SenterNovem

Bio-energy in Europe 2005

Policy trends and issues

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Policy trends and issues

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Colofon

This report has been written by Jasper Faber and Geert Bergsma (CE, Delft www.ce.nl .) partly bases on country reports made by the participants in EUBIONET (www.eubionet.net). The project has been commissioned by SenterNovem (www.senternovem.nl) and has been supervised by Kees Kwant of SenterNovem.

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Summary

Biomass is an important topic for European energy, climate and waste policy. The recently published European Biomass Action Plan promotes the use of biomass for heat and power generation and biofuels for transport. As for climate policy, generating useful energy from biomass limits the greenhouse gas emissions associated with fossil fuel use. In addition, municipal waste contains a varying fraction of biogenic products and can also be considered a source of bio-energy.

This report analyses current European trends in bio-energy policies as they relate to electricity and heat production. The focus is on European legislation and its implementation in the Member States. This report is partly based on the country reports made by de participants in EUBIONET (www.eubionet.net) as a case study, German bio-energy and waste policies are considered in more detail, and the major effects of recent changes in these policy areas are assessed.

European legislation and biomass use
With regard to European legislation, the Renewable Energy Sources (RES) Directive and the Landfill Directive are currently giving a significant incentive to bio-energy projects across the EU. Under the RES directive most Member States have adopted policies supporting bio-energy generation. The nature and level of this support varies among Member States from 0 to 21.5 € ct/kWhe and there has consequently been similarly wide variation in the growth of biomass use.
In Germany, with the highest support tariffs, bio-energy use doubled between 2000 and 2004, while in certain other countries there was no increase at all. Because of these policy differences, within Europe today there is subsidy-driven biomass transport to countries with relatively generous support systems.

The Landfill Directive is now effectively reducing the amount of biodegradable waste being landfilled in some countries. In Austria, Belgium, Germany, the Netherlands and Sweden the share of waste being landfilled fell by over 10 percentage points between 2000 and 2004. In many other countries there is still little public support for waste incineration, which is hampering the reduction of landfill. In the EU25 overall, 5% of household waste shifted from landfilling to recycling and energy production between 2000 and 2004 (5 Mtonne increase of incineration). In the EU25, 113 Mtonne (Mt) of burnable municipal waste is still landfilled each year. Shifting this amount to high-efficiency incineration (30%) could generate 4% (95 TWhe) of the annual electricity demand of the EU25. And even much more is possible if we improve the efficiency of existing incinerators and included non-municipal waste also. Furthermore, such a shift would lower EU CO_2-eq. emissions by at least 45-113 Mt. Because of the avoidance of methane emissions from the breakdown of the biogenic waste fraction in the landfill, which are only captured partly, the CO_2 avoidance factor of bio-energy from the waste is about ten times greater than that of other forms of bio-energy.

In the future, two other directives may have an increasing impact on the use of biomass: the CO_2 Emission Trading Scheme (ETS) Directive and the Biofuels Directive.

The first of these directives encourages generation of bio-energy in installations covered by the ETS. With current prices of around 27 €/tonne CO_2 the bonus for co-firing biomass amounts to 2.5 €cent/kWhe. In Finland this has increased the amount of bio-energy derived from wood otherwise left in the forest. In Germany the ETS combined with priority status for biomass-co-firing power plants has also encouraged more co-firing of biomass. In the Netherlands, with no such priority status, this effect is not noticeable. The ETS has not yet developed into a mature market and actors are therefore still reluctant to invest in biomass co-incineration. Once the market has stabilised, and provided prices do not

drop below current levels, the ETS may give a considerable boost to biomass use across Europe.

The Biofuels Directive is leading to a considerable increase in demand for biomass for conversion to biofuels. Many Member States have recently set ambitious goals for biofuel use, which will lead to a considerable increase in demand for biomass. In the UK and the Netherlands there is already competition for products like palm oil, tallow and other fats. In the near future it may become feasible to produce biofuels from wood and wet biomass that is currently used to generate heat and electricity. In that case even greater competition will emerge between biofuel policies and bio-energy policies.

