmful fractions from the sector. First, the need for separation of metal-containing fractions will be studied



Source: Waste Statistics 1997, Environmental Review no. 1, 1999 from the Danish Environmental Protection Agency

The concept of environmentally correct design takes waste prevention and recycling into consideration already in the design phase. The use of environmentally correct design is voluntary today, but the possibility of making it compulsory will be studied in co-operation with the Ministry of Housing and Urban Affairs.

D 2.3 Regulation

In spring 1994, the Minister for Environment and Energy, the National Association of Local Authorities in Denmark, the City of Copenhagen, and the Municipality of Frederiksberg entered an agreement on waste suitable for incineration, construction and demolition waste, organic waste, and landfilling. In connection with this agreement, a Circular² was issued on municipal regulations on separation of construction and demolition waste for recycling. The Minister for Environment and Energy also entered an agreement with the Danish Demolition Association³ on selective demolition of building materials. With this agreement, separation at source was ensured.

The Circular lays down the requirement that in demolition works involving more than 1 tonne of construction and demolition waste, waste shall be separated at source in clean fractions, so that for example, bricks and concrete are not mixed

In pursuance of this Circular, local authorities have issued regulations with requirements for separation. These regulations took effect at the latest on 1st January 1997.

² Circular No. 94 of 21st June 1995

³ Nedbrydningsbranchens Miljøkontrolordning NKM 96 (Environmental control agreement of Danish Demolition Industries)

In the regulation of construction and demolition waste, the waste tax has played a significant role, as waste for recycling is not subject to the tax.

Public subsidies for recycling initiatives have also had a significant effect.

D 2.4 Capacity

A large proportion of construction and demolition waste is reprocessed in mobile crushing plants relocated according to needs, and capacity is assessed not to be a barrier to objectives

D 2.5 Environmental assessment

Separation of environmentally harmful fractions is expected to lead to improved quality in waste treatment. The application of environmentally correct design is expected, in the long term, to lead to a reduction in waste amounts and substitution of materials containing environmental contaminants.

D 2.6 Implications for national authorities

National authorities will be responsible for issuing requirements for recycling of residues and soil in the form of a Statutory Order

National authorities are also responsible for laying down requirements for separation and collection of certain environmentally harmful fractions⁴.

In co-operation with the Ministry of Housing and Urban Affairs, national authorities will study the possibility of mandatory use of environmentally correct design.

D 2.7 Implications for local authorities

At the implementation of the Statutory Order on recycling of residues and soil in building and construction works, local authorities are to prepare a prognosis of landfill capacity needs for inorganic residues and soil to be used for regional authorities' planning.

At the implementation of requirements for separation of certain waste fractions, local councils, in their planning, must take into consideration the mandatory sorting and separate collection of fractions.

⁴ Revision of Circular No 94 of 21st June 1995

D 3 Households

<i>Environmental problem</i>	<p><i>Waste amounts are increasing, and recycling of waste today is lower than desired. Too many resources are lost.</i></p> <p><i>Household waste contains environmental contaminants, and this creates problems in waste treatment.</i></p>
<i>Initiatives</i>	
<i>Domestic waste</i>	<p><i>Increased collection and recycling of glass, paper and cardboard, and plastic packaging.</i></p> <p><i>Extension of experience from biogas plants. Subsequent, introduction of requirements for collection of organic domestic waste.</i></p>
<i>Bulky waste</i>	<p><i>Establishment of separate schemes for waste electrical and electronic equipment, impregnated wood, and PVC.</i></p> <p><i>When new treatment methods have been developed, all types of battery will be collected separately.</i></p>
<i>Hazardous waste</i>	<i>Increased information on hazardous waste in households in order to increase collection.</i>
<i>Garden waste</i>	<i>Maintenance of present effort for garden waste.</i>

Objective year 2004

- *increased focus on link between material consumption and waste amounts*
- *maintenance of return bottle system.*
- *increased collection of hazardous waste from households*

D 3.0 1 Status

Household waste covers domestic waste, bulky waste and garden waste. In 1997, 28 per cent was recycled, 56 per cent incinerated, and 15 per cent landfilled. One per cent was subjected to special treatment. Some household waste is hazardous waste.

On 1st January 1997 a ban was introduced on landfilling of waste suitable for incineration. This ban is expected to shift waste from landfilling to incineration or recycling.

Household waste amounted to 2,776,000 tonnes in 1997⁵. From 1994 to 1997, an increase in household waste amounts of 200,000 tonnes was registered. This increase is mainly attributable to garden waste.

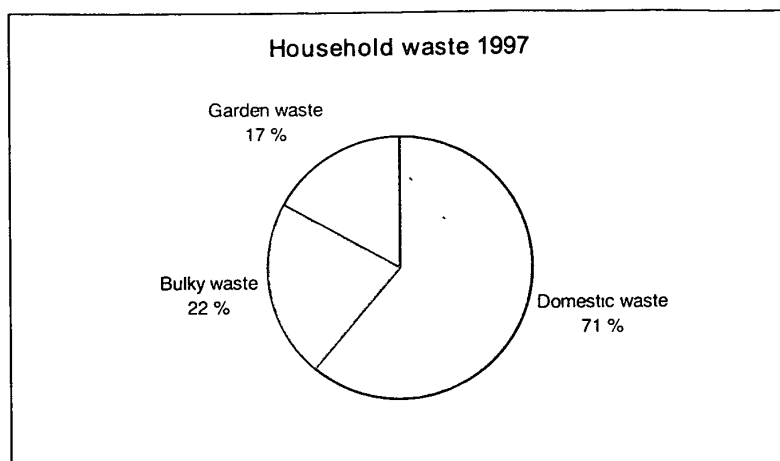
There was also a slight increase for bulky waste which may be due to extended municipal schemes in recent years. In addition, purchasing power, and thereby consumption of durable consumer goods, has increased.

Consumer habits are decisive for waste amount developments in households. Purchase of goods with a long lifetime and of environmentally high quality will, all other things being equal, result in decreasing waste amounts.

Household waste contains environmentally harmful waste fractions causing problems in waste management. Citizens will, to a far larger extent, have the opportunity to separate these fractions for separate treatment (PVC, impregnated wood, waste electrical and electronic equipment).

⁵ Source: The ISAG (Danish Information System for Waste and Recycling). This corresponds to an increase per capita from 371 kg in 1985 and 497 kg in 1994 to 526 kg in 1997. This is an increase of 155 kg per capita in the period from 1985 to 1997.

In most municipalities, management of household waste is financed by an overall waste collection fee. There is no incentive for individuals to reduce amounts of waste or increase recycling, but neither is there a gain from disposing of waste in an environmentally inappropriate manner (fly-tipping).



Household hazardous waste is found both in domestic waste and bulky waste. It may be residues from chemical substances and products, paint residues, medicine residues, batteries etc., which citizens want to discard. Hazardous waste from households is to be collected separately.

Today, many different collection schemes have been established, all with the objective that citizens can easily dispose of hazardous waste.

Collection schemes must be adapted to the different conditions prevailing in urban and rural municipalities, and in single-family housing and housing estates. Another difference is found in waste management organisation that differs from one municipality to another.

Some local authorities have introduced green collection vehicles that collect hazardous waste in residential areas at certain intervals. Other local authorities have introduced kerbside collection schemes for hazardous waste, using special containers.

Certain schemes involve retailers, and citizens may deliver hazardous waste to shops selling the products (medicine residues to pharmacies, paint and varnish residues to paint shops, batteries to shops selling new batteries). In some municipalities, bring schemes have been established with containers at different locations in the community.

In addition, local authorities have established permanent recycling centres (collection banks) where citizens can bring various waste types, including hazardous waste.

Studies have shown that in municipalities with kerbside collection, hazardous waste amounts collected are largest.

D 3 0 2 **Future initiatives**

Information campaigns will be launched giving concrete recommendations on, for example, quality/durable products, products manufactured from recyclates, reuseable packaging and packaged goods etc. Information campaigns will be carried out in co-operation between the Danish Environmental Protection Agency and the National Consumer Agency of Denmark. The effects from this initiative should be seen in the long term

Measures

- *information campaign on link between material consumption and waste amounts*
- *processing of experience from differentiated waste collection fees*
- *information on management of hazardous waste*
- *preparation of guidelines for hazardous waste*

Experience with differentiated waste collection fees based on weight or volume is to be collected and processed. This experience will give the basis for assessing whether differentiated fees in general will give greater incentives for individual citizens to increase recycling and prevent waste arisings

Citizens are to be informed of types of hazardous waste and municipal schemes in their community

Rules on household hazardous waste will be clarified in a guideline on hazardous waste.

D 3 0 3 **Regulation**

Management of household waste, including household hazardous waste is regulated in the Statutory Order on waste⁶. Waste must be collected by the local authority

D 3 0 4 **Environmental assessment**

Waste prevention reduces resource consumption and amounts of waste to be managed

Improved collection of hazardous waste will ensure environmentally appropriate management of waste

D 3 0 5 **Implications for national authorities**

An information campaign will be launched on the link between consumption and waste arisings. Experience from differentiated waste collection fees will be collected and processed

A guideline will be prepared on hazardous waste, covering waste both from enterprises and households

D 3.0 6 **Implications for local authorities**

In their information efforts, local authorities are to focus on the link between consumption and increasing waste amounts - and in this connection on behavioural changes that may contribute to waste prevention.

Local authorities will inform citizens on municipal schemes for hazardous waste.

⁶ Statutory Order on waste, Ministry of Environment and Energy no. 299 of 30th April 1997

D 3.1 Domestic waste from households

Objective year 2004

- 30 % recycling of domestic waste

Long term objective

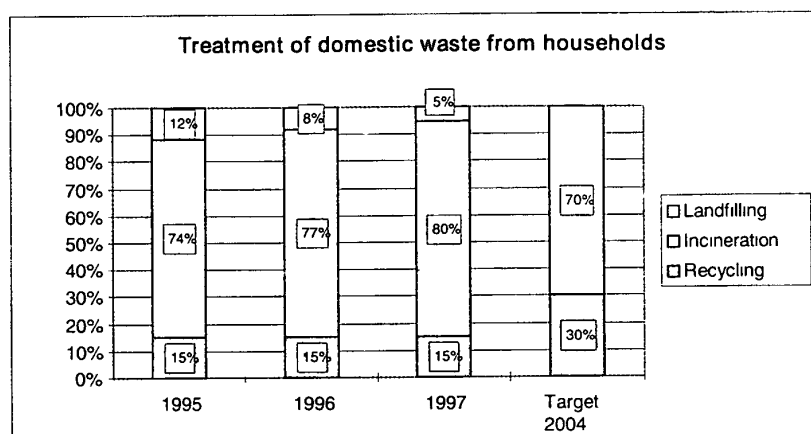
- 40-50% recycling of domestic waste

D 3 1 1 Status

Recycling of domestic waste is to be increased. This can be achieved by citizens increasing separation of glass, paper and cardboard, as well as separation of the organic fraction of domestic waste

Today, separate collection of paper and glass is ensured as a consequence of regulations, whereas separate collection of organic domestic waste is less widespread

In 1997, domestic waste amounts were 1,621,000 tonnes. This is more or less identical to amounts in 1994. In 1997, the rate of recycling was 15 per cent⁷



Source: Waste Statistics 1997, Environmental Review no. 1, 1999 from the Danish Environmental Protection Agency

Packaging waste accounts for around one quarter of domestic waste, corresponding to 425,000 tonnes. Around 30 per cent is material recycled, and 70 per cent is incinerated

Two thirds of waste packaging for incineration consist of cardboard, paper, and plastic. The rest is glass, steel, and aluminium packaging. Glass is not suitable for incineration, whereas a certain proportion of aluminium packaging is recovered. Steel packaging may be recovered after incineration, as iron is separated from slag by magnets. It is sold as incineration scrap

Separation of plastic and cardboard may be improved, ensuring recycling to a larger extent than today

⁷ Objectives for recycling of domestic waste in the Plan of Action for waste and recycling 1993-97 were 40-50% in year 2000. This was to be achieved through increased recycling of paper and the organic fraction of domestic waste. According to the Plan of Action, the remaining part of domestic waste was to be incinerated with energy recovery. In absolute figures, recycling of domestic waste from households was in 1996 more than 2½ times that of 1985. In per cent, the increase was from 8% in 1985 to 15% in 1996.

Measures

- *collection and processing of experience from use of differentiated waste collection fees*
- *increased recycling of organic waste, paper, cardboard, and glass*
- *study of possibilities for recycling plastic drums and bottles*

D 3 1 2 Future initiatives

For domestic waste, the use of differentiated waste collection fees is possible today. Experience from differentiation of waste collection fees based on weight or volume will be collected and processed to form the basis for local decisions on the introduction of differentiated waste collection fees.

Separate collection of glass, paper and cardboard, and organic domestic waste will be enhanced. See also under separate fractions in Appendix E.

Environmental and economic advantages from recycling of plastic drums and bottles will be studied. Results of the studies will be assessed and disseminated to relevant operators.

D 3 1 3 Regulation

In areas with more than 1,000 inhabitants, domestic waste must be collected⁸. In rural areas, waste shall be assigned to treatment. Mixed domestic waste shall be assigned to incineration.

Newspapers, magazines and glass must be collected for recycling from built-up areas with more than 2,000 households.

Local councils may establish collection schemes or other common schemes for other fractions.

Citizens, freeholders, enterprises and institutions have a duty to use municipal schemes.

Local councils may assign waste suitable for incineration to temporary storage, though for a duration of maximum one year. Domestic waste and other putrescible waste may not be assigned to temporary storage.

D 3 1 4 Environmental assessment

Increased recycling reduces resource consumption and amounts of waste for incineration.

D 3 1 5 Implications for national authorities

A study will be launched to survey the effect of recycling of plastic drums.

D 3 1 6 Implications for local authorities

Depending on the results of the above study on plastic drums, it may be possible in the planning period to establish special bring schemes for this fraction.

D 3.2 Bulky waste

D 3 2 1 Status

Recycling of bulky waste may be increased through enhanced separation of household waste.

In many municipalities, staffed recycling centres have been established in recent years. However, there are big variations in which and how many waste fractions are separated. Recycling centres are often supplemented by separate collection schemes.

Objective year 2004

- *25% recycling*
- *37.5% incineration*
- *37.5% landfilling*

⁸ According to Statutory Order on waste no. 299 of 30th April 1997.

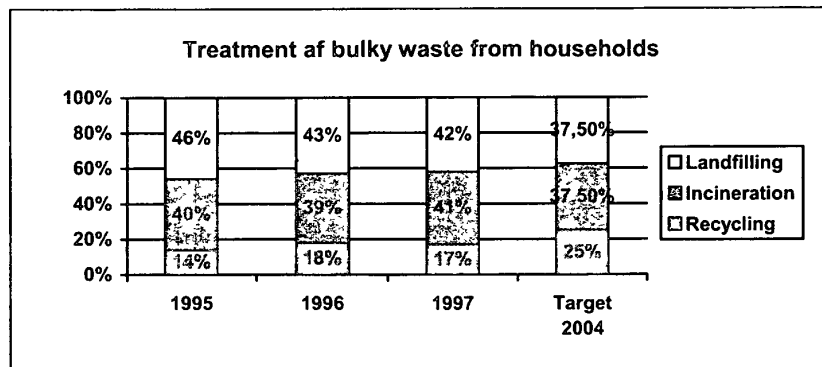
With stricter requirements for bulky waste schemes with regard to separation of waste fractions or special treatment, citizens may contribute actively to increased recycling

Amounts of bulky waste have been increasing due to, for example, the establishment of separate collection schemes and staffed recycling centres. Part of this waste is therefore no longer disposed of in other ways. From 1996 to 1997 amounts decreased, however, by 51,000 tonnes

In 1997, bulky waste amounted to 588,000 tonnes. Of this, 17 per cent was recycled, 41 per cent incinerated, and 42 per cent landfilled

Due to different methods of calculation in local administrations, figures for bulky waste are uncertain. In some administrations, bulky waste is stated as such, and in other administrations it is stated as industrial waste. Therefore, objectives for recycling, incineration and landfilling should be assessed with certain reservations⁹.

The ban on landfilling of waste suitable for incineration which took effect on 1st January 1997, will reduce amounts of bulky waste for landfilling



Source: Waste Statistics 1997, Environmental Review no. 1, 1999 from the Danish Environmental Protection Agency

Bulky waste covers many different materials, and one overall effort for increased recycling is not ideal. Efforts will therefore be directed specifically at single fractions

D 3.2.2 Future initiatives

The possibility of increasing recycling by making requirements for bulky waste schemes will be assessed.

Cardboard and waste electrical and electronic equipment fraction will be collected separately for recycling. The impregnated wood fraction will be considered as waste not suitable for incineration. Recyclable PVC waste will be separated and assigned to recycling. Non-recyclable PVC waste will be separated and landfilled. It is recommended that local authorities assign PVC waste to landfilling in separate cells, allowing subsequent alternative treatment of such waste. See also under separate fractions in Appendix E

Measures

- requirements for bulky waste schemes will be assessed

⁹ Plan of Action for waste and recycling 1993-97. Objectives year 2000: 25 % recycling, 37.5 % incineration, 37.5 % landfilling

D 3 2 3 Regulation

Local councils must assign treatment methods for bulky waste, and they must ensure that citizens separate waste suitable for incineration

D 3 2 4 Environmental assessment

Efforts to increase recycling will ensure utilisation of resources in waste and reduce the need for incineration and landfill capacity. Separate treatment of a number of bulky waste fractions will reduce the contents of environmental contaminants in incineration slag

D 3 2.5 Implications for national authorities

The Statutory Order on waste will be revised to state that cardboard, PVC-containing waste, impregnated wood, and waste electrical and electronic equipment is no longer considered as waste suitable for incineration

D 3.2 6 Implications for local authorities

Local authorities are to consider possible improvements in existing bulky waste schemes. They must prepare for requirements for separate collection, recycling, separate treatment, or landfilling of certain bulky waste fractions such as cardboard, waste electrical and electronic equipment, PVC, and impregnated wood

D 3.3 Garden waste

D 3 3 1 Status

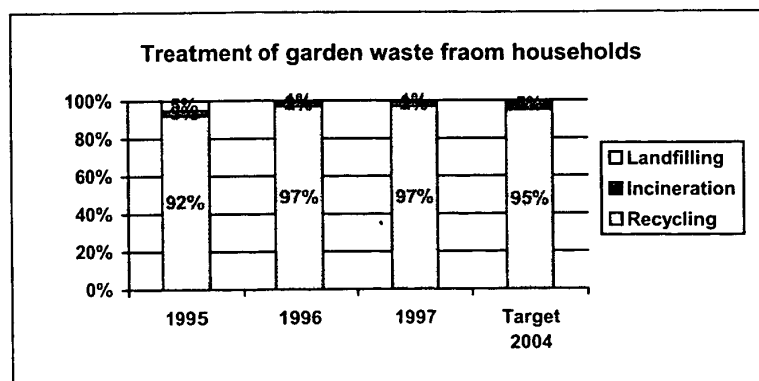
As much as 97 per cent of garden waste was recycled in central composting plants in 1997, which is above the target of 85 per cent for year 2000. As a consequence, landfilling of garden waste decreased from 10 per cent in 1994 to 1 per cent in 1997. It is not considered possible to increase the rate of recycling of garden waste

Objective year 2004

- 95% recycling of garden waste

Home composting has been promoted for a number of years through information campaigns, and local authorities have established schemes and composting plants for garden waste on a voluntary basis. Efforts for garden waste are considered very successful.

In addition to home composting, garden waste is collected in municipal recycling schemes. Amounts have increased considerably in recent years, from 290,000 tonnes in 1994 to 443,000 tonnes in 1997. This is due to increased use of schemes and improved collection of data on garden waste.



Source: Waste Statistics 1997, Environmental Review no. 1, 1999 from the Danish Environmental Protection Agency

Measures

- *maintain present efforts*

D 3 3 2 Future initiatives

Present efforts will be maintained, and no new initiatives are called for

D 3 3.3 Regulation

Local councils must assign garden waste to treatment. Garden waste may be treated in home composting without authorisation from local councils, insofar as rules in relevant regulations are complied with.

Incineration of waste is only permitted in approved plants. Local councils may authorise private burning of garden waste.

D 3 3 4 Implications for national authorities

None

D 3.3 5 Implications for local authorities

Local councils will continue their information efforts concerning schemes for home composting and/or collection and central composting. They will ensure that the present recycling rate for garden waste is maintained.

D 4 Industry

<i>Environmental problem</i>	<i>Increasing waste amounts from industry, a large proportion is land-filled</i>
<i>Initiatives</i>	<i>Improved information on waste in green accounts, environmental management, environmental approvals, and through sector-specific information</i> <i>Special efforts for sectors landfilling large amounts of waste (for example foundries and scrap enterprises)</i> <i>Guidelines on cardboard and paper</i> <i>Increased recycling of hazardous waste and environmentally harmful waste</i> <i>Guidelines on hazardous waste</i> <i>Evaluation of experience with waste consultants</i> <i>Organisation of workshop on, among others, establishment of waste exchanges</i>

Objective year 2004

- *65 % recycling of waste from industry*
- *maximum 15 % landfilling*
- *improved collection of hazardous waste*

D 4.1.1 Status

Industrial waste in this connection means waste from discarded products and production waste from manufacturing enterprises

Waste prevention must be improved, and recycling of industrial waste must be increased - also when it comes to hazardous waste. Environmentally harmful fractions must be separated, and technologies are to be developed so that energy and raw material resources are utilised to a maximum extent

Industrial waste amounts increased by almost 4 per cent from 1996 to 1997. In 1997, industrial waste amounted to 2,736,000 tonnes. The objective for recycling year 2004 is 65 per cent, and amounts of waste landfilled must not exceed 15 per cent¹⁰.

Focus will be put on industrial waste and the loss of resources connected with waste generation. Information on, for example, waste generation, waste composition, and possibilities of separating environmental contaminants in waste will in future be important elements of green accounts and environmental approvals, as well as environmental management.

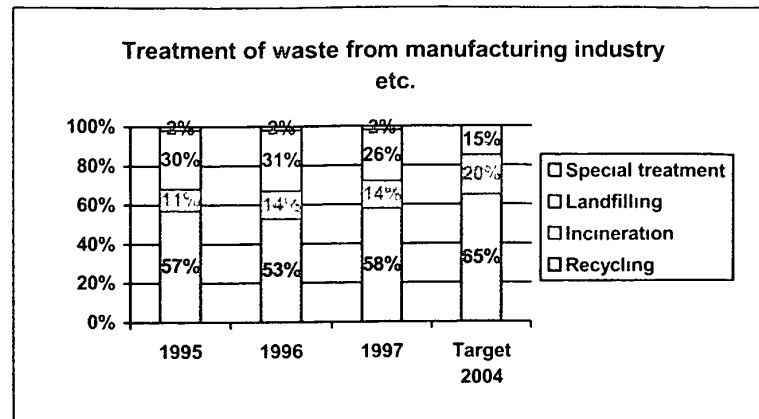
Different strategies for waste prevention will be used for process waste and waste from discarded products.

In 1997, a good quarter of waste was landfilled, whereas 58 per cent was recycled and 14 per cent incinerated¹¹. Amounts and composition of waste differ very much and depend on the sector generating the waste and the size and number of enterprises. Possibilities of recycling or reducing waste

¹⁰ In 1997, 58 % of waste from industry was recycled and 26 % landfilled. According to the Plan of Action for waste and recycling 1993-97 the objective year 2000 was a rate of recycling between 50-60%, and landfilling of only 10 %

¹¹ The increase is first and foremost due to an increase in the amounts of various burnable waste, as well as iron and metal

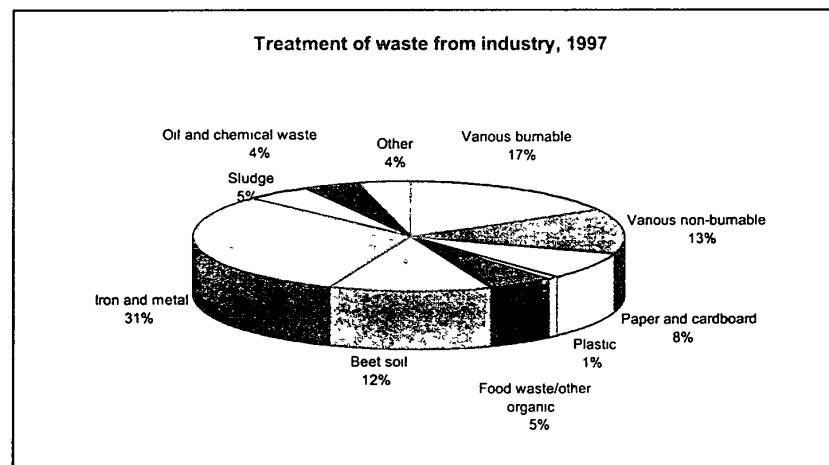
amounts are therefore very different from one waste fraction to another and from one sector to another



Source: Waste Statistics 1997, Environmental Review no. 1, 1999 from the Danish Environmental Protection Agency

For sectors with many small enterprises, it may be crucial to collect waste in larger units so that supply and economy allow for recycling

The figure below shows a statement of industrial waste divided by form of treatment. It is seen that the fractions "iron and metal", "various burnable", and "various non-burnable", as well as "beet soil" account for the largest quantities of industrial waste.



Source: Waste Statistics 1997, Environmental Review no. 1, 1999 from the Danish Environmental Protection Agency

The fraction "various non-burnable" is mainly landfilled. This fraction covers primarily beet soil, foundry waste, and waste from scrap enterprises. It should, however, be considered whether it is possible to recycle beet soil instead of landfilling this fraction.

Measures

- *evaluation of experience with waste consultants*
- *focus on waste in environmental approvals, green accounts, and environmental management*
- *establishment of waste exchanges*
- *implementation of the IPPC Directive*
- *separation of recyclable fractions from burnable waste*
- *enhancement of local councils' responsibility for increased separation of cardboard and paper*
- *guidelines on hazardous waste*

D 4.1 2 Future initiatives

The different schemes and experience with waste consultants will be evaluated

Waste prevention

Information on waste amounts, composition, and possibilities of recycling will be improved in future preparation of environmental approvals, green accounts, and in the establishment of environmental management in enterprises

- Environmental approvals will be improved with respect to waste. In the implementation of the IPPC Directive¹², the section on waste will be given priority.
- The evaluation of green accounts is expected to be completed in September 1999. In this connection it will be evaluated whether regulation must be adjusted, or whether further information is to be prepared for enterprises - also on waste.
- Preparation of a number of sector-specific reports may lead to increased use of environmental management in enterprises.

Recycling

- In 1999, a workshop will be organised in which it will be discussed how to improve the market for recyclable materials and increase recycling, including how possibilities for establishing waste exchanges may be improved.
- Burnable waste contains recyclable fractions that must be separated because they may be recycled or contain environmental contaminants. In future, in addition to cardboard and paper, industry must also separate plastic, waste electrical and electronic equipment, and impregnated wood (see Appendix E).
- Hazardous waste. Schemes will be established especially for sectors with many small enterprises for which it is a prerequisite for recycling that waste is collected into larger units. It will be studied whether the waste tax may contribute to increased recycling of hazardous waste (see Appendix E). Furthermore, a guideline will be prepared on hazardous waste, clarifying present rules.
- Collection of cardboard and paper from commerce and industry can be increased. In 1999, guidelines will be prepared, clarifying the responsibility for separation of this fraction (see Appendix E)

Landfilling

- Overall, too large amounts of industrial waste are landfilled. Especially waste from foundries and scrap enterprises account for significant amounts. Specific initiatives are directed at specific fractions. See Appendix E on foundry and shredder waste, electronics, refrigeration equipment, and end-of-life vehicles.

¹² Industrial Pollution Prevention and Control Directive no 96/61/EC, 24th September 1996

D 4 1.3 Regulation

Management of industrial waste is regulated in the Statutory Order on waste¹³. Enterprises are responsible for knowing the composition of waste, including the assessment whether waste is hazardous. If this is so, the local council must be notified.

Local authorities must assign disposal possibilities for waste generated. Local councils must establish collection or bring schemes for hazardous waste from enterprises.

Today, enterprises must separate paper, cardboard, carton, steel drums, and plastic transport packaging for recycling¹⁴.

With the above new initiatives, requirements will be made for separation of recyclable and environmentally harmful waste fractions such as PVC, impregnated wood, and waste electrical and electronic equipment (see also Appendix E).

D 4 1.4 Environmental assessment

Increased separation of environmentally harmful waste fractions will lead to better recycling possibilities for residues. Separation of recyclable fractions from the burnable waste fraction will also mean that resources in waste are utilised, and that the need for incineration capacity is reduced.

D 4.1.5 Implications for national authorities

The Statutory Order on waste will be revised to give requirements for increased separation of environmentally harmful waste fractions and recyclable fractions.

A workshop will be organised on the possibilities of increased recycling by, for example, the establishment of waste exchanges.

A guideline on hazardous waste will be prepared.

A guideline on cardboard and paper will be prepared.

A number of sector-specific reports will be prepared.

In the implementation of the IPPC Directive, focus will be put on enterprises' waste management.

In the evaluation of green accounts in 1999, it will be assessed whether waste management issues are sufficiently clarified.

D 4.1.6 Implications for local authorities

Local authorities will ensure source separation of cardboard, plastic, impregnated wood, and waste electrical and electronic equipment. Local authorities will assign separated waste fractions for recycling, landfilling, or special treatment.

¹³ Statutory Order on waste no. 299 of 30th April 1997

¹⁴ Art. 36 in Statutory Order on waste

D 5 Institutions, trade and offices

<i>Environmental problem</i>	<p>Waste amounts are increasing. Recycling today is lower than desired, and consequently resources are lost.</p> <p>Waste from institutions, trade and offices, including public offices and the service sector, contain environmental contaminants that are to be separated for special treatment.</p>
<i>Initiatives</i>	<p>Increased collection and recycling of cardboard, paper, and plastic.</p> <p>When new treatment methods have been developed, all batteries will be collected.</p> <p>Establishment of special scheme for end-of-life vehicles. Requirements will be laid down in a Statutory Order.</p> <p>Special requirements for the treatment of electronic waste.</p> <p>PVC to be separated for special treatment/disposal.</p> <p>Existing scheme for tyres to be extended.</p> <p>Existing scheme for food waste from catering centres to be re-evaluated.</p> <p>Subsidy scheme for waste oil to be re-evaluated.</p>

Objectives year 2004

- 50% recycling
- 45% incineration
- 5% landfilling

D 5 1.1 Status

This sector covers waste from institutions, trade, and private and public offices, i.e. the service sector.

This waste covers many different waste fractions, and often the composition is not known. This causes difficulties in making focused efforts for the sector as a whole.

Amounts of waste from institutions, trade and offices are increasing. Recycling of waste from this sector must be increased, and environmentally harmful fractions must be separated for special treatment. Enterprises and public and private institutions play an important role in increasing separation of recyclable materials and environmentally harmful fractions.

Total waste amounts were 861,000 tonnes in 1997¹⁵. Amounts from the service sector increased steeply - by a good 25 per cent - from 1994 to 1995, whereas amounts only increased by between 1 and 2 per cent from 1995 to 1997.

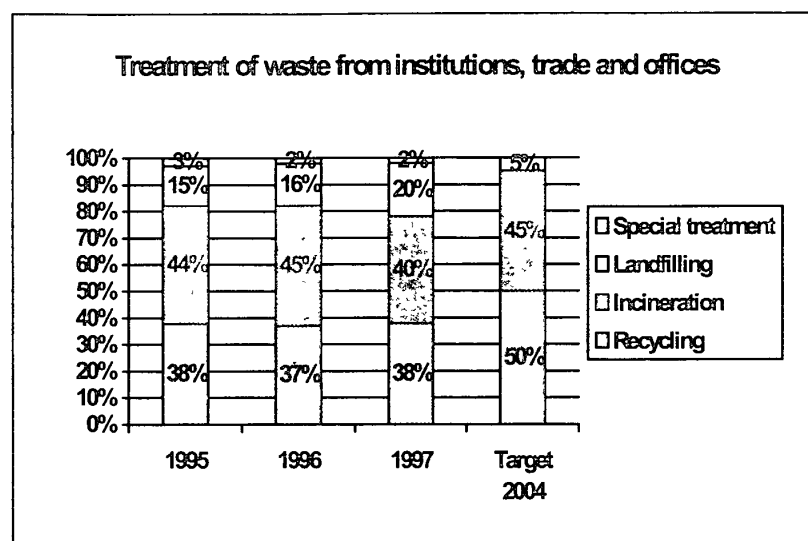
In 1997, the rate of recycling was 38 per cent which is below the target of 60 per cent for year 2000. 41 per cent was incinerated and 20 per cent land-filled, whereas 2 per cent was transferred to special treatment. As considerable changes have been seen in amounts and composition of waste from the

¹⁵In the Plan of Action for waste and recycling 1993-97 the target was to recycle 60% of waste from trade and offices and to incinerate 40%.

service sector, the objective for recycling is reduced to 50 per cent, and it is not expected to be possible to avoid landfilling completely

A few local authorities and waste companies have engaged waste consultants with the task of increasing information on municipal regulations and to guide enterprises to more environmentally appropriate waste management. Existing schemes for waste consultants will be evaluated.

In 1998, a study was carried out to clarify barriers to increased recycling of waste suitable for incineration. The resulting report gives a number of recommendations to overcome these barriers. It is recommended that local authorities do more fieldwork at enterprises (for example in the form of waste consultant schemes), that easier schemes are introduced for small enterprises, or that monitoring is introduced at waste incineration plants in order to avoid delivery of recyclable waste.



Source: Waste Statistics 1997, Environmental Review no. 1, 1999 from the Danish Environmental Protection Agency

Measures

- increased recycling of paper, cardboard, plastic and glass
- separation of environmentally harmful fractions such as batteries, tyres, PVC, waste electrical and electronic equipment, and refrigeration equipment
- re-evaluation of existing schemes for organic waste and waste oil
- evaluation of waste consultant schemes
- survey of waste composition

D 5 1.2 Future initiatives

A number of initiatives launched in this sector will be directed at specific fractions.

