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Viewpoint

# How European waste will contribute to renewable energy

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**Abstract**

Whereas the European Union (EU) has been showing its committal to the promotion of renewable energy already since a couple of years, it is only recently that more clarity is being created about the potential role of biomass and waste in the EU's policy on renewable energy. This note provides an interpretation of the current legislation process as regards biomass, waste and renewable energy. 

*Keywords:* Biomass; Waste; Regulation; Renewable energy

## 1. Introduction

In the policies of the European Union (EU) and its member states, biomass is expected to play a major role as a renewable energy source (EU, 1997). In the course of implementing this policy it appeared that a large proportion of the resource base for biomass consists of waste. Waste processing, however, is regulated in particular manners which differ from the way in which the production of electricity and heat is controlled. This experience resulted in the stalling of a number of renewable energy initiatives. An example is the currently halted co-firing facility of the Gelderland power station in Nijmegen (Netherlands), built for the conversion of demolition wood into electricity. The characterisation of certain biomass types as waste does not only bear consequences for the applicable regulatory framework, but also for the EU's policy on renewable energy in general, a basic question being whether energy generated from waste should be regarded as renewable energy. This paper does not address the issues from the viewpoint of environmental sciences, but rather provides an interpretation of recent events in the development of legislation in the EU.

## 2. Definitions of biomass and waste

Whereas in biological sciences, biomass is the amount of living matter, expressed in gram per unit area or per volume of habitat, the energy sector defines biomass in a more limited way as the fuel source which originates from plant materials and animal waste. Plant-based biomass mainly consists of three chemical structures: Cellulose, hemi-cellulose and lignine, all of which are compounds of carbon, hydrogen and oxygen. These types of biomass contain only few other elements like nitrogen, sulphur and metals. Animal-derived biomass consists mainly of fats and proteins. They are also made of carbon, hydrogen and oxygen—although their ratios differ from those observed in vegetable biomass—their content of nitrogen, sulphur and metals is usually higher than those found in biomass from vegetable origin. Biomass can be made available in a variety of shapes: Logs, chips, bales, charcoal, sludges, fluids, powders, etc. These facts are important for the design of suitable energy conversion technologies. They also determine the economy of biomass energy technologies.

The resources of current and future biomass fuels can be categorised as indicated in Table 1.

The categories in this overview are exhaustive. Yet there are some conceptual difficulties. Energy crops, of course, are a clear concept. These are products which are deliberately grown to produce energy. We find them only occasionally in industrialised countries. Oil seeds, such as rapeseed grown in France and Austria, for the manufacture of diesel fuel substitutes (bio-diesel) are an example. In developing countries, one may come across fuelwood plantations, managed for the fuel provision of specific industries (tobacco curing, tea manufacture). Actually, the conceptual difficulties arise with regard to the meaning of the expressions 'residues' and 'wastes'.

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Table 1
The categories of biomass fuels

| Category | | Examples |
|---|---|---|
| Residues | Agricultural residues | Straw |
| | Forestry residues | Tops, thinnings |
| | Industrial residues | Sawdust, bagasse |
| Wastes consisting of or containing biomass | Regulated wastes | Municipal waste |
| | Non-regulated wastes | Landfill gas, sludge gas[a] |
| Energy crops | | Miscanthus, willow, eucalyptus |

[a] Sludge gas: Exhaust gas from water treatment plant. Strictly speaking, landfill gas and sludge gas are not biomass fuels. If released to ambient they are emissions. If used as fuels, they are biomass *derived* fuels.