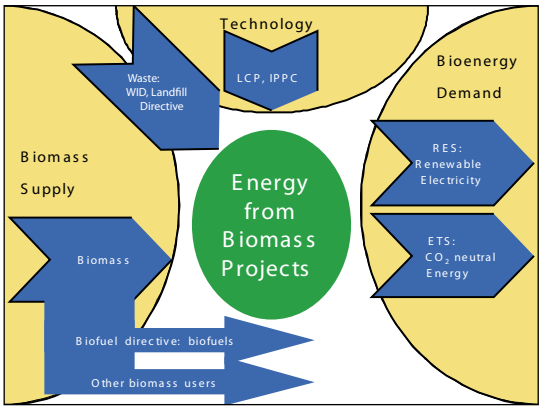
In some countries like Austria and the Netherlands there is also debate on competition with other biomass-using sectors like oleo chemistry (oils & fats) and the chip-board and paper industries. This topic needs further attention. A level playing field for different biomass users is necessary. Furthermore also in some countries there is debate about the sustainability of biomass supply (CO_2 balance, emissions and biodiversity effects). It is positive that in the EU Biomass Action Plan the need for sustainability guarantees is addressed.

The Waste Incineration Directive (WID), Large Combustion Plant (LCP) Directive and IPPC directive all have an important effect on emission restrictions on bio-energy plants. In general, though, they are of little further influence. In October 2007 this may change because by then all larger energy and waste incineration plants will need an IPPC permit, which may create problems for both governments and industry.

A closer look at Germany

In 2004 Germany changed its support system for electricity from renewable sources. Feed-in tariffs for bio-electricity are now generally higher and power production from biomass is consequently on the increase. As the new support system provides generous incentives for the use of 'self-regenerating' raw materials

Figure 1 *EU Directives influencing supply and demand for biomass and bio energy*



and innovative technologies, generation of biogas from energy crops is currently booming. The feed-in tariffs also seem to have resulted in an increase in the prices paid for biomass in Germany. The little information available on biomass prices indicates that these are higher in Germany than in neighbouring countries.

Case study on border effects between Germany and the Netherlands

The German tariff structure differs from that in the Netherlands. Analysis shows that most types of biomass like clean waste wood, straw, chicken manure and oil cake can be used more profitably in Germany, while dirtier waste wood attracts more subsidy in the Netherlands. This is a clear example of policy competition giving incentives to maximise subsidisation rather than increase biomass use.

On 1 July 2005, Germany banned the landfilling of untreated organic waste. As a result a growing amount of waste is being incinerated, in both dedicated facilities and co-incineration plants. More than half the waste formerly landfilled is now incinerated or co-incinerated, leading to an increase in generation of useful energy from waste. The landfill ban has also resulted in a decrease of imports of waste from the Netherlands. As a result, 1 Mtonne more waste is annualy landfilled in the Netherlands now. It will take some years before incineration facilities for this waste will be build.

Recommendations

Bio-energy policy gives rise to policy competition among Member States, one result of which may be higher biomass prices, which would have a negative impact on the cost-efficiency of bio-energy policy. Member States should therefore coordinate their bio-energy support regimes. It is not necessary to introduce a uniform system of supports throughout the EU, for each country can take its natural endowments into due consideration when designing an appropriate support regime. However, it is necessary to avoid wasting subsidies.

Shifting biogenic waste from landfill to energy production, in particular, is a means of substantially increasing bio-energy production in Europe. This is even more important because it can potentially reduce European CO_2-eq. emissions by 200-300 Mt per year. Landfill bans or substantial landfill taxes have proved to work well in many European countries in pursuit of this aim.

Member States should carefully consider bio-energy and biofuel goals in combination. This is a potential area of policy competition that may lead to wastage of subsidies and reduce the cost efficiency of both policies. In this respect, it is also recommended that more attention should be given to competition with other biomass-using sectors like oleo chemistry and the paper and chipboard industries.