Recycling of cardboard and paper, glass, and plastic from institutions, trade and offices should be increased (see Appendix E).

Environmentally harmful fractions such as batteries, tyres, PVC, waste electrical and electronic equipment, and refrigeration equipment are to be separated for special treatment (see Appendix E).

Existing schemes for organic waste and waste oil will be re-evaluated (see Appendix E).

Various schemes and experience with waste consultants will be evaluated.

A survey of waste composition will be carried out, focusing on landfilled waste and on the recycling potential.

D 5.1 3 Regulation

Local councils must assign disposal possibilities for waste generated in this sector

Today, enterprises, institutions, offices etc must separate cardboard, paper, carton, steel drums, and transport packaging of plastic for recycling.

In 1994, an agreement was made between the Ministry of Environment and Energy and the Confederation of Danish Industries, the Danish Plastics Federation and the Packaging Industry on transport packaging. The agreement set up the objective that 80 per cent of transport packaging of plastic, and cardboard and paper should be recycled before year 2000, either by reuse or material recycling. In 1998, the agreement was adjusted so that the definition of transport packaging now follows the definition given in the EU packaging Directive, and so that the objectives set in percentages now only apply to material recycling.

D 5 1 4 Capacity

For the major part of recyclable fractions, treatment capacity is sufficient. For several environmentally harmful fractions, treatment methods have not yet been fully developed

D 5.1 5 Environmental assessment

Efforts for increased recycling will reduce the need for incineration and landfill capacity and ensure utilisation of resources in waste.

D 5.1 6 Implications for national authorities

The Statutory Order on waste will be revised to state that environmentally harmful waste fractions are to be separated for special treatment. A guideline for collection of cardboard and paper will be prepared.

D 5.1.7 Implications for local authorities

Local authorities will improve information on existing schemes, and enhance supervision at enterprises and institutions in this sector, especially concerning the duty to use assignment schemes for recyclable waste.

D 6 Power plants

Objective year 2004

- 90% recycling of residues from coal-fired power plants
- reduce coal-based energy generation
- ensure that recycling of bioash takes place in an environmentally appropriate manner

D 6 1 1 Status

Danish power supply has primarily been based on coal. In 1996, the Danish Government presented a comprehensive plan of action for energy - Energy 21 - which will ensure that Denmark contributes to reducing CO₂ emissions by 20 per cent in year 2005 compared to the 1988 level.

The target of Energy 21 is to reduce energy consumption by utilising energy more efficiently, and to convert supply from fossil fuel to renewable energy sources.

As a consequence, the use of coal as fuel will be phased out almost completely, in parallel to an increase of energy generation based on renewable energy, including biofuel, within the next 30 years.

The use of biofuel primarily takes place today at plants that only generate heating. In the extension in the coming years, biomass will be used to a far larger extent at power generating plants, as new technology is developed.

In energy generation, varying amounts of residues are generated. Oil and natural gas-fired power plants, for example, generate hardly any residues.

Amounts of residues generated depend on power generation and also on imports/exports of power. Waste amounts from power plants can therefore only be reduced by reducing the generation of power, increasing energy efficiency of power plants, or by phasing out fuels that cause generation of waste, such as coal.

The phasing-out of coal-based energy generation will have a decisive influence on amounts of residues generated, and amounts are expected to drop significantly over the next 30 years. Correspondingly, increasing use of biofuel will lead to increasing amounts of bioash. Recycling of this waste fraction will be prioritised in the coming years.

So far, residues from coal-fired power plants have accounted for the largest waste fraction from power plants.

Residues from coal-fired power plants cover slag, fly ash, gypsum, TASP and sulphuric acid. Residues contain a number of heavy metals, and thereby possibilities of recycling are limited.

The objective for recycling of residues from coal-fired power plants has been achieved with a recycling rate in 1997 of 73 per cent¹⁶. A total of 1,775,000 tonnes residues were generated in 1997. The objective in year 2004 is 90 per cent recycling of residues from coal-fired power plants.

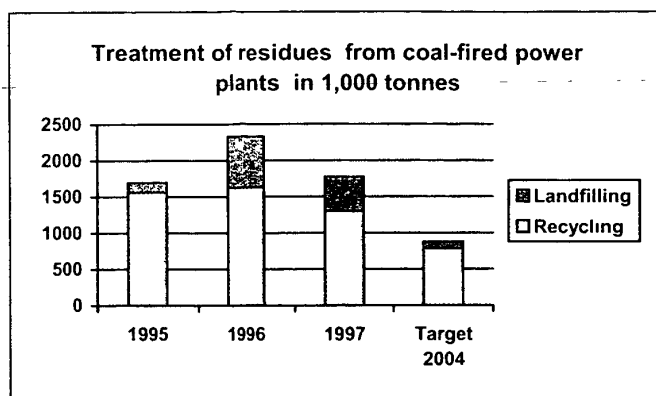
¹⁶ In the Plan of Action for waste and recycling 1993-97 the objective was to recycle 56%, and to landfill 44% of total amounts of residues before year 2000.

Measures

- *implementation of Energy 21*

D 6.1 2 Future initiatives

Energy 21 will be implemented. The Plan of Action is part of the Government's efforts against climate change. The phasing-out of coal-fired power plants will, however, also lead to a reduction of residues.



Source: Waste Statistics 1997, Environmental Review no. 1, 1999 from the Danish Environmental Protection Agency

D 6.1 3 Regulation

Since the amendment to the waste tax in December 1998, the tax now also includes landfilling of residues in the high rate for landfilling. This gives a further incentive to reduce amounts of residues or alternatively to recycle residues.

Energy 21 will lead to a conversion from the use of fossil fuel to renewable energy sources.

D 6.1 4 Environmental assessment

In the long term, residues from coal-based energy generation will disappear, as energy generation based on coal is phased out. As a consequence, leaching of metals and salts from such residues will stop. The fertilising content of bioash will be utilised.

D 6.1 5 Implications for national authorities

None.

D 6.1 6 Implications for local authorities

None.

D 7 Wastewater treatment plants

D 7 1.1 Status

Objective year 2004

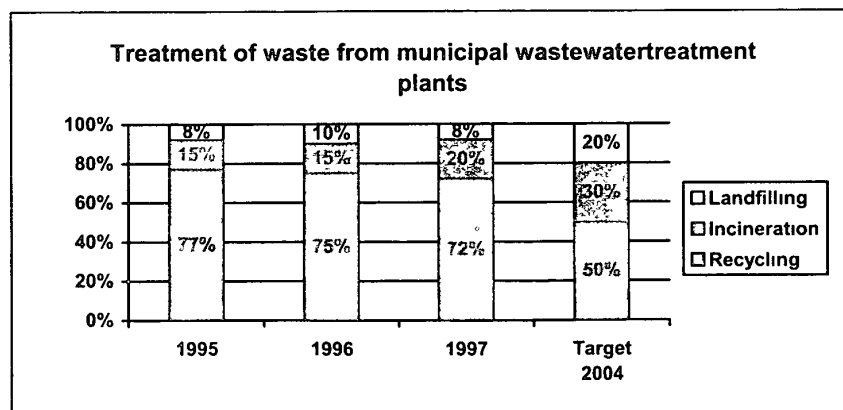
- 50% recycling of sludge by application to farmland

In 1987, the Folketing adopted an Aquatic Environment Plan according to which all wastewater treatment plants with a capacity above 5,000 person equivalents were to improve wastewater treatment before 1st January 1993. The extension of treatment plants was completed in the beginning of 1996.

Waste from wastewater treatment plants covers sludge, sand, and screenings. In 1997, around 1,248,000 tonnes waste were generated (wet weight) at municipal wastewater treatment plants. Sludge accounts for 1,209,000 tonnes. No significant changes are expected in future.

Of total waste amounts from wastewater treatment plants, 70 per cent was recycled in 1997. 20 per cent was incinerated and 10 per cent landfilled. This means that the Government's objective of 50 per cent recycling in year 2000 has been attained.

The introduction in 1997 of requirements for the contents of certain organic chemical substances in sludge is expected to lead to a need for alternatives to application to farmland in a transitional period.



Source: Waste Statistics 1997, Environmental Review no. 1, 1999 from the Danish Environmental Protection Agency

D 7 1.2 Future initiatives

In the long term, it is expected that the quality of sludge and possibilities of recycling will be improved through the general policy of phasing-out environmental contaminants. The contents of these substances in sludge will thereby be reduced.

D 7 1.3 Regulation

Application of sludge to farmland is regulated in the Statutory Order on sludge¹⁷, and the Statutory Order of the Ministry of Food, Agriculture and Fisheries on inspection of the quality of municipal sewage sludge and composted household waste applied to farmland¹⁸. The Statutory Order on sludge lays down limit values for a number of heavy metals, and cut-off

¹⁷ Statutory Order no. 823 of 16th September 1996 on application of waste products for agricultural purposes

¹⁸ Statutory Order no. 528 of 20th June 1997

values for organic xenobiotic substances NPE, DEHP, LAS and certain PAHs. Cut-off values for organic substances took effect on 1st July 1997 and will, together with limit values for cadmium, become stricter as per 1st July 2000.

D 7.1.4 Environmental assessment

In the long term, contents of xenobiotic substances in sludge are expected to decrease.

D 7.1.5 Implications for national authorities

None

D 7.1.6 Implications for local authorities

None

APPENDIX E

Fractions

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E Fractions

A number of waste fractions are discussed below. Several fractions play a significant role in Waste 21. Waste fractions have been selected because they constitute a special environmental problem

Waste fractions are described whether or not new initiatives will be launched

The EU has surveyed a number of waste streams with a view to having the Commission put forward proposals for regulation of these fractions. These fractions - the so-called "priority waste streams" - are discussed. Priority waste streams are health-care risk waste, end-of-life vehicles, waste electrical and electronic equipment, tyres, building waste, and chlorinated solvents. For these waste streams, initiatives have already been launched in Denmark.

Under each waste fraction status, future initiatives, objectives year 2004, and measures to be implemented to meet objectives are described. Implications of initiatives for national and local authorities are also described, and waste treatment capacity is assessed.

In order to achieve objectives for year 2004, the State and local councils must live up to their obligations, including the preparation of necessary rules and regulations, and citizens and enterprises must contribute to good waste solutions. Information and development activities planned require substantial support from the Environmental Council for Cleaner Products.

E 1 Batteries and accumulators

<i>Environmental problem</i>	<i>Batteries and accumulators may contain large quantities of heavy metals, especially lead but also mercury, cadmium, and nickel</i> <i>Non-collected nickel-cadmium batteries are the most significant source of cadmium in waste streams</i> <i>Mercury is the largest barrier to efficient treatment of batteries</i> <i>Some batteries also contain resources such as steel, zinc, manganese, and carbon that may be recovered</i>
<i>Initiatives</i>	<i>When suitable separation and treatment methods have been developed, collection schemes for all types of battery will be established</i>

Objective year 2004

- *recover raw material resources in all batteries*
- *99.9 % collection of lead accumulators*
- *95 % collection of Ni-Cd batteries*

E 1.1 Status

Special collection schemes and suitable recycling methods exist for lead accumulators and nickel-cadmium batteries. The collection schemes work well.

In 1998, 14,900 tonnes of lead accumulators were sold in Denmark. This corresponds to the amounts of accumulators that, on an average, become waste every year. The collection rate for spent lead accumulators is 98 per cent, and the objective of 99.9 per cent in year 2000 is expected to be achieved.

It is assessed that 86 per cent of discarded batteries and accumulators derives from the service sector, 10 per cent from domestic waste, 2 per cent from bulky waste, and 2 per cent from industry. Accumulators mainly derive from the service sector, and from bulky waste.

Batteries may be subdivided roughly into two categories: single-use batteries and rechargeable batteries (see table).

Types of battery
Single-use batteries <ul style="list-style-type: none"> alkaline batteries which used to contain mercury. Today most types are without mercury manganese dioxide batteries that for many years have been mercury-free lithium batteries silver oxide batteries
Rechargeable batteries <ul style="list-style-type: none"> nickel-cadmium batteries, nickel-metal hydride batteries lithium batteries

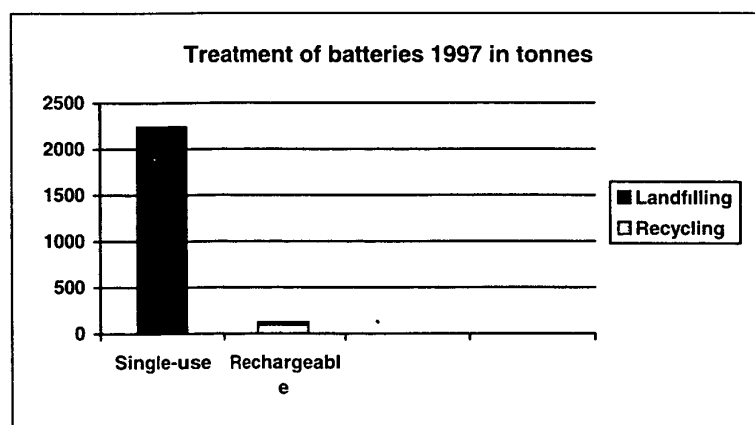
In 1998 around 2,500 tonnes batteries were sold of which 260 tonnes were rechargeable.

According to assessments, some 120 tonnes of waste nickel-cadmium batteries were generated in 1997. Of these, 95 tonnes were collected for recycling. Nickel-cadmium batteries and lead accumulators are reprocessed in Sweden or France.

Experience from many years' collection of batteries in Denmark shows that it is difficult for consumers to distinguish between different types of battery, despite the fact that recyclable batteries carry a special recycling label. The result is that many consumers either collect all batteries regardless of type, or dispose of all types in domestic waste.

As a consequence, around half the discarded batteries are collected as a mixture of single-use and rechargeable batteries. The rest are disposed of in domestic waste.

Local authorities, municipal waste companies, and Kommunekemi A/S separate Ni-Cd batteries for recycling. The rest of collected batteries are landfilled. Mercury-bearing batteries are normally landfilled at the Kommunekemi A/S special landfill site, and other types at conventional landfills.



Mercury contents in batteries have in the past been an obstacle to reprocessing. In future, the major part of single-use batteries will not contain mer-

cury, and in future they may be recovered. At international level, significant progress has been seen in the development of new technology for recovery of resources in new battery types. It is therefore expected that far more batteries can be recovered in future.

However, it is a prerequisite for efficient recycling that, in addition to recovery technology, reliable separation technologies are developed.

In a draft amendment to the EU Directive on batteries it is suggested that all batteries should be collected for separate reprocessing of different fractions.

Measures

- *development of new treatment and separation methods*

E 1.2 Future initiatives

Initiatives to support the development of suitable methods of treatment and separation will be promoted.

When such methods have been developed, requirements for separate collection of all batteries will be made.

E 1.3 Regulation

Collection of batteries is regulated in the Statutory Order on waste¹. Nickel-cadmium batteries, lead accumulators and lithium batteries as well as un-separated batteries are classified as hazardous waste, whereas clean fractions of, for example, non-heavy-metal-containing batteries are normally not considered as hazardous waste.

The collection of nickel-cadmium batteries and lead accumulators is also regulated by economic instruments, and collection is assumed by both private and public companies.

Collection of *lead accumulators* is ensured in an agreement between the Minister for Environment and Energy and the battery industries (Returbat), under which Returbat is liable for collection of all spent lead accumulators in Denmark. The agreement is supplemented by two Statutory Orders. The first Statutory Order² lays down conditions for being registered as collector and thereby obtain subsidies. The second Statutory Order³ gives the financial basis for the scheme.

Returbat administers the scheme and, on the basis of an approved budget, receives funds from the Danish Environmental Protection Agency for remuneration.

Remuneration of maximum DKK 0.80/kg is granted to collectors delivering spent accumulators to approved recycling plants.

An environmental fee⁴ is levied on *nickel-cadmium batteries*. The fee is remunerated for the collection of spent nickel-cadmium batteries. In connection with the scheme, a Statutory Order has been issued⁵, stating criteria to be met by collectors of spent nickel-cadmium batteries in order to achieve a registration as a professional collector and thereby be granted remuneration.

The scheme is administered by the Danish Environmental Protection Agency.

¹ Statutory Order on waste no. 299 of 30th April 1997

² Statutory Order no. 91 of 22nd February 1996 on collection of lead accumulators and remuneration for collection and disposal for recycling

³ Statutory Order on fees on lead accumulators

⁴ In 1995, an environmental fee on nickel-cadmium batteries was introduced in Denmark, in pursuance of Act no. 414 and Act no. 404 of 14th June 1995

⁵ Statutory Order no. 93 of 22nd February 1996

A remuneration of DKK 120/kg is granted for spent Danish batteries delivered to an approved recycling plant

E 1.4 Capacity

Capacity for recovery of lead, cadmium and nickel is available in Sweden and France

Mercury-bearing batteries may be sent for treatment in, for example, Germany, the Netherlands and Switzerland

E 1.5 Environmental assessment

The establishment of collection schemes for all batteries may lead to an even higher collection rate - also for nickel-cadmium batteries

Furthermore, in the longer term, collection of all types of battery will lead to better financial utilisation of resources in more types of battery.

However, it is a prerequisite for utilisation of resources that mercury contents in batteries are reduced to a level where they do not present an obstacle to reprocessing

E 1.6 Economic aspects

Exact treatment costs for all types of battery cannot be calculated before treatment methods have been developed

E 1.8 Implications for national authorities

An amendment to the Statutory Order on waste is necessary to state that all batteries are to be collected when new treatment methods have been developed

E 1.7 Implications for local authorities

In their waste management planning, local authorities will take into account the collection of all batteries when new treatment methods have been developed

E 2 End-of-life vehicles (ELV)

<i>Environmental problem</i>	<i>Waste from end-of-life vehicles contains many environmentally harmful substances. These are especially heavy metals that today end at waste incineration plants or landfills</i>
<i>Initiatives</i>	<i>Establishment of separate scheme for end-of-life vehicles</i> <i>Requirements will be laid down in a Statutory Order</i> <i>Increased recycling of windscreens by development of new separation technologies</i> <i>Preparation of environmental guidelines for public purchasers of vehicles</i>

Objective year 2004

- *80% recycling of waste amounts*
- *environmentally safe management of harmful fractions*

E 2.1 Status

Different waste fractions are generated both before and after shredding (scrapping) of vehicles. End-of-life vehicles contain waste such as iron and metal parts, tyres, plastic, glass, oil, and other liquids

For tyres, waste oil, and lead accumulators special schemes have been introduced, and they are described under the relevant sections of this Appendix

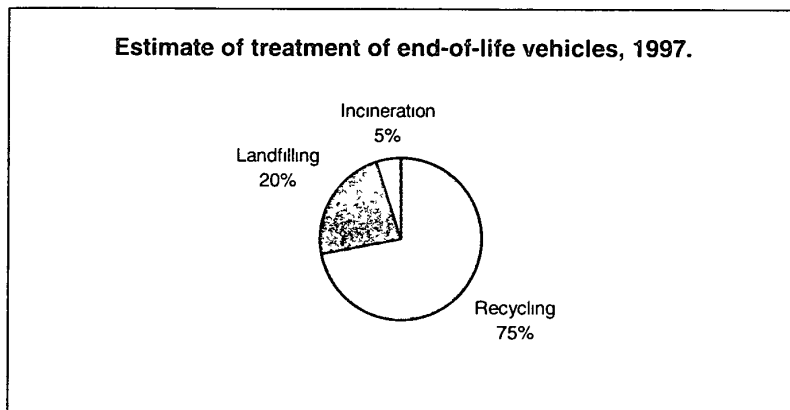
After shredding, recyclable fractions such as iron, aluminium, and copper arise. The residue (shredder waste) is landfilled today (see also Section E 20).

End-of-life vehicles contain environmental contaminants, which end up in residues from incineration plants and at landfills. Management of end-of-life vehicles will be improved, ensuring increased recycling and environmentally appropriate treatment of environmentally harmful fractions.

In 1997, around 130,000 tonnes of vehicles were discarded, of which around 1,000 tonnes were hazardous waste.

A rough estimate shows that 95 per cent of waste from ELV is collected via car scrappers and similar service enterprises, and 5 per cent comes directly from industry.

Of total amounts of waste from ELV, it is assessed that around 75 per cent was recycled and around 20 per cent landfilled. The remaining 5 per cent was incinerated. The objective for year 2000 of 80 per cent recycling is to be achieved by increased recycling of tyres and windscreens.⁶



Various projects have been launched to develop new separation technologies with a view to recovery of glass by recycling.

Environmental guidelines have been prepared for public purchasers of vehicles.

A draft Directive on end-of-life vehicles has been tabled in the EU.

⁶ In the Plan of Action for waste and recycling 1993-97 the objective was to reduce amounts of waste generated in scrapping of vehicles. The objective was to be achieved by entering voluntary agreements with relevant industrial associations. In 1995, the Minister for Environment and Energy entered an agreement with the Danish Motor Trade Association, the Association of Danish Recycling Industries and municipal associations on a take-back scheme for discarded tyres.

Measures

- *requirements for management of waste from ELV*
- *requirements for separation of recyclable and environmentally harmful fractions*
- *requirements for enterprises reprocessing ELV*
- *development of new technology for recycling of windscreens*

E 2.2 Future initiatives

In 1999, a Statutory Order will be issued on management of end-of-life vehicles. Recyclable and environmentally harmful fractions will be separated for recycling or environmentally appropriate disposal. A certification scheme will be introduced for enterprises reprocessing ELV. Such a certification scheme will mean that waste can only be assigned to enterprises documenting that they comply with requirements stated in the Statutory Order. The requirement for a certification scheme requires an amendment to the Danish Environmental Protection Act.

Initiatives supporting the development of new separation technologies for recovery of windscreens by recycling, will be promoted. Results will be evaluated regularly. The legal base for increased recycling of windscreens will be amended as necessary.

E 2.3 Regulation

Management of end-of-life vehicles is regulated in overall rules in the Statutory Order on waste and in environmental approvals of enterprises shredding and scrapping vehicles.

E 2.4 Capacity

Today, around 350-400 enterprises exist for the reprocessing of end-of-life vehicles. Of these, five are shredder enterprises.

The planned Statutory Order on management of waste from end-of-life vehicles will have an impact on the number of dismantling enterprises which is expected to drop to some 100-150 enterprises.

Capacity is not expected to present an obstacle to achieving new objectives for recycling.

E 2.5 Environmental assessment

It is expected that the planned Statutory Order on management of end-of-life vehicles will lead to

- dismantling of 3,500 tonnes of tyres for recycling
- separation of 25 tonnes of lead for recycling
- drawing-off of around 400 tonnes of waste oil
- drawing-off of around 400 tonnes of other liquids

Within two to three years, the development of new separation technologies for recycling of windscreens is expected to lead to requirements for dismantling and recovery of glass. Around 2,000 tonnes of windscreens per year will presumably be recycled.

E 2.6 Economic aspects

The implementation of the Statutory Order on management of end-of-life vehicles is expected to lead to additional costs for consumers of DKK 30-40 million.

Consumers normally pay today DKK 300-400 per scrapped end-of-life vehicle. The future scrapping price is expected to be DKK 600-700 per vehicle.

E 2.7 Implications for national authorities

A Statutory Order on management of end-of-life vehicles will be issued.

E 2.8 Implications for local authorities

In their waste management plans, local authorities will ensure assignment of waste to plants complying with requirements of the Statutory Order for management of end-of-life vehicles.

E 3 Tyres

<i>Environmental problem</i>	<i>Tyres constitute an important resource which is not recovered to a satisfactory extent today</i>
<i>Initiatives</i>	<i>The existing tyre collection scheme to be extended to cover large tyres</i> <i>Development of new possibilities of recycling for rubber powder</i> <i>Preparation of environmental guidelines for public purchasers of tyres</i> <i>Information campaign to be launched on limitation of damage in fitting, and promotion of sale of retreaded tyres</i>

Objective year 2004

- 80 % recycling or incineration of all discarded tyres

E 3.1 Status

Tyres contain rubber, steel, and textiles

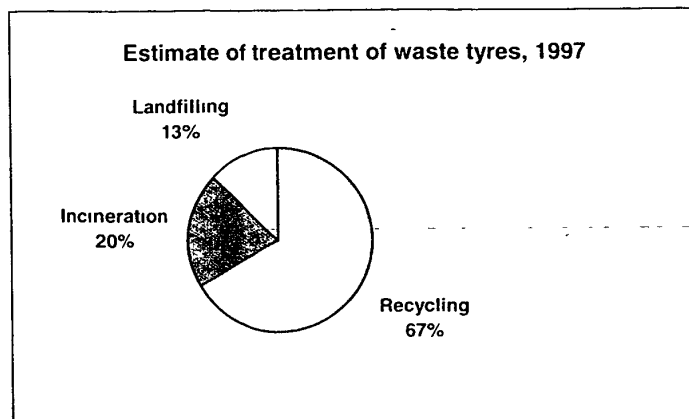
Waste tyres are an important resource which should be recycled or incinerated. Resource utilisation of waste tyres is not sufficient today. Until now, it has only been possible to recycle small tyres, and the objective for 1997 for recycling of such tyres has been achieved⁷. The objective before year 2004 is recycling or incineration of 80 per cent of all discarded tyres.

In 1997, waste tyres amounted to around 40,000 tonnes, of which around 25,000 tonnes were recycled. The remaining part was incinerated or land-filled⁸. Around 40 per cent of total amounts of tyres is assessed to derive from private consumers, and 60 per cent is assessed to come from industry and commerce. It is furthermore believed that the major part of tyres is disposed of via the service sector.

Studies on recycling of rubber powder have been started

⁷Cf the take-back agreement for tyres, the objective was to recycle 80% of all small tyres from private cars, vans, and motorbikes. In 1997, a collection rate of 93% was registered for small tyres.

⁸ In 1997, it became possible to dispose of large tyres either for recycling or incineration with energy recovery. On this basis, objectives were revised.



Measures

- *requirement for collection and recycling/incineration with energy recovery of large tyres*
- *development of new possibilities of recycling of rubber powder*
- *information campaigns*
- *environmental guidelines to public purchasers of tyres*

E 3.2 Future initiatives

In 1999, the Statutory Order on fees and subsidies for disposal of tyres⁹ will be revised and sent to hearing. Requirements will be made for collection and granting of subsidies to enterprises either recycling or incinerating large tyres

Initiatives to support the development of new recycling possibilities for rubber powder will be promoted. Legislation and objectives will be revised as necessary.

As part of the take-back agreement, the Danish Tyre Trade Environmental Foundation carries out information campaigns with the purpose of limiting damage in fitting and promoting sales of retreaded tyres.

According to the plan of action for public purchasers, environmental guidelines will be prepared in the planning period for public purchasers of tyres.

E 3.3 Regulation

On 20th February 1995, the Minister for Environment and Energy entered an agreement with the Danish Motor Trade Association, the Association of Danish Recycling Industries and municipal associations on a take-back scheme for discarded tyres.

Through the agreement it is ensured that discarded tyres are collected and recycled or incinerated, avoiding thereby landfilling and ensuring resource utilisation of waste tyres. The collection and disposal system is designed on the following prioritisation: retreading, rubber powder production, incineration.

The agreement requests enterprises selling tyres to take back a corresponding number of discarded tyres without additional costs for the consumer.

Professional collectors are required to receive all tyres from enterprises collecting or receiving discarded tyres, including municipal collection schemes, and to deliver these for recycling or incineration.

⁹ Statutory Order no 799 of 4th September 1996

Further to the agreement, a fee was introduced on tyres¹⁰ to finance collection and treatment, administration of the scheme, and information campaigns¹¹

Subsidies are granted to tyre collectors that must be registered under the Danish Environmental Protection Agency. Registered enterprises must state in which municipalities tyres are collected. On certain conditions, enterprises are required to collect tyres from waste producers. The payment of subsidies for collection is effected only when tyres have been delivered to a reprocessing plant (rubber powder manufacturer).

No subsidies are granted for tyres delivered for reuse, including retreading

An intermediary objective is that at least 80 per cent of all discarded tyres from private cars, vans, and motorbikes will be collected and recycled or incinerated before 1997. According to the agreement, 80 per cent of all discarded tyres must be recycled or incinerated before year 2000. In 1999, the rules will therefore be extended to cover large tyres.

E 3.4 Capacity

Around 40 reuse plants exist in Denmark, retreading small tyres. In addition, one recycling plant exists, manufacturing rubber powder from tyres.

It is not considered that existing plant capacity constitutes a barrier to achieving the objective for year 2004 for recycling or incineration.

E 3.5 Environmental assessment

It is expected that the amendment to the Statutory Order will lead to all tyres being covered by the fee and subsidy scheme. Thereby, at least 90 per cent of total waste tyres will be recovered through reuse, material recycling, or incineration with energy recovery.

E 3.6 Economic aspects

The costs to industry and commerce of also introducing a fee for large tyres are expected to amount to some DKK 20 million.

Costs of collection and landfilling large tyres today are DKK 14-16 million. Therefore, extra costs of the new scheme will be DKK 4 to 6 million.

E 3.7 Implications for national authorities

In the coming planning period, Statutory Order no. 799 of 4th September 1996 on fees and subsidies for disposal of tyres will be revised.

E 3.8 Implications for local authorities

Local authorities are to assign tyres to special treatment.

¹⁰ The agreement took statute form in Statutory Order no. 144 of 3rd March 1995, now replaced by Statutory Order no. 799 of 4th September 1996 on fees and subsidies for disposal of tyres. The Statutory Order is, among others, based on Art. 53 in the Danish Environmental Protection Act, stating that rules can be issued to the effect that importers and manufacturers of certain specifically stated products must pay a fee for waste disposal to cover, in part or in total, costs of disposal of products, and stating rules on fee levying and application.

¹¹ Since January 1996, the subsidy scheme has been administered by the Danish Tyre Trade Environmental Foundation.

E 4 Waste electrical and electronic equipment

<i>Environmental problem</i>	<i>Waste electrical and electronic equipment contains many environmentally harmful substances, especially heavy metals</i>
<i>Initiatives</i>	<i>Establishment of separate scheme for waste electrical and electronic equipment Requirements for the scheme have been laid down in a Statutory Order</i> <i>Preparation of environmental guidelines to public purchasers of electrical and electronic equipment and eco-labelling criteria for several products</i> <i>Establishment of product panel for electronics</i> <i>Better resource utilisation by development of new technologies for reprocessing of products</i>

Objective year 2004

- *increased recycling of resources from waste electrical and electronic equipment*
- *avoid delivery to waste incineration plants and landfills of waste electrical and electronic equipment*
- *environmentally safe disposal of waste electrical and electronic equipment*

E 4.1 Status

Electrical and electronic equipment primarily covers radio and television equipment, IT products, regulation and monitoring equipment, white goods, and office equipment

A special scheme for the treatment of refrigeration equipment exists, see Section E 11.

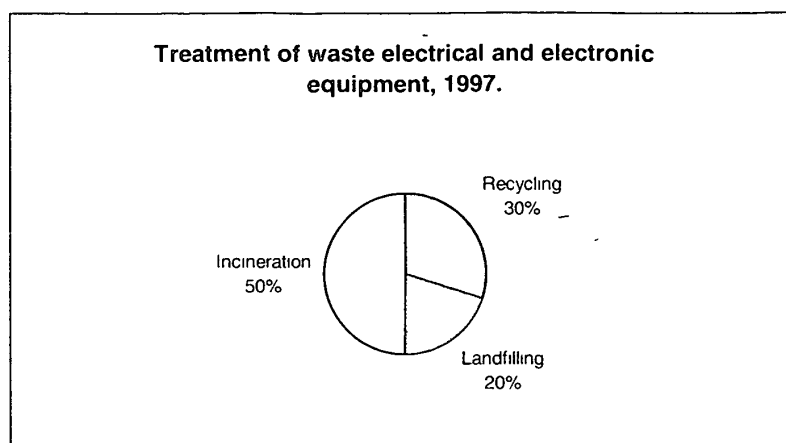
Management of waste electrical and electronic equipment will be improved. Products are managed today in the conventional waste management system and account for a large part of environmental contaminants ending up in residues and landfills. Recycling of waste electrical and electronic equipment's contents of metals, glass etc. will be increased, and as far as possible this waste fraction will be kept away from incineration plants and landfills. Mass flow analyses for copper and lead show that 60 per cent of copper and 40 per cent of lead going to landfills and incineration plants derives from waste electrical and electronic equipment

Total amounts of waste electrical and electronic equipment, with a deduction of refrigeration equipment, which is discussed in Section E 11, have been calculated at 103,000 tonnes in 1997¹². The largest part is assessed to come from municipal bulky waste schemes (48 per cent). The remaining part is assumed to come from domestic waste (15 per cent), from institutions, trade and offices, the service sector (20 per cent), and industry (15 per cent). The remaining 2 per cent comes from the building and construction sector. Around 6,000 tonnes electronic equipment were subjected to special treatment in 1997, and 60,000 tonnes electrical equipment were mainly led to shredder plants. Against this background, it is assessed that around 30,000 tonnes were recycled in 1997, corresponding to around 30 per cent of calculated amounts of waste electrical and electronic equipment.

A Directive on disposal and reprocessing of waste electrical and electronic equipment is expected to be presented in the EU in 1999.

¹² Total amounts are distributed as follows

around 43,000 tonnes electronic equipment and around 60,000 tonnes electrical equipment



Measures

- *requirements for management and disposal of waste electrical and electronic equipment*
- *environmental guidelines to public purchasers of electronic office equipment*
- *establishment of product panel*
- *development of improved reprocessing methods*

E 4.2 Future initiatives

In 1998, a Statutory Order on management of waste from electrical and electronic products was issued¹³. It is required that such waste is treated in an environmentally appropriate manner.

