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Solid Recovered Fuels

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Solid Recovered Fuels

This Technical Report was approved by CEN on 18 July 2003. It has been drawn up by the Technical Committee CEN/TC 2.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document CEN/TR 14745:2003 has been prepared by Technical Committee CEN/SS NO2 "**Solid fuels**", the secretariat of which is held by **CMC**

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2004, and conflicting national standards shall be withdrawn at the latest by April 2004.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom

This technical report considers the production of solid recovered fuels from selected, non-hazardous, mono- and mixed-wastes and has been prepared by members of the CEN Task Force 118 "*Solid Recovered Fuels*".

Solid recovered fuels can be derived from a wide range of waste streams and are processed into different physical forms for the (partial) substitution of primary fuels in various combustion technologies.

The estimated quantity of solid recovered fuels produced in the European Union in 2000 was 1.4 million tonnes (0.7 Mtoe). That figure is expected to rise to 13 million tonnes (6.5 Mtoe) in 2005 and to continue to grow as combustible waste that is not suitable for material recovery is diverted from landfill in accordance with the Council Directive on the landfill of waste.

This report aims to present sufficient information about the production, use and environmental considerations of solid recovered fuels to justify the establishment of a Technical Committee for solid recovered fuels by the CEN Technical Board, with the approval of the relevant services of the European Commission (EC).

The preparation of the report was supported financially by Contract NNE5-1999-00533 "*Waste to Recovered Fuel*" awarded through the ENERGIE Programme of the European Commission's Fifth Framework Programme for research.

Annex H of the report was prepared by the European Commission's Joint Research Centre at Ispra, which has participated in the CEN Task Force on behalf of DG Environment Unit A.2 and provides an additional survey of solid recovered fuels in CEN Member Countries, including data on fuel properties and composition, sampling techniques and analytical methods.

Introduction

CEN Task Force 118 "*Solid Recovered Fuels*" was created by BT Resolution C64/2000 in April 2000. Its aims are to initiate the drafting of a CEN Report to describe solid recovered fuels and their use, and also to develop a Work Programme for drafting relevant Standards. The Work Programme will provide the basis for a CEN Technical Committee to work on Standards for solid recovered fuels.

CEN/TF118 was established as a consequence of previous CEN activity in the field of solid biofuels. During the pre-normative work undertaken by CEN Working Group 108 "*Solid Biofuels*" in 1999/2000 it was decided that the scope of a future Technical Committee should not include fuels comprising waste materials that would be subject to the forthcoming Council Directive for the incineration of waste. In due course, that limitation was

applied to the scope of CEN/TC335 “*Solid Biofuels*” which was established in April 2000, and CEN/TF118 took on the responsibility for investigations into solid recovered fuels. CEN/TF118 maintains a close working relationship with CEN/TC335, to avoid any duplication of effort.

This report is concerned with the current and potential market for solid recovered fuels made from non-hazardous, mono- and mixed-wastes, excluding those fuels which are included in the scope of CEN/TC335. The point at which Standards can be applied to solid recovered fuels in the transformation from waste to useful thermal and electrical energy is illustrated in Figure 1 below. It is intended that Standards should be used to promote trade in solid recovered fuels and to improve environmental protection.