1 Introduction

The Dutch Ministry of Economic Affairs has commissioned its agency SenterNovem to carry out the programme 'Sustainable Energy in the Netherlands' (Duurzame Energie in Nederland, DEN). As part of this programme SenterNovem commissioned CE Delft to review the principal trends affecting the availability of biomass suitable for energy production in the European Union. The emphasis of the project is on biomass availability in the Netherlands and the effects of European trends on that availability. This report is partly based on the country reports made by de participants in EUBIONET (www.eubionet.net).

1.1 Objectives

The project has two main objectives:

1 To assess the main European trends affecting biomass and bio-energy.
2 To analyse the consequences of these trends for the availability of biomass, with the emphasis on imports and exports of biomass from and to Germany.

This report focuses on the use of biomass for generating electricity and heat. Biomass for chemistry or transport fuels, also interesting routes to greening our economies, are described in many other reports by SenterNovem and CE.

1.2 Method

The main European trends affecting bio-energy have been assessed by studying the development of relevant policies and legislation, including in particular the following European Directives:

- IPPC Directive (96/61/EC).
- Large Combustion Plant Directive (2001/80/EC).
- Waste Incineration Directive (2000/76/EC).
- Landfill Directive (1999/31/EC).
- Renewable Energy Sources Directive (2001/77/EC).
- Emission Trading Scheme Directive (2003/87/EC).
- Biofuel Directive (2003/30/EC).

National transposition and implementation of these directives has been studied by means of a literature review and interviews with experts.

In addition, policies promoting the generation of heat and power from biomass throughout the European Union have been reviewed.

Finally, the consequences of trends in biomass availability in the Netherlands have been studied by means of economic analyses and interviews with experts.

1.3 Results

The project will ultimately have three material results:

1 Country reports on the status of bio-energy in national legislation and implementation of relevant directives in the 25 Member States of the European Union. These country reports were written partly in collaboration with SenterNovem and partners in EUBIONET II. Although most of them have been finalised, they are not included in this report. They can be found on the EUBIONET II website (http://www.eubionet.net).
2 The present report, which assesses the trends in the country reports, with special emphasis on the situation in Germany.
3 Two workshops, to be held in early 2006 and early 2007.

1.4 Definitions of biomass, bio-energy and biofuels

In this report, we distinguish between biomass, bio-energy and biofuels. Biomass is defined (in accordance with the CEN definition) as all material of biological origin, excluding fossil biomass like coal, natural gas and oil. Bio-energy is electricity or heat generated from biomass, while biofuels are transport fuels derived from biomass. These definitions are in line with the European Biomass Action Plan[1].

[1] COM (2005) 628 final, 7.12.2005.

1.5 Report outline

Chapter 2 analyses the current availability of biomass in the Netherlands. It is based mainly on a recently published TNO report on the subject. Chapter 3 reviews the transposition and implementation of EU directives in Member States and their relevance to biomass projects. Chapter 4 focuses on Germany and analyses the impact of German feed-in tariffs for renewable energy and the German ban on landfilling untreated biodegradable waste. Chapter 5, finally, assesses the effects of the trends identified in the previous chapters on the availability of biomass in the Netherlands.

2 European legislation affecting biomass projects

2.1 Introduction

The generation of bio-energy is strongly influenced by a wide range of legal and fiscal provisions, many of which stem from European legislation. Thus, EU directives set targets for renewable energy production, encourage low-carbon energy production and set limits on emissions from biomass combustion or disposal. The second section of this chapter evaluates the transposition and implementation of seven key directives in EU Member States. The implications of each directive on the supply of biomass and on biomass projects are assessed, with emphasis on the Dutch situation.

2.2 Relevant EU directives

EU legislation affects the availability of biomass and its use for heat and power generation in a variety of ways. Some of this legislation is intended specifically to support bio-energy, and in this context the most important directives are the following:

1 Renewable Energy Sources Directive, 2001/77/EC.
2 Emission Trading Scheme Directive, 2003/87/EC.
3 Landfill Directive, 99/31/EC.
4 Biofuels Directive, 2003/30/EC.