Further to the plan of action for public purchasers, guidelines were prepared in 1998 for public purchasers on a number of electronic office equipment, and eco-labelling criteria will be prepared for several products.

The integrated product policy will improve products by considering waste management already in the design of products. A product panel for electronics will be established in 1999.

Development of new technologies for reprocessing waste electrical and electronic equipment will be evaluated regularly. If there is a need for amending rules and regulations with a view to using best available technology, this will be done currently.

E 4.3 Regulation

Management of waste electrical and electronic equipment has so far been regulated in general rules in the Statutory Order on waste, the Statutory Order on management of waste from electrical and electronic products, and through environmental approvals of enterprises managing, reprocessing or disposing of this waste fraction.

E 4.4 Capacity

Of total amounts of electronic equipment, it is assessed that a further 20,000-30,000 tonnes will be collected and treated separately.

Around ten disassembly enterprises exist today.

Present capacity is around 12,000 tonnes per year, but the industry has stated that there will be no capacity problems in future.

¹³ Statutory Order no 1067 of 22nd December 1998 on management of waste from electrical and electronic products

E 4.5 Environmental assessment

Separate treatment of waste electrical and electronic equipment will increase recycling of heavy metals contained in the products. The possibility of recycling slag from incineration plants will also be improved.

It is expected that the Statutory Order on management of waste from electrical and electronic products will shift around 25,000 tonnes of electronics from waste incineration and landfilling to recycling. This corresponds to 40 per cent of copper landfilled today.

The integrated product policy is expected at the same time to lead to products more suitable for recycling and products containing less environmental contaminants.

E 4.6 Economic aspects

Total costs of reprocessing waste electrical and electronic equipment are calculated at DKK 100-200 million/year. It is assessed that the Statutory Order will lead to an increase in the annual waste collection fee for households of some DKK 40. For enterprises and institutions, the costs of managing 10-15,000 tonnes of electronic products will amount to some DKK 5,000/tonne compared to present costs of maximum DKK 800/tonne.

The purchase price of a television set or a computer is today from DKK 2,000 to DKK 10,000. Costs of disposal with today's requirements amount to DKK 10 to 20 per unit. Further to the new requirements, costs of disposal will increase to DKK 100 to 200. It is seen that costs of disposal will still constitute a small proportion of the purchase price.

E 4.7 Implications for local authorities

Local authorities will ensure that waste electrical and electronic equipment is collected and assigned to separate treatment at approved enterprises.

E 5 Packaging waste

<i>Environmental problem</i>	<i>Packaging waste contains large quantities of reuseable packages and recyclable materials. When environmental and economic considerations make it feasible, packaging waste is to be recycled instead of incinerated.</i>
<i>Initiatives</i>	<i>Citizens will have the opportunity to separate cardboard packaging, for example via bulky waste schemes.</i> <i>It will be studied how collection of plastic drums from households can be organised.</i> <i>Glass collection will be improved.</i>

Objectives year 2001

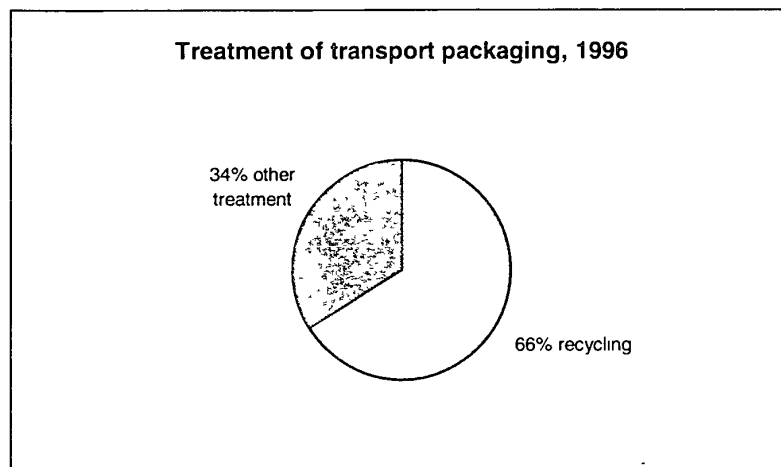
- *cardboard/paper packaging - 55% recycling in year 2001*
- *plastic packaging - 15% recycling in year 2001*
- *metal packaging - 15% recycling in year 2001*
- *glass packaging - 65% recycling in year 2001*

E 5.1 Status

Contrary to many other countries, Denmark has chosen not to establish one separate management system for all packaging waste. Instead, focus is put on how best to utilise various recyclable materials in waste from different sectors - and this also applies to packaging waste.

Packaging waste covers many different waste fractions such as glass, paper and cardboard, and plastic. Fractions are also discussed in separate sections in this Appendix.

As a general rule, it has been chosen not to include sales packaging of paper and cardboard, metal and plastic in recycling systems. Considering environmental economics and occupational environment and health aspects, such sales packaging is thought to be less suitable for material recycling than transport packaging. This is partly due to the fact that a fraction of, for example, plastic packaging from households will contain different types of plastic, and that the fraction will typically be contaminated with residues of foodstuffs, detergents, and similar.



The objective for material recycling of paper and cardboard is primarily achieved by recycling transport packaging from industry and commerce, in accordance with the voluntary agreement on recycling of transport packaging which was made in 1994 between the Minister for Environment and Energy and the Confederation of Danish Industries, the Danish Plastics Federation, and the Packaging Industry. In 1996, the rate of recycling for transport packaging of paper and cardboard amounted to 66 per cent.

The objective for plastic packaging is also expected to be primarily achieved through transport packaging from industry and commerce.

Material recovery of metal packaging covers recycling of steel drums from industry and commerce, as well as recycling metal scrap from incineration plants which arises from incineration of, among others, domestic waste.

Material recycling of glass packaging is done partly by recycling end-of-life beer and soft drink bottles, partly by recycling bottles for wine and spirits,

as well as packaging glass collected in municipal schemes. The objective for recycling of glass packaging in year 2001 is set at 65 per cent¹⁴

On the basis of national objectives for each packaging fraction, it is expected that total recycling of packaging waste will be around 45 per cent. National objectives for recycling of packaging waste will be revised no later than year 2000

By far the major part of remaining packaging waste is incinerated with energy recovery. On the basis of launched and planned initiatives in packaging waste management and waste management as a whole, including the ban on landfilling of waste suitable for incineration, it is expected that total recovery of packaging waste will exceed 80 per cent

Specific Danish initiatives for prevention of packaging waste and reuse of packages are described in Appendix A 2.3 on specific requirements for packaging and packaging waste

Measures

- *increased recycling of cardboard packaging*
- *study of possibilities of recycling plastic drums*
- *more efficient glass collection*

E 5.2 Future initiatives

In future, citizens will have the opportunity to separate cardboard packaging for recycling, for example via bulky waste schemes.

It will be studied how best to design a bring scheme for plastic bottles and drums from households

An information campaign will be launched to increase glass collection from households. Studies have shown that many citizens are not aware that municipal glass collection schemes cover other packaging glass than bottles for wine and spirits

E 5.3 Regulation

Rules on management and recovery of packaging waste are included in Statutory Order on waste no. 299 of 30th April 1997

Requirements for manufacture and composition of packaging are laid down in Statutory Order on certain requirements for packaging no. 298 of 30th April 1997.

Requirements for packaging for beverages are laid down in Statutory Order on packaging for beer and soft drinks, no. 124 of 27th February 1989, with subsequent amendments.

E 5.4 Capacity, environmental assessment and economic aspects

Reference is made to sections on plastic, paper and cardboard, and glass.

E 5.5 Implications for local authorities

Further to the Statutory Order on waste local authorities must, in their waste management planning, give a statement of initiatives for prevention and recycling of packaging waste

¹⁴ This objective is not directly comparable to the objective for recycling of glass from households described in the section on glass. In overall objectives for packaging, more streams are included, and the statement method is different

E 6 Hazardous waste

<i>Environmental problem</i>	<i>By definition, hazardous waste implies risk of fire, health or environmental risks, and it must therefore be managed in an environmentally safe way</i>
<i>Initiatives</i>	<i>Preparation of guidelines on hazardous waste</i> <i>Improvement of criteria for hazardous waste (environmental risk)</i> <i>Study of waste tax exemption for hazardous waste</i>

E 6.1 Status

Objective year 2004

- *efficient collection of hazardous waste*
- *increased recycling of hazardous waste*

Hazardous waste is waste which is highly inflammable or constitutes a risk for health or the environment. Rules for hazardous waste are regulated in the EU and are developed regularly.

Amounts of hazardous waste in 1997 were around 1.5 per cent of total waste amounts ¹⁵.

Hazardous waste covers many different waste fractions and is generated in all sectors (see table below).

Some fractions are described separately in this Appendix: batteries and accumulators, health-care risk waste, PCB/PCT, and waste oil. For these fractions, separate schemes have been established.

The remaining part of hazardous waste is mainly treated by destruction or landfilling at Kommunekemi A/S.

In addition, some residues from waste incineration plants are classified as hazardous waste, viz. filter dust and flue gas cleaning products. These fractions are discussed separately in Section E18 of this Appendix.

<i>Hazardous waste 1997 (tonnes)</i>	<i>Reprocessing</i>	<i>Incineration</i>	<i>Special treatment</i>	<i>Landfilling</i>	<i>Total</i>
<i>Primary sources</i>					
-Lead batteries ¹	14,448	447			14,895
-Hermetically sealed Ni-Cd accumulators ⁸	95				120
-Waste oil led to district heating plants ²		22,576			22,576
-Oil/chemical waste led to Kommunekemi ^{3 and 7}			74,215		74,215
-Dust emitting asbestos ³				7 000	7,000
-Hospital waste ^{3 and 4}		5,900	2,900		8,800
-Sulphuric acid (coal-fired power plants) ³	8,000				8,000
-Oil and chemical waste from other primary sources ¹	28,600	9,500	5,400	3 000	46,500
Total primary sources	51,143	38,423	82,515	10,000	182,106
<i>- in per cent</i>	28 %	21 %	45 %	6 %	
<i>Secondary sources</i>					
- Flue gas filter dust ¹	10,137				10,137

¹⁵ Hazardous waste covers waste from both primary and secondary sources (e.g. residues from waste incineration plants). In 1997, 182,106 tonnes were generated by primary sources (corresponding to some 1.5 per cent of total waste amounts) and 71,437 tonnes by secondary sources.

-Fly ash and flue gas cleaning products from waste incineration plants ¹⁶			24,600	36,700	61,300
Total secondary sources	10,137		24,600	36,700	71,437
Overall total	61,727	37,976	107,115	46,700	253,543

Sources (1) Registrations under the EU regulation on shipments of waste, (2) Subsidies granted for disposal of waste oil (3) ISAG reporting 1997, (4) Odense University Hospital, but only for 1995 (5) Elsam (6) Figure under special treatment means that waste is in storage, (7) Kommunekemi A/S, (8) Calculations from Danish Environmental Protection Agency Differences between total amounts of waste hermetically sealed Ni-Cd accumulators (120 tonnes) and amounts collected for recycling reflect the fact that batteries are not collected separately, but included in general waste collection

In addition to waste incineration plants, Kommunekemi also generates residues These residues are also classified as hazardous waste, see Table below

Hazardous waste from Kommunekemi

Hazardous waste	1997 tonnes	1998 tonnes
Ash ¹⁾	8 380 (30)	5 910 (80)
Slag ²⁾	10,910	11,040
Gypsum ³⁾	970	1,150
Total	20,260	18,100

1) Reduction in amounts of ash from 1997 to 1998 is due to reduced operation in 1998 because of renovation of flue gas system in F4 Figures in brackets state the calculated part of thermal treatment of soil etc in F1

2) Only part from treatment of hazardous waste in F3 and F4

3) Gypsum is generated only in the thermal treatment of contaminated soil etc in F1

Criteria for hazardous waste are laid down in the EU Directive on hazardous waste¹⁶ and are based on the European Waste Catalogue¹⁷

Like many other EU Member States, Denmark has supplemented the national list of hazardous waste with more fractions than those stated on the European list of hazardous waste

National proposals for improvement of the European list of hazardous waste are being negotiated in the European Commission In parallel, rules on hazardous waste are being interpreted regularly

In 1998, a development project was launched in co-operation between the Nordic countries, the European Commission, and France with the purpose of developing criteria for the property "environmental risk"

As a consequence of new criteria for hazardous waste, requirements for reporting hazardous waste to the ISAG have been extended, so that the Danish Environmental Protection Agency in future will collect much more detailed information on hazardous waste

A need has been seen among enterprises and local authorities to clarify rules for hazardous waste and to have a guideline on environmentally correct management of hazardous waste

¹⁶ Council Directive 91/689/EEC of 12th December 1991 on hazardous waste

¹⁷ Council Decision (94/904/EC) of 22nd December 1994 establishing a list of hazardous waste pursuant to Article 1 (4) of Council Directive 91/689/EEC on hazardous waste

Measures

- *guidelines on hazardous waste*
- *development of new treatment methods*

E 6.2 Future initiatives

In 1999, guidelines on hazardous waste will be prepared. The purpose is to enhance understanding of how to apply hazardous waste criteria.

The basis for the tax exemption for hazardous waste will be re-evaluated.

Initiatives for recycling hazardous waste such as flue gas cleaning products, will be promoted.

E 6.3 Regulation

Hazardous waste is regulated in the Statutory Order on waste¹⁸. Rules for hazardous waste were incorporated in Danish legislation in 1996.

Enterprises are responsible for assessing whether waste is hazardous, and they must notify local authorities thereof.

Local authorities must collect all hazardous waste.

E 6.4 Capacity

28 per cent of hazardous waste is recycled today:

- lead accumulators and Ni-Cd batteries are collected and sent for reprocessing in Sweden or France
- sulphuric acid is exported for recycling
- waste from photographic industry is recycled in Great Britain

21 per cent is incinerated.

- waste oil is treated at district heating plants and at Kommunekemi A/S
- health-care risk waste is treated at SWS (Special Waste System) and at seven conventional waste incineration plants
- oily sludges are treated at Ålborg Portland

45 per cent is subjected to special treatment:

- oil and chemical waste is primarily treated at Kommunekemi A/S. A small fraction of laboratory waste is treated at Special Waste System

6 per cent is landfilled.

- asbestos and contaminated soil is deposited at special landfills.

A number of enterprises have been established, pre-treating hazardous waste, for example by separating non-hazardous fractions from hazardous waste (oil filters, paint drums, water components in waste oil). Hazardous fractions are mainly delivered to Kommunekemi A/S or to district heating plants (waste oil).

For a few waste fractions (silver from the photographic industry, organic solvents) recycling enterprises exist (recovery of silver, cooling liquids), but generally only few treatment methods have been developed, for example, for recovery or recycling of hazardous waste fractions.

Filter dust and flue gas cleaning products from waste incineration plants account for around 30 per cent of total hazardous waste amounts.

These residues are today sent abroad for landfilling. Initiatives have been launched to establish three landfills receiving stabilised flue gas cleaning

¹⁸ Statutory Order on Waste no. 299 of 30th April 1997

products from the whole country. When the sites have been established and stabilisation methods are operational, residues will be deposited at these landfills.

E 6.5 Environmental assessment

Improved collection of hazardous waste will ensure environmentally appropriate management of this waste.

E 6.6 Implications for national authorities

Guidelines on hazardous waste will be prepared.

E 6.7 Implications for local authorities

Local authorities will inform citizens on municipal schemes for hazardous waste.

E 7 Glass

<i>Environmental problem</i>	<i>Recycling of glass and reuse of refillable glass bottles reduce energy consumption compared to manufacture of new glass. Raw materials (glass) are thereby utilised several times. Collection of glass for recycling must therefore be increased.</i>
<i>Initiatives</i>	<i>Maintaining a return bottle system</i> <i>Launching an information campaign in particular aimed at increased collection of packaging glass</i> <i>Evaluate the market for wine bottle reuse.</i> <i>Start development work with the purpose of improving collection equipment and reducing rate of cullets</i> <i>Information to local authorities on colour separation</i>

E 7.1 Status

Recycling of glass leads to a reduction of energy consumption in the manufacture of new glass. Furthermore, raw materials (glass) are utilised several times. Collection of bottles and packaging glass for recycling must therefore be improved.

Total amounts of waste glass in 1997 were 190,000 tonnes. Of these, 115,000 tonnes glass were collected separately¹⁹ (bottles and packaging glass), corresponding to a collection rate of 61 per cent. Bottles are collected in municipal schemes (60 per cent), by retailers and wholesalers (32 per cent), and from restaurants, bars and cafés (8 per cent).

Separate collection will be increased through enhanced information efforts directed at citizens. Studies show that one quarter of the population is not aware that packaging glass may be delivered for recycling under present schemes. This means that only a minor part of packaging glass is collected compared to bottles. Incorrect separation is also taking place, as one fifth of the population does not know that ceramics, stoneware, and chinaware are not to be delivered together with recyclable glass.

Objective year 2004

- 75% recycling of glass

¹⁹ Source: Rendan Glass statistics 1997. Glass collected in the form of bottles and packaging glass. Collection rate is calculated on the basis of glass consumption.

Recycling of whole bottles may also be increased through the development of collection equipment reducing the rate of cullets. Recycling of cullets may be increased by improving colour separation of cullets.

Measures

- *maintaining return bottle system*
- *information campaign on increased collection of packaging glass*
- *study of market for reuse of bottles*
- *study of reduced rate of cullets by use of better collection equipment*
- *information to local authorities on colour separation*

E 7.2 Future initiatives

A return bottle system for packaging for beer and soft drinks is one of the key elements in the achievement of the Government's objective for waste minimisation. The system ensures reuse of packaging and thereby a considerable reduction of both waste arisings and resource consumption²⁰. A return bottle system will be maintained.

In 1999, the Danish Environmental Protection Agency will evaluate the Danish market for bottles for reuse and assess environmental impacts from export of bottles for reuse abroad.

On the basis of this evaluation, development work will be launched aimed at reducing the rate of cullets in collection through further development of collection equipment.

In year 2000, an information campaign will be launched aimed at increasing collection of packaging glass from households and relevant enterprises. The campaign will also aim at reducing incorrect separation in the form of, for example, delivery of ceramics, stoneware, and chinaware together with recyclable glass.

In year 2000, information will be distributed to local authorities on the possibilities of colour separating glass, so that the rate of discarded glass is reduced.

E 7.3 Regulation

Local councils are under an obligation²¹ to establish collection of glass from built-up areas with more than 2,000 households. Collection will be designed so that significant parts of glass are recycled. In most municipalities, bring-schemes have been introduced with glass banks located at central places in the area, and at recycling centres. Citizens have the duty to use collection schemes as described in municipal waste regulations.

E 7.4 Capacity

It is expected that recycling industries are able to receive increasing amounts of recyclable glass.

E 7.5 Environmental assessment

Increased colour separation and reduced rate of cullets will bring down raw material and energy consumption in the manufacture of new glass. Reduction of the rate of cullets may lead to increased reuse of whole bottles, ensuring a significant reduction of energy consumption. Reuse only requires around 15 per cent of the energy needed to produce a new bottle.

Amounts of domestic waste for incineration will be reduced, which will bring down slag amounts from incineration plants.

²⁰ The return bottle system avoids overall what in 1995 corresponded to around 390,000 tonnes waste (calculated as if it were single-use packaging), and assuming the same distribution between plastic and glass packaging as in the present system. Reuse of packaging reduces resource consumption for the manufacture of new packaging and for recycling of spent packaging.

²¹ According to Statutory Order on waste no. 299 of 30th April 1997.

E 7.6 Economic aspects

Increased collection of glass packaging is not thought to have an effect on waste collection fees

E 7.7 Implications for national authorities

An information campaign will be launched to increase collection of packaging glass and reduce incorrect separation. Information will be distributed to local authorities on colour separation. A study will be carried out on the possibilities of reducing the rate of cullets by use of better collection equipment

E 7.8 Implications for local authorities

Local authorities will participate in the information campaign to increase collection of glass for recycling. Furthermore, local authorities will assess possibilities of increased collection and recycling by more frequent collections and more dense location of glass banks.

Local authorities must take into consideration information to be distributed in year 2000 on the possibilities for colour separation of glass, thereby reducing the rate of discarded glass.

E 8 Impregnated wood

<i>Environmental problem</i>	<i>Impregnated wood contains a number of environmental contaminants which cause problems in the disposal. The amount of waste impregnated wood is increasing</i>
<i>Initiatives</i>	<i>It will be ensured that impregnated wood is managed as waste not suitable for incineration. Incineration of creosote-treated wood may be authorised.</i> <i>When suitable treatment methods for impregnated wood have been developed, it will be collected and treated separately</i>

Objective year 2004

- *utilise energy and raw material resources in waste impregnated wood*

E 8.1 Status

Impregnated wood is treated with impregnators containing, for example, chromium, copper, arsenic (CCA), tin, and creosote.

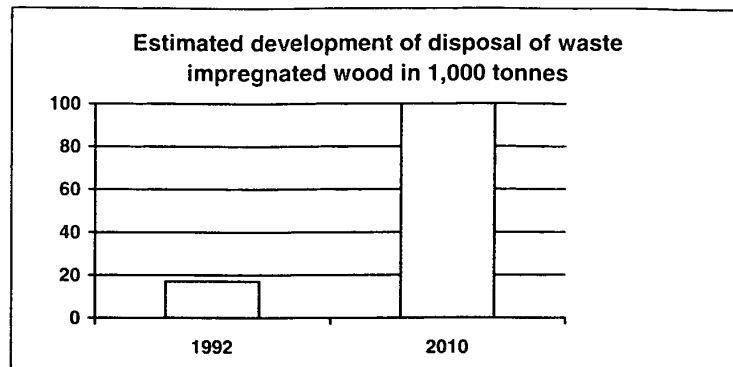
Impregnated wood containing heavy metals causes problems in incineration, as substances are not decomposed but remain in slag and flue gas waste

Creosote-treated wood (for example sleepers, wood from wharfs) can be decomposed in incineration, as creosote is destroyed. This requires, however, that such wood is pre-treated (crushed), ensuring complete incineration, and that the incineration temperature is sufficiently high.

Sources of waste impregnated wood are primarily bulky waste and the building and construction sector. Impregnated wood is mostly disposed of today by landfilling, but small amounts of impregnated wood are incinerated

New and better treatment methods are being developed, allowing for utilisation of resources contained in impregnated wood (energy, chromium, copper, arsenic)

In the coming years, increasing amounts of waste impregnated wood are expected. It is assessed that since the 60s, around 2.7 million tonnes impregnated wood have been used (accumulated), and that in year 2010 it will be necessary to dispose of some 100,000 tonnes impregnated wood²²



Measures

- rules for the treatment of impregnated wood
- development of new methods to treat waste impregnated wood

E 8.2 Future initiatives

In 1999, it will be ensured that impregnated wood is separated as waste not suitable for incineration

Rules for the treatment of creosote-treated wood will be prepared in 1999. Initiatives for the development of methods to destroy creosote-treated wood completely, and to recover heavy metals from impregnators will be promoted.

When new treatment methods have been developed, all impregnated wood will be collected and treated separately. Until then, impregnated wood is to be landfilled.

E 8.3 Regulation

Management of impregnated wood is regulated today in general waste regulations. This means that local councils must assign disposal possibilities for impregnated wood.

E 8.4 Environmental assessment

Impregnated wood is today disposed of by both incineration and landfilling. By avoiding impregnated wood at incineration plants, heavy metal contents in slag and flue gas cleaning waste will be reduced

Some 50,000 tonnes of separated impregnated wood are expected in year 2004.

E 8.5 Economic aspects

In the next few years, no considerable extra costs of disposal of impregnated wood are expected. At present, it is not possible to assess treatment costs in new treatment technologies.

E 8.6 Implications for national authorities

The Statutory Order on waste will be revised to include a ban on assignment of heavy metal-containing impregnated wood to incineration

²² This estimate assumes an average lifetime of wood of 32 years

E 8.7 Implications for local authorities

In their planning, local authorities will take into consideration that impregnated wood may not be incinerated. They will also plan for separate treatment when suitable treatment methods have been developed.

E 9 Health-care risk waste

<i>Environmental problem</i>	<i>Health-care risk waste is infectious</i>
<i>Initiatives</i>	<i>No new initiatives</i>

E 9.1 Status

Objective year 2004

- *status quo*

Health-care risk waste is generated in both the primary and the secondary health sectors. The characteristic feature of health-care risk waste is that it may be infectious by direct contact.

According to the ISAG, 8,800 tonnes of health-care risk waste were generated in 1997.

Due to its infectious nature, health-care risk waste is classified as hazardous waste²³.

Almost all health-care risk waste is generated in the service sector.

Waste is incinerated both at special incineration plants and at conventional plants in compliance with special conditions reducing the risk of contact with waste. From an environmental point of view, the incineration process is similar to incineration of, for example, domestic waste. Incineration leads to inactivation of waste, energy recovery, reduction in volume and unrecognisability, which is preferable, especially for tissue waste.

Disposal requires a relatively large amount of packaging. To the extent that improved separation will reduce amounts of health-care risk waste, it will indirectly reduce overall waste amounts, as packaging needs would be reduced correspondingly.

A guideline on health-care risk waste was issued in 1998²⁴.

The European Commission has informed that by the end of 1998, initiatives will be taken to discuss definitions and requirements of management of health-care risk waste. This may be in the form of a proposal for a Directive.

E 9.2 Future initiatives

No new initiatives are envisaged for health-care risk waste.

E 9.3 Regulation.

Health-care risk waste management is regulated in the Statutory Order on waste. Health-care risk waste is classified as hazardous waste, and under the

²³ Cf. Statutory Order on waste no. 299 of 30th April 1997.

²⁴ This guideline replaces guideline no. 1/1984 from the Danish Environmental Protection Agency on the disposal of hospital waste.

terms of the Statutory Order on waste, local councils must therefore establish collection schemes for such waste.

E 9.4 Capacity

Disposal of health-care risk waste takes place at one special plant and seven conventional waste incineration plants.

E 9.5 Implications for national authorities

None - if an EU directive is adopted, it will have implications for national authorities

E 9.6 Implications for local authorities

None

E 10 Sludge from municipal wastewater treatment

<i>Environmental problem</i>	<i>Sewage sludge is a resource that is not utilised sufficiently today</i>
<i>Initiatives</i>	<i>Re-evaluation of present rules for application of sludge to farmland</i>

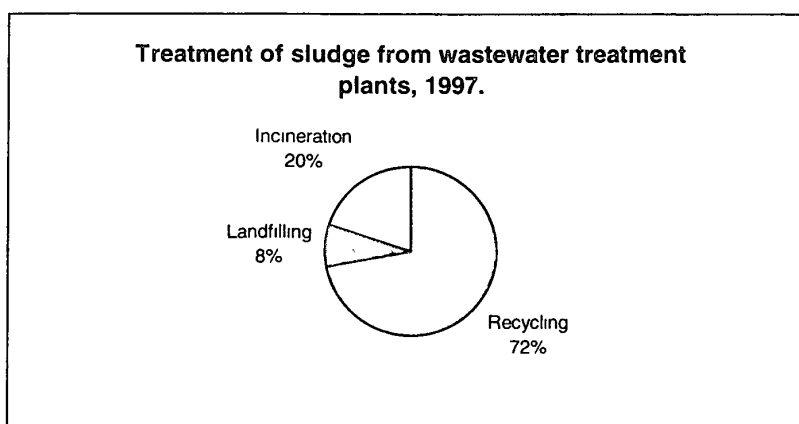
E 10.1 Status

Objective year 2004

- 50% recycling on farmland
- 30% incineration
- 20% landfilling
- increased utilisation of both fertiliser and energy contents in sludge by recycling

The contents of both fertiliser and energy in sewage sludge may be utilised in recycling. Today, it is often only the fertiliser content that is recovered, as sewage sludge is applied directly to farmland due to the content of nutrients, especially phosphorus

In 1997, around 1,209,000 tonnes sludge (wet weight) were generated at municipal wastewater treatment plants. Of this, 72 per cent was recycled, fulfilling the Government's objective for 50 per cent recycling in year 2000. 20 per cent was incinerated and 8 per cent landfilled.



Requirements for the content of certain chemical substances in sludge, which took effect in 1997 will become stricter in year 2000²⁵, and this means that in a transitional period alternatives to application to farmland must be found

²⁵ Statutory Order no 823 of 16th September 1996 on application of waste products for agricultural purposes. Cut-off values for various organic chemical substances took effect on 1st April 1997. These values will become stricter in year 2000

The present high rate of application of sludge to farmland is not expected to be upheld. The objective is therefore 50 per cent recycling in year 2004. It is expected that 30 per cent will be incinerated and 20 per cent landfilled in year 2004.

The quality of sludge and possibilities of increased recycling are expected to improve by reducing the use of xenobiotic substances. The contents in sludge of certain of the chemical substances for which limit and cut-off values have been introduced, are therefore expected to be reduced in the long term.

A number of studies have been launched in order to assess regularly requirements in connection with recycling sludge. The studies deal with assessment of decomposition of xenobiotic substances in sludge by different forms of treatment, long term effects of application of sludge to farmland, and the assimilation in plants of xenobiotic substances.

E 10.2 Future initiatives

Measures

- *re-evaluation of current rules*
- *study of biogasification of sludge*

In the study programme for biogas, funds will be provided for detailed studies of biogasification of sludge prior to application to farmland. The intention is that as much sewage sludge as possible will be subjected to biogasification in the long term.

Against the background of results from studies and evaluations, it will be considered to revise rules for application of sewage sludge to farmland.

In late 1999, the Danish Environmental Protection Agency will prepare a status report for recycling of organic domestic waste and sewage sludge. This will be done on the basis of, partly, results of ongoing studies. This status report will form the basis for a plan of action for recycling organic waste.

E 10.3 Regulation

Application of sludge to farmland is regulated in the Statutory Order on sludge²⁶, and the Statutory Order of the Ministry of Food, Agriculture and Fisheries on inspection of the quality of municipal sewage sludge and composted household waste applied to farmland²⁷. The Statutory Order on sludge lays down limit values for a number of heavy metals and cut-off values for organic xenobiotic substances NPE, DEHP, LAS, and certain PAHs. Cut-off values for organic substances took effect on 1st July 1997 and will, together with limit values for cadmium, become stricter as per 1st July 2000.

E 10.4 Capacity

Capacity for treatment of sludge at biogas plants is expected to increase. In year 2004 these plants are expected to be able to treat 100,000 tonnes of sludge (wet weight).

E 10.5 Environmental assessment

In biogasification, the energy contents of sludge are utilised. For example, biogasification of 100,000 tonnes of sludge will generate energy in the

²⁶ Statutory Order no. 823 of 16th September 1996 on application of waste products for agricultural purposes

²⁷ Statutory Order no. 528 of 20th June 1997

range of 100-150 TJ The process is evaluated not to degrade the fertiliser potential of sludge, but on the contrary, in some cases to improve this potential

E 10.6 Implications for national authorities

If an evaluation shows it necessary, the Statutory Order on sludge may be revised

In the end of 1999, a status for recycling of organic domestic waste and sewage sludge will be prepared

E 10.7 Implications for local authorities

Local authorities will investigate possibilities of biogasification of sewage sludge, for example by contacting centralised biogas plants, co-digesting manure and organic waste, and will find alternatives to application to farmland, in cases where limit values and cut-off values cannot be complied with

E 11 Refrigeration equipment

<i>Environmental problem</i>	<i>Refrigeration equipment contains environmentally harmful fractions, especially heavy metals and CFCs</i>
<i>Initiatives</i>	<i>Maintaining existing scheme</i>

E 11.1 Status

Refrigeration equipment contains CFCs and other environmentally harmful fractions. Refrigeration equipment must be managed in an environment-friendly way, and separation of environmental contaminants for separate treatment must be ensured Furthermore, separation of recyclable fractions (iron and metal parts) must be ensured

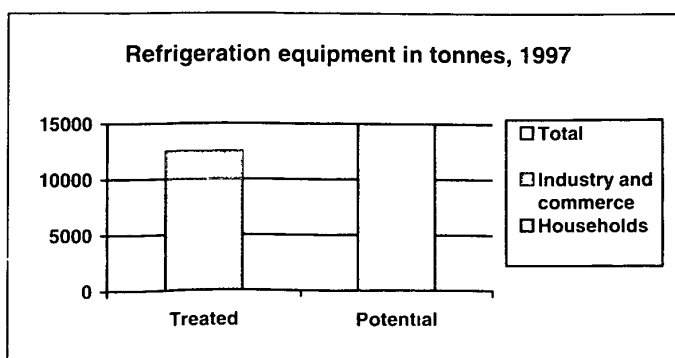
For waste electrical and electronic equipment a special scheme exists (see Appendix E 4)

Total amounts of waste refrigeration equipment were around 15,000 tonnes in 1997 It is estimated that 12,500 tonnes of refrigeration equipment were collected in 1997, corresponding to 83 per cent of the potential.

80 per cent of waste refrigeration equipment is collected in municipal bulky waste schemes, and 15 per cent derives from institutions, trade and offices. The remaining 5 per cent is collected from industry.

Objective year 2004

- 90% collection of total number of discarded products



E 11.2 Future initiatives

No new Danish initiatives for refrigeration equipment are planned in the coming planning period. The existing scheme will be maintained.

E 11.3 Regulation

Collection and management of CFC-containing refrigeration equipment is ensured by an agreement between the Minister for Environment and Energy and relevant associations on the disposal of CFC-containing refrigeration equipment, as well as in a Circular²⁸ on municipal regulations on disposal of CFC-containing refrigeration equipment.

The objective of the agreement is to collect a minimum of 90 per cent of the total amount of discarded refrigeration equipment for treatment, in compliance with requirements laid down in the Circular.

The Circular states that local councils are under an obligation to establish assignment or collection schemes for discarded CFC-containing refrigeration equipment and certain waste fractions.