## 3. Regulatory issues

On the one hand, residues are the remains of a raw material generated during its processing. They are not constituting a main product, but rather a by-product. In practice, the further handling and processing of residues is regulated on the basis of the physical characteristics of these residues and perhaps of the processes involved, but not on the factuality that they are residues. For wastes this is different. The mere fact that a material is labelled a waste poses certain regulations for its employment, particularly with respect to allowable emissions and permit allocation. At least, this applies in the member states of the European Union. As a result of this European policy, the production of electricity from commercial fuels is regulated in a manner different from the production of electricity out of waste. Compare e.g. EU (2000b) the coverage of which includes the regulation of electricity production from waste, and EU (1988) and EU (1994) which regulate among other issues the production of electricity from ordinary, non-waste fuels. The consequences are far reaching. For example, in the Netherlands sulphur emissions from high-sulphur coal fuelled electricity plant are limited at $133\,mg/N\,m^3$, whereas this limit value is set at $40\,mg/N\,m^3$ for waste fuelled electricity plant, even if low-sulphur waste is concerned (BEES-A, 2000; BLA, 2000). In view of the costs of conversion technologies (costs of exhaust gas cleaning are substantial) and of permit acquisition, this situation makes it quite relevant for the establishment of biomass prices whether a biomass type falls within the category of wastes or not.

What is waste? In the context discussed here, waste is a label applied by the government for the purpose of environmental management. The governmental definition should therefore be adopted. According to EU legislation, waste is defined as follows (EU, 1975, Article 1):

*(a) 'waste' means any substance or object which the holder disposes of or is required to dispose of pursuant to the provisions of national law in force.*

Indirectly the article quoted defines 'to dispose of' as well:

*(b) 'disposal' means: the collection, sorting, transport and treatment of waste as well as its storage and tipping above or under ground, –the transformation operations necessary for its re-use, recovery or recycling.*

A step forward away from the legalistic standpoint that any waste biomass fuel should be legally treated as a waste according to the environmental laws on waste incineration, was made by the European Commission in a communication to the European Parliament (EU, 2000a). This position paper proposes to regulate the use of particular types of waste biomass in the same way as other non-waste fuels for combustion plant. These biomass types are (EU, 2000a, Article 2.11):

"*(a) vegetable waste from agriculture and forestry;*

*(b) vegetable waste from the food processing industry;*

*(c) vegetable waste from virgin pulp production and from production of paper from pulp;*

*(d) cork waste;*

*(e) 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 which includes in particular such wood waste originating from construction and demolition waste.*"

Simultaneous with the publishing of this political approach, the European Parliament and the Council created the necessary leeway within the legislation for waste management by excluding from the coverage of the new waste incineration directive, electricity production plants which do not convert other wastes than those listed above (Directive 2000/76/EU on waste incineration, EU, 2000b, Article 2.2).[1] The reason for exempting the energy conversion of these types of wastes from the legislation concerning waste incineration, is that these waste types, in comparison with other wastes, are

[1] EU (2000b, Article 2.2) states: "Scope: 1. This Directive covers incineration and co-incineration plants. 2. The following plants shall however be excluded from the scope of this Directive: (a) Plants treating only the following wastes: (follows a listing of the same biomass types as quoted above from EU, 2000a)".

typically not or substantially less contaminated with those substances which are a cause for increased environmental care, such as chlorine, sulphur, fluor and heavy metals. They are clean. Nevertheless, there remains one conflicting item between the waste incineration directive (EU, 2000b) and the position paper on waste utilisation as an ordinary fuel (EU, 2000a). Directive 2000/76/EC on waste incineration says that, in order to be exempted from its coverage, pulp and paper waste should be converted into energy at the place of its production (EU, 2000b, Article 2.2).[2] By placing this additional condition (it is not mentioned in EU, 2000a) to the fuel application of these waste types, the directive on waste incineration keeps the potential trade of this type of biomass fuel in check. In parallel to the European Parliament and Council, the Dutch Government is preparing its own listing of clean and contaminated waste biomass fuels, thereby exempting the clean waste biomass from waste legislation (Pronk, 2000). The draft listing deviates from the European one, cited above. As recognised in the draft text of the Dutch circular, the legal basis fails and, at the time of preparing this note, it should be doubted whether the policy can ever become effective in view of European Union legislation. Whatever the intended and coincidental consequences of these developments for particular types of biomass will be—the conclusion can be drawn that in view of waste legislation three types of biomass fuels will result:

- non-waste biomass fuels legally treated as other non-waste fuels (NWB: non-waste biomass),
- waste biomass fuels legally treated as non-waste fuels (EWB: exempted waste biomass), and
- waste biomass fuels legally treated as wastes (WB: waste biomass).

The distinction is illustrated in Fig. 1. For the sake of simplicity, the first two types can be referred to as 'clean' biomass, the third one as 'contaminated' biomass.