Other European legislation imposes constraints on the production of bio-energy, mainly through rules on emissions control:

5 Integrated Pollution Prevention and Control (IPPC) Directive, 96/61/EC.
6 Large Combustion Plants (LCP) Directive, 2001/80/EC.
7 Waste Incineration Directive, 2000/76/EC.

Each of these directives potentially affects biomass projects in a different way (see Figure 2).

The Renewable Energy Sources Directive requires Member States to increase the share of renewable sources in electrical power generation. For most Member States this entails financial incentives for bio-energy. This directive thus stimulates bio-energy.

The EU Emission Trading Scheme (ETS) is a general support system for CO_2 emission reduction. In many countries, trading tariffs are considered too low to serve as an incentive for bio-energy, but even low-level support helps. In some countries like Finland, where bio-energy is relatively cheap, this system having an impact on bio-energy use.

The Waste Incineration and Landfill Directives could affect the amount of waste available for generating useful energy. Whether or not waste incineration qualifies as a bio-energy project depends on the national definition of 'bio-energy'. In Germany, for example, the biodegradable fraction of municipal waste is not subsidised as bio-energy, while in the Netherlands it is. These directives also regulate the technology to be used for landfilling and waste incineration.

The Biofuels Directive could affect bio-energy, for two reasons. First, most energy crops and other materials of biological origin can either be converted to biofuel or used directly to generate useful energy. If implementation of the Biofuels Directive leads to greater demand for biofuels, this could result in a decline in the supply of biomass available for bio-energy. Especially in the fats and oil market (palm oil, tallow, etc.), competition between bio-electricity and biofuels is emerging in the UK and the Netherlands. When second-generation biofuels based on wood and cellulose are market-ready in 5 to 10 years' time, much broader competition is to be expected. The present report focuses specifically on bio-electricity and heat, and from this perspective this can be seen as a negative trend. In a broader approach to biomass utilisation and sustainability, though, the more sectors that can and do use biomass the better. The IPPC and LCP Directives set limits on emissions from bio-energy installations and/or specify the technology to be used. For the latter reason, particularly, these directives are important for bio-energy projects.

Figure 2 depicts schematically how the various directives affect bio-energy projects. Three directives affect biomass supply, two affect technology and two affect demand.

Competition with other biomass-using sectors like the cattle feed industry, oleo chemistry (palm oil, fats), the building sector (chipboard) and the paper industry (wood) is also important. In some countries like the Netherlands and Austria there is ongoing national debate on this competition, initiated by the bio-energy sector or NGOs. Because there are currently no European regulations on this issue, in the present report it has been given no further consideration.

In the following sections of this chapter, the implementation of each of the directives in the 25 Member States is evaluated. Furthermore, the implications of each directive and its implementation for the availability of biomass in the EU and the Netherlands are discussed.

2.3 Renewable Energy Sources Directive (2001/77/EC)

The Renewable Energy Sources (RES) Directive aims to increase the share of renewable energy sources in power production for the internal electricity market. It does so by:

- Setting indicative targets for the amount of electricity to be produced from renewable sources in each Member State, known as 'obligation quota'.
- Establishing a reporting mechanism.
- Reviewing experiences with support schemes, and
- Establishing a system for guarantee of origin.

Table 1 shows the indicative targets for electricity from renewable sources for the 25 Member States. The targets vary from 3.6% for Hungary to 78% for Austria. The range of values reflects the variety in natural endowments, for example the scope for hydropower or large wind farms. For the EU as a whole, a target of 21.0% has been set for 2010.