At least 95 per cent of the content of the cooling agent CFC-12 must be extracted and collected. The frothing agent CFC-11 must be extracted at a rate of at least 80 per cent. Extracted CFC-12 must either be recycled or disposed of. CFC-11 must be disposed of.

In municipal regulations, rules are laid down for processing of refrigeration equipment, ensuring resource recovery of recyclable waste fractions.

The Circular also states that rules should be laid down for removal of mercury switches and condensers (PCB), see Section E15.

E 11.4 Capacity

Around five enterprises exist that extract CFCs from refrigeration equipment.

E 11.5 Environmental assessment

It is estimated that around 250,000 pieces of refrigeration equipment (corresponding to some 12,500 tons) are managed in compliance with the Circular, and that around 100 tonnes CFCs are extracted and destroyed in an environmentally appropriate manner.

E 11.6 Implications for national authorities

None.

E 11.7 Implications for local authorities

Local authorities are to establish assignment or collection schemes for discarded refrigeration equipment, and environmentally correct treatment should be ensured.

²⁸ Circular no. 132 of 13th June 1996 on municipal regulations on disposal of CFC-containing refrigeration equipment.

E 12 Organic domestic waste

<i>Environmental problem</i>	<i>Organic domestic waste is a resource that is not utilised sufficiently today</i>
<i>Initiatives</i>	<i>Launching of full-scale tests with collection and biogasification of organic domestic waste</i> <i>Study of optimised collection and biogasification of organic domestic waste</i> <i>Requirement for mandatory collection when experience from biogasification allows it</i> <i>Preparation of status for recycling of organic domestic waste and wastewater sludge</i>

E 12.1 Status

Organic domestic waste is a resource which is not utilised sufficiently today in composting or biogasification.

Biogasification is the highest priority treatment form for organic domestic waste, as both energy and fertiliser contents of waste are recovered. Composting, including home composting, is still a suitable form of treatment to utilise the fertiliser contents of waste.

Organic domestic waste is both vegetable and animal food waste, and other putrescible organic material. Organic waste accounts in general for 40-45 per cent of total domestic waste²⁹. In 1997, around 70,000 tonnes of domestic waste were recycled in biological treatment³⁰, corresponding to some 4 per cent of domestic waste

Residues from biological treatment of organic domestic waste must comply with the same requirements as sewage sludge from municipal waste water treatment plants with respect to contents of heavy metals and xenobiotic substances in relation to application to farmland (see also Appendix E 10)

On the basis of contents of heavy metals and xenobiotic substances, it is evaluated that in general there will be no problems with biological residues and their compliance with limit and cut-off values. A number of studies, including studies on the effects of composting and biogasification processes on the decomposition of xenobiotic organic substances, have been launched.

²⁹ In 1997, the amount of organic domestic waste was assessed at just below 700,000 tonnes

³⁰ Around 23,000 tonnes for home composting (Rendan compost statistics 1997) and 47,000 tonnes for treatment at central plants (the ISAG 1997). Amounts treated at central plants were distributed by around 46,000 tonnes at composting plants and 1,000 tonnes for biogasification

Objective year 2004

- *recycling of organic domestic waste corresponding to 7% of total domestic waste amounts*
- *100,000 tons recycled by biogasification*

Long term objective

- *recycling of organic domestic waste corresponding to 20-25% of total domestic waste amounts*

Measures

- *full-scale tests with collection and biogasification*
- *study of optimised collection and treatment*
- *requirements for mandatory collection*

Recycling is today far from the objective for year 2000³¹. This is primarily due to the fact that mandatory dual collection of organic waste and residual waste, allowing composting and biogasification, has not been introduced, for organisational and technical reasons.

Positive experience has been gained with treatment of organic domestic waste at biogas plants based on manure, and at a plant for co-digestion of sludge and organic domestic waste. However, more experience is needed, and technologies shall be better documented.

The objective is to recycle a total of 150,000 tonnes of organic domestic waste, corresponding to 7 per cent of total amounts of domestic waste in year 2004. Longer term objectives are still to recycle organic domestic waste corresponding to 20-25 per cent of total domestic waste amounts.

E 12.2 Future initiatives

It is planned to launch a full-scale pilot project to gain further documentation and demonstration of biogasification. The project will be located in a number of municipalities with collection of organic domestic waste and treatment at centralised biogas plants co-digesting manure and organic waste.

Under the Danish Energy Agency's development programme for biogas, funds will be granted to studies of optimisation of environmental and financial aspects of sorting, collection, pre-treatment, and biogasification of organic domestic waste.

In late 1999, on the basis of results from ongoing studies, the Danish Environmental Protection Agency will prepare a status report for recycling of organic domestic waste and sewage sludge. This status report will form the basis for a plan of action for recycling of organic waste.

Mandatory separate collection will be introduced when experience from biogas plants is sufficient. The expected extension of centralised biogas plants co-digesting manure and organic waste, cf. Energy 21, will be based on future experience with biogas technology. It is a prerequisite for meeting long term objectives for recycling of organic domestic waste that mandatory dual collection is introduced.

E 12.3 Regulation

Under the terms of the Statutory Order on waste no. 299 of 30th April 1997, local councils must establish collection of domestic waste from households in built-up areas accommodating permanently more than 1,000 inhabitants. In municipal regulations, local councils may permit home composting of the vegetable fraction of domestic waste.

In 1994, the Minister for Environment and Energy entered an agreement with the National Association of Local Authorities in Denmark, the City of Copenhagen, and the Municipality of Frederiksberg on organic waste. It was established that biogasification of organic waste is environmentally superior to alternative forms of treatment, and that a flexible solution should be chosen, supporting local initiatives for introduction of separate collection and treatment of organic domestic waste.

³¹ According to the Plan of Action for waste and recycling 1993-97 the target was to ensure biological treatment of the major part of organic waste, corresponding to 20-25% of total domestic waste from households.

E 12.4 Capacity

Capacity at existing biogas plants amounts to 20,000 tonnes organic domestic waste per year, and utilisation is far from maximum. With some reconstruction of plants, capacity may be increased to 50,000 tonnes/year. According to the Government's plan of action for energy - Energy 21 - energy supply from biogas will increase from 2 PJ today to 20 PJ in year 2020¹².

With some reservations, including rules from the Ministry of Food, Agriculture and Fisheries, it is assessed that in year 2004 around 100,000 tonnes of organic domestic waste may be treated at biogas plants based on manure, and thereby objectives will be achieved.

E 12.5 Economic aspects

Establishment of separate collection and biological treatment of organic fractions requires that investments are made in collection systems and treatment capacity. Calculations show that costs of total operation (including interest payment and depreciation) will not necessarily exceed costs of today's single-string system. Costs will largely depend on types of housing and chosen systems.

E 12.6 Environmental assessment

Biogasification of 100,000 tonnes of organic domestic waste will give a gain of energy of 50-100 TJ compared to incineration of the same amounts of organic domestic waste. Furthermore, the digestate from biogasification of 100,000 tonnes of organic domestic waste may replace around 780 tonnes of chemical fertilisers.

E 12.7 Implications for national authorities

Full-scale tests will be launched on collection and biogasification of organic domestic waste.

In late 1999, a status report for recycling of organic domestic waste and sewage sludge will be prepared.

E 12.8 Implications for local authorities

Local authorities should start planning new waste collection systems with source separation and separate collection of organic domestic waste. They should investigate possibilities for co-operation with existing biogas plants based on manure or establishment of new biogas plants.

E 13 Organic waste from industry and food waste from catering centres

<i>Environmental problem</i>	<i>Organic waste is a resource that should be utilised to an optimum extent</i>
<i>Initiatives</i>	<i>Re-evaluation of existing scheme for food waste from catering centres</i>

¹² It is assumed that in year 2004, 5 million tonnes of manure are subjected to biogasification compared to around 1 million tonne today. Manure-based biogas plants will typically be able to treat up to 20 per cent of organic domestic waste in relation to the amounts of manure.

E 13.1 Status

Organic waste is generated both in industry and catering centres. Some waste from industry is homogeneous by-products and is therefore not included in the ISAG (Information System for Waste and Recycling, see Appendix B)

Objective year 2004

- *recycling of at least 95%*

In industry, just below 8.5 million tonnes of organic waste are generated each year. This waste is biologically decomposable waste such as abattoir waste, dairy waste, fishery waste etc, often with a low content of dry matter³³

The major part is recycled. Part of this waste is used directly as fertiliser on farmland, and some waste substitutes other raw materials. The remaining tenth is subjected to biogasification³⁴. Only around one per cent is incinerated or landfilled. It is expected that the landfilled amount will decrease, further to the ban on landfilling of waste suitable for incineration, which took effect on 1st January 1997. Overall, no disposal problems for such residues are encountered.

Food waste from catering centres³⁵ is generally reprocessed into animal fodder and similar. Reprocessing plants estimated in 1996 that the potential for collection of food waste was between 22,000 and 30,000 tonnes/year, of which around 22,000 tonnes were reprocessed.

E 13.2 Future initiatives

Measures

- *recycling of food waste from catering centres to be evaluated*

Alternative recycling possibilities for food waste from catering centres will be studied, with due respect to rules issued by the Ministry of Food, Agriculture and Fisheries.

E 13.3 Regulation

The collection scheme for food waste from catering centres is based on a Statutory Order³⁶, according to which local authorities must establish collection of food waste from catering centres for reprocessing into fodder or similar.

E 13.4 Capacity

Due to the extension of biogas plant capacity planned under the Government's plan of action for energy, Energy 21, there is thought to be sufficient treatment capacity at biogas plants.

E 13.5 Environmental assessment

No significant changes in environmental aspects are expected.

³³ Miljøprojekt nr. 397 og 398, 1998. Organiske restprodukter i industrien, del 1 og 2 (*Environmental Project nos. 397 and 398, 1998. Organic residues in industry, parts 1 and 2. Danish only*)

³⁴ This study shows (data from 1992-94) that around 8.4 million tonnes of organic residues are generated in industry each year. Of these, 99% is recycled (47% in substitution of raw materials, 8% for biogasification, and 44% directly as fertiliser on farmland). Less than 1% (52,000 tonnes) is incinerated or landfilled. In the study, all residues from industry have been included, also such that are normally not registered as waste.

³⁵ Defined as kitchens generating more than 100 kg food waste per week.

³⁶ Statutory Order no. 883 of 11th December 1986 on municipal collection of food waste from catering centres.

E 13.6 Implications for national authorities

Depending on possibilities of applying alternative treatment forms for food waste, rules on collection of food waste from catering centres will be amended

E 13.7 Implications for local authorities

Local authorities will maintain their present efforts.

E 14 Paper and cardboard

<i>Environmental problem</i>	<i>Waste paper and cardboard is a valuable resource which is not utilised sufficiently today</i>
<i>Initiatives</i>	<i>Paper collection will be extended by establishment of kerbside collection schemes from households</i> <i>Householders will have the opportunity to separate cardboard for recycling, for example via bulky waste schemes</i> <i>Guidelines will be prepared clarifying local authorities' responsibility for ensuring increased collection of cardboard and paper from enterprises</i> <i>Possibilities for increased recycling of paper and cardboard will be studied</i>

E 14.1 Status

Paper and cardboard collection can be improved, and citizens, enterprises, public and private institutions will have an important role to play in this respect.

In 1997, 583,000 tonnes of paper and cardboard were collected, corresponding to 43 per cent of paper consumption³⁷. The rate of collection increased steadily from 1985 to 1997

In 1996, collection efficiency was assessed to be around 32 per cent from households, and around 63 per cent from enterprises and institutions³⁸. Amounts of paper and cardboard suitable for recycling³⁹ are smaller in households than in all other sectors put together, which is one of the reasons for differences in collection efficiency.

Objective year 2004

- 60% recycling of paper and cardboard from households
- 75 % recycling of paper and cardboard from enterprises, public and private institutions

³⁷ The ISAG 1997

³⁸ Collection efficiency is calculated on the basis of statements of potentials

³⁹ Wiping paper and dirty packaging are not suitable for recycling, and such paper is widely used in households

Measures

- *kerbside collection of paper from households*
- *local authorities' responsibility for ensuring increased recycling of paper and cardboard from industry and commerce to be clarified*
- *guidelines on paper and cardboard collection from public and private enterprises*

E 14.2 Future initiatives

Collection of paper from households will be doubled by using more efficient collection systems and collecting more types of clean paper. From year 2000, kerbside collection schemes from households are to be established. Schemes are to be introduced allowing householders to separate cardboard for recycling, for example via bulky waste schemes.

Collection of paper and cardboard from industry and commerce may be improved by enhancing local authorities' responsibility for ensuring separation. In 1999, a guideline will be prepared, clarifying responsibility for separation.

In order to limit problems and increase recycling possibilities for paper and cardboard, factors inhibiting possibilities of recycling (for example glue and inks) will be studied, and know-how on environmental aspects of paper and cardboard recycling will be updated.

E 14.3 Regulation

Rules on collection and recycling of paper and cardboard are laid down in the Statutory Order on waste⁴⁰. Local councils are under an obligation to collect paper for recycling from built-up areas with more than 2,000 households. In most municipalities, bring-schemes have been established with paper banks located at central places and at recycling centres. In many housing estates, collection schemes have been introduced, and waste paper is delivered to the same place as domestic waste.

Requirements for collection of paper from households will be amended in future, and in year 2000 local councils are to establish kerbside collection schemes with permanent collection equipment.

For a number of years, local councils have been under an obligation to ensure recycling of paper and cardboard from commercial enterprises. With effect from 1st July 1998, this obligation has been extended to comprise all enterprises as well as public and private institutions.

In 1994, an agreement was made between the Ministry of Environment and the Confederation of Danish Industries, the Danish Plastics Federation and the Packaging Industry on transport packaging. The agreement set up the objective that 80 per cent of transport packaging of plastic, cardboard and paper was to be recycled before year 2000, either by reuse or material recycling.

In 1998, the agreement was adjusted so that the definition of transport packaging now follows the definition of the EU packaging Directive, and so that the objectives expressed in percentages now only apply to material recycling.

E 14.4 Capacity

Recycling capacity is sufficient in Denmark. The market for recycled paper is good both at national and international levels, but prices fluctuate greatly.

Around 20 enterprises exist in Denmark today, marketing waste paper. Five enterprises exist reprocessing waste paper into new products.

⁴⁰ Statutory Order on waste no. 299 of 30th April 1997

Treatment capacity is sufficient for recycling increasing waste paper amounts

E 14.5 Environmental assessment

Recycling waste paper is environmentally superior to manufacturing new paper. Increased recycling of paper entails CO₂ reduction in all countries affected by the Danish waste paper cycle. Amounts of domestic waste for incineration will also decrease, reducing capacity needs.

E 14.6 Economic aspects

The extension of paper schemes will lead to additional annual costs of around DKK 125 million, corresponding to DKK 60 - 100 per household. This is due to the fact that costs of collection systems and collection equipment are higher than for present systems.

E 14.7 Implications for national authorities

The Statutory Order on waste will be amended, stating requirements for establishment of kerbside collection schemes from year 2000.

A guideline will be prepared, clarifying rules for collection of paper and cardboard from enterprises and public and private institutions.

E 14.8 Implications for local authorities

In their future planning, local authorities will:

- establish kerbside collection of waste paper from households
- order private and public enterprises to separate paper and cardboard for recycling
- prioritise supervision and other efforts for recycling of paper and cardboard from enterprises and public and private institutions.

E 15 PCB/PCT

<i>Environmental problem</i>	<i>PCB/PCT is hazardous to human health and the environment</i>
<i>Initiatives</i>	<i>No new initiatives</i>

E 15.1 Status

PCB is a group of polychlorinated biphenyls, and PCT is a group of polychlorinated terphenyls. Substances are heavily decomposable and accumulate in the food chain. PCBs and PCTs are mutagenic, carcinogenic and are also suspected of having hormonal effects on reptiles and mammals. High concentrations of PCBs and PCTs have been found in fat tissues of, for example, polar bears, seals, and birds of prey.

In a 1986 report from the Danish Environmental Protection Agency it was documented that PCB/PCT constitutes a risk to the environment.

PCBs and PCTs have been used as cooling and insulation liquids in electrical equipment such as transformers and condensers. They have furthermore been used in heat pumps, gas turbines, hydraulic systems, glue, fire inhibitors, sealing compounds etc.

In Denmark and internationally, special efforts have been made to phase out the use of these substances. Import and marketing of PCB/PCT as well as

Objective year 2004

- *Status quo due to objective for year 2000 to phase out PCB/PCT-bearing oils (> 0,05 per cent by weight) in transformers*

equipment containing these substances have been prohibited in Denmark since 31st October 1986

Furthermore, since 1st January 1995 the use of PCB/PCT-containing condensers and equipment above a certain limit (total weight > 1 kg or effect > 2kW) has been banned. Therefore, large transformers (>5 l PCB) do not exist in Denmark. Smaller condensers and transformers may be used until the end of their useful life.

As from 1st January 1999, requirements are in effect that transformers with a PCB concentration above a certain limit (>0.05 per cent by weight) must be decontaminated as soon as possible.

The delivery of PCB-containing waste to Kommunekemi A/S peaked in 1995. In 1997, 6,805 kg PCB-containing waste were delivered, corresponding to around 13 per cent of deliveries in 1995.

E 15.2 Future initiatives.

No new initiatives for PCB/PCT waste are planned.

E 15.3 Regulation

In the Statutory Order on waste, PCB/PCT waste is regulated as hazardous waste. As a consequence, local authorities are responsible for collecting such waste.

In 1998, a Statutory Order on PCB, PCT and substitute substances was emitted⁴¹ and took effect on 1st January 1999.

Furthermore, in the Statutory Order on waste from electrical and electronic products⁴² regulations are laid down for PCB-containing condensers.

E 15.4 Capacity

Kommunekemi is the only treatment plant in Denmark authorised to destroy PCB/PCT condenser and transformer oils with a PCB/PCT content above 50 ppm.

E 15.5 Environmental assessment

New requirements will ensure controlled disposal of remaining PCB/PCT.

E 15.6 Implications for local authorities

In parallel to the decontamination of transformers with PCB-containing oils, local authorities must collect waste.

E 16 Plastic

<i>Environmental problem</i>	<i>Waste plastic is a non-renewable resource which can be utilised better than today</i>
<i>Initiatives</i>	<i>Study of existing methods to collect, separate, and treat plastic</i>

⁴¹ Statutory Order no. 925 of 13th December 1998 on PCB, PCT, and substitute substances.

⁴² Statutory Order no. 1067 of 22nd December 1998 on management of waste from electrical and electronic products.

Objective year 2004

- *increased recycling of plastic*

E 16.1 Status

In Denmark, plastic consumption is stated at around 420,000 tonnes, and waste amounts at around 240,000 tonnes in 1996⁴³. Amounts of plastic in waste are estimated lower than consumption, as plastic is part of many products with a very long useful life, such as water and sewage pipes, electricity and telecommunication cables, district heating pipes, and building materials.

Consumption of plastic packaging in 1995 has been calculated at some 150,000 tonnes

Plastic accounts for some 7 per cent of domestic waste, corresponding to around 120,000 tonnes in 1996. Of this, plastic packaging is the dominant part and corresponds to 90,000 tonnes. Almost all plastic in domestic waste is incinerated.

In 1996, around 29,000 tonnes of plastic were recycled; of this, just below 13,000 tonnes were packaging waste from industry and commerce.



There is thought to be rather high levels of plastic in the burnable part of waste from industry and commerce (institutions, trade and offices, as well as industry), but no statements of plastic contents in these fractions are available. It is assessed that a total of 190,000 tonnes of plastic are incinerated each year.

Plastic is also found in two environmentally harmful waste fractions: PVC and shredder waste. See also Sections E17 and E20.

Denmark will comply with minimum requirements in the EU Directive on packaging, a minimum of 15 per cent of packaging plastic, around 22,500 tonnes, will be recycled in year 2001.

Recycling of plastic is faced with a number of barriers:

- Many types of plastic exist, covering different types of polymers and often with different types of stabilisers etc. Recycling of plastic in an en-

⁴³ Source: APME (Association of Plastic Manufacturers in Europe) publishes every year statistics of amounts of plastic supplies and waste in Europe, stating waste amounts in Denmark in 1996 at 219,000 tonnes clean plastic excluding additives. On an average, 10 per cent fillers and auxiliary substances are added to plastic, and therefore waste amounts are assessed at 240,000 tonnes.

environmentally appropriate way therefore requires that plastic is separated into clean fractions

- Only experts are able to distinguish different types of plastic
- Much waste plastic is generated by many small waste producers, especially households, which makes separation and collection difficult and resource consuming
- Plastic used for packaging, especially for liquids, to a certain degree assimilates substances from these products, so that recycling of plastic is limited due to odour, taste, and toxicology from these products

Denmark has primarily focused on transport packaging made of plastic in achieving EU objectives, and this is due to the fact that it is easier to overcome barriers for this type of waste, as it is normally found in the form of large, clean, and relatively homogeneous fractions

E 16.2 Future initiatives

In 1999-2000, studies will be carried out to identify existing separation criteria, collection equipment, and especially treatment methods that may ensure a market for and an environmentally acceptable recycling of plastic bottles and drums. Such recycling is only done to a very limited extent in Denmark today. It exists, for example, in Germany, but environmental advantages are not known in detail, and it is uncertain to what extent experience from abroad can be transferred to Danish conditions.

On the background of these studies, local authorities will be ordered to give citizens the opportunity to separate relevant packaging for recycling from year 2002.

E 16.3 Regulation

Under the terms of the Statutory Order on waste, local councils have a duty to ensure recycling of plastic transport packaging from enterprises⁴⁴. This duty is to be seen in continuation of the agreement on transport packaging entered between the Ministry of Environment and Energy and the Confederation of Danish Industries, the Danish Plastics Federation, and the Packaging Industry in 1994. The schemes are expected to result in increased recycling of plastic film of around 10,000 tonnes in year 2001 compared to 1996 figures.

A future recycling scheme for plastic bottles and drums will require an amendment to the Statutory Order on waste.

E 16.4 Capacity

It is assessed that sufficient capacity for reprocessing transport packaging and other homogeneous fractions of plastic film is available in Denmark.

Capacity for reprocessing plastic bottles and drums is not known, but a survey will be carried out in connection with the above-mentioned study of possibilities for starting recycling of these fractions.

Measures

- *possibility of recycling plastic drums*

⁴⁴ Art 36, with effect from 1st July 1998

E 16.5 Environmental assessment

Plastic is normally manufactured on the basis of oil, which is a non-renewable resource. The conversion of oil into plastic is very energy intensive. The consumption of oil is close to 2 kg per 1 kg plastic manufactured. Recycling of plastic, replacing virgin plastic with recycled plastic, will therefore give a significant environmental benefit.

When plastic is incinerated, the energy that was used for the conversion of oil into plastic is lost. Energy utilisation of plastic in conventional incineration plants is poor, as power generated only corresponds to 20 to 25 per cent of energy fed in.

If significant parts of waste plastic cannot be recycled nor prevented, it should be considered whether it would be advantageous to separate plastic for energy recovery at special plants, ensuring optimum utilisation of the calorific value of plastic, so that it is only the conversion from oil into plastic that causes a loss of resources.

E 16.6 Implications for national authorities

The Statutory Order on waste will be amended at the turn of the year 2000/2001, when the above-mentioned studies on plastic recycling have been finalised.

E 16.7 Implications for local authorities

In their future planning, local authorities are to take into consideration that from year 2002 a requirement will come to give citizens the opportunity to deliver certain bottles and drums of plastic for recycling, for example at recycling centres.

E 17 PVC

<i>Environmental problem</i>	<i>PVC contains a number of environmental contaminants causing environmental problems in waste management.</i> <i>Incineration of PVC at waste incineration plants with dry and semi-dry cleaning systems entails larger amounts of flue gas cleaning waste for landfilling than amounts of waste fed.</i>
<i>Initiatives</i>	<i>Preparation of PVC statement and plan of action for phthalates</i> <i>Ensure separation of PVC. The fraction that cannot be recycled is to be landfilled. When suitable treatment technologies are available, new requirements for management of PVC waste will be made.</i> <i>Development of suitable final treatment technologies</i> <i>Statutory Order on prohibition of import, marketing, and use of lead and lead-containing products</i> <i>Promote development of alternatives to certain PVC products.</i>

E 17.1 Status

A focused effort will be made for environmental problems related to PVC. Additives harmful to the environment and human health will be phased out, and PVC-containing waste be kept away from waste incineration plants. Alternative methods for treatment of PVC waste will be developed.

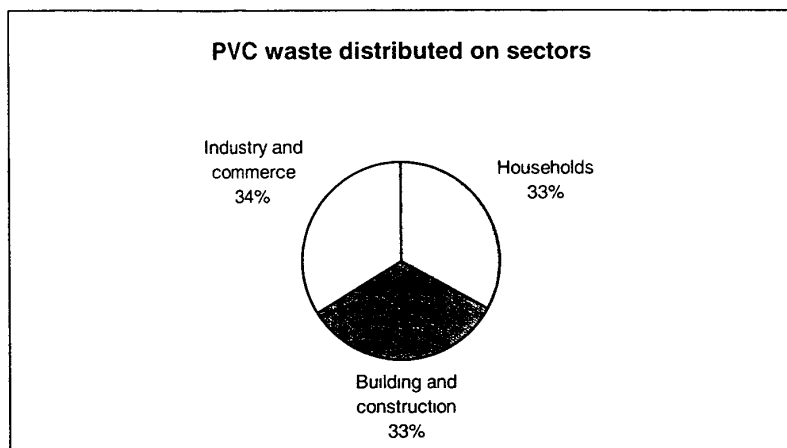
It is estimated that around 34,000 tonnes of PVC waste were generated in 1997⁴⁵. PVC waste is generated in the building and construction sector, industry and commerce, and households, each accounting for around one third

Objective year 2004

- no delivery of PVC-containing waste to incineration plants
- substitute certain PVC products with alternative products
- phase out use of additives harmful to human health and the environment (e.g. lead and phthalates)
- develop technologies for final treatment

Amounts of PVC waste from the building and construction sector are expected to increase. From the other sectors, amounts will decrease

The present rate of recycling PVC building waste is 10 - 15 per cent



Raw PVC is not manufactured in Denmark. PVC contains various additives such as colorants, stabilisers, anti-static agents, fire inhibiting substances, fillers and plasticisers. Different environmental aspects are connected to the different additives.

PVC-containing waste is primarily treated today by incineration at conventional waste incineration plants. During the incineration of PVC, acids are formed that must subsequently be neutralised by adding lime. This increases amounts of flue gas cleaning waste for landfilling (1 kg PVC results in around 2 kg residues in dry/semi-dry cleaning). Heavy metals (lead and cadmium) are concentrated in residues in the incineration process.

Alternative treatment methods are being developed that allow for utilisation and recycling of resources in PVC waste (energy, NaCl, heavy metals).

⁴⁵ Primary sources are the building and construction sector (around 10,000 tonnes/year), industry and commerce, including end-of-life vehicles (around 14,000 tonnes/year), and households (around 10,000 tonnes/year)

Measures

- *rules for management of PVC waste*
- *development of new treatment technologies*
- *PVC statement and plan of action for phthalates*
- *requirements for use of lead in products*
- *substitution of certain PVC products*

E 17.2 Future initiatives

In 1999, a PVC statement and a plan of action for phthalates will be prepared. Specifically, descriptions will be made of future initiatives for reducing consumption of phthalates and PVC. As to future efforts to reduce the use of PVC products and additives, including lead, reference is made to the PVC statement.

In 1999, rules for the treatment of PVC waste will be issued. It will, for example, be ensured that PVC waste is separated. What cannot be recycled is to be landfilled. It is recommended that local authorities assign PVC waste to landfilling in separate cells, allowing subsequent alternative treatment of such waste.

Certain recycling possibilities exist today for hard PVC building waste. However, it is not expedient to recycle all hard PVC building waste, including such waste that contains cadmium.

Initiatives supporting the development of better treatment methods, allowing utilisation of resources contained in PVC waste, will be promoted.

When new treatment methods have been developed, new requirements for management of PVC waste will be made.

E 17.3 Regulation

The Minister for Environment and the Danish Plastics Federation made an agreement in 1991 on the management of PVC waste.

The overall purpose of the agreement was to avoid delivery of PVC to waste incineration plants. The agreement lays down specific targets for building materials, packaging, and other products, as well as heavy metals and fire inhibitors⁴⁶.

Non-recyclable PVC waste has so far been regulated in general provisions of the Statutory Order on waste.

E 17.4 Environmental assessment

In future building projects, it will be possible to a far greater extent to substitute part of conventional PVC products by less environmentally harmful products. Increased application of environmentally correct design is expected to result in certain PVC products with harmful effects on the environment in a life-cycle aspect to be substituted by alternative products.

Separation of PVC with a view to avoiding delivery to waste incineration plants will lead to a reduction in amounts of flue gas cleaning waste. Reduced delivery of PVC waste to incineration plants will also lead to improved quality of slag for recycling.

However, it is assessed that part of PVC waste cannot be identified as such. This waste will still be delivered to incineration plants.

E 17.5 Economic aspects

In the first years, no significant additional costs are expected in the disposal of PVC waste. At present, it is not possible to evaluate costs of treatment in future technologies.

⁴⁶ Reference is made to the PVC statement.

E 17.6 Implications for national authorities

The Statutory Order on waste will be amended to state that non-recyclable PVC waste must be separated and landfilled. When suitable treatment methods have been developed, new requirements for management of PVC waste will be made.

A Statutory Order will be issued prohibiting import, marketing, and use of lead and products containing lead. The Statutory Order will include regulation of the use of lead-containing pigments and stabilisers in PVC.

E 17.7 Implications for local authorities

Local authorities are to ensure that non-recyclable PVC waste is assigned to landfilling. It is recommended that local authorities assign PVC waste to landfilling in separate cells, allowing subsequent alternative treatment of such waste.

When new treatment methods have been developed, new requirements for management of PVC waste will be made.

E 18 Residues from waste incineration plants

<i>Environmental problem</i>	<i>Residues contain heavy metals which, by leaching, threatens groundwater</i>
<i>Initiatives</i>	<i>Establishment of permanent landfill sites for flue gas cleaning waste</i> <i>Preparation of requirements for recycling of slag in due consideration of groundwater</i> <i>Statutory Order to be issued banning import, marketing and use of lead and lead-containing products</i>

E 18.1 Status

Residues from waste incineration contain heavy metals.

Residues cover slag and flue gas cleaning waste, including fly ash.

In 1997, 82 per cent of slag was recycled, and the rest was landfilled. Flue gas cleaning waste is now being stored temporarily, but a permanent solution is being established. Requirements for recycling of residues will be adapted so that groundwater resources are protected.

The objective of recycling residues from incineration plants has been achieved⁴⁷, as 77 per cent of residues from waste incineration plants was recycled in 1997.

In 1997, 493,800 tonnes of slag and 61,300 tonnes of flue gas cleaning waste were generated. Flue gas cleaning waste contains large amounts of environmental contaminants, and it results in very high leaching of salts and heavy metals. Flue gas cleaning waste is classified as hazardous waste.

Objective year 2004

- *70% recycling of slag in due consideration of groundwater*
- *establishment of permanent landfill sites for flue gas cleaning waste*

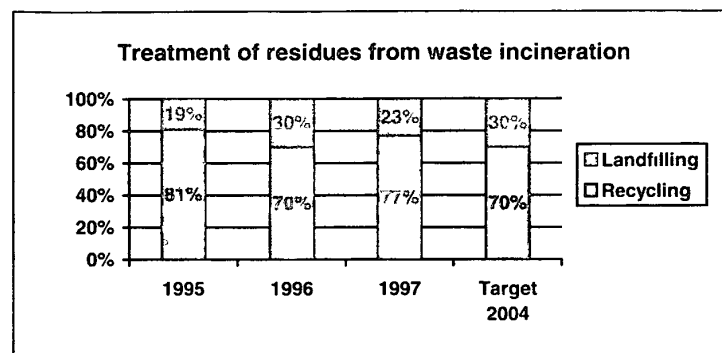
⁴⁷ Objectives for year 2000 were to recycle 53 per cent of total residues from waste incineration plants. For slag, objectives were to recycle 65 per cent.

Slag and flue gas cleaning waste are generated at 31 waste incineration plants and Kommunekemi A/S, as well as the special incineration plant SWS

Slag from waste incineration is primarily recycled in building and construction works. Present criteria for recycling will be adjusted so that groundwater resources are protected

In 1997, around 35,000 tonnes of flue gas waste were stored in temporary storage, and around 25,000 tonnes were exported for landfilling in Norway and Germany. Temporary storage is used, as so far no suitable methods for stabilisation of flue gas waste have been developed, and no suitable locations for landfilling of stabilised flue gas cleaning waste found

A method for stabilisation of flue gas cleaning waste has now been developed. Dansk Restproduktbehandling, Danish Residues Treatment, has carried out pilot tests of the method, but full-scale tests are still outstanding



Measures

- requirements for recycling of slag
- permanent solution for landfilling of stabilised flue gas cleaning products

E 18.2 Future initiatives

In 1999, a Statutory Order regulating recycling of slag will be submitted to hearing. The purpose of the Statutory Order is to ensure recycling of residues in due respect of groundwater resources

Initiatives have been launched to establish three landfills receiving stabilised flue gas cleaning products from the whole country. In respect of principles of proximity and self-sufficiency, export of flue gas cleaning products will no longer be permitted when these landfills have been established and started operation. In connection with the preparation of Waste 21, the European Commission has been notified of these measures in accordance with regulations in Article 4, section 3 a) i) in Council Regulation (EEC) no. 259/93.

In parallel to these initiatives, Dansk Restproduktbehandling, Danish Residues Treatment, will investigate possibilities of recycling residues.