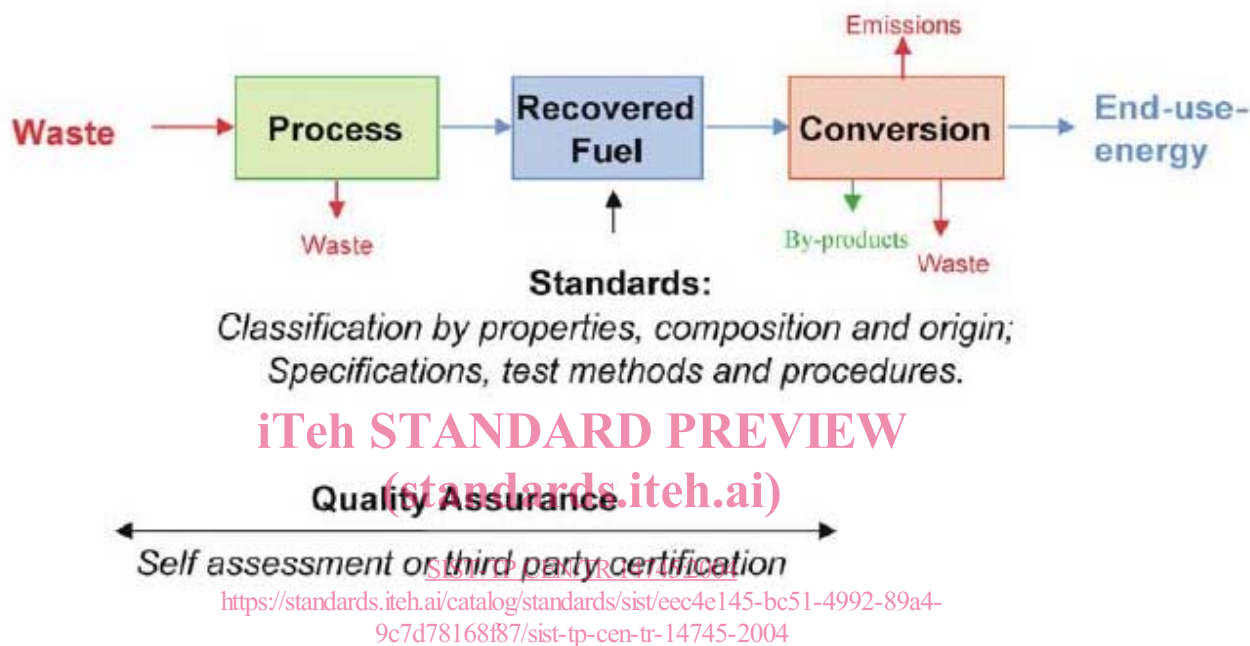


Figure 1 — The application of standards to solid recovered fuels

1 Scope

This technical report considers the production of solid recovered fuels from selected, non-hazardous, mono- and mixed-wastes.

2 Terminology

The terminology used in this report is explained in detail in Annex A. It takes account of terms and definitions derived from European legislation (such as Council Directives), the ongoing work of CEN Technical Committees (such as CEN/TC292 “*Characterisation of waste*”) and published technical reports. In cases where definitions conflict, those set out in legislation must take precedence.

It is not the aim of this report to introduce standardised terminology and definitions; that will be the task of an expert Working Group within a CEN Technical Committee. The terminology and definitions presented are simply a means to assist the discussion of the topic of solid recovered fuels and to reduce ambiguity by providing a common point of reference for all participants in the debate.

At present, there is no clear definition of Solid Recovered Fuel that can claim general acceptance. However, as a first step, the following definition (based on the term defined in the report “*Fuel and Energy Recovery*” produced under Contract DIS-1375-97-FI of the European Commission’s THERMIE Programme) is offered:

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Solid Recovered Fuel is a solid fuel of uniform quality which meets public user-oriented specifications. It is prepared from selected pre- and post-use, non-hazardous combustible waste in a dedicated process applying a quality assurance system.

NOTE Note: Combustible wastes fall within the scope of European Directive 2000/76/EC on the incineration of waste (WID). Plants incinerating only the following wastes are excluded from the scope of the WID. These wastes are included in the scope of work of CEN/TC335 Solid Biofuels:

- i) vegetable waste from agriculture and forestry,
- ii) vegetable waste from the food processing industry, if the heat generated is recovered,
- iii) fibrous vegetable waste from virgin pulp production and from production of paper from pulp, if it is co-incinerated at the place of production and the heat generated is recovered,
- iv) wood waste with the exception of wood waste which may contain halogenated organic compounds or heavy metals as a result of treatment with wood-preservedatives or coating, and includes in particular such wood waste originating from construction and demolition waste,
- v) cork waste.

It will be a clear priority for a future CEN Technical Committee to establish an acceptable definition as a sound basis for the rest of its work.

3 Abbreviations

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Abbreviations used in this report are listed below:

CFB	Circulating-fluidised-bed (combustor)
IPPC	Integrated Pollution Prevention and Control
IRWM	Integrated Resource and Waste Management
kt	kilotonne (1,000 tonnes)
MSW	Municipal Solid Waste
Mt	Megatonne (1,000,000 tonnes)
Mtoe	Million tonnes of oil equivalent
PPWD	Packaging and Packaging Waste Directive
toe	tonne of oil equivalent
WD	Waste Directive
WID	Waste Incineration Directive

4 Summary of conclusions and recommendations

The following conclusions can be drawn from the information presented in the report:

- 1) Solid recovered fuels can be derived from household waste, commercial waste, industrial waste and other non-hazardous, combustible waste streams.