Figure 2 *How EU directives affect bio-energy projects*

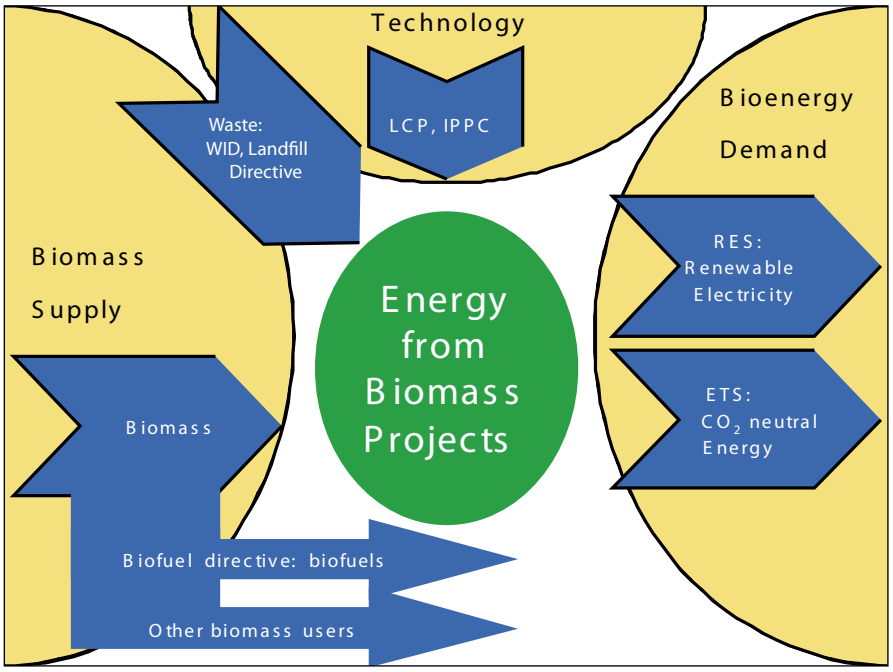


Table 1 *Indicative targets (obligation quota) for electricity from renewable sources under the RES Directive*

	RES-E % in 1997	RES-E % in 2002	RES-E % 2010
Austria	70.0	**68)	78.0
Belgium	1.1	1.4	6.0
Cyprus	0.05	0	6.0
Czech Republic	3.8	3.9	8.0
Denmark	8.7	20	29.0
Estonia	0.2	0.2*	5.1
Finland	24.7	24.7	31.5
France	15.0	14.4	21.0
Germany	4.5	8.1	12.5
Greece	8.6	**5.8)	20.1
Hungary	0.7	0.6	3.6
Ireland	3.6	5.1	13.2
Italy	16.0	16.8	25.0
Latvia	42.4	48	49.3
Lithuania	3.3	4.6	7.0
Luxembourg	2.1	2.2	5.7
Malta	0.0	0	5.0
Netherlands	3.5	3.4	9.0
Poland	1.6	2.0	7.5
Portugal	38.5	**21.8)	39.0
Slovakia	17.9	20.2	31.0
Slovenia	29.9	30.4	33.6
Spain	19.9	**12.6)	29.4
Sweden	49.1	46	60.0
UK	1.7	2.8	10.0
EU 15	13.9	13.4	22.0
EU 25	12.9	*14.2	21.0

*Notes: * Figure for 2001. **) Affected by drought: much less hydropower.*

Source: SEC (2004) 547, 26.5.2004

2.3.1 Impact on bio-energy projects

As the EU is already exploiting almost all its hydropower potential, future growth of power production from renewable sources will have to rely on wind, bio-energy and solar power. This means that national policies deriving from the RES Directive are likely to increase demand for bio-energy.

2.3.2 Transposition status

By mid-2004 all Member States but Malta had introduced policies to promote the share of renewable sources in power production. At that time Malta was still in the process of formulating a national strategy[2].

National transposition will not necessarily result in the indicative targets being achieved. According to the European Commission, of the EU-15 only Denmark, Finland, Germany and Spain are likely to secure their targets. Greece and Portugal have not introduced appropriate policies[3]. Other Member States may ultimately achieve their targets, but this is by no means certain. The Member States that acceded in 2004 still have limited experience implementing this directive, so it is too early to assess whether they are on the right track.