E 18.3 Regulation

According to general rules on waste⁴⁸ local authorities must assign slag to disposal, and they are responsible for collecting flue gas cleaning waste

Recycling of slag is regulated by Statutory Order no. 568 of 6th December 1983 on the use of slag and fly ash, and for other construction works by

⁴⁸ Statutory Order on waste no. 299 of 30th April 1997

rules of the Danish Environmental Protection Act⁴⁹ on heavily polluting enterprises

Landfilling of flue gas cleaning waste is regulated in a Circular on landfilling of residues from waste incineration plants (dated 19th January 1989). This Circular has so far constituted guidelines for regional authorities in the landfilling of such waste. A supplementary Circular on guidelines for temporary storage of residues was issued on 29th October 1993

A Statutory Order will be issued including a ban on import, marketing and use of lead and lead-containing products. The Statutory Order will have an effect on products containing lead transferred to waste incineration plants

E 18.4 Capacity

Through the establishment of permanent landfills for stabilised flue gas cleaning products, suitable and sufficient plants for disposal of this type of waste will be ensured in Denmark. In respect of principles of proximity and self-sufficiency, export of flue gas cleaning products will no longer be permitted when these landfills have been established and started operation.

It may be necessary to landfill increasing amounts of slag, due to stricter rules for recycling.

E 18.5 Environmental assessment

The establishment of the above-described landfills for flue gas cleaning waste and new rules for recycling of slag will lead to enhanced protection of groundwater resources

E 18.6 Implications for national authorities

When the coastal landfills receiving waste from the whole country have been established, requirements will be issued to the effect that waste is removed from present temporary storage to these landfills. At the same time, it will be required that future flue gas cleaning waste arisings are landfilled at these sites.

E 18.7 Implications for local authorities

In their future planning, local authorities must take into consideration new rules for the management of residues from waste incineration plants, including future landfilling of flue gas cleaning waste.

In case the amendment to the Statutory Order on recycling of residues leads to landfilling of larger amounts of slag, local councils must plan for increased landfill capacity.

⁴⁹ Statutory Order no. 625 of 15th July 1997

E 19 Residues from power plants

<i>Environmental problem</i>	<p><i>Residues contain trace elements harmful to human health and the environment</i></p> <p><i>Residues represent resources that should be recycled instead of taking up capacity at landfills</i></p>
<i>Initiatives</i>	<p><i>Revision of requirements for recycling of residues, protecting groundwater resources Requirements to be incorporated in a Statutory Order</i></p> <p><i>Preparation of requirements for recycling of bioash for fertilising purposes Requirements to be incorporated in a Statutory Order</i></p> <p><i>Development of methods to increase recycling of residues from biofuel</i></p> <p><i>Establishment of close co-operation with operators in the area</i></p>

E 19.1 Status

Energy generation at power plants is today based on either coal, oil, natural gas, or biofuels. During the process, a number of residues are generated which can be recycled for various purposes.

According to Energy 21, the use of coal for energy generation will be phased out within the next 30 years. Phasing-out will be done in parallel to the extension of energy generation based on biofuel. As a consequence, the generation of residues from coal-fired power plants will drop in this period, whereas amounts of residues from bio-based power plants will increase.

Objective year 2004

- *90% recycling of total amounts of bottom ash and fly ash from coal-fired power plants*
- *environmentally safe recycling of bioash*

Hardly any residues are generated at oil and natural gas-fired power plants.

Residues from biofuel

Residues cover fly ash and bottom ash. Amounts of bioash in year 2000 are expected to be 60,000 tonnes.

Fly ash contains much cadmium, and consequently total amounts of ash cannot be recycled. It is therefore necessary to develop methods to separate cadmium-bearing fly ash. Part of bottom ash can thereby be recycled in agriculture.

Recycling of ash has high priority and will be done with due respect for groundwater resources.

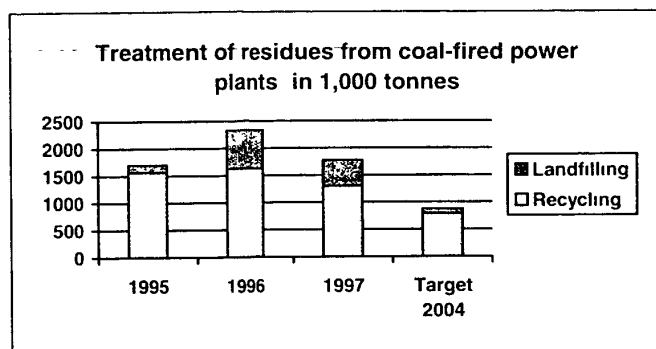
Residues from coal-fired power plants

Residues from coal-fired power plants are slag, fly ash, gypsum, TASP, and sulphuric acid. Residues from coal-fired power plants contain a number of heavy metals, limiting possibilities of recycling.

In 1997, 1.8 million tonnes of residues were generated, which is far below the level of 1996.

The objective for recycling of residues from coal-fired power plants has been achieved⁵⁰, as 73 per cent was recycled in 1997⁵¹.

The following figure shows the development of treatment of residues from coal-fired power plants



A good 70 per cent of recycled residues in 1997 was used in industrial production as recyclable materials (see table below)

The remaining part of residues is recovered in building and construction works in the form of backfilling below buildings, roads and squares, backfilling of cable conduits and trenches, for harbour backfilling, or for construction of barriers

Recovery in 1997 of residues from coal-fired power plants (1,000 tonnes)	Fly ash	Slag/ bottom ash	Gyp- sum	TASP	Sul- phuric acid	Total
Cement	311					311
Concrete	220					220
Porous concrete	7					7
Asphalt	49					49
Roofing felt	5					5
Backfilling (S O 568)	34	111				145
Backfilling (EPA, Part 5)	169	5				174
Granulates				4		4
Fertiliser					8	8
Backfilling				36		36
Plaster board			306			306
Total	795	116	306	40	8	1265

27 per cent of residues was landfilled. This is a relatively large decrease compared to 1996 (703,000 tonnes landfilled against 475,000 tonnes in 1997)

For the disposal of large amounts, coastal landfilling is preferred in order to protect groundwater resources.

⁵⁰ 73% of residues from coal-fired power plants was recycled in 1997, corresponding to 1,300,000 tonnes. Of this amount, 113,000 tonnes were exported for recovery

⁵¹ In the Plan of Action for waste and recycling 1993-97 the objective was to recycle 56 per cent of total amounts of residues before year 2000

Danish power supply companies expect to completely stop landfilling fly and bottom ashes from coal-fired power plants within the next three years.

An initiative for the creation of a centre for management of residues has been taken by operators in the area. The purpose of the centre is to improve possibilities of recovery and reduce environmental impacts from landfilling or recovery of residues.

Measures

- *requirements for recycling of residues*
- *requirements for recycling of bioash for fertilising purposes*
- *formalised co-operation with centre of residues*
- *development of methods to separate fly ash from bottom ash from biofuel with a view to increased recycling*

E 19.2 Future initiatives

In 1999, a Statutory Order on recycling of residues will be submitted to hearing. The purpose of the Statutory Order is to protect groundwater resources in connection with recycling.

In 1998, a Statutory Order on the application of bioash to farmland was prepared.

Closer co-operation between operators in the area is envisaged.

Initiatives for the development of methods for increased recycling of residues from biofuel will be promoted.

Methods for separating fly ash from bottom ash in energy generation using wood, chips, and energy crops as fuel will be promoted.

E 19.3 Regulation

Recycling of slag and fly ash from coal-fired power plants is regulated in Statutory Order no. 568 of 6th December 1983 on the use of slag and bottom ash in connection with establishment of roads, paths, squares, foundations, and cable conduits and trenches, and for other construction works in the rules of the Danish Environmental Protection Act on heavily polluting enterprises.

A waste tax was introduced on residues on 1st January 1998. The purpose was to ensure permanent incentives to reduce residues, or alternatively to recycle residues. In connection with the increase of the waste tax on 1st January 1999, the rate for landfilling of residues was increased to DKK 375/tonne, corresponding to the general rate for landfilling.

The use of bioash is regulated by the Statutory Order on sludge⁵².

E 19.4 Environmental assessment

In the long term, energy generation based on coal will be phased out. This will reduce amounts of residues from coal-fired power plants.

E 19.5 Implications for national authorities

In 1998, the Statutory Order regulating recycling of slag and fly ash will be revised so that respect of groundwater resources is better ensured in the recycling of residues.

E 19.6 Implications for local authorities

In their future planning, local authorities are to take into consideration changed conditions for management of residues from coal-fired power plants.

⁵² Statutory Order on application of waste products for agricultural purposes, no. 823 of 16th September 1996.

If the revision of the Statutory Order on recycling of residues leads to larger amounts of residues for landfilling, this will have implications for local planning

E 20 Shredder waste

<i>Environmental problem</i>	<i>Shredder waste has a high content of environmental contaminants and accounts for a large part of industrial waste landfilled today</i>
<i>Initiative</i>	<i>Development of new treatment methods for extracting heavy metals</i>

Objective year 2004

- 75% recycling and better resource utilisation of shredder waste
- reduced amounts of shredder waste for landfilling

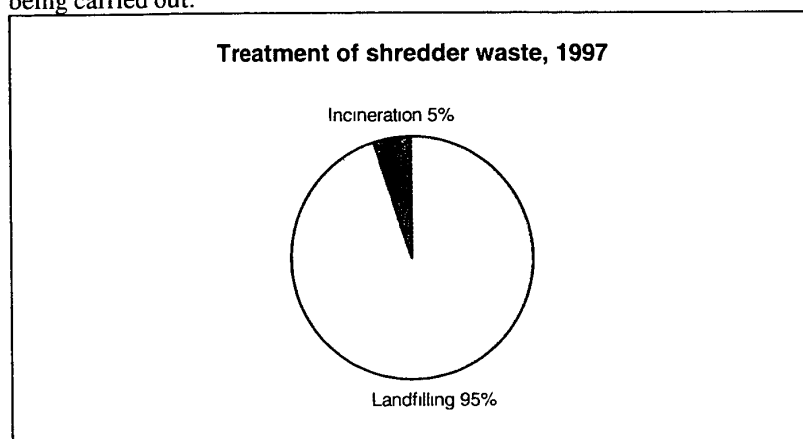
E 20.1 Status

Shredder waste arises in the form of production waste at enterprises crushing various metal-containing products, such as vehicles and white goods. The major proportion of shredder waste is landfilled today.

Shredder waste has a high content of environmental contaminants (heavy metals, PCB). The treatment of waste from shredder plants will be improved, and the possibility of developing new treatment techniques will be investigated.

In 1997, amounts of shredder waste were 95,000 tonnes, 90,000 tonnes were landfilled and 5,000 tonnes incinerated. Relatively large amounts were incinerated in 1997, as tests with incineration of shredder waste were undertaken at Kommunekemi A/S. The objective for 2004 is to recover 75 per cent of shredder waste in a way ensuring recycling of heavy metals and utilisation of energy.

Trials of reprocessing shredder waste at special plants, primarily gasification plants, have caused large problems in the past. In recent years, however, many resources have been invested in the development of new technology to treat shredder waste and other heavy metal-containing waste fractions, in an environmentally appropriate manner. In order to share results of this development, a study has been launched, financed by funds from the Council for Recycling and Cleaner Technology, to identify plants at international level that have been established at industrial scale, and that may be adapted to Danish waste management. It will also be investigated what is being done abroad in terms of research, and in parallel Danish pilot tests are being carried out.



Measures

- *development of methods to reprocess heavy metal-containing fractions*
- *collection and dispersion of knowledge*
- *requirements for management of shredder waste*
- *requirements for enterprises handling shredder waste*
- *full-scale tests with new treatment technology*

E 20.2 Future initiatives

On the basis of the ongoing study of reprocessing plants on an industrial scale, up to three plants will be selected for detailed study. Experts will monitor operations for two to three weeks. As it is unrealistic to base the establishment of a Danish reprocessing plant only on shredder waste, the three selected plants will be evaluated in their reprocessing of shredder waste, pressure-impregnated wood, fire-inhibiting plastic, and galvanic waste. Results of these projects are expected to form the basis of a realistic decision on which technique for the treatment of shredder waste can best be adapted to Danish waste management.

Initiatives supporting the development of better treatment methods utilising resources contained in shredder waste, will be promoted. When treatment methods have been developed, rules will be issued on management of shredder waste.

E 20.3 Regulation

Management of shredder waste has so far been regulated by general rules in the Statutory Order on waste and in environmental approvals of enterprises using shredder plants in reprocessing of composite products. Such enterprises are iron and metal recycling enterprises which are on the list of the Danish Environmental Protection Act of heavily polluting enterprises in point K2, and car scrapping enterprises listed under point K5 of the same Act

E 20.4 Capacity

It is estimated that sufficient capacity is available for landfilling shredder waste.

E 20.5 Environmental assessment

Environmental impacts from reprocessing shredder waste will be a reduction of waste for landfilling and thereby reduced risk of leaching to groundwater, increased recycling of the contents of metals in shredder waste, and utilisation of energy of the organic waste fraction.

E 20.6 Implications for national authorities

When a suitable treatment method has been developed, a Statutory Order on management of shredder waste will be issued.

In the coming planning period, efforts will be made to prepare guidelines for environmental design of industrial products and to exploit the possibilities offered by the product panel for electronics, which has been established under the integrated product strategy

E 20.7 Implications for local authorities

When the Statutory Order on management of shredder waste has been issued, local councils will assign waste to plants complying with requirements for management of shredder waste.

E 21 Waste oil

<i>Environmental problem</i>	<i>Waste oil is hazardous waste, and fractions are generated unevenly throughout the country</i>
<i>Initiatives</i>	<i>Subvention scheme for waste oil will be evaluated</i>
	<i>Present treatment of waste oil will be evaluated</i>

Objective year 2004

- environmentally safe management of waste oil

E 21.1 Status

Waste oil is collected and incinerated with energy recovery. Today, subsidies are granted for private collection of waste oil.

Waste oil is collected from, for example, garages, transport companies, industry, the military, and private car owners. The collection of waste oil is made through municipal transfer stations and a number of private collectors. After collection, water is separated from waste oil, and it is transferred to further treatment, or to Kommunekemi A/S.

Almost all registered waste oil collected by private companies is sold after processing for incineration at district heating plants. In 1997, these plants treated 22,576 tonnes of waste oil.

In the treatment of waste oil, around 2,000-3,000 tonnes of water and distillation residues are generated. Distillation residues are transferred to Ålborg Portland.

Oily waste is also collected from shipping (slop oil). Such waste is primarily delivered to municipal transfer stations and transferred on to Kommunekemi for destruction. In 1997, Kommunekemi A/S received 13,217 tonnes of oily waste.

The subsidy scheme gives an incentive to collect oil and incinerate it as district heating plants. No subsidies are granted for recovery as base oil.

A study has been launched to clarify economic advantages and disadvantages of reprocessing waste oil into base oil.

E 21.2 Future initiatives

Future treatment of waste oil will be determined when the results of this study are available.

E 21.3 Regulation

Management of waste oil is regulated in the Statutory Order on waste. Waste oil is hazardous waste, and under the terms of the Statutory Order on waste, local councils must establish collection schemes for such waste.

Subsidies are granted for the disposal of waste oil⁵³. Subsidies are given in the form of reimbursement of mineral oil taxes, at the incineration at district heating plants. The scheme gives an incentive to collect and dispose of waste oil at district heating plants.

⁵³ Cf. Statutory Order from the Ministry of Environment and Energy no. 1179 of 23rd December 1993 on subsidies for disposal of waste oil (as amended by Statutory Order no. 1047 of 15th December 1995), which took effect on 1st May 1993.

The subsidy scheme is administered by the Danish Environmental Protection Agency. In 1997, reimbursements amounted to DKK 44 4 million

E 21.4 Capacity

Waste oil is destroyed today at district heating plants and Kommunekemi A/S.

E 21.5 Implications for national authorities .

The subsidy scheme for waste oil will be evaluated

E 21.6 Implications for local authorities

No implications for local authorities

E 22 Foundry waste

<i>Environmental problem</i>	<i>Foundry waste contains chemicals, and this is a barrier to recycling Today, foundry waste accounts for a large part of landfilled industrial waste</i>
<i>Initiatives</i>	<i>Development of recycling methods</i>

Objective year 2004

- *80 % recycling of foundry waste*
- *10 % waste reduction*

E 22.1 Status

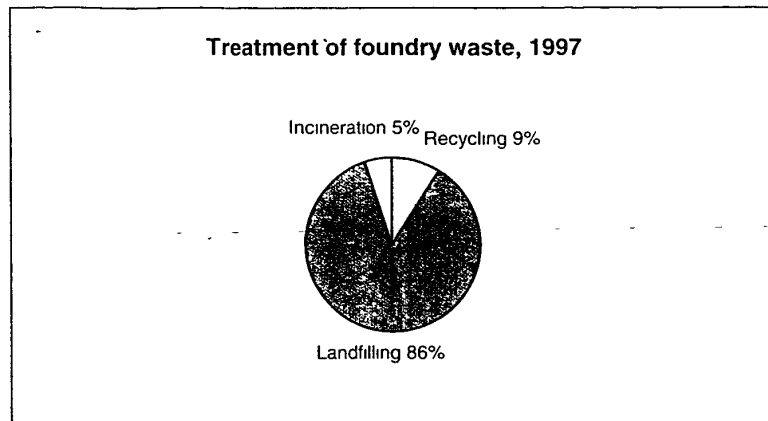
Foundry waste accounts for a large part of landfilled industrial waste. Suitable recycling possibilities have been developed for this waste, and they are now gaining ground in the foundry industry

The foundry industry covers just below 40 foundries (10 iron foundries, the rest metal foundries) with between one and 300 employees. In 1997, 95,000 tonnes of foundry waste were generated.

Environmental problems related to foundry waste primarily derive from discarded foundry sand, amounting to 80,000 tonnes per year. Such sand contains chemicals which are used in the production of moulds. Around 5,000 tonnes of slag are generated each year. Furthermore, around 400 tonnes of furnace filter dust are generated that are classified as hazardous waste.

The foundry industry has started introducing environmental management. Experience from the industry (from black sand foundries) has shown that environmental reviews of enterprises may lead to a reduction in waste amounts of around 20 per cent.

Good treatment methods have been developed, so that, for example, black sand can be recycled, and zinc and lead can be extracted from filter dust. The industry is investigating possibilities of recycling slag from melting furnaces and foundry ladles. Technically, large parts of waste generated at foundries can be recycled today



Measures

- *improved treatment methods for chemically bound foundry sand*
- *implementation of environmental management*

E 22.2 Future initiatives

Initiatives supporting the development of recycling methods for chemically-bound foundry sand will be promoted. Results and developments will be evaluated regularly

Technically, large parts of waste generated at foundries can be recycled today. It will therefore be ensured that all foundries in Denmark make efforts to recycle waste. This will be ensured in co-operation between the Danish Environmental Protection Agency and the foundry industry.

E 22.3 Capacity

Spent black sand is suitable for application as foundations in construction works and is expected to replace virgin sand in products.

A suitable plant for reprocessing zinc from filter dust is expected to be established in Norway as a result of Nordic co-operation.

Recycling capacity is available for large fractions. Capacity for reprocessing furnace filter dust depends on the establishment of the Norwegian plant.

The need for landfill capacity will decrease over time, as a result of increased recycling.

E 22.4 Environmental assessment

Environmental impacts from recycling of foundry sand and filter dust from furnaces are expected to be almost similar to the use of virgin raw materials, whereas recycling of slag will have a minimal impact

E 22.5 Economic aspects

The introduction of environmental management at foundries will allow for recycling of larger parts of waste. Increased recycling will entail savings for enterprises, as

- recycled waste is exempt from the waste tax. This will lead to savings of DKK 335 x 60,000 tonnes = approximately DKK 2.5 million, and
- costs of purchase of raw materials will be reduced

E 22.6 Implications for national authorities

Foundry sand is used for cover at landfills, and in their planning local authorities will therefore take into consideration that, in the long term, less waste of this type will be available

E 22.7 Implications for local authorities

Decreasing needs for landfill capacity for foundry waste will have implications for local planning

附 件 四

INDUSTRIAL SYMBIOSIS

**We welcome You to the
Symbiosis presentation
by
Valdemar Christensen
The Symbiosis Institute**

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INDUSTRIAL SYMBIOSIS

Definition

The symbiosis partners

The evolution of the symbiosis

Principles and features

Conclusion

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INDUSTRIAL SYMBIOSIS

SYMBIOSIS IS:

**Collaboration between
different organisms
for mutual
benefit**

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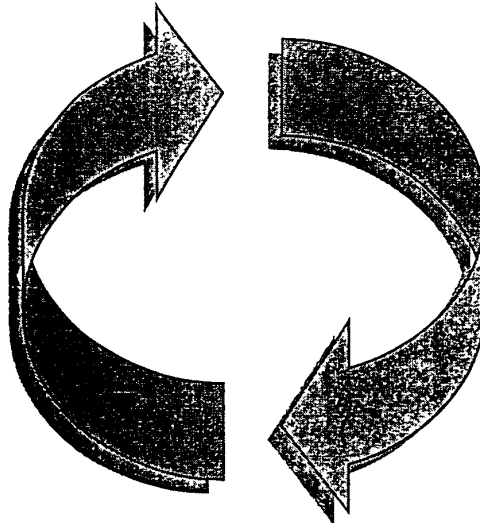
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Collaboration between different industries for mutual economic and environmental benefit.

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INDUSTRIAL SYMBIOSIS

BY-PRODUCTS



ECONOMIC AND
ENVIRONMENTAL
BENEFITS

INDUSTRIAL
NETWORKING

RAW-MATERIALS

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INDUSTRIAL SYMBIOSIS

INDUSTRIAL SYMBIOSIS IN KALUNDBORG

Collaboration between five industrial
enterprises and a municipality

Exchange of resources for mutual benefit

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[www symbiosis dk](http://www.symbiosis.dk)

INDUSTRIAL SYMBIOSIS

INDUSTRIAL SYMBIOSIS IN KALUNDBORG

The Symbiosis is based upon commercial agreements between independent partners

**The Symbiosis is not an invention
- just common sense**

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INDUSTRIAL SYMBIOSIS IN KALUNDBORG

**The Symbiosis is not an invention
- just common sense**

**The Symbiosis was created as a “non-project”
made by a “non-organization”**

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INDUSTRIAL SYMBIOSIS IN KALUNDBORG

The Symbiosis was created as a “non-project”
made by a “non-organization”

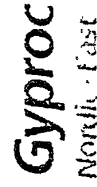
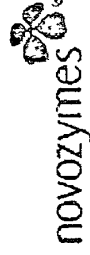
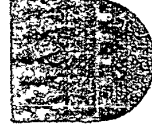
The Symbiosis combines economy and
environmental concern

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THE SYMBIOSIS PARTNERS

Gyproc Nordic East
Bioteknisk Jordrens - SOILREM
Energy E2 - Asnæs Power Station
The Statoil Refinery
The Municipality of Kalundborg
Novo Nordisk A/S - Novozymes A/S





GYPROC Nordic East

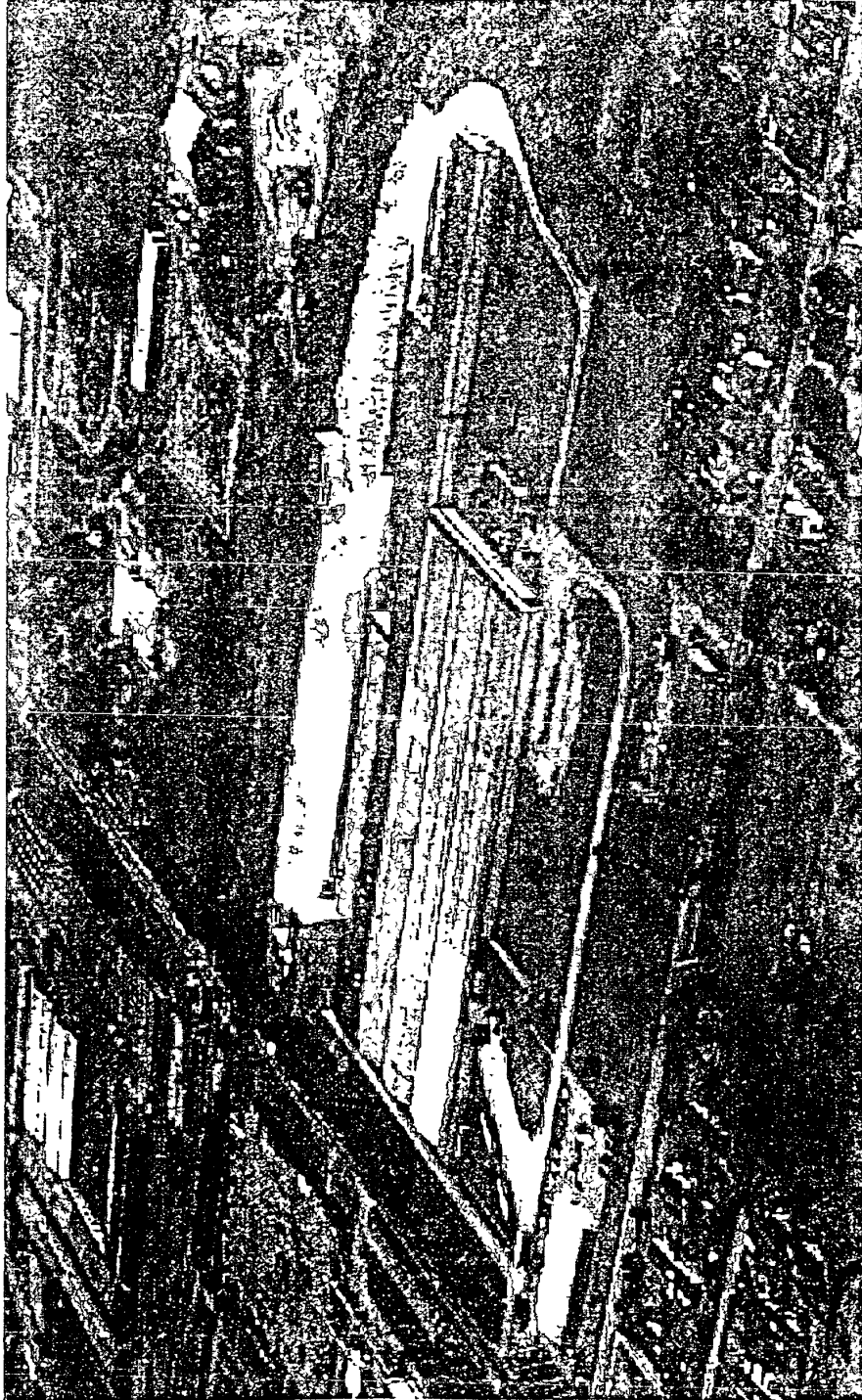
The factory in Kalundborg

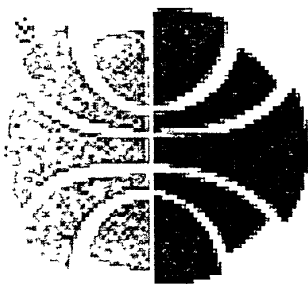
Production of plaster boards

No. of employees: 170

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Picture of Gyproc Nordic East





A/S BIOTEKNISK JORDRENS SOILREM

The branch in Kalundborg

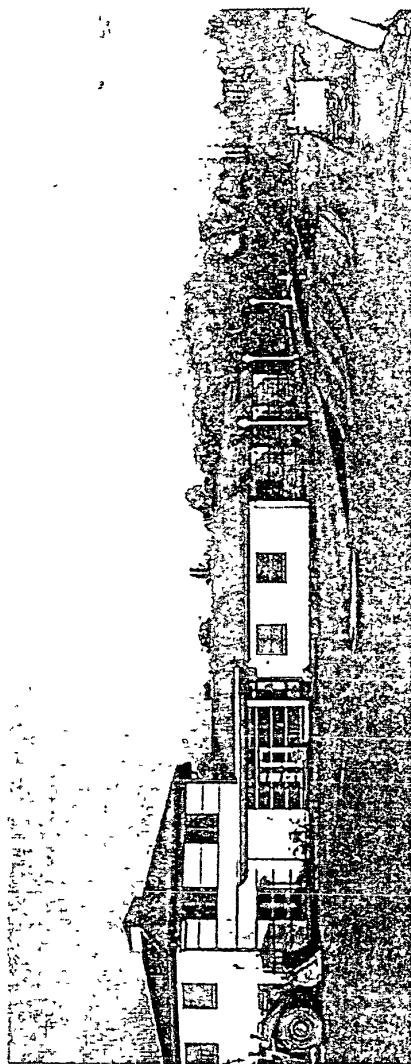
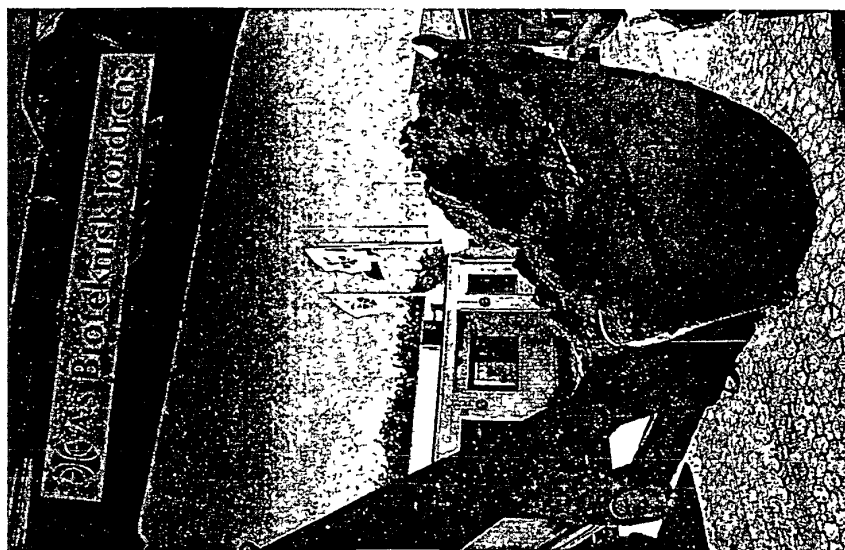
Soil Remediation

No. of employees : 35

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Picture of A/S Biotechnisk Jordrens SOILREM





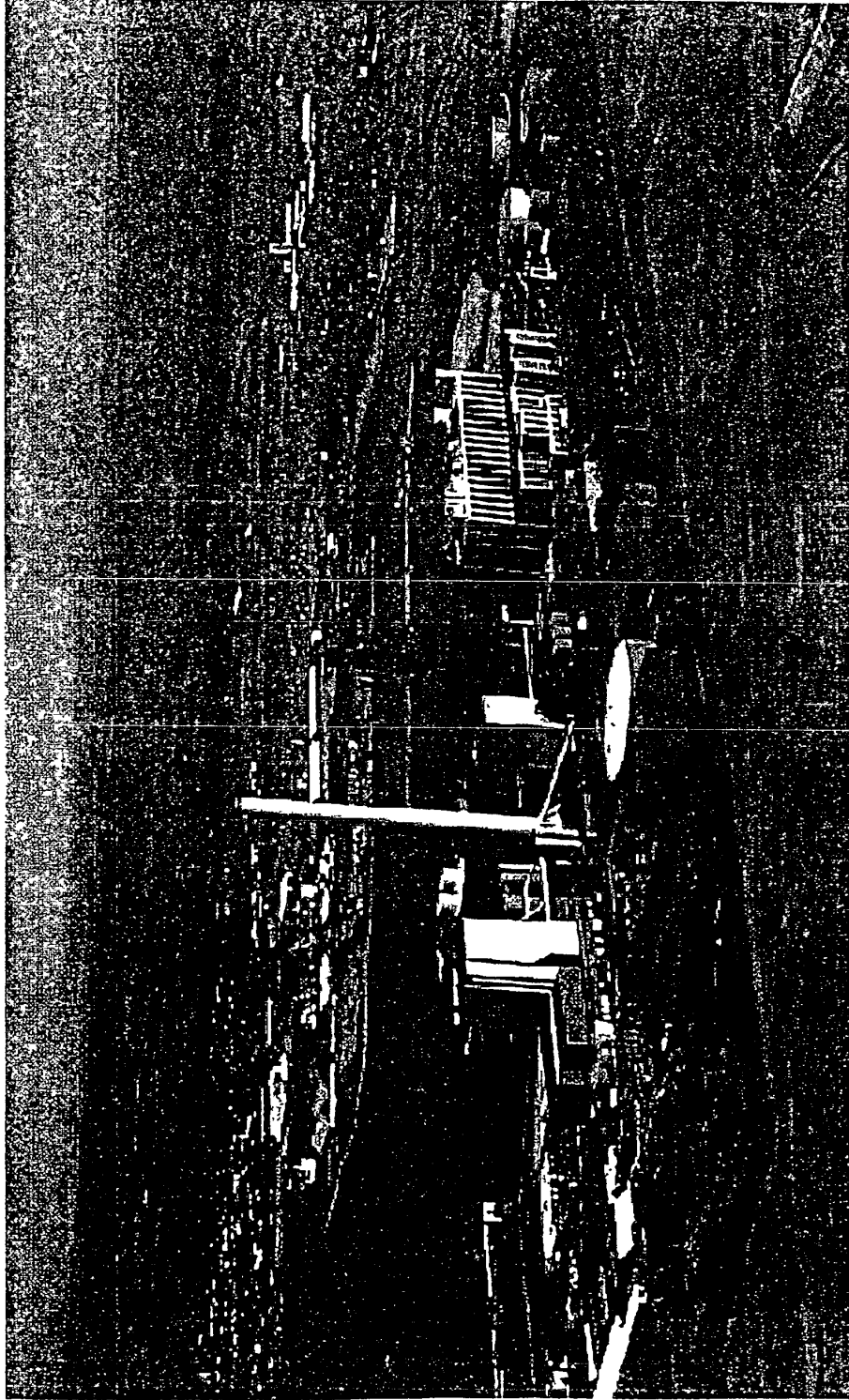
ASNAÆS POWER STATION

Production of energy (electricity and heat)

No. of employees: 500

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Picture of The Asnæs Power Station