- 2) European Standards for solid recovered fuels are important for:
 - the facilitation of trans-boundary shipments (in accordance with the European Regulation 259/93 and the OECD Green List or Appendix B of the Basel Treaty)
 - access to permits for the use of recovered fuels
 - cost savings for co-incineration plants as a result of reduced measurements (e.g. for heavy metals)
 - the rationalisation of design criteria for combustion units, and the cost savings for equipment manufacturers that go with it
 - guaranteeing the quality of fuel for energy producers.
- 3) The estimated quantity of solid recovered fuel produced in 2000 was 1,000 kt/a, corresponding to 500 ktoe/a. That figure is expected to rise to 10,000 kt/a in 2005, corresponding to 5,000 ktoe/a. The main market drivers are economic, resulting from the implementation of instruments within the framework of European policy on environmental protection.
- 4) Solid recovered fuels are already used to substitute fossil fuels in cement kilns, power stations and industrial boilers. Their use in co-incineration and incineration plants is expected to increase.
- 5) The cost-benefit analysis presented in Annex E shows that, for the three model regions considered, energy recovery scenarios lead to a significant reduction of greenhouse gas emissions (carbon dioxide and methane) compared to the baseline scenario of landfilling. The reduction is proportionate to the diversion of combustible waste from landfill and the yield of recovered fuel (that substitutes fossil fuel).
- 6) Fuel recovery is suited to sparsely populated regions where relatively small, de-centralised fuel-production plants can deliver recovered fuel to existing power stations or plants for the production of material products. However, this is subject to the granting of appropriate permits in accordance with the applicable legislation.
- 7) For larger cities or regions, the production of recovered fuel on the one hand and direct incineration with energy recovery on the other hand may be an appropriate solution.
- 8) A survey of solid recovered fuel producers in 2001 has concluded that:
 - there is a large variation in the standards applied for the sampling, digestion and analysis of solid recovered fuels and harmonisation is required urgently
 - the wide ranges in the analytical results reported justify the need for a fuel standard with limit values
 - more detailed information is required about the waste input to the production process
 - there is sufficient information available to justify the drafting of a Standardisation Mandate to be issued to CEN by the European Commission for developing European standards for solid recovered fuels (RDF, etc.)

It is strongly recommended that a CEN Technical Committee should be established as soon as possible, with a view to producing relevant European Standards by the end of 2003.

5 Status of the waste market

It must be said that it is very difficult to obtain accurate, up-to date information about waste generation and recovery/disposal routes in the European Union. One of the greatest obstacles is the lack of consistency among the Member States in the definition of waste categories such as Domestic Waste and Municipal Solid Waste. The data for Member States in the two tables below are based on the report from the Commission to the Council and the European Parliament on the implementation of Community waste legislation for the period 1995 to 1997 (COM (1999) 752 final of 10th January 2000), unless stated differently in the notes following the table.

Table 1 — Solid waste generation in Europe

State	Domestic Waste/MSW (kt/a)	Other Waste (kt/a)	Other Waste that is incinerated (kt/a)
Austria	2 775	42 950	1 940
Belgium	(1997) 4 633	42 253	2 261
Denmark	(1996) 2 767	(1996) 9 876	867
Finland	(1997) 980	(1997) 65 787	4 779
France	(1998) 27 000	(1998) 600 000	3 600
Germany	(1997) 39 068	N/r	N/r
Greece	(1992) 3 197	N/r	N/r
Ireland	(1995) 1 503	(1995) 4 888	36
Italy	(1995) 25 400	N/r	N/r
Luxembourg	(1997) 208	(1997) 2 520	0
Netherlands	(1997) 7 945	(1997) 44 740	2 925
Norway	2 794	4 698	N/r
Portugal	(1994) 3 480	N/r	N/r
Spain	(1994) 14 296	N/r	N/r
Sweden	(1994/95) 3 200	N/r	N/r
Switzerland	(1999) 2 600		
UK	(1995/96) 26 500	(1994/95) 221 915	N/r
Total	168 346		

NOTE kt/a = 1,000 tonnes per year

(1995) = source-year for data

N/r = not reported

Domestic Waste = Household Waste

Data for France come from ADEME (French Agency for Environment and Energy Management). The figure for Other Waste that is incinerated does not include the biomass waste that is incinerated.