[2] *The share of renewable energy in the EU: Country Profiles: Overview of Renewable Energy Sources in the Enlarged European Union, Commission staff working document, SEC (2004)547, Brussels, 26.5.2004.*

[3] *European Commission, Directorate-General for Energy and Transport, s.t.: Renewable energy to take off in Europe? 2004 - overview and scenario for the future, Brussels.*

2.3.3 Implementation status

In some Member States, implementation of the RES Directive is proving problematic. As already mentioned, the Commission has serious doubts about its implementation in Greece and Portugal. Poland, additionally, is hardly enforcing its obligation quota[4]. This results in underachievement.

Member States also differ with respect to the prominence given to bio-energy in the national strategy as well as the definition of 'biomass' employed. The RES directive defines biomass as:
'the biodegradable fraction of products, waste and residues from agriculture (including vegetal and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste'.

Several Member States employ definitions of their own. The most important deviation from the EU definition is to exclude mixed municipal solid waste. Austria, the Czech Republic, Denmark, Germany and Slovenia all do so, either formally or in practice. Furthermore, Latvia considers peat to be biomass.

As for national strategies on renewable energy sources, Table 2 lists the main features of the bio-energy component of these. Seven Member States have specified a target for biomass-based power production in 2010, with the others only formulating an aggregate target for all renewables. Most Member States have special feed-in tariffs for bio-electricity, which in some countries are augmented by support for investments in bio-energy installations in the form of grants or loans on favourable terms, for example.

Table 2 *Bio-energy in national RES strategies*

Member State	Target for bio-energy	Feed-in tariff for bio-energy	Other support measures for bio-energy
Austria	No	Unknown	Unknown
Belgium	Flanders: No Wallonia: Yes	No	Investment support
Cyprus	No	Yes	No
Czech Republic	Yes	Yes	No
Denmark	No	Yes	No
Estonia	No	Yes	No
Finland	Yes	No	Investment support
France	Yes	No	Tax credits, subsidies
Germany	Yes	Yes	Investment support
Greece	Unknown	No	Investment support
Hungary	No	No	No
Ireland	No	Yes	No
Italy	No	No	No
Latvia	No	Yes	No
Lithuania	No	Yes	No
Luxembourg	No	Yes	No
Malta	No	No	No
Netherlands	Yes	Yes	Investment support
Poland	No	No	No
Portugal	Yes	Yes	No
Slovakia	No	No	Tax break and investment support
Slovenia	No	Yes	No
Spain	Yes	Yes	Investment support
Sweden	No	No	Investment support and tax break
UK	No	No	Tax break

Source: Country reports.

[4] *The share of renewable energy in the EU: Country Profiles: Overview of Renewable Energy Sources in the Enlarged European Union, Commission staff working document, SEC (2004)547, Brussels, 26.5.2004.*

Feed-in tariffs or quota obligations?

The recent review carried out by the European Commission shows that feed-in tariffs result in higher growth of bio-energy than is the case in countries opting only for quota obligations, although economists say both systems will work equally well in the long term. Canadian wood-chip exporters told us that in countries with feed-in tariffs they can calculate the business case of a bio-energy project in a few hours, while in countries with quota obligations it is very difficult for investors to make such predictions, leading to a 'wait-and-see' attitude. The conclusion may therefore be that feed-in tariffs work faster than quota obligations. Figure 3 shows their respective use in European countries.

Figure 3 *Feed-in tariffs (yellow) and quota obligations (blue) for renewable energy in Europe*

Table 3 reviews national policies on bio-electricity (demand-enhancing policies) in more detail. Fixed feed-in tariffs are the most popular support mechanism, an incentive adopted by at least 15 Member States. At least 6 Member States have introduced tradable quota for renewable energy, while in one Member State a variety of incentives are used.

Level of feed-in tariffs highest in Germany

Fixed feed-in tariffs typically range from 5 to 8 € ct/kWh. Only three Member States have higher tariffs, of up to 21.5 ct/kWh (Germany , Slovenia and for some biomass the Netherlands), while three others (Finland, France[5], and Luxemburg) have lower tariffs.

Although the system in place in Germany is complex, with many categories of biomass-technology combination, support in Germany is higher than in other European countries.