STATOIL

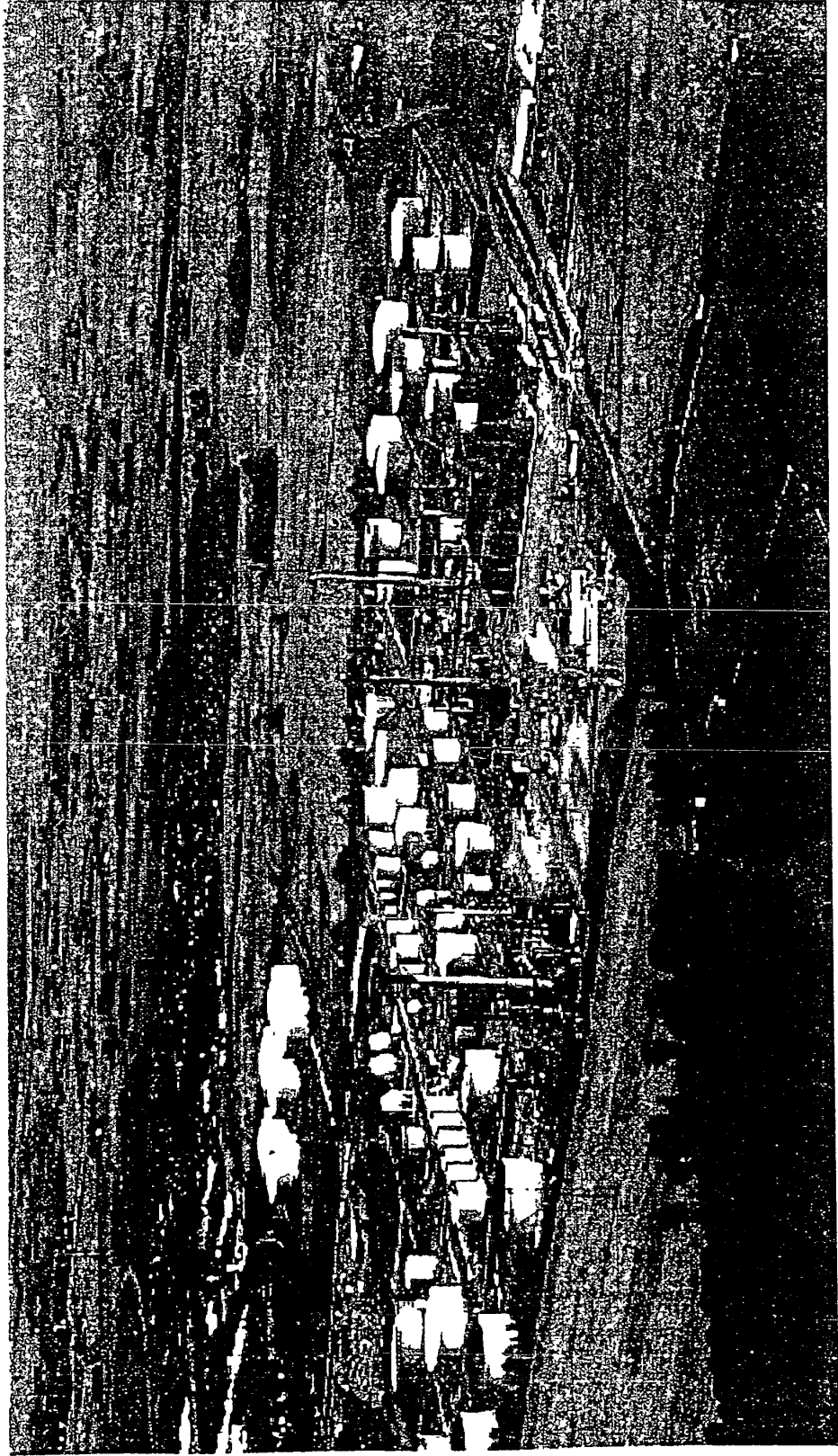
The refinery in Kalundborg

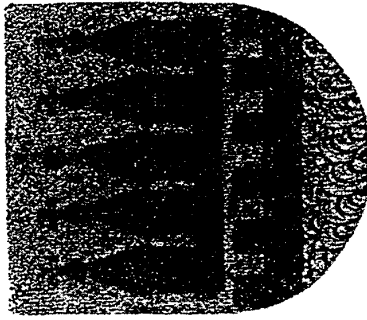
Production of gasoline
and other oil based products

No. of employees: 290

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Picture of Statoil





MUNICIPALITY OF KALUNDBORG

Distribution of water and energy

Population: App. 20.000

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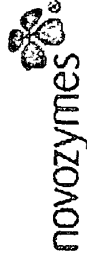
NOVO NORDISK A/S

Production of insulin



NOVOZYMES A/S

Production of enzymes for industrial use



No. of employees: All together 2000

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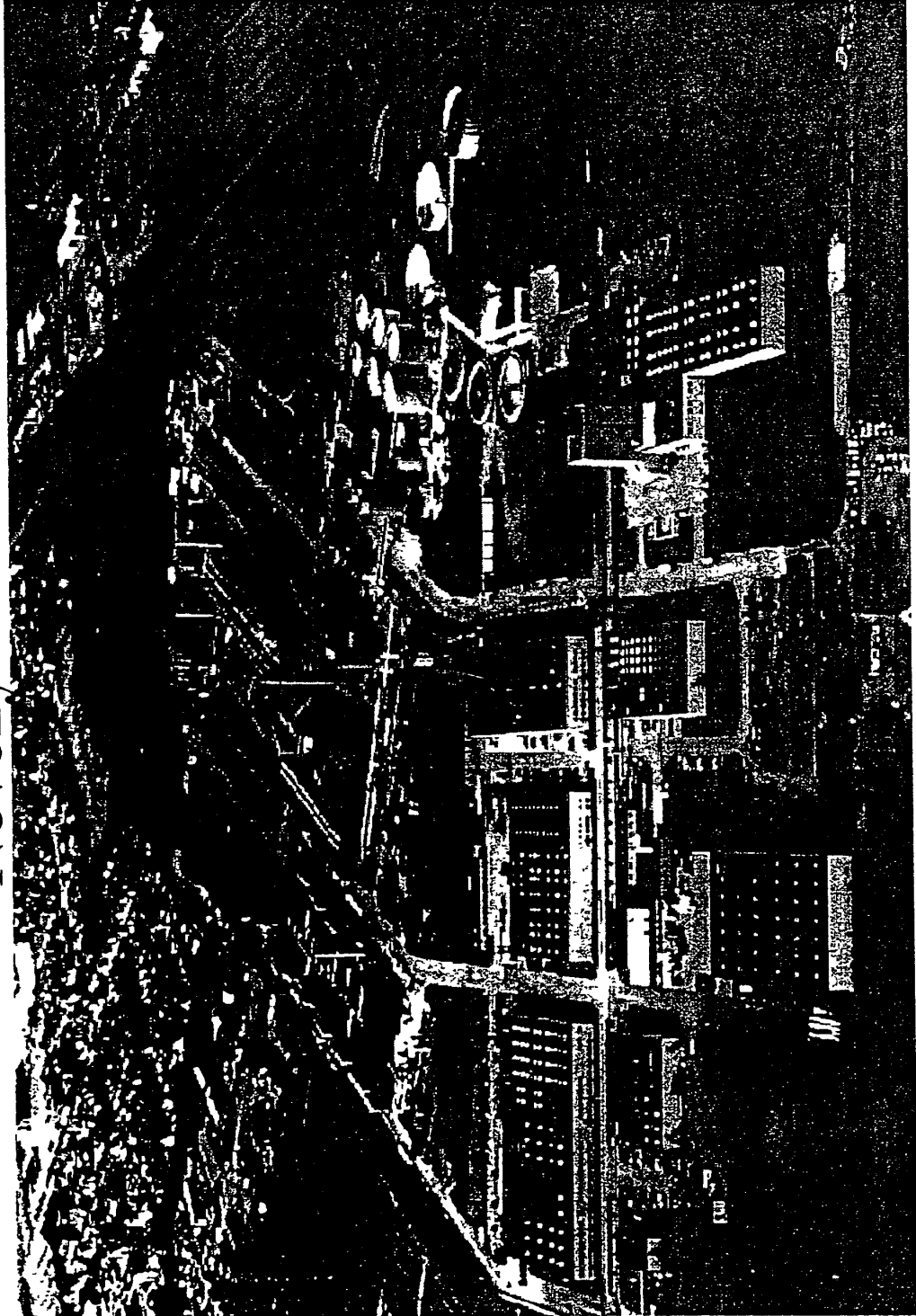
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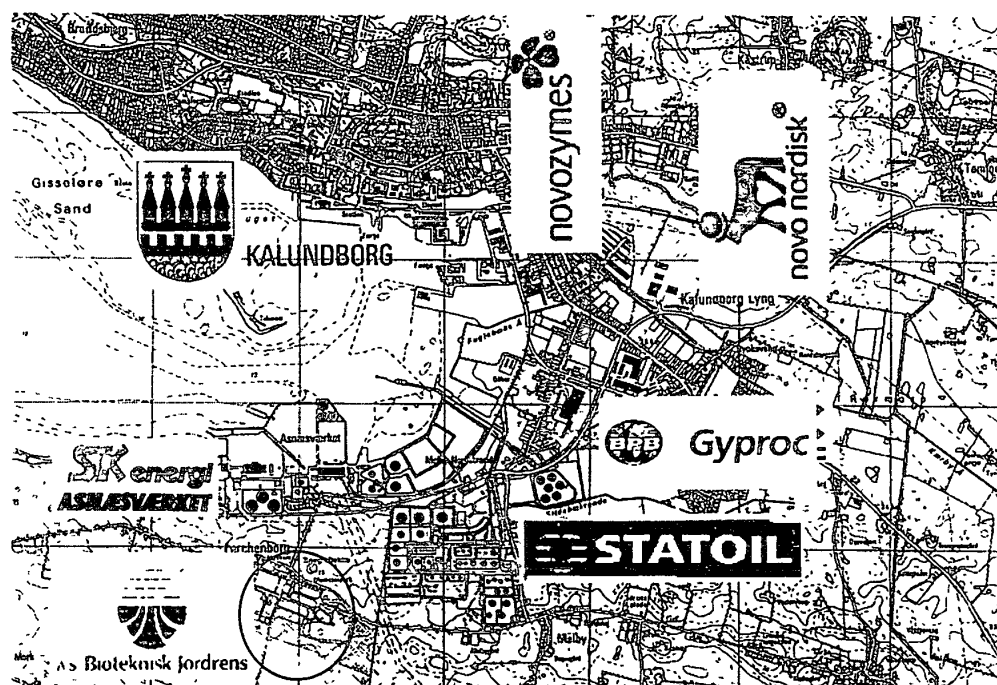
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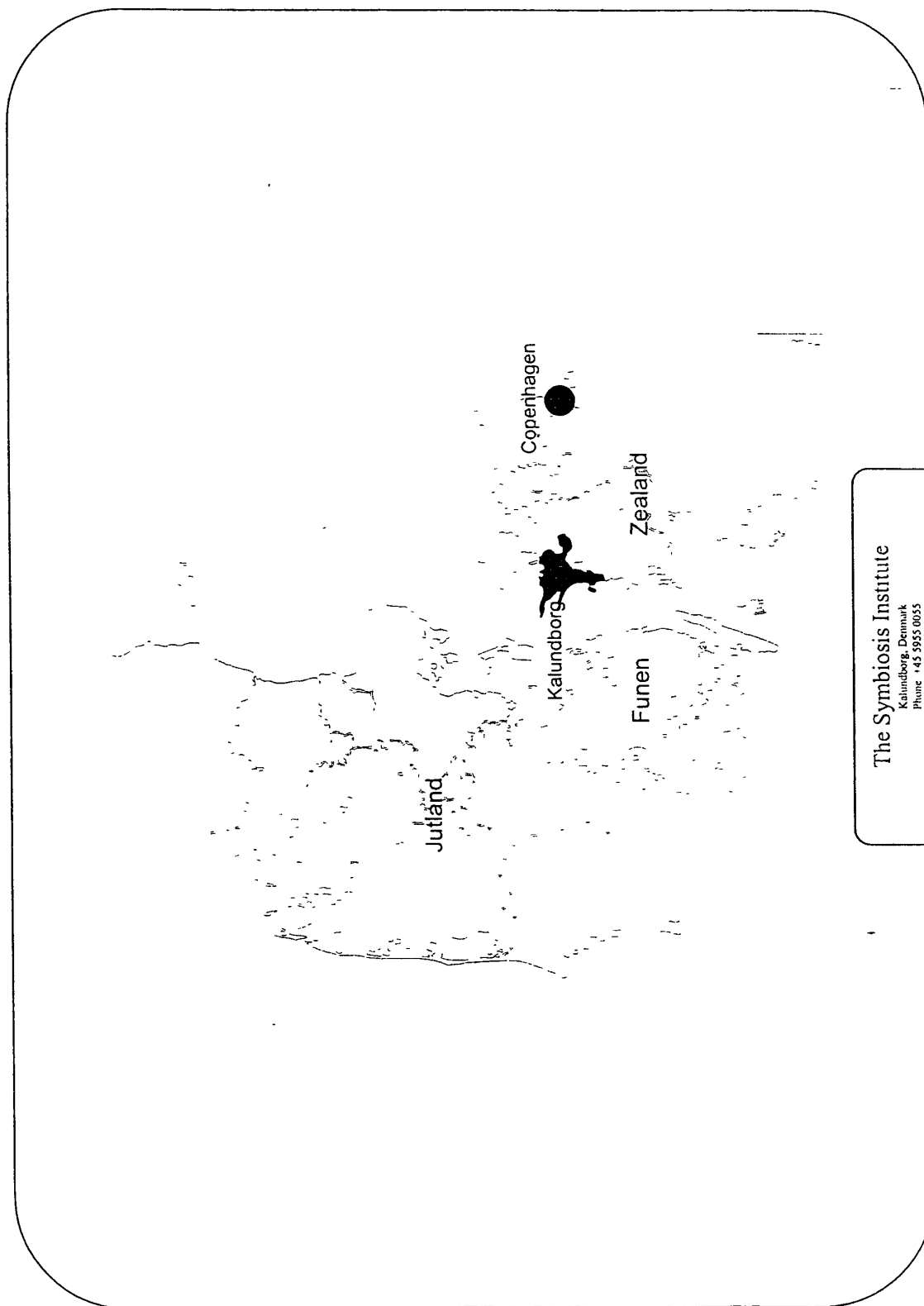
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Picture of Novo Nordisk A/S Novozymes A/S



Map of Kalundborg





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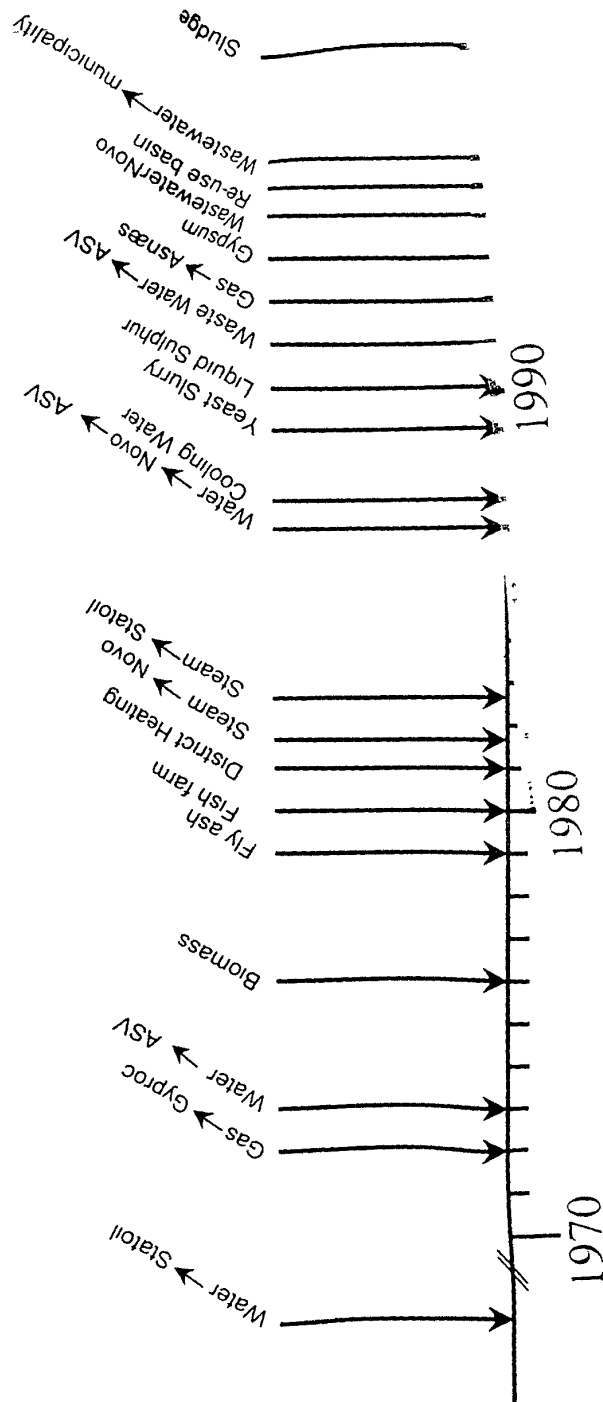
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INDUSTRIAL SYMBIOSIS

Recycling of water:	9 Projects
Exchange of energy:	6 Projects
Recycling of waste products:	6 Projects
The "internal" Symbiosis:	15 Projects
The "external" Symbiosis	4 Projects

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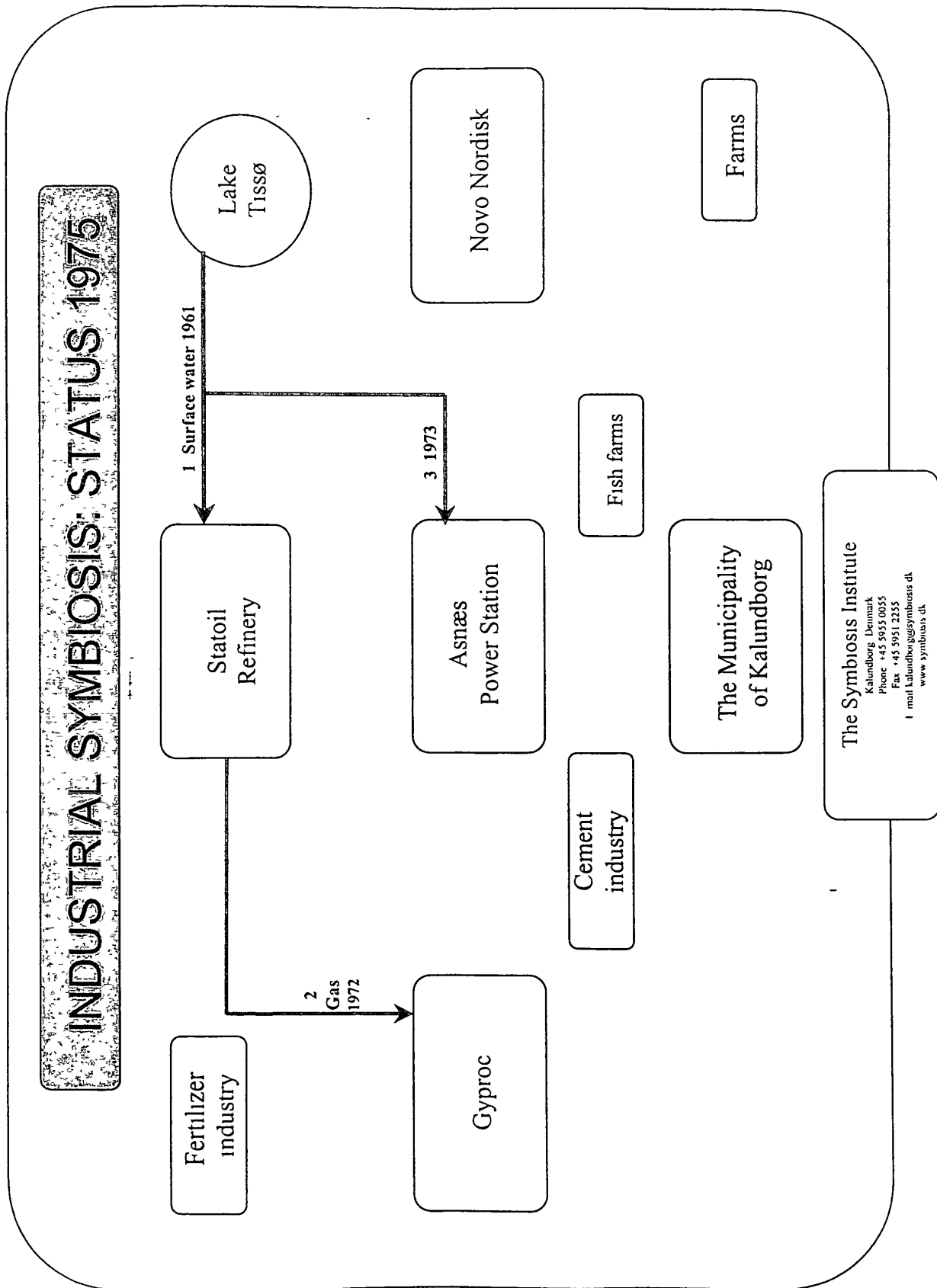
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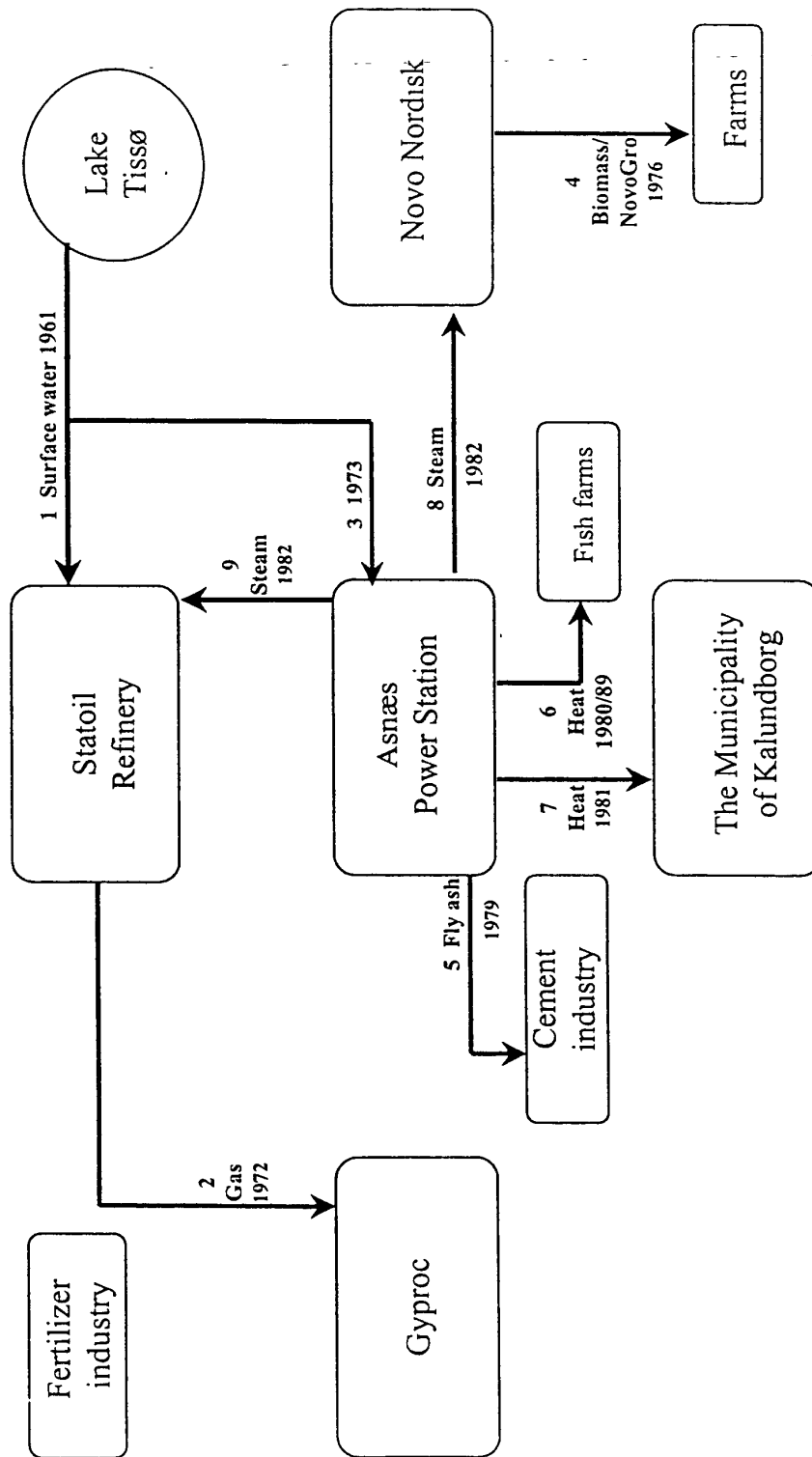
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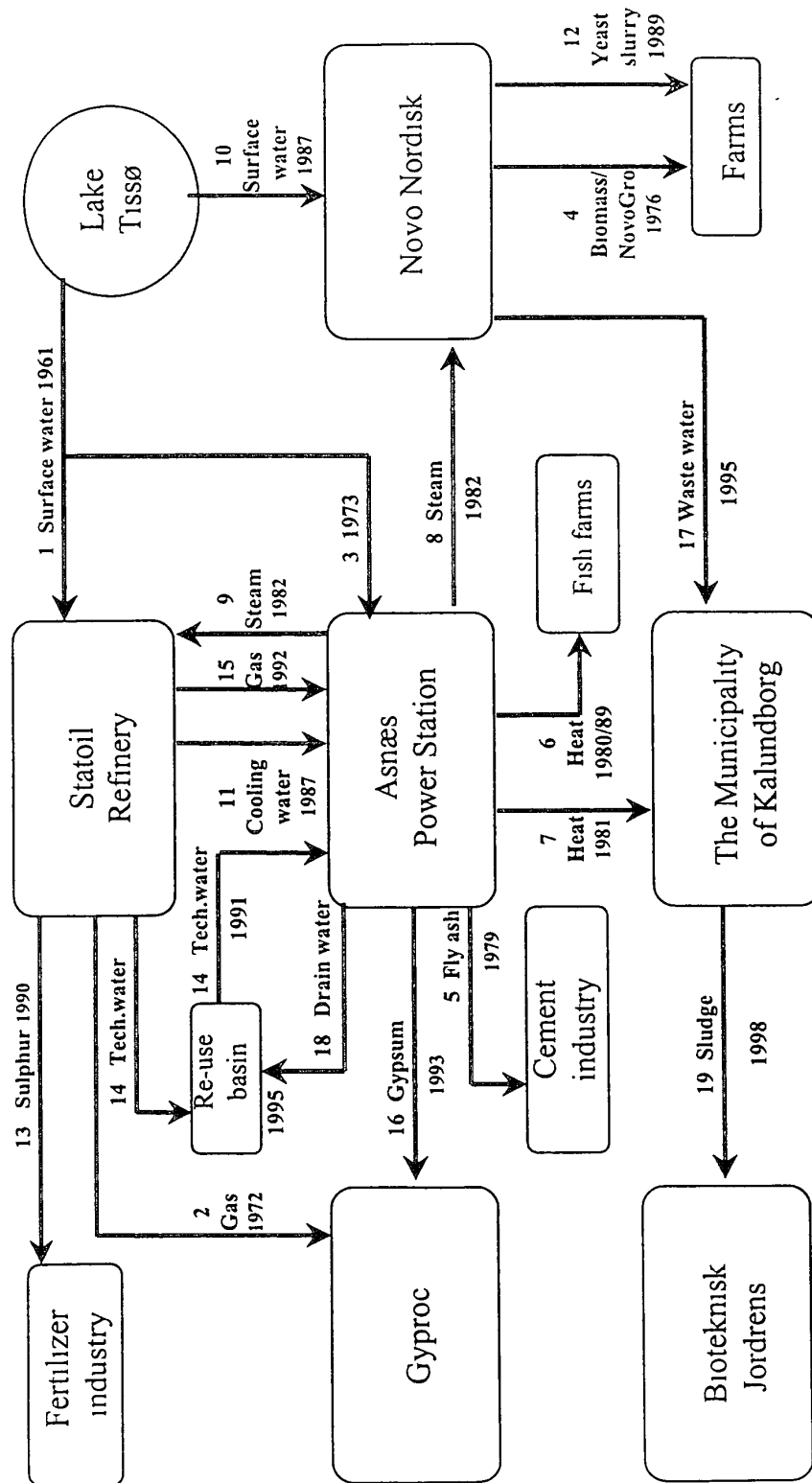
INDUSTRIAL SYMBIOSIS: STATUS 1985



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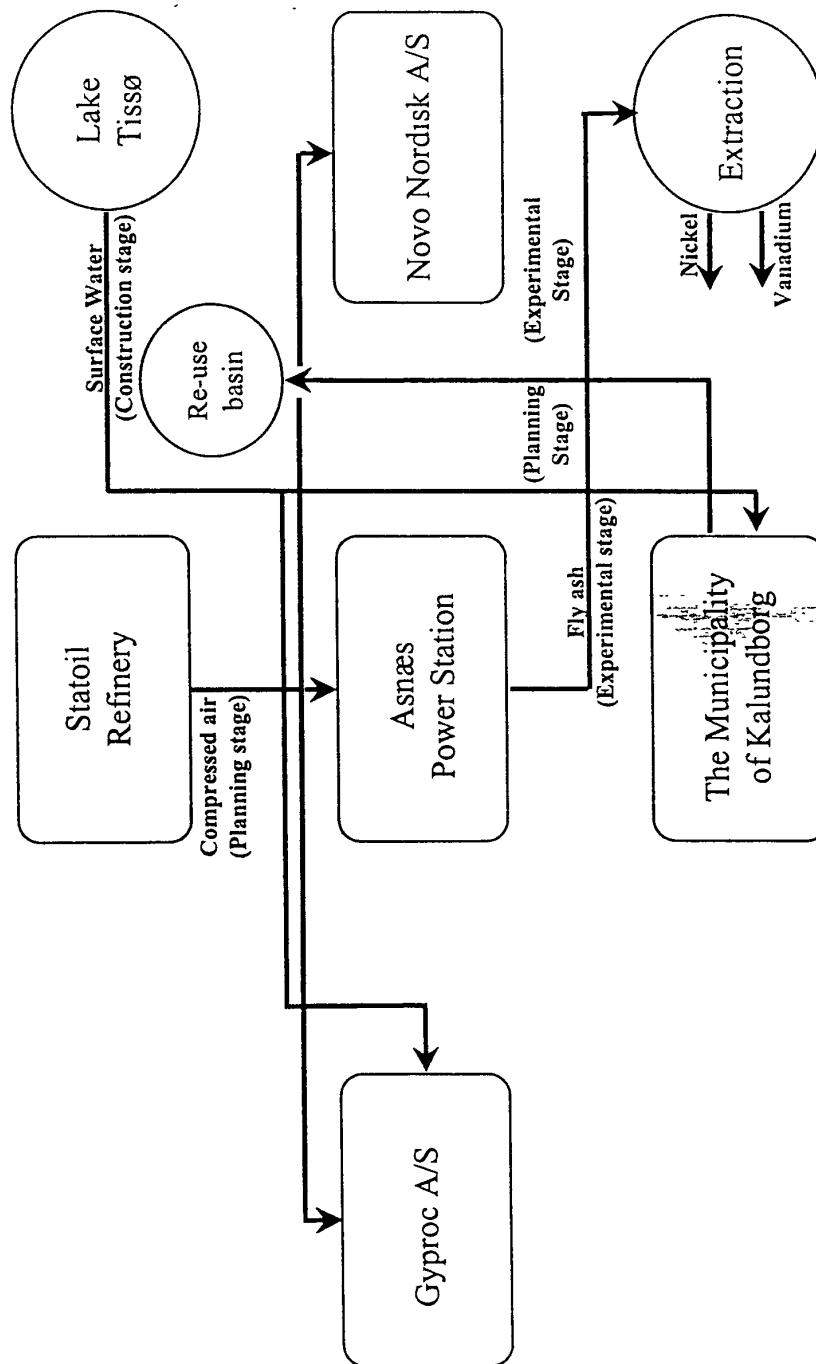
INDUSTRIAL SYMBIOSIS: STATUS 2000