Data for Norway come from the Norwegian Council for Building Standardisation

Data for Switzerland come from the Swiss Agency for the Environment, Forests and Landscape

The figures in this table are only indicative as they do not correspond to the same harmonized definition throughout the European Union.

The term “*Other Waste*” in Table 1 (as it is applied to the figures for EU Member States with the exception of France) covers a multitude of waste materials such as sludge, industrial waste, waste from energy and water supply, mining waste, agricultural waste and construction waste. A proportion of Other Waste is combustible, as can be seen from the last column of Table 1. The total quantity of combustible waste other than Domestic/MSW could be estimated at 30 to 50% of the Domestic/MSW total i.e. 50 to 80 Mt/a.

Table 2 —Domestic Waste/MSW management options applied in Europe

State	Recycling (kt/a)	Incineration (kt/a)		Landfill (kt/a)	Other (kt/a)
		With energy recovery	Without energy recovery		
Austria	1 263	431	0	1 261	0
Belgium (1997)	1 828	1 089	235	1 481	0
Denmark (1996)	777	1 545	N/r	428	16
Finland (1997)	170	32	0	560	218
France (1998)	2 204	7 900	1 800	13 700	1 400
Germany (1997)	11 562	8 992	0	17 904	N/r
Greece (1992)	226	1		2 970	N/r
Ireland (1995)	118	N/r	N/r	1 383	N/r
Italy	N/r	1400		24 000	N/r
Luxembourg (1997)	15	16	N/r	77	N/r
Netherlands (1997)	3 520	3 220	130	1 205	N/r
Norway	480	391	84	1 676	168
Portugal (1994)	N/r	N/r	N/r	3 060	420
Spain (1994)	N/r	625		11 901	1 770
Sweden (1994)	500	1 300	N/r	1 200	200
Switzerland (1999)	2 000	486	0	114	
UK (1995/96)	1 868	1 217	1 099	22 080	236
Total	26 531			105 000	

NOTE kt/a = 1,000 tonnes per year

(1995) = source-year for data

N/r = not reported

Domestic waste = Household Waste

Data for France come from ADEME (French Agency for Environment and Energy Management).

Data for Norway come from the Norwegian Council for Building Standardisation

Data for Switzerland come from the Swiss Agency for the Environment, Forests and Landscape

In the Netherlands, the GEVUDO plant still has two incinerators without energy recovery

The figures in this table are only indicative as they do not correspond to the same harmonised definition throughout the European Union.

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The total installed capacity for waste incineration in the EU Member States in 2000 has been estimated at 45 Mt/a (according to a European Incineration Profile compiled by the Juniper Consultancy in October 2000).

6 Status of the market for solid recovered fuels**6.1 Market drivers and barriers****6.1.1 Community energy policy**

The EU's main energy policy targets include:

- Meeting Kyoto objectives (through 8% reduction in CO₂ emissions between 2008 and 2012 compared to 1990)
- Doubling the share of renewable energy sources (from 6% to 12% of gross inland energy consumption)
- Improving energy efficiency (increase it by 18% until 2010 compared to 1995)
- Maintaining security of supply.

The tools for the EU's strategy for renewable energy are:

- White Paper on Energy (1995)
- White Paper on Renewable Energy Sources (RES) (1997), including the Action Plan and Campaign for Take-Off
- Draft Directive on RES (2000)

The use of biomass and waste accounted for 44.8 Mtoe in 1995. Its projected contribution in 2010 is 135 Mtoe, of which about a third will come from waste.

6.1.2 Community environmental policy

The European Commission has proposed a new action programme for the environment (the 6th EU Environment Action Programme). The Programme focuses on areas where more action is needed. It sets out objectives for the next ten years and beyond. It suggests that the key to our long-term welfare is *sustainable development*; finding ways of improving our quality of life without causing harm to the environment.