## 4. The role of waste in the EU's renewable energy policy

It is relevant to discuss the topic of waste and its role in the energy provision from another angle as well: that of sustainability. In the policies of the countries committed to increased sustainability of the energy sector, biomass and waste as energy sources are virtually taken together continually. Just two examples are the policies of the European Union and the Netherlands. See for example the European Union's 'Energy for the future' (EU, 1995), and, for the Netherlands, 'Renewable energy-advancing power' (Wijers, 1997). Waste is a much broader category than biomass, however. Municipal waste for example contains plastics, which usually do not originate from biomass resources. Where statistical data and quantified policy targets regarding renewable energy categorise biomass and waste under the same heading, an interpretation as to how much biomass is involved, is not possible. Yet, this is desirable for the development of effective policies stimulating the role of biomass in energy provision. With the new directive on the promotion of electricity from renewable energy sources (in preparation, 1 September 2001), the European Commission effectively proposes to exclude the non-biodegradable fraction of wastes from the category of renewable sources (EU, 2001, Article 2b). This is a new position and has immediate consequences for an interpretation of the targets on the implementation of renewable energy, e.g. in the EU's White Paper 'Energy for the future' (EU, 1997).

A further consequence of this view is that it will be possible to generate renewable energy from contaminated biomass fuels (the category WB, identified above). An immediate result is that applications of biogas from landfills and sewage water treatment plants can be included in the balance of renewable energy, even though the original wastes out of which this gas is produced does not appear in the listing of clean biomass types. Also the producers of electricity from contaminated biomass types, such as demolition wood, may participate in the market of Green Certificates (As proposed in EU, 2001, a Green Certificate will be issued to the producer of renewable energy and can be sold). This opens up new perspectives for the waste management sector, and also for operators in the electricity sector who accept contaminated biomass fuels. At the same time, it is also getting clear that not all types of waste conversion into energy will come under the label of renewable energy. Energy generation out of the non-biodegradable component of municipal waste, e.g., is evidently excluded.

## 5. Summary

In summary, the result of the developments described above result in the regulatory perspectives for biomass depicted in Table 2.

## 6. Challenging questions

In the European Union, both clean and contaminated biomass types may be used as fuels. However, the stricter emission limit values for waste incineration will

[2] EU (2000b, Article 2.2): "*The following plants shall however be excluded from the scope of this Directive: (a) Plants treating only the following wastes: … (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…*"

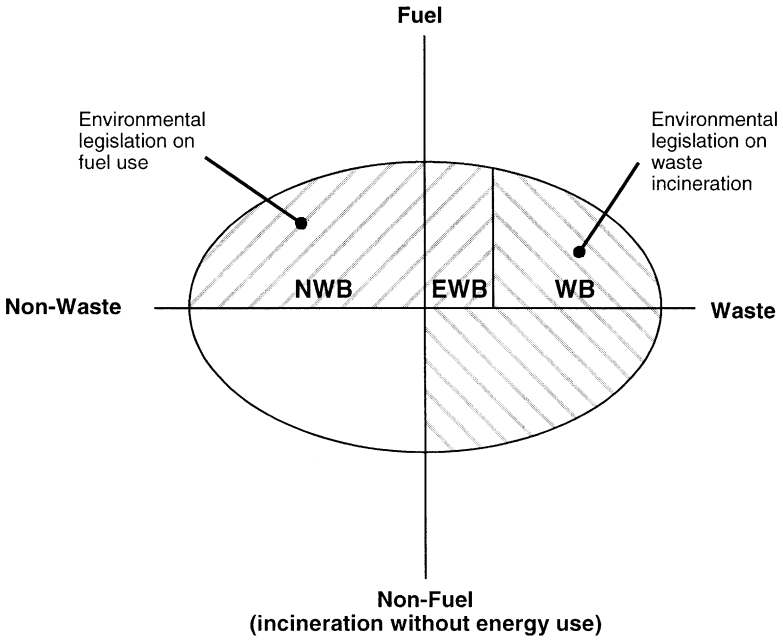


Fig. 1. Categorisation of biomass in view of European environmental legislation.