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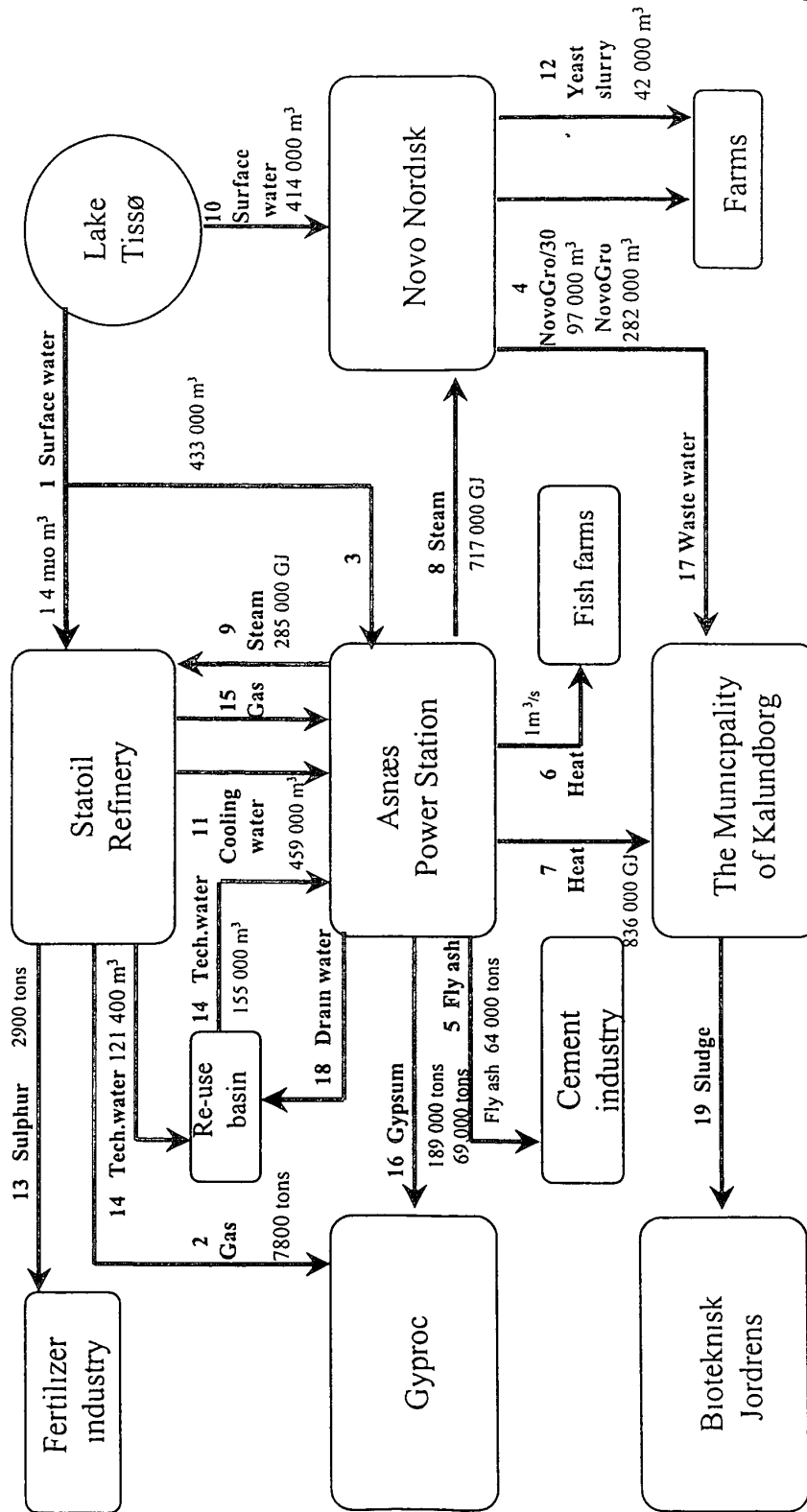
INDUSTRIAL SYMBIOSIS: NEW PROJECTS



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INDUSTRIAL SYMBIOSIS: QUANTITIES 1998



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INDUSTRIAL SYMBIOSIS ENVIRONMENTAL PARAMETERS

Resource savings:

Ground water:	1,9 mill. m ³ /year
Surface water:	1,0 mill. m ³ /year
Oil:	20,000 tonnes/year
Gypsum:	200,000 tonnes/year

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INDUSTRIAL SYMBIOSIS: ECONOMIC PARAMETERS

Total investments in 19 projects: ~ 75 mio. US\$

Annual savings: > 15 mio. US\$

Total savings until 1999: ~ 160 mio. US\$

Currency rates as per January 1999

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INDUSTRIAL SYMBIOSIS: PREREQUISITES

- Participants must fit together but be different
 - Large, continuous waste streams
 - Each project must be economically viable
- There has to be a short physical distance between the participants
- There has to be a short mental distance between the participants

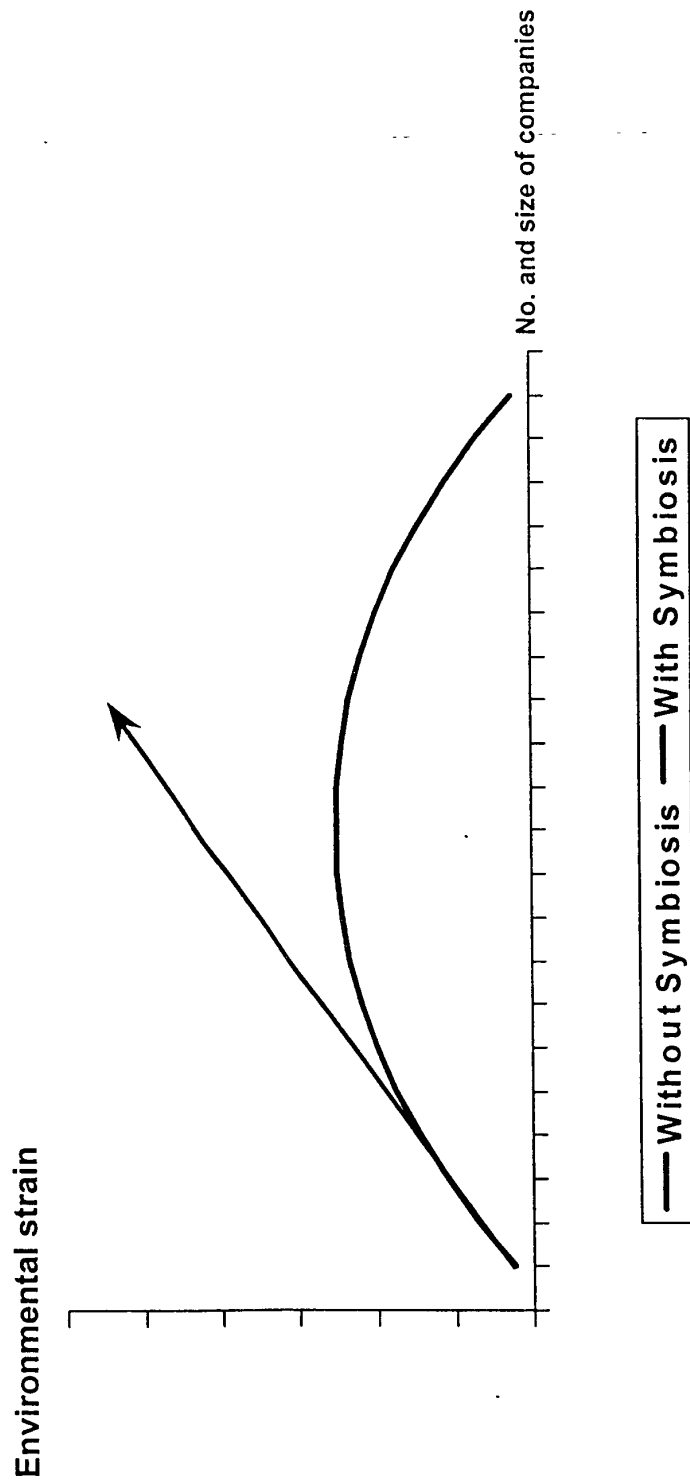
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INDUSTRIAL SYMBIOSIS: PRINCIPLES AND FEATURES

- Co-operation and communication
 - Voluntariness
- Environmental benefits, resource savings and economy go hand in hand
 - Spin-off effects

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INDUSTRIAL SYMBIOSIS

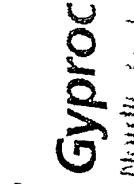
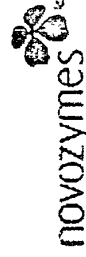


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CONCLUSION

INDUSTRIAL SYMBIOSIS IS:

- Environmental action with economic advantages
- Economic action with environmental advantages
- An effective network model for production in the future



THE SYMBIOSIS INSTITUTE

Systems make it possible,
people make it happen.

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THE SYMBIOSIS INSTITUTE OBJECTIVES

- To gather data concerning the industrial symbiosis and other examples of industrial ecology
- To communicate the experiences of the symbiosis project
- To co-ordinate studies of the industrial symbiosis
- To arrange study tours to the industrial symbiosis
- To contribute to, and assist at creating new symbiosis projects

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THE SYMBIOSIS INSTITUTE

THE WASTE EXCHANGE ASPECT

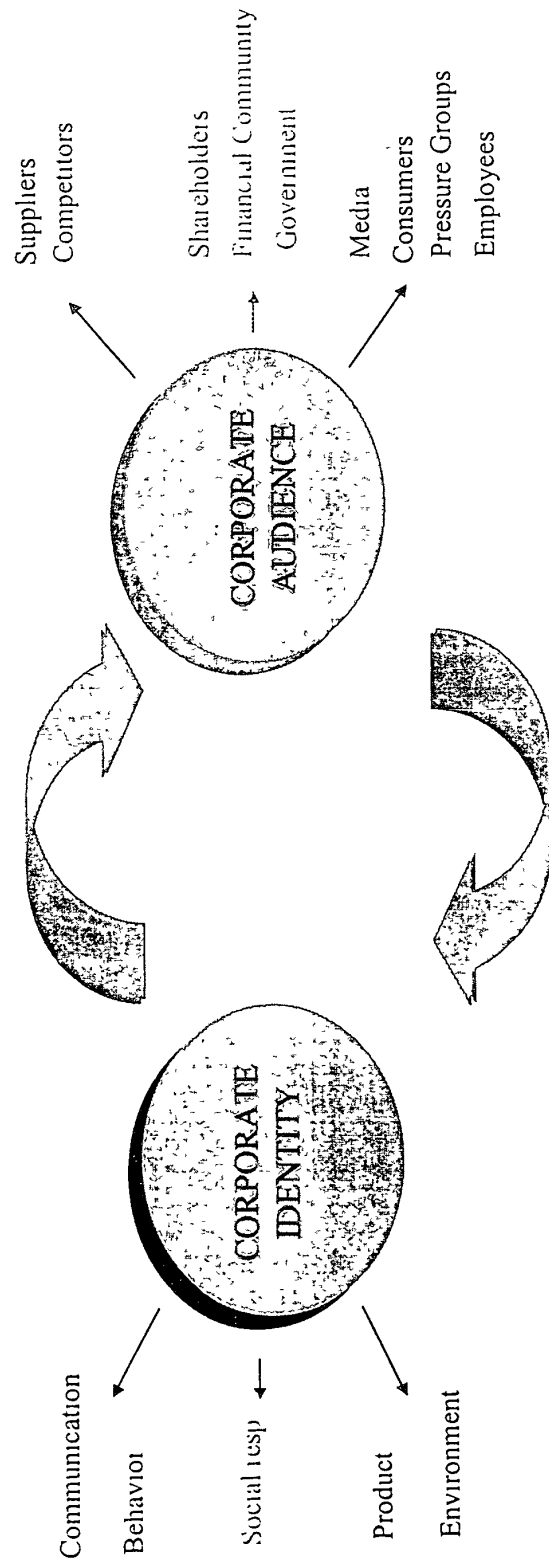
Aim: To develop the symbiosis further

- To analyze waste streams
- To gather detailed technical data concerning the residual products
- To look for new symbiosis projects
- To develop projects
- To encourage others to look for new projects

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Source: Olins, 1995/ The Symbiosis Institute

Kalundborg 2001.09.13

Measures to be taken in order to create an Eco Industrial Network

1. Motivators:

- **Financial matters: Example: Tax on waste that can be reduced.**
- **Good environmental practise.**
- **Possibility for good projects with a short pay-back time.**
- **Good will to the company in general.**
 - **Now and in the future, it would attract the best young people to the company as employees.**
 - **Customers' satisfaction**
 - **The company comes into a positive view.**

2. How to start

- **Remember: Technology makes it possible. People make it to happen.**
- **Create understanding and commitment in the top of the company, by using the above named motivators.**
- **"Sell" the idea to the middle level managers. They would identify the good projects.**
- **Start with a smaller project in order to have a success in a short time.**

3. Continuous improvements

- **Openness about waste. (If it is taxed, this would be natural)**
- **Create scenarios in order to make the possibilities visible.**

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6. SALG AF PRODUKTER OG SOFTWARE

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BILAG

Almindelige salgs- og leveringsbetingelser - ASL

Software licensaftale - SWL

Leveringsbetingelser - Incoterms 1990

NL 92 - "Almindelige Leveringsbetingelser for leverancer af maskiner og andet mekanisk, elektrisk og elektronisk udstyr"

6.1. OM SALGSAFTALER

Når der sælges materiel og software, vil det i de fleste situationer være hensigtsmæssigt, at aftale de nærmere forhold om hvordan handlen skal afvikles samt hvilket ansvar sælgeren har. Som det fremgår beskæftiger dette afsnit sig med salg af materiel og software. Således behandles f.eks. salg af fast ejendom ikke. Netop salg af fast ejendom er en så vanskelig affære, at der bør inddrages specialister på dette område (advokat).

Hvis intet andet anføres gælder Købelovens regler. Da Købeloven er fra 1906 er den på en række områder noget forældet. Ved tillæg til Købeloven eksisterer der dog en række branchemæssige kutymmer. Til gengæld vil mange uoverensstemmelser kunne løses ved brug af Købeloven og den omfattende praksis der er opbygget gennem årene. Erfaringerne fra afgørelser på baggrund af Købeloven vil også blive anvendt til at fortolke aftaler, hvor der er aftalt mere eller andet end Købelovens bestemmelser.

Da der i Danmark stort set er aftalefrihed, vil man kunne stille sig selv gunstigere end købelovens regler ved at indgå en egentlig og specificeret aftale. Naturligvis skal ressource-forbruget i forbindelse med at skrive en aftale stå mål med ordrens størrelse (værdi), men også med den potentielle risiko en leverance medfører for sælger. Værdi og risiko hænger sjældent sammen proportionalt, hvorfor det vil være hensigtsmæssigt at begrænse sit ansvar.

Mange produkter frembyder en vis risiko for at øve skade på produktet selv, andre ting eller ejendom samt personer. Det ansvar som producenten har, når produkter forvolder skade på andres person eller ting, betegnes produktansvar. Herudover udbyder visse produkter en risiko for at volde skade på miljøet - producenten har her et såkaldt miljøansvar.

Disse to typer ansvar er sammen med forhold vedrørende mangelansvaret behandlet nedenfor i afsnit 6.2 "Leverandørens ansvar".

Ved salg af materiel af en vis størrelse fremsættes ofte et tilbud. Dette tilbud bør have en sådan karakter, at det umiddelbart vil kunne udgøre den endelige aftale, såfremt kunden accepterer tilbuddet uden anmærkninger. Tilbuddet bør derfor indeholde samtlige tekniske og kommercielle forhold, som skal lægges til grund for handlen

I forbindelse med salg af software, skal man være opmærksom på denne ydelses særlige karakter. Det man sælger er ikke et produkt, men en brugsret til et ophavsretligt beskyttet produkt.

6.2. LEVERANDØRENS ANSVAR

Som leverandør udsætter man sig for følgende typer ansvar:

- Ansvar for forsinket levering.
- Mangelansvar (det leverede savner forudsatte egenskaber).
- Produktansvar.
- Miljøansvar.
- Vanhjemmelansvar (hvis man sælger noget man ikke har ejendomsretten til).

Et generelt problem i forbindelse med leverandørens ansvar er, at hvis der ikke er aftalt noget andet, så hæfter leverandøren for kundens indirekte tab f.eks. fortjeneste. Dette er en meget uforudsigelig størrelse. Man bør altid aftale, at man ikke hæfter for sådanne indirekte tab. Denne begrænsning er foretaget i de i dette afsnit angivne standardbetingelser.

6.2.1 Ansvar for forsinket levering

Leverandøren skal levere som aftalt, medmindre dette er umuligt eller er forbundet med uhensigtsmæssigt store vanskeligheder. Man skelner mellem salg af varer bestemt efter art (genus køb) og salg af "specielle" varer (species køb).

Ved salg af varer bestemt efter art, er det ikke undskyldeligt, at f.eks. produktionen ikke kan følge med. Leverandøren skal skaffe erstatningsprodukt andetsteds fra.

Ved salg af specielle varer, kan der ikke skaffes erstatningsprodukter. Dette kan fritage leverandøren for ansvar. Hvis aftalen omhandler et standardprodukt, som justeres til et specialprodukt, vil der på et tidspunkt i bearbejdningsprocessen ske det, at produktet bevæger sig fra at være en standardvare til at være en speciel vare.

Konsekvensen af forsinket levering vil være, at køberen kan hæve aftalen. Leverandøren kan - også hvor aftalen ikke hæves - blive afkrævet at skulle refundere de eventuelle tab kunden måtte få som følge af forsinkelsen.

6.2.2 Mangelansvar

Leverandøren indestår for at produktet har de egenskaber, som er aftalt og/eller som kunden med rette kan forvente. Er dette ikke tilfældet kan køberen hæve aftalen (hvis manglen er væsentlig). Køberen kan endvidere vælge at kræve at leverandøren afhjælper manglen, alternativt kræve, at der gives et nedslag i prisen.

6.2.3 Produktansvar

Produktansvaret forveksles ofte med mangelansvaret. De to typer ansvar er dog helt forskellige. Produktansvaret er også forskyldt af en mangel ved produktets 'konstruktion', men produktansvaret omfatter leverandørens ansvar i de situationer, hvor produktet volder skade på andre materialer, på fast ejendom eller på personer.

Forhold vedrørende produktansvar er lovreguleret eller reguleret af retspraksis. Som ved mangelansvaret kan man i visse tilfælde aftale sig ud af eller begrænse et produktansvar, men man kan f.eks. ikke fraskrive sig ansvaret for de skader et defekt produkt forvolder personer.

Produktansvaret gælder i en periode på 10 år fra det tidspunkt, hvor produktet markedsføres første gang.

Det er som udgangspunkt producenten, der har produktansvar, da det er ham, som har produceret produktet. En skadelidt kan dog kræve erstatning for produktansvarsskader fra ethvert led i omsætningskæden. Det vil f.eks. sige, at en forhandler kan blive krævet at betale erstatning for producentens produktansvar - forhandleren kan normalt kræve refusion hos producenten (med mindre denne er "forsvundet").

Selskabet er forsikret mod eventuelt produktansvar ved salg af en række angivne produkter. Forsikringen omfatter også salg til kunder i USA, men da erstatningerne for produktansvar der er uforudsigeligt store frarådes det at sælge produkter til kunder i USA. Udvis særlig opmærksomhed, hvis produkter man selv producerer kan havne hos slutkunder i USA. Selvriskoen i forbindelse med produktansvarsforsikringen er typisk 500.000 kr. Hvis salg til USA alligevel forekommer skal det forinden meddeles til Forsikringskontoret således at forsikringen er reguleret inden et eventuelt erstatningskrav stilles.

I forbindelse med fremstilling af produkter eller software kan det være hensigtsmæssigt at oprette et system, som sikrer sporbarheden af de producerede produkter samt de dele, der eventuelt er indarbejdet i disse. Derved sikrer man sin bevisstyrke, hvis nogen kræver erstatning for produktansvar. Man får også mulighed for at begrænse skaderne i tilfælde, hvor man f.eks. konstaterer at en bestemt produktion er behæftet med fejl (det er det der sker, når f.eks. Opel kalder alle biler af en model produceret i en bestemt periode ind til f.eks. skift af et bremserør). I forbindelse med salg af software er der etableret et system, som sikrer, at vi kan bevise, at en diskette har været checket for kendte vira. Dette sker, når disketten checkes på en af de 'officielle' virus-pc'er, som gemmer det nummer enhver diskette er født med, så vi kan bevise, at den bestemte diskette har været viruschecket.

6.2.4 Miljøansvar

Miljøansvaret er et såkaldt særligt objektivt ansvar, d.v.s. ansvar uden skyld, som påhviler særlig farlige eller forurenende virksomheder. Ansvaret er primært aktuelt i forbindelse med brugen af produktet, hvor brugeren, der "sviner", pålægges miljøansvar. Også i forbindelse med produktion vil der være tale om miljøansvar.

Selskaberne er begrænset forsikret på dette område, og der gøres opmærksom på, at der er en selvrisiko på 500.000 kr. ved enhver skadebegivenhed. Kontakt Frskon (lokal 1515) for nærmere oplysninger.

6.3. CHECKLISTE FOR UDARBEJDELSE AF AFTALE OM SALG AF PRODUKTER ELLER SOFTWARE

For at lette tilbuds-/aftaleskrivningen kan der henvises til standard salgs- og leveringsbetingelser. Derved sikrer man sig, at de overordnede forhold vedrørende mangelansvar, garantiperioder, leveringsbetingelser, ansvarsbegrænsninger, lovvalg m.v. er fastlagt. Altså vil en række mere juridiske forhold være på plads, hvis man i aftalen henviser til standardbetingelser. Man kan så koncentrere sig om at skrive de mere specifikke og tekniske dele af aftalen.

Man kan således koncentrere sig om følgende forhold:

- Aftalens parter (køber og sælger).
- Aftalens genstand (hvad sælges).
- Henvisning til de relevante standardbetingelser.
- Hvor og hvornår skal der leveres.
- Pris.
- Parternes underskrifter.

I aftaler vedrørende "småsalg" af produkter, kan det virke overdimensioneret at henvise til standardbetingelser. Der er typisk tale om hurtige "her og nu salg". Det er dog nødvendigt, at man får lavet en skriftlig aftale, hvor man får begrænset sit ansvar. Denne aftale bør bestå af de øvrige 5 punkter på ovenstående liste. Hvor varen udleveres samtidig med at aftalen indgås, kan man undlade punktet "hvor og hvornår skal der leveres". For at begrænse sit ansvar, skal man anføre "*varen er købt som beset. Sælger hæfter ikke for fejl og mangler.*".

I "større" aftaler, hvor der henvises til standardbetingelser, arbejdes der i dette afsnit med to sæt standardbetingelser:

- Almindelige salgs- og leveringsbetingelser (ASL) - se bilag.
- Software Licensaftale (SWL) - se bilag.

ASL anvendes ved salg af alle produkter - også software. Ved salg af software anføres det at køber yderligere er forpligtet af vedlagte SWL. Hvis man henviser til standardbetingel-

serne, men ønsker at ændre lidt i dem, bør man skrive hele det reviderede punkt ind i sin aftale (F.eks. "Pkt. x i ASL udgår og erstattes af følgende. .").

Originaleksemplarer af ASL og SWL kan rekvireres hos Ulla Yde, lokal (3948)1501, eller Jytte Tornbo, lokal (3948)1502, Finkon.

Se i øvrigt afsnit 2.2 om *tilbudsgivning*. Af hensyn til den almene interesse for generelle standardvilkår henvises til NL 92 - "Almindelige Leveringsbetingelser for leverancer af maskiner og andet mekanisk, elektrisk og elektronisk udstyr". Disse betingelser bør ikke anvendes - anvend istedet ASL og SWL.

Checkliste:

Ved udarbejdelse af tilbud/aftale bør der tages stilling til følgende punkter, og tilbudet/aftalen bør indeholde bestemmelser om emnerne, såfremt dette findes nødvendigt:

A. Parterne

Klar og tydelig identifikation af parterne ved navn, adresse, SE-nr. og eventuelt referencperson.

B. Formålet med aftalen

Er der tale om en rammeaftale. Beskrivelse af aftalens/projektets formål. Hvad skal leveres. Hvad omfattes ikke af leverancen. Hvad skal kunden selv bidrage med. Hvilket kvalitetsniveau forventes. Hvordan skal varen emballeres. I forbindelse med softwareaftaler, vil det ofte være relevant at definere forhold vedrørende opdatering og support.

C. Aftalegrundlag

Henvis eventuelt til standardbetingelser (ASL).

D. Definitioner

Hvis der i aftalen eller parternes forhold i øvrigt indgår særlige fagudtryk, kan det være hensigtsmæssigt at definere disse, så begge parter er enige om opfattelsen af disse udtryk.

E. Ikrafttræden

Hvor der er tale om en aftale der løber over længere tid, bør det fremgå hvornår den starter, og hvornår den slutter. Sluttidspunktet kan være en dato eller ved fuldendt levering. Det bør så fremgå hvad der forstås ved fuldendt levering.

F. Leveringstidspunkt

Præciser, hvornår levering skal foregå. Lov ikke for meget da enhver forsinkelse giver køber ret til at hæve aftalen, medmindre andet er aftalt.

Ved større eller sammensatte leverancer kan det være en fordel at opstille en egentlig leveringsplan. Er leverancen opdelt i dellerancer, sørg da for at fastslå hvornår hver enkelt dellerance skal foretages.

G. Leveringsbestemmelser

Hvem skal betale for transport og forsikring under transport, og hvem skal bære risikoen under transporten. Det anbefales at anvende de internationale Incoterms leveringsbetingelser, da disse er velkendte og veldefinerede (se skema over Incoterms i dette afsnits bilag).

ASL bruger bestemmelsen "Ex-Works" d.v.s. afhentet hos sælger. Transportrisikoen er således købers.

H. Leveringssted

Fastlæg klart hvor der skal leveres. Da levering på et forkert sted kan medføre forsinkelser - selv om sælger har leveret rettidigt, men til forkert sted.

I. Betaling

Hvad er prisen. Er der reguleringer i forhold til valutaer, råvarer etc. Hvis der er regulering fastlægges udgangspunktet og tidspunktet for regulering. Hvad indeholder den tilbudte pris (moms, afgifter, dokumentationsmateriale etc.).

Hvornår skal der betales. Hvad sker der ved for sen betaling - morarenter.

ASL fastlægger at betaling skal ske 14 dage efter levering.

J. Lovlighed og offentlige godkendelser

Hvem skal indhente eventuelle offentlige godkendelser. Hvad sker der hvis disse forsinkes. Hvem har ansvar for eventuelle miljø- og arbejdsmiljøkrav.

K. Garantier

Hvilke garantier stiller leverandøren og hvor længe.

ASL fastlægger et års ansvar for mangler.

L. Ansvar

Hvad sker der hvis garantien ikke overholdes eller hvis kvalitet, mængde og leveringstid ikke overholdes. Ansvarsfrihed, bod, erstatning etc.

ASL har begrænset ansvaret. Således hæfter sælger f.eks. ikke for købers indirekte tab som f.eks. avancetab. Endvidere er sælger ikke ansvarlig for eventuel rådgivning

M. Sikkerhedsstillelse

Skal leverandøren stille sikkerhed for sine leverings- og garantiforpligtelser. Dette bør generelt undgås, hvis det er muligt, da det er fordyrende (husk derfor evt. at indregne dette i prisen).

N. Øvrige pligter

I den udstrækning parterne måtte være pålagt yderligere forpligtelser er det hensigtsmæssigt at nævne disse for at undgå eventuel senere tvivl.

O. Kontraktens ophør

Hvilke muligheder har parterne for at bringe aftalen til ophør inden dens opfyldelse. En del af dette kan være reguleret under pkt. L "ansvar".

P. Overdragelse / transport

Kan sælger og/eller køber overdrage rettigheder og/eller forpligtelser til trediemand.

Q. Fordeling af omkostninger

I den udstrækning det ikke er fastlagt andetsteds, kan fordelingen af omkostninger forbundet med aftalens indgåelse og/eller opfyldelse aftales her. Det kan være stempel (hvor pligter og udgifter i forbindelse med eventuel stempling af aftalen bør påhvile køber), tinglysningsgebyr, advokathonorarer m.v.

R. Tvister, væmeting og lovvalg

Hvordan løses uoverensstemmelse. Det kan være hensigtsmæssigt at fastlægge, at de i første omgang skal søges forhandlet på plads. Hvis dette ikke lykkes kan man gå til domstol eller voldgift.

Det bør fastlægges, hvor eventuelle tvister skal afklares, f.eks. hvor en voldgift skal have hjemsted, og hvilket lands ret der skal gælde. Det anbefales at aftale, at tvister løses efter sælgers ret og i sælgers land.

ASL fastlægger at tvister skal afgøres ved voldgift og efter dansk rets regler.

S. Bilag

I den udstrækning visse forhold er aftalt i form af bilag (prislister, tekniske specifikationer, standardbetingelser etc.) laves en fuldstændig liste over disse bilag, som er en del af aftalegrundlaget.

T. Underskrifter

Begge parter bør skrive under på større aftaler.

6.4 SÆRLIGT OM AFTALER OM SALG AF SOFTWARE

Salg af software-produkter medfører ofte et større ansvarspotentiale end umiddelbart forventet. Det er derfor hensigtsmæssigt i aftalen af fastlægge hvilket ansvar man har for f.eks. databaser, som kan pådrage køberen ganske store tab.

Software er ved lov beskyttet mod kopiering. Den som har udviklet programmet har ophavsret. Det er dog ikke ukendt, at kopiering af software er svær at beskytte sig imod og at det er ret udbredt. Det vil derfor være hensigtsmæssigt at præcisere hvad der sker, hvis køberen kopierer programmet og hvad der sker hvis han sælger sin licens.

Det er vigtigt at afklare i aftalen om man køber en brugsret (licens) eller man køber programmet (ophavsretten). Oftest vil der være tale om, at man køber en licens til en begrænset anvendelse af softwaren.

Er der tale om distribution af småprogrammer mod intet eller meget begrænset vederlag, hvor risikoen for mangelansvar er begrænset (man bytter bare), kan følgende formulering, som bør fremgå af tilbud/aftale/faktura samt på diskettens label, anvendes.

"Sælger har intet ansvar for skader hverken direkte eller indirekte, som måtte opstå i forbindelse med dette materiel."

Da køber skal påvise, at sælger har forvoldt en skade, må det tilrådes, at der foretages et viruscheck af alt elektronisk datamateriale inden det forlader huset. Ved at teste disketter på selskabernes "officielle" viruscheckmaskiner sikrer man sig, at det kan bevises, at der har været foretaget viruscheck af en diskette. Maskinerne registrerer og gemmer en diskettes ID-nummer når denne checkes for virus. Derved vil man kunne bevise, at en diskette på fornuftig vis har været scannet for vira.