One of the main areas where new effort and impetus is needed is "Preserve natural resources and manage waste". The Commission proposes to the European Parliament and the Council to agree the following aims:

The Programme aims at stabilising the atmospheric concentration of greenhouse gases at a level that will not cause unnatural variations of the earth's climate. (3)

The Programme aims at protecting and restoring the functioning of natural systems and halting the loss of biodiversity. (4)

The Programme aims at an environment where levels of man-made contaminants do not give rise to significant impacts on, or unacceptable risks to, human health. (5)

The Programme aims at better resource efficiency and resource and waste management (6)

The Programme shall stimulate the development of a global partnership for environment and contribute to a sustainable development (9)

The Programme shall ensure that the Community's environmental policy-making is undertaken in an integrated way (10)

6.1.3 Community legislation

The Waste Directive, WD (75/442/EEC and its amendments)

- gives a wide definition of waste. The definition does not distinguish between well-controlled industrial residues (pre-use waste, by-products) and mixed Municipal Solid Waste, MSW
- does not give a practical definition of recovery process but refers to a list of operations as they occur in practice
- does not take a position on when and how a waste that has entered a recovery operation becomes a non-waste product that freely can enter the eco-cycle (= market).

The Waste Strategy (Council Resolution of 24th February 1997)

The first waste strategy dates from 18th September 1989. The Commission produced a revision after some years. On 1st August 1996 the revision was presented to the Council, who accepted it on 24th February 1997 (397Y0311(01)).

In the draft resolution (paragraph 20) the Commission confirms the principal hierarchy (established in the document from 1989), which gives preference first to waste prevention, then to waste recovery (which includes reuse, recycling and energy recovery, with preference being given to material recovery), and lastly to waste disposal (which includes incineration without energy recovery and landfilling). The hierarchy must be applied in a flexible way. The realisation of the hierarchy must be guided by the best solution for the environment with regard to economic and social costs.

In the resolution the Council

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(21) INSISTS on the need for promoting waste recovery with a view to reducing the quantity of waste for disposal and saving natural resources, in particular by reuse, recycling, composting and recovering energy from waste,

(22) RECOGNIZES, as regards recovery operations, that the choice of option in any particular case must have regard to environmental and economic effects, but considers that at present, and until scientific and technological progress is made and life-cycle analyses are further developed, reuse and material recovery should be considered preferable where and insofar as they are the best environmental options, and

(27) IDENTIFIES the importance of Community criteria concerning the use of waste, in particular as a fuel or other source of energy.

The Directive on Packaging and Packaging Waste, PPWD (94/62/EC)

- defines energy recovery as “direct incineration of waste With recovery of the heat”
- sets limits on the contents of four heavy metals in packaging allowed on the internal market.

The Landfill Directive (1999/31/EC)

- sets binding targets for the diversion of biodegradable waste from landfill.

NOTE 1 Some Member States do not, or will not, allow combustible waste in landfill; others do the same for untreated waste.

NOTE 2 Combustible waste is often of biogenic origin but will not pass the test on biodegradability as developed by CEN under Mandate M 200 rev.3 for the PPWD.

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NOTE 3 Some Member States have introduced a Landfill Tax to encourage diversion of wastes from landfill.

The Waste Incineration Directive, WID (2000/76/EC)

- sets emission limit values for incineration and co-incineration of all wastes
- excludes plants that incinerate only certain types of waste from its scope
- requires continuous measurements of several emission components, and dioxin and heavy metal measurements twice a year.

NOTE 1 Plants treating only the following wastes are excluded from the scope of the WID:

- i) vegetable waste from agriculture and forestry,
- ii) vegetable waste from the food processing industry, if the heat generated is recovered,
- iii) fibrous vegetable waste from virgin pulp production and from production of paper from pulp, if it is co-incinerated at the place of production and the heat generated is recovered,
- iv) wood waste with the exception of wood waste which may contain halogenated organic compounds or heavy metals as a result of treatment with wood-preservatives or coating, and includes in particular such wood waste originating from construction and demolition waste,
- v) cork waste,
- vi) radioactive waste,
- vii) animal carcasses as regulated by Directive 90/667/EEC without prejudice to its future amendments,
- viii) waste resulting from the exploration for, and the exploitation of, oil and gas resources from off-shore installations and incinerated on board the installation.

NOTE 2 The emission measurement costs can be substantial enough, in some cases, to make an economic barrier for some combustion plants.