Table 2
The emerging regulatory framework for biomass fuels

| Biomass type | Emission regulation | Permit allocation | Greenhouse gas mitigation (issuing of Green Certificates) |
|---|---|---|---|
| Clean biomass (NWB, EWB) | Environmental legislation on fuel use | Environmental legislation on fuel use | Recognised as renewable energy |
| Contaminated biomass (WB) | Environmental legislation on waste incineration | Environmental legislation on waste incineration | Recognised as renewable energy |

be applied for those waste biomass fuels which are not exempted from the waste incineration legislation. As a consequence, stricter emission limit values will be set for electricity plants which employ contaminated biomass (WB) than for electricity plants which are fired with fossil fuels, or clean biomass (NWB or EWB). In this manner, the use of non-exempted waste biomass for electricity production is either prevented or made more expensive. If prevented, the non-exempted waste biomass is likely to be incinerated in a dedicated waste incineration plant at a low electricity recovery efficiency, and the balance of the electricity consumption is probably made up by firing additional coal in an electricity plant, with all associated additional emissions. In this case the quality of the environment loses. If its use as a fuel in electricity plant is not prevented, but takes place after all, its conversion costs are higher than under a non-waste regime. By substituting fossil fuels the emission of greenhouse gases will be reduced. But not only those—also $SO_2$ and dust emissions from the aggregate of power plants and waste incineration plants will be lower, since stricter emission limits apply for these substances than for those substances if released from fossil fuels or clean biomass. The additional costs therefore for substituting fossil fuels by waste, should not be regarded as costs purely made to reduce greenhouse gas emissions, but rather as expenses to achieve other environmental objectives as well. Clarification of this ambiguity would probably help further negotiations about emission regulations for the conversion of biomass fuels.

Since recovery and recycling are clearly implied in the course of the use of non-exempted waste biomass types (WB) for electricity production, it is important to know, in view of biomass fuel trade and the selection of energy conversion technologies, whether at all or at which processing stage a waste biomass gets rid of its defaming label. In any case this happens to every waste type which is recycled in some way or another, somewhere during the transformation operations referred to in the governmental definition of waste quoted earlier. Would it be possible to manufacture a biomass fuel by some means of preparation such that it is legally recognised as a fuel just like coal, natural gas

and furnace oil? Conceivable manufacturing processes are for example:

- Upgrading of mixed waste types by material separation recovering combustible materials of various qualities.
- Upgrading of demolition wood by making a heterogeneous product more homogeneous (e.g. chipping).
- Upgrading of wood shavings by pelletisation.
- Gas manufacture from digestible wastes such as animal manure.
- Oil manufacture from contaminated wood (e.g. by liquefaction).

Both European Union law and Dutch law were analysed and it was concluded that the question as to whether the products resulting from these or similar processes are wastes or not, is not legally solved. Relevant jurisdiction is currently being developed with regard to the coal fired Gelderland power plant situated in Nijmegen which installed a co-firing facility for wood. The power plant owner intends to use chips made from demolition wood bought from the waste management company BFI. Environmental NGOs object against the permit granted by the authority by stating that the chips should be considered a waste. The case is currently being tried.

Perhaps an economic consideration may shed some light on the evaluation. At the root of a waste management chain, the value of a waste is always negative since even its handling by the owner goes at a cost. However, what is a waste for the one may become a valuable material for another to an extent that this value is paid to the primary owner. For example: in some instances sawdust and wood shavings which serve no purpose at a timber factory when no space heating or wood drying is required, are disposed of at the factory by means of incineration. In other instances they are sold to fuel briquette manufacturers. It is an established economic principle that a positive value develops for any material which becomes scarce. This may also happen to a waste material. Such development may take place over time, if new technologies or products are developed or if market circumstances change. Alternatively, a waste may become valuable in the course of a processing chain. The opposite may occur as well: a valuable product may become a waste if market conditions change. Recently, this happened for example with pig manure in the Netherlands. Being a valuable nutrient provider in agriculture, it became an available surplus and, for some producers, a waste as well when the balance between its production and use was disturbed. Would it not be an option to make the value of a material one of the indicators for the decision of whether it is a waste or not?

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