ALMINDELIGE SALGS- OG LEVERINGSBETINGELSER - ASL

1. Anvendelse

Nedenstående almindelige salg- og leveringsbetingelser er gældende for alle tilbud, ordrer m.v. medmindre andet er aftalt skriftligt mellem parterne

2. Tilbud og ordrer

Skriftlige tilbud er bindende for sælger i 8 dage fra tilbudsdato. Ordre, som ikke er baseret på forudgående skriftligt tilbud er først bindende, når sælgers skriftlige ordrebekræftelse er modtaget af køber

3. Produktinformation, tegninger m.v.

Oplysninger i produktinformation og prislister er kun bindende i det omfang, aftalen udtrykkeligt henviser til dem

Alle tegninger og andre tekniske dokumenter vedrørende produktet eller fremstillingen heraf, som før eller efter aftalens indgåelse overlades fra den ene part til den anden, tilhører den part, som har udleveret dem. Modtagne tegninger, andre tekniske dokumenter eller teknisk information kan ikke uden samtykke fra den anden part anvendes til andet end det, der var formålet med overladelsen. Uden samtykke fra den anden part må det nævnte materiale ikke kopieres, reproducere, overgives til eller på anden måde bringes til tredjemands kundskab

4. Pris

Alle priser er angivet Ex-Works (EXW) - Incoterms 1990 ("af fabrik") og eksklusiv told, moms og andre offentlige afgifter

5. Betaling og ejendomsforbehold

Den aftalte købesum skal betales senest 14 dage efter levering. Alle omkostninger i forbindelse med betalingen afholdes af køber

Erlægges købesummen eller dele heraf ikke rettidigt, beregnes morarenter svarende til 2% pr. påbegyndt måned regnet fra forfaldsdagen af det udestående beløb

Produktet forbliver sælgers ejendom, indtil betaling er erlagt fuldt ud i den udstrækning, et sådant ejendomsforbehold er gyldigt efter gældende ret

6. Forsendelse, levering og forsinkelse

Forsendelse sker for købers risiko, uanset om køber eller sælger har betalt forsendelsesomkostningerne. I tilfælde hvor sælger forestår forsendelsen, foretages denne på den måde sælger finder mest hensigtsmæssig

Leveringsstider regnes fra dato for sælgers ordrebekræftelse

I tilfælde af svigtende levering, herunder forsinkelse, der ikke er omfattet af punkt 10, hæfter sælger aldrig for bøder, stand-by udgifter, driftstab, avancetab eller andet indirekte tab

Sælgers erstatning for tab som følge af forsinket levering vil aldrig kunne overstige det dobbelte af den aftalte købesum ex moms

7. Ansvar for mangler

Såfremt der inden 1 år efter leveringen viser sig mangler ved produktet, og det konstateres, at manglerne kan henføres til fejl i forbindelse med produktets konstruktion eller fremstilling eller de anvendte materialer, vil den mangelfulde leverance efter sælgers valg blive udbedret eller ombyttet. Anvendes produktet - mere intensivt, end det er aftalt eller kan anses forudsat ved aftalens indgåelse, forkortes denne periode forholdsmæssigt

Køber skal give skriftlig meddelelse om en mangel til sælger uden grundet ophold efter at manglen har vist sig. Meddelelsen skal indeholde en beskrivelse af, hvorledes manglen ytrer sig. Er der grund til at tro, at manglen kan medføre risiko for skade, skal sådan meddelelse gives straks. Overholdes disse frister, ikke mister køber sin ret til at fremsætte krav i anledning af manglen

Såfremt køber har afgivet en sådan meddelelse, og det viser sig, at der ikke foreligger nogen mangel som sælger bærer ansvaret for, har sælger ret til godtgørelse for det arbejde og de omkostninger, reklamationen har påført ham

Eventuel reparation foretages hos køber, medmindre sælger finder det hensigtsmæssigt, at den mangelfulde del eller eventuelt produktet returneres. Således at sælger kan foretage reparation eller udskiftning hos sig selv. Kræver demontering og montering af delen speciel fagkundskab, er sælger forpligtet til at foretage sådan demontering og montering. Er en sådan speciel fagkundskab unødvendig, er sælgers forpligtelse vedrørende den mangelfulde del opfyldt, når han har leveret en tilborligt repareret eller udskiftet del til køber

Såfremt eventuel reparation og udskiftning medfører indgreb i andet end materiellet, påhviler arbejdet og omkostningerne herved køber

Transport eller forsendelse til sælger af dele til udskiftning eller reparation sker for købers regning og risiko, mens transport eller forsendelse af reparerede eller nye dele til køber sker for sælgers regning og risiko

Køber skal bære de meromkostninger, som sælger påføres ved afhjælpning af mangler som følge af, at materiellet befinder sig på et andet sted end det i aftalen angivne bestemmelsessted eller - hvis et sådant ikke er angivet - leveringsstedet

Sælgers ansvar omfatter ikke mangler, forårsaget af materiale, som er tilvejebragt af køber, eller af konstruktioner, der er foreskrevet eller specificeret af denne

Sælgers ansvar omfatter kun mangler, som opstår under de i aftalen forudsatte funktionsvilkår og ved rigtig anvendelse. Ansvar omfatter ikke mangler, der skyldes mangelfuld vedligeholdelse eller unrigtig montering fra kundens side, konstruktionsmæssige ændringer, foretaget uden sælgers skriftlige samtykke, fejl ved nogen af kunden udført reparation eller normalt slid eller ælde

Sælger påtager sig intet ansvar for mangler udover det ovenfor anførte, og hæfter således ikke for nogen form for tab, som måtte være forårsaget af manglerne, herunder driftstab, avancetab eller andet indirekte tab

Mangler i varens kvalitet ved en dellevering kan ikke begrunde ophævelse af den resterende ordre eller kontrakt

8. Ansvar for tingskade, forvoldt af materiellet (produktansvar)

Forvolder leveret produkt - indenfor en 10 års periode efter produktet er markedsført - skade på købers eller tredjemands liv eller ejendom, er sælger ansvarlig, hvis det kan dokumenteres, at skaden skyldes en fejl begået af sælgers ansatte. Sælgers ansvar for skade på ting er begrænset til 5 mio. DKK

Sælgeren er ikke ansvarlig for skade på fast ejendom eller løsøre, som indtræder, medens materiellet er i købers besiddelse. Sælger er ligeledes ikke ansvarlig for skade på produkter, der er fremstillet af køberen, eller på produkter hvori disse indgår, eller for skade på fast ejendom eller løsøre, som disse produkter som følge af materiellet forårsager. I intet tilfælde er sælger ansvarlig for driftstab, tabt fortjeneste eller andre økonomiske konsekvenser

Hvis tredjemand fremsætter krav mod en af parterne om erstatningsansvar i henhold til dette punkt, skal denne part straks underrette den anden herom. I den udstrækning sælger måtte ifalde produktansvar overfor tredjemand, er køber forpligtet til at holde sælger skadesløs i samme omfang, som dennes ansvar er begrænset ovenfor

Sælger og køber er gensidigt forpligtet til at lade sig sagsøge ved den domstol eller voldgiftsret, som behandler erstatningskrav, der er rejst mod en af dem på grundlag af en skade eller et tab, som påstås forårsaget af materiellet. Det indbyrdes forhold mellem køber og sælger skal dog altid afgøres ved voldgift i henhold til punkt 11

9. Rådgivning

Sælger påtager sig ingen forpligtelser eller ansvar for råd og vejledninger, der afgives af sælger i forbindelse med dennes leverancer, med mindre rådgivningen er en nødvendig del af leverancen eller sker i henhold til særlig skriftlig aftale

10. Force majeure

Sælger er ikke erstatningsansvarlig for manglende opfyldelse af sine forpligtelser i henhold til den indgåede aftale, såfremt opfyldelse er umulig eller umulig byrdefuld på grund af omstændigheder, der er indtruffet uden hans skyld, og over hvilke han ikke er herre, og som han i øvrigt ikke på tidspunktet for aftalens indgåelse kunne forudsæ eller tage i betragtning herunder forhold der kan tilskrives underleverandører. Som eksempel på sådanne force majeurebegivenheder kan nævnes krig, ildsvåde, strejke af mere generel karakter, lock-out, mangel på transportmidler, almindelig vareknaphed, restriktioner af drivkraft samt usædvanlige naturbegivenheder

I disse tilfælde udskydes leveringstidspunktet i samme omfang, som omstændighederne giver anledning til forsinkelse. Hvis disse omstændigheder udelukker eller medfører uoverskuelige vanskeligheder ved levering, er køber berettiget til at annullere ordren uden ansvar

11. Tvister. Lovvalg

Alle tvistigheder om leverancer eller forståelsen af aftalens indhold eller omfang afgøres efter dansk ret og afgøres ved den almindelige voldgiftsret i Danmark efter de af denne voldgiftsret fastsatte procedureregler

september 1996

Vs Sjællandske Kraftværker

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39 47 39 47	Fax 53 51 50 04	36 78 87 63	Fax 42 32 11 66	Fax 53 59 59 40	39 47 39 47
Fax 39 47 35 33		Fax 36 77 11 21			Fax 44 65 99 97

ver 1.1 01.09.96

"ALMINDELIGE SALGS- OG LEVERINGSBETINGELSER - ASL" er optaget i Konkurrencerådets aftaleregister september 1996

SOFTWARE LICENSAFTALE - SWL

Betingelser for anvendelse af programmet, som er udviklet af eller for Licensgiveren SK energi.

1. **Brugsrettens omfang**
 - 1.1 Licenstagere erhverver retten til at benytte Programmet på én og kun én maskine, der er egnet hertil. Brugsretten er ikke eksklusiv.
 - 1.2 Der er tale om en enkeltbrugerlicens. Programmet må således kun anvendes af en person ad gangen, og må kun anvendes på et computernetværk såfremt denne begrænsning i anvendelsen overholdes. Ønskes Programmet anvendt af flere personer på samme tid, må der anskaffes supplerende licenser.
2. **Kopiering**
 - 2.1 Licenstagere må ikke kopiere Programmet eller den hertil hørende dokumentation, hverken helt eller delvist.
 - 2.2 Licenstagere er dog berettiget til at tage én sikkerhedskopi af Programmet og dokumentationen, men må herudover ikke tage yderligere kopier. Sikkerhedskopien må kun benyttes ved forringelse eller undergang af det oprindelige program.
3. **Ophavsret**
 - 3.1 Licensgiveren ejer og har dermed den fulde ophavsret til Programmet.
 - 3.2 Licenstagere må ikke ændre Programmet.
 - 3.3 Licenstagere må ikke bryde eller ændre eventuelle sikkerhedskoder, ligesom Licenstagere ikke må ændre eller fjerne angivelser af retighedsforhold, varemærker eller lignende.
4. **Overdragelse**
 - 4.1 Licenstagere er berettiget til at sælge, udleje, udlåne eller på anden måde overlade brugsretten til den originale kopi af Programmet til trediemand - Slutbrugeren.
 - 4.2 Overdragelsesretten i pkt. 4.1 er betinget af, at Licenstagere selv ophører med brugen af Programmet.
 - 4.3 Overdragelsesretten i pkt. 4.1 er endvidere betinget af, at Licenstagere ved overdragelse af nærværende dokument gør Slutbrugeren opmærksom på nærværende betingelser for brugen af Programmet.
5. **Garanter**
 - 5.1 Licensgiver indestår for, at den originale kopi af selve Programmet vil fungere som beskrevet af Licensgiver, forudsat at Licenstagere maskinen er egnet dertil. Er dette ikke tilfældet, vil Licensgiver efter eget valg levere ny funktionsdygtig udgave af Programmet eller rette eventuelle programfejl inden rimelig tid.
 - 5.2 Ovenstående garantiforpligtelse består i tres (60) dage regnet fra den dag, hvor Programmet er leveret til Licenstagere (førstebruger).
 - 5.3 Garantiforpligtelsen i henhold til pkt. 5.1 gælder ikke for nyudviklet programmet, idet dette kan være behæftet med enkelte fejl, jf. i øvrigt pkt. 6.5.
6. **Ansvarsforhold og ansvarsbegrænsning**
 - 6.1 Licenstagere er selv ansvarlig for valget, installationen og anvendelsen af Programmet samt resultaterne af brugen af Programmet. Licensgiver påtager sig således intet ansvar for, at Programmet vil leve op til Licenstagere forventninger.
 - 6.2 Såfremt den aftalte leveringsdag overskrides med 14 kalenderdage, er Licenstagere berettiget til - efter at have givet påkrav med 5 arbejdsdages varsel - at hæve Licensaftalen, dersom der fortsat ikke er leveret.
- 6.3 Licensgiver er under ingen omstændigheder ansvarlig for driftstab, tabt avance, følgeskader eller andet indirekte tab.
- 6.4 Ud over ovenstående vil Licensgiver ikke kunne drages til ansvar for tab som overstiger det beløb, som Licenstagere har betalt for brugsretten til Programmet.
- 6.5 For nyudviklet programmet, der måtte vise sig fejlbehæftet, kan licenstagere ikke gøre noget erstatningsretligt ansvar gældende mod licensgiver. Licenstagere beføjelser i tilfælde af mangler ved nyudviklet programmet er begrænset til ophævelse af aftalen. Sådant ophævelse kan gennemføres af licenstagere, såfremt manglerne er væsentlige og ikke er afhjulpet af licensgiver inden for en rimelig frist.
- 6.6 Licensgiver påtager sig intet ansvar for, at Programmet ved den forudsatte brug ikke krænker trediemands rettigheder, herunder ophavs-, patent-, varemærke- og halvlederrettigheder. Licensgiver erklærer dog, at programmet så vidt muligt ikke krænker trediemands ret.
7. **Produktansvar**
 - 7.1 Licensgiver er kun ansvarlig for personskaade, hvis det bevises, at skaden skyldes fejl eller forsømmelse begået af ham eller andre, som han har ansvar for.
 - 7.2 Licensgiver er ikke ansvarlig for skader på fast ejendom eller løsøre, som indræder, medens Programmet er i Licenstagere besiddelse. Licensgiver er heller ikke ansvarlig for skade på produkter, der er fremstillet af Licenstagere eller på produkter, hvori disse indgår. I øvrigt er Licensgiver ansvarlig for skade på fast ejendom eller løsøre på samme betingelser som for personskaade.
 - 7.3 I den udstrækning Licensgiver måtte blive pålagt produktansvar overfor trediemand, er Licenstagere forpligtet til at holde Licensgiver skadesløs i samme omfang som Licensgivers ansvar er begrænset efter 7.1 og 7.2.
 - 7.4 Hvis trediemand fremsætter krav mod en af parterne om erstatningsansvar i henhold til dette punkt, skal denne part straks underrette den anden part herom.
 - 7.5 De i dette punkt indeholdte ansvarsbegrænsninger for produktansvar skal også gælde i tilfælde af tab af data, herunder disses retablering.
8. **Misligholdelse**
 - 8.1 Såfremt Licenstagere eller Slutbrugeren misligholder nærværende bestemmelser, ophører brugsretten øjeblikkeligt. Programmet inklusiv den tilhørende dokumentation samt eventuel sikkerhedskopi skal straks - og for Licenstagere regning og risiko - returneres til Licensgiver.
 - 8.2 I tilfælde af misligholdelse er Licensgiver berettiget til erstatning for tab i henhold til dansk rets almindelige bestemmelser herom.
9. **Lovvalg og værning**
 - 9.1 Alle tvistigheder om leverancer eller forståelsen af aftalens indhold eller omfang afgøres efter dansk ret og afgøres ved den almindelige voldgiftsret i Danmark efter de af denne voldgiftsret fastsatte procedureregler.

september 1996

if's Sjællandske Kraftværker

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ver 1.1 01.09.96

"SOFTWARE LICENSAFTALE - SWL" er optaget i KonkurrenceRådets aftaleregister september 1996

Incoterms 1990 - oversigt over anvendelse, pligter, ansvar og omkostninger **SK energi** **NESA**

Leveringsklausuler / anvendelse:	Luft	Bane	Sø	BII
DDP Delivered Duty Paid	..... ja	ja	ja	ja
DDU Delivered Duty Unpaid	..... ja	ja	ja	ja
DEQ Delivered Ex Quay - duty paid	..... nej	nej	ja	nej
DES Delivered Ex Ship	..... nej	nej	ja	nej
DAF Delivered At Frontier	..... ja	ja	ja	ja
CIP Cost and Insurance Paid to	..... ja	ja	ja	ja
CPT Carriage Paid To	..... ja	ja	ja	ja
CIF Cost, Insurance and Freight	..... nej	nej	ja	nej
FOB Free On Board	..... nej	nej	ja	nej
FAS Free Alongside Ship	..... nej	nej	ja	nej
FCA Free Carrier	..... ja	ja	ja	ja
EXW Ex Works	..... ja	ja	ja	ja

Handling / forpligtelse / ansvar (K=købers forpligtelse / S=sælgers forpligtelse)	EXW	FCA	FAS	FOB	CFR	CIF	CPT	DAF	DES	DEQ	DDU	DDP
01. Lastning ved sælgers fabrik	K	S	S	S	S	S	S	S	S	S	S	S
02. Ansvar under lastning ved sælgers fabrik	K	S	S	S	S	S	S	S	S	S	S	S
03. Afale om for-lokaltransport (frem til hovedtransportør)	K	K	S	S	S	S	S	S	S	S	S	S
04. Betaling for for-lokaltransport (frem til hovedtransportør)	K	K	S	S	S	S	S	S	S	S	S	S
05. Ansvar under for-lokaltransport (frem til hovedtransportør)	K	K	S	S	S	S	S	S	S	S	S	S
06. Losning ved fremkomst til hovedtransportør	K	K	S	S	S	S	S	S	S	S	S	S
07. Ansvar under losning ved hovedtransportør	K	K	S	S	S	S	S	S	S	S	S	S
08. Fremskaffelse af eksporttilladelse	K	K	K	K	S	S	S	S	S	S	S	S
09. Betaling for eksporttilladelse	K	K	K	K	S	S	S	S	S	S	S	S
10. Lastning ved fragtførers (hovedtransportørs) terminal	K	K	K	S	S	S	S	S	S	S	S	S
11. Ansvar under lastning ved fragtførers (hovedtransportørs) terminal	K	K	K	S	S	S	S	S	S	S	S	S
12. Afale om transportforsikring for hovedtransport	K	K	K	K	K	S	S	S	S	S	S	S
13. Betaling for transportforsikring for hovedtransport	K	K	K	K	K	S	S	S	S	S	S	S
14. Afale om hovedtransport	K	K	K	K	S	S	S	S	S	S	S	S
15. Betaling for hovedtransport	K	K	K	K	S	S	S	S	S	S	S	S
16. Ansvar under hovedtransport	K	K	K	K	K	S	S	S	S	S	S	S
17. Losning ved terminal (hovedtransportørs "afslutning")	K	K	K	K	K	K	K	S	S	S	S	S
18. Ansvar under losning ved terminal (hovedtransportørs "afslutning")	K	K	K	K	K	K	K	S	S	S	S	S
19. Fremskaffelse af importtilladelse	K	K	K	K	K	K	K	K	K	K	K	K
20. Betaling for importtilladelse	K	K	K	K	K	K	K	K	K	K	K	K
21. Afale om efter-lokaltransport (fra hovedtrans. "afslutn." til købers sted)	K	K	K	K	K	K	K	K	K	K	K	K
22. Betaling for efter-lokaltransport (fra hovedtrans. "afslutn." til købers sted)	K	K	K	K	K	K	K	K	K	K	K	K
23. Losning ved købers lager/fabrik	K	K	K	K	K	K	K	K	K	K	K	K
24. Ansvar under losning ved købers lager/fabrik	K	K	K	K	K	K	K	K	K	K	K	K
26. Øvrigt	Aftales parterne imellem (S*=ikke krav om at der skal tegnes forsikring, S**="K" hvis køber selv losses)											

HUSK AT ANGIVE LEVERINGSSTED (F.eks DDP alsat på jorden ved varemodtagelsen, Lagervej 1)

ALMINDELIGE LEVERINGSBETINGELSER

NL 92

for leverancer af maskiner og andet mekanisk, elektrisk og elektronisk udstyr mellem Danmark, Finland, Norge og Sverige samt inden for disse lande
Udgivet 1992 af Hovedorganisationen Dansk Industri, Danmark, Metalliteollisuusuden Keskusliitto - Metallindustriens Centralförbund ry, Finland, Teknologibedriftenes Landsforening, Norge, samt Sveriges Verkstadsindustrier, Sverige

Anvendelse

1 Nedenstående almindelige leveringsbetingelser finder anvendelse såfremt parterne skriftligt eller på anden måde har aftalt dem. Gælder leveringsbetingelserne for en leverance skal eventuelle fravigelser ske ved skriftlig aftale mellem parterne.

Produktinformation

2 Oplysninger i produktinformation og prislister er kun bindende i det omfang aftalen udtrykkeligt henviser til dem.

Tegninger og andre tekniske dokumenter

3 Alle tegninger og andre tekniske dokumenter vedrørende materiellet eller fremstillingen heraf som før eller efter aftalens indgåelse overlades fra den ene part til den anden tilhører den part som har udleveret dem. Modtagne tegninger, andre tekniske dokumenter eller teknisk information kan ikke uden samtykke fra den anden part anvendes til andet end det der var formålet med overladelsen. Uden samtykke fra den anden part må det nævnte materiale ikke kopieres, reproducere, overgives til eller på anden måde bringes til tredjemands kundskab.

4 Sælgeren skal senest ved leveringen vederlagsfrit forsyne køberen med et eller et større aftalt antal eksemplarer af tegninger og andre tekniske dokumenter som er tilstrækkeligt udtørlige til at køberen kan udføre montering, igangsætning, drift og vedligeholdelse (herunder løbende reparationer) af alle materiellets dele. Sælgeren har dog ikke pligt til at udlevere tegninger og dokumenter som ligger til grund for fremstilling af materiellet eller reservedele.

Leveringsprøve

5 Såfremt der er aftalt leveringsprøve skal prøven udføres der hvor materiellet fremstilles, medmindre et andet sted er aftalt. Såfremt tekniske krav til prøven ikke er angivet i aftalen skal denne udføres i overensstemmelse med sædvane i den pågældende industri i det land hvor materiellet fremstilles.

6 Sælgeren skal give køberen sådant varsel om en leveringsprøve at køberen kan overvære denne. Leveringsprøve kan afholdes, selv om køberen ikke er repræsenteret, dersom han er indvarslet.

Sælgeren skal fore protokol over leveringsprøven. Prøveprotokollen skal sendes til køberen. Prøveprotokollen skal anses for at give en korrekt beskrivelse af leveringsprøvens gennemførelse og dennes resultat, medmindre køberen beviser noget andet.

7 Såfremt materiellet ved leveringsprøven viser sig ikke at være kontraktmæssigt skal sælgeren så hurtigt som muligt sørge for at materiellet bringes i overensstemmelse med aftalen. På køberens forlangende skal ny leveringsprøve derefter udføres. Var manglen ubetvælsk kan ny leveringsprøve dog ikke forlanges.

8 Medmindre anden fordeling er aftalt bærer sælgeren alle omkostninger ved leveringsprøver som udføres hvor materiellet fremstilles. Køberen bærer dog alle omkostninger for sine repræsentanter herunder rejse- og opholdsudgifter i forbindelse med sådanne leveringsprøver.

Levering

9 Er leveringsklausul aftalt fortolkes denne i henhold til de ved aftalens indgåelse gældende Incoterms.

Er ingen leveringsklausul aftalt anses levering for sket i Ex Works.

Leveringstid, Forsinkelse

10 Såfremt parterne i stedet for et bestemt leveringstidspunkt har angivet et tidsrum inden for hvilket levering skal finde sted anses dette tidsrum at løbe fra indgåelsen af aftalen.

11 Finder sælgeren at han ikke kan levere i rette tid eller må forsinke sig fra hans side anses for sandsynlig skal han uden ugrundet ophold give køberen skriftlig meddelelse herom og samtidig angive

årsagen til forsinkelsen samt så vidt muligt det tidspunkt da levering påregnes at kunne finde sted. Undlader sælgeren at give den ovennævnte meddelelse skal han uanset bestemmelse i punkterne 13 og 14 erstatte køberen de merudgifter denne påføres som følge af den manglende meddelelse.

12 Hvis forsinkelse med levering skyldes nogen omstændighed som i henhold til punkt 37 udgør en ansvarshedsgrund eller skyldes køberens handling eller undladelse forlænges leveringstiden i det omfang hvori det efter omstændighederne skønnes rimeligt. Leveringstiden skal forlænges selv om årsagen til forsinkelsen indtræfter efter udløbet af den oprindeligt aftalte leveringstid.

13 Hvis sælgeren ikke leverer materiellet i rette tid er køberen berettiget til konventionalbod fra den dag hvor levering skulle have fundet sted.

Konventionalboden udgør 0,5% for hver hele uge forsinkelsen varer beregnet af den del af den aftalte købesum som dækker den del af materiellet der på grund af forsinkelsen ikke kan tages i brug som forudsat.

Konventionalboden kan ikke overstige 7,5% af dette beregningsgrundlag.

Konventionalboden forfalder til betaling ved skriftligt påkrav fra køberen dog tidligst når materiellet leveres fuldt ud eller eventuelt på det tidspunkt hvor køberen hæver aftalen i henhold til punkt 14.

Køberen fortaber sin ret til konventionalbod såfremt han ikke har fremsat skriftligt krav herom inden 6 måneder efter at levering skulle have fundet sted.

14 Såfremt køberen er berettiget til maksimal konventionalbod i henhold til punkt 13 og materiellet fortsat ikke leveres, kan køberen ved skriftlig meddelelse til sælgeren kræve levering og fastsætte en sidste rimelig frist som ikke kan være kortere end 1 uge.

Såfremt sælgeren heller ikke leverer inden for den fastsatte frist og dette ikke skyldes forhold som køberen bærer ansvaret for kan køberen ved skriftlig meddelelse til sælgeren hæve aftalen for så vidt angår den del af materiellet som ikke kan tages i brug som forudsat.

Køberen har såfremt han således hæver aftalen, herudover krav på erstatning for det tab han har lidt ved sælgerens forsinkelse, dersom tabet overstiger den maksimale konventionalbod, han har kunnet kræve i henhold til punkt 13. Denne erstatning kan ikke overstige 7,5% af den del af den aftalte købesum som dækker den del af materiellet for hvilken aftalen hæves.

Køberen har desuden ret til, ved skriftlig meddelelse til sælgeren at hæve aftalen såfremt det står klart at der vil indtræffe en forsinkelse som efter reglerne i punkt 13 ville give køberen ret til maksimal konventionalbod. Ved en sådan ophævelse har køberen ret til såvel maksimal konventionalbod som erstatning i henhold til nærværende punkts tredje stykke.

Bortset fra konventionalbod i henhold til punkt 13 og ophævelse med begrænset erstatning i henhold til punkt 14 er ethvert krav fra køberen i anledning af sælgerens forsinkelse udelukket. Denne begrænsning i sælgerens ansvar gælder ikke såfremt sælgeren har gjort sig skyldig i grov uagtsomhed.

15 Finder køberen at han ikke vil kunne modtage materiellet på den aftalte dag eller må forsinke sig fra hans side anses som sandsynlig skal han uden ugrundet ophold give sælgeren skriftlig meddelelse herom og samtidig angive årsagen til forsinkelsen samt så vidt muligt det tidspunkt da modtagelse påregnes at kunne finde sted.

Undlader køberen at modtage materiellet på den aftalte dag er han desuagtet forpligtet til at erlægge enhver af levering betinget betaling som om levering af det pågældende materiel havde fundet sted. Sælgeren skal sørge for at materiellet opbevares for køberens regning og risiko. På køberens anmodning skal sælgeren forsikre materiellet for køberens regning.

16 Medmindre køberen i punkt 15 angiver undladelse skyldes noget i punkt 37 nævnt forhold kan sælgeren skriftligt optordre køberen til at modtage materiellet inden for en rimelig tid.

Undlader køberen at gøre dette inden for et sådant tidsrum - af årsager som sælgeren ikke bærer ansvaret for - er sælgeren berettiget til ved skriftlig meddelelse til køberen at hæve aftalen for den leveringsklare del af materiellet som på grund af køberens undladelse ikke bliver leveret. Sælgeren har da ret til erstatning for den skade som køberens misligholdelse har påført ham. Erstatningen kan ikke overstige den del af købesummen der dækker den del af materiellet som ophævelsen omfatter.

Betaling

17 Medmindre andet er aftalt, forfalder den aftalte købesum til betaling med en tredjedel ved aftalens indgåelse og med en tredjedel ved sælgerens skriftlige meddelelse om at den væsentlige del af materiellet er rede til levering. Restbeløbet erlægges ved leveringen af materiellet.

18 Betaler køberen ikke til aftalt tid, har sælgeren fra forfaldsdagen krav på morarente med den rentesats, som gælder i henhold til lovgivning om renter ved forsinket betaling i sælgerens land. Såfremt sælgerens land er Danmark, skal morarenten dog udgøre den officielt fastsatte diskonto med tillæg af 9 procentpoints.

19 Såfremt køberen ikke efter 3 måneder har betalt det forfaldne beløb, er sælgeren berettiget til ved skriftlig meddelelse til køberen at hæve aftalen og foruden morarente at kræve erstatning af køberen for det tab han har lidt. Erstatningen kan ikke overstige den aftalte købesum.

Ejendomsforbehold

20 Materiellet forbliver sælgerens ejendom, indtil betaling er erlagt fuldt ud i den udstrækning et sådant ejendomsforbehold er gyldigt efter gældende ret.

Ansvar for mangler

21 Sælgeren er forpligtet til at afhjælpe alle mangler, som skyldes fejl i konstruktion, materiale eller fremstilling ved at foretage reparation eller udskiftning af materiellet i overensstemmelse med punkterne 22-34 nedenfor.

22 Sælgerens ansvar omfatter kun mangler, som viser sig inden et år fra den dag, materiellet blev leveret. Anvendes materiellet mere intensivt, end det er aftalt eller kan anses forudsat ved aftalens indgåelse, forkortes denne periode forholdsmæssigt.

23 For dele, som er udskiftet eller repareret ifølge punkt 21, påtager sælgeren sig de samme forpligtelser, som gælder for det oprindelige materiel i et tidsrum af et år. For materiellets øvrige dele forlænges den i punkt 22 nævnte periode kun med det tidsrum, materiellet ikke har kunnet anvendes som følge af de i punkt 21 nævnte mangler.

24 Køberen skal give skriftlig meddelelse om en mangel til sælgeren uden ugrundet ophold, efter at manglen har vist sig, og i intet tilfælde senere end 2 uger efter at den i punkt 22 nævnte frist er udløbet. I punkterne 23 og 34 Meddelelsen skal indeholde en beskrivelse af hvorledes manglen ytrer sig.

Såfremt der er grund til at tro, at manglen kan medføre risiko for skade, skal sådan meddelelse gives straks.

Såfremt køberen ikke skriftligt underretter sælgeren om en mangel inden for de frister, som er angivet i dette punkt, mister køberen sin ret til at fremsætte krav i anledning af manglen.

25 Efter at have modtaget skriftlig meddelelse fra køberen i henhold til punkt 24 skal sælgeren afhjælpe manglen uden ugrundet ophold. Sælgeren skal selv bære omkostningerne herved i henhold til bestemmelserne i punkterne 21-33.

Reparationen foretages hos køberen, medmindre sælgeren finder det hensigtsmæssigt, at den mangelfulde del eller eventuelt materiellet returneres, således at sælgeren kan foretage reparation eller udskiftning hos sig selv.

Kræver demontering og montering af delen speciel fagkundskab, er sælgeren forpligtet til at foretage sådan demontering og montering. Er en sådan speciel fagkundskab unødvendig, er sælgerens forpligtelse vedrørende den mangelfulde del opfyldt, når han har leveret en tilborligt repareret eller udskiftet del til køberen.

26 Såfremt køberen har afgivet en sådan meddelelse, som nævnt i punkt 24, og det viser sig, at der ikke foreligger nogen mangel, som sælgeren bærer ansvaret for, har sælgeren ret til godtgørelse for det arbejde og de omkostninger reklamationen har påført ham.

27 Såfremt eventuel demontering og montering medfører indgreb i andet end materiellet påhviler arbejdet og omkostningerne herved køberen.

28 Enhver forsendelse i forbindelse med reparation eller udskiftning skal ske for sælgerens regning og risiko.

Køberen skal følge sælgerens instruktioner om forsendelsesmåde.

29 Køberen skal bære de meromkostninger, som sælgeren påføres ved afhjælpning af mangler som følge af, at materiellet befinder sig på et andet sted end det i aftalen angivne bestemmelsessted eller - hvis et sådant ikke er angivet - leveringsstedet.

30 Mangelfulde dele, som udskiftes i henhold til punkt 21, stilles til sælgerens disposition og bliver hans ejendom.

31 Såfremt sælgeren ikke inden rimelig tid opfylder sine forpligtelser i henhold til punkt 25, kan køberen skriftligt give sælgeren en sidste frist for opfyldelse. Er forpligtelserne ikke opfyldt inden udløbet af den fastsatte frist, kan køberen efter eget valg

a) lade udføre de reparationer, som er nødvendige, og/eller få fremstillet nye dele for sælgerens regning og risiko forudsat, at han gør dette på en fornuftig og rimelig måde.

eller

b) kræve forholdsmæssigt afslag, dog højst 15% af den aftalte købesum.

Såfremt manglen er væsentlig, kan køberen i stedet hæve aftalen ved skriftlig meddelelse til sælgeren. Køberen har også ret til således at hæve aftalen, såfremt manglen efter tiltag som nævnt under a) fortsat er væsentlig. Køberen kan ved ophævelse kræve erstatning for sit tab, dog højst 15% af den aftalte købesum.

32 Sælgerens ansvar omfatter ikke mangler forårsaget af materiale, som er tilvejebragt af køberen, eller af konstruktioner, der er foreskrevet eller specificeret af denne.

33 Sælgerens ansvar omfatter kun mangler, som opstår under de i aftalen forudsatte arbejdsforhold og under korrekt anvendelse af materiellet.

Ansvaret omfatter ikke mangler, som skyldes årsager opstået efter at risikoen er gået over på køberen. Ansvaret omfatter for eksempel ikke mangler, der skyldes mangelfuld vedligeholdelse, urigtig montering, foretaget af køberen, ændringer foretaget uden sælgerens skriftlige samtykke eller reparationer, som køberen har udført på fejlagtig måde. Endelig omfatter ansvaret ikke normal slitage og forringelse.

34 Uanset bestemmelserne i punkterne 21-33, gælder sælgerens mangelsansvar ikke for nogen del af materiellet ud over 2 år fra den i punkt 22 nævnte periodes begyndelse.

35 Sælgeren har intet ansvar for mangler ud over det i punkterne 21-34 foreskrevne. Dette gælder ethvert tab, manglen måtte forårsage herunder driftstab, tabt fortjeneste og andre økonomiske konsekvenser. Denne begrænsning i sælgerens ansvar gælder ikke, dersom han har gjort sig skyldig i grov uagtsomhed.

Ansvar for tingskade, forvoldt af materiellet (produktansvar)

36 Køberen skal holde sælgeren skadesløs i den udstrækning, sælgeren pålægges ansvar overfor tredjemand for sådan skade og sådant tab, som sælgeren efter dette punkts andet og tredje afsnit ikke er ansvarlig for overfor køberen.

Sælgeren er ikke ansvarlig for skade, forvoldt af materiellet

a) på fast ejendom eller løsøre, som indtræder, medens materiellet er i køberens besiddelse,

b) på produkter, der er fremstillet af køberen, eller på produkter, hvori disse indgår, eller for skade på fast ejendom eller løsøre, som disse produkter som følge af materiellet forårsager.

I intet tilfælde er sælgeren ansvarlig for driftstab, tabt fortjeneste eller andre økonomiske konsekvenser.

De nævnte begrænsninger i sælgerens ansvar gælder ikke, hvis han har gjort sig skyldig i grov uagtsomhed.

Hvis tredjemand fremsætter krav mod en af parterne om erstatningsansvar i henhold til dette punkt, skal denne part straks underrette den anden herom.

Sælger og køber er gensidigt forpligtet til at lade sig sagsøge ved den domstol eller voldgiftsret, som behandler erstatningskrav, der er rejst mod en af dem på grundlag af en skade eller et tab, som påstås forårsaget af materiellet. Det indbyrdes forhold mellem køber og sælger skal dog altid afgøres ved voldgift i henhold til punkt 40.

Ansvarsfrihed (force majeure)

37 Følgende omstændigheder medfører ansvarsfrihed, såfremt de forhindrer aftalens opfyldelse eller gør opfyldelsen urimeligt byrdefuld: arbejdskonflikt og enhver anden omstændighed, som parterne ikke er herre over, såsom brand, krig, mobilisering eller militærindkaldelser af tilsvarende omfang, rekvisering, beslaglæggelse, valutarestriktioner, oprør og uroligheder, mangel på transportmidler, almindelig vareknaphed, restriktioner af drivkraft samt mangler ved eller forsinkelse af leverancer fra underleverandører, som skyldes nogen af de i dette punkt nævnte omstændigheder.

Omstændigheder, som nævnt medfører kun ansvarsfrihed, såfremt deres indflydelse på aftalens opfyldelse ikke kunne forudses ved indgåelsen af aftalen.

38 Det påhviler den part, der ønsker at påberåbe sig nogen ansvarsfrihedsgrund, som nævnt i punkt 37, ufortøvet, skriftligt at underrette den anden part om dens opståen og ophør.

Ved force majeure hos køberen skal denne dække de omkostninger, sælgeren pådrager sig for at sikre og beskytte materiellet.

39 Uanset hvad der i øvrigt følger af disse almindelige leveringsbetingelser, kan enhver af parterne hæve aftalen ved skriftlig meddelelse til den anden part, såfremt aftalens opfyldelse hindres i mere end 6 måneder af en begivenhed, som nævnt i punkt 37.

1 viser Lovvalg

40 Tvistigheder i anledning af aftalen og alt, som har sammenhæng hermed, kan ikke underkastes domstolens prøvelse, men skal afgøres ved voldgift i overensstemmelse med de lovregler om voldgift, som gælder i sælgerens land.

41 Alle retsspørgsmål, der måtte opstå i anledning af aftalen, skal bedømmes efter loven i sælgerens land.