NOTE 3 The introduction of the Directive states that "(21) Criteria for certain combustible fraction of non-hazardous waste not suitable for recycling, should be developed in order to allow the authorisation of the reduction of the frequency of periodical measurements". Periodic measurements of HCl, HF and SO₂ instead of continuous measuring may be authorised if the operator can prove that the emissions of those pollutants can under no circumstances be higher than the prescribed emission limit values. The reduction of the frequency of the periodic measurements for heavy metals, dioxins and furans may be authorised provided that the emissions are below 50% of the relevant emission limit values and provided that criteria for the requirements to be met (to be developed in a Technical Adaptation Committee) are available. Until 1 January 2005, the reduction of the frequency may be authorised even if no such criteria are available provided that:

- the waste consists only of certain sorted combustible fractions of non-hazardous waste not suitable for recycling and presenting certain characteristics
- national quality criteria, which have been reported to the Commission, are available for these wastes
- co-incineration and incineration of these wastes is in line with the relevant waste management plans
- the operator can prove that the emissions are under all circumstances significantly below the relevant emission limit values
- the quality criteria and the new period for the periodic measurements are specified in the permit

- all decisions on the frequency of measurements and information on the amount and quality of the waste concerned shall be communicated to the Commission.

The Draft Directive on Large Combustion Plants (**88/609 Directive on the limitation of emissions of certain pollutants into the air from large combustion plants, Common Position 52/2000 of 28th December 2000, and text approved by the Conciliation Committee on 2nd August 2001**)

- Defines fuel as any solid, liquid or gaseous combustible material used to fire the combustion plant with the exception of waste covered by Council Directive 89/369/EEC of 8 June 1989 on the prevention of air pollution from new municipal waste incineration plants, Council Directive 89/429/EEC of 21 June 1989 on the reduction of air pollution from existing municipal waste incineration plants and Council Directive 94/67/EC of 16 December 1994 concerning the incineration of hazardous waste, or any subsequent Community act repealing and replacing one or more of these Directives.

The Directive on Integrated Pollution Prevention and Control (IPPC) (96/61)

- IPPC sets the requirement for installations to use best available technologies (BAT). “*Integrated*” means that the permits must take into account the whole environmental performance of the plant i.e. emissions to air, water and land, generation of waste, use of raw materials, energy efficiency, noise, prevention of accidents, risk management, etc.

The Directive on the promotion of electricity produced from renewable energy sources in the internal electricity market (RES-E) (2001/77/EC)

- The Directive and its position will affect the market for solid recovered fuels. It states that “Where they use waste as an energy source, Member States must comply with current Community legislation on waste management. The application of this Directive is without prejudice to the definitions set out in Annex 2a and 2b to Council Directive 75/442/EEC of 15 July 1975 on waste. Support for renewable energy sources should be consistent with other Community objectives, in particular respect for the waste treatment hierarchy. Therefore, the incineration of non-separated municipal waste should not be promoted under a future support system for renewable energy sources, if such promotion were to undermine the hierarchy.”

NOTE 1 Some Member States classify the biodegradable share or the whole amount of energy from MSW as renewable energy. A brief review of the legal definitions of waste as a source of energy is presented in 6.1.4.

NOTE 2 The Rapporteur to the European Parliament has proposed to ask the Commission to draft a separate Directive on the promotion of energy from waste.

Working Document on the biological treatment of biowaste (2nd draft, 12 February 2001)

The Working Document and its position will affect the market for solid recovered fuels.

6.1.4 The Kyoto Protocol

The Kyoto Protocol sets binding targets for different countries for six different greenhouse gas emissions. Member States have different practices for calculating the reductions of greenhouse gas emissions from energy generation through the incineration of waste and combustion of waste-derived fuels. A summary of those practices is given below.

The Austrian strategy for climate protection acknowledges the high potential of an optimisation of the waste management sector for the reduction of greenhouse gases by the application of thermal treatment instead of landfilling (according to a climate strategy paper by the Federal Ministry of the Environment, 2000).

In Belgium, the AMPERE Commission has estimated that 65% of MSW is biogenic.

NOTE Commissie AMPERE, October 2000. Rapport van de Commissie voor de Analyse van de Productiemiddelen van Elektriciteit en de Reorientatie van de Energievectoren.