[5] *For some biomass-technology combinations only.*

Table 3 *Policies to promote bio-electricity production*

Member State	Policies
Austria	A federally uniform purchasing and payment obligation for bio-electricity-plants (feed-in tariffs). Details unknown.
Belgium (a)	Flanders: quota and tradable certificates. Wallonia: quota and tradable certificates.
Cyprus	Investment subsidies up to 40% of investments. Feed-in tariff: 6.3 €ct/kWh.
Czech Republic	Fixed feed-in tariff (15 years) or green bonus. Level unknown.
Denmark	Fixed feed-in tariff (10-20 years), depending on type of installation and date of commissioning. Tariffs vary from about 5 to 8.1 €ct/kWh, but depend on electricity prices.
Estonia	Fixed feed-in tariff 1.8 times the tariff paid for power from conventional sources (fixed for 7-12 years). No CO_2 charge for companies using biomass internally.
Finland	Fiscal subsidies equivalent to feed-in tariffs of 0.42 – 0.69 €ct/kWh.
France	Fixed feed-in tariffs (15 years) for installations up to 12 MW. Tariffs vary from 4.5 to 5.7 €ct/kWh, depending on biomass/technology combination.
Germany	Fixed feed-in tariffs of 3.9 – 21.5 €ct/kWh (fixed for 20 years).
Greece	Tax exemptions for investments up to 75%. Investment subsidies up to 40%. Interest subsidy up to 40%. Several other subsidies, and guaranteed feed-in tariff of 90% of existing tariffs for 10 years.
Hungary	Currently in transition from feed-in tariffs to green certificate scheme (quota).
Ireland (b)	Feed-in tariffs. Current level: 7.2 €ct/kWh.
Italy (a)	Quota and tradable certificates.
Latvia	Fixed feed-in tariffs. Level unknown.
Lithuania	Fixed feed-in tariff (fixed for 10 years). Current level: 6.9 €ct/kWh.
Luxembourg	Feed-in tariff of 2.5 €ct/kWh.
Malta	No information available.
Poland	Quota obligation for producers, but hardly enforced.
Portugal	Fixed feed-in tariffs. Level not known.
Slovakia	Tax-break and investment subsidy.
Slovenia	Fixed feed-in tariffs. Current level: 10.04 €ct/kWh.
Spain	Currently no information available.
Sweden (a)	Quota and tradable certificates.
The Netherlands	Investment tax deduction. Fixed feed-in tariffs (fixed for 10 years). Current level: 2.9 – 9.7 €ct/kWh.
United Kingdom (a)	Quota and tradable certificates.

Sources: EU Bionet Country Reports, 2005; (a) ECN, 2005; (b) Environment Daily, 1949, 27.09.2005.

These different feed-in tariffs distort markets and are a major driver of international trade in biomass. Some years ago, when German tariffs for waste wood were higher than Dutch, this resulted in a boom in waste wood exports from the Netherlands to Germany. As will be shown in Chapter 3, however, price differentials are not always the only driver of exports. Today, the Netherlands is still exporting waste wood to Germany, despite lower government support in the form of feed-in tariffs there. In this case the lack of installations with emission permits in the Netherlands is the bottleneck.

Frequently, international trade in biomass is not driven by differences in natural endowments or sectoral characteristics, and thus by comparative advantages, but above all by differences in subsidies. Whenever this is the case, it almost certainly results in inefficient use of subsidies. It is beyond the scope of this project, however, to assess or quantify these inefficiencies.

2.3.4 Assessment of impact on bio-energy projects

In most Member States the RES Directive will lead to increased use of biomass for electrical power production. All Member States are now encouraging the use of renewable energy sources and many provide specific support to bio-energy plant. As a result, many projects have become economically viable.

Across Member States, bio-energy strategies differ significantly in various key respects:

- The definition of biomass: most Member States consider the biodegradable fraction of municipal solid waste to be biomass, but some countries do not.
- Whether or not specific targets have been adopted for different renewables: most Member States have no specific targets for bio-energy, but some do.
- Whether or not bio-energy is encouraged by a specific feed-in tariff: about half the Member States have feed-in tariffs for bio-energy, while the others do not.
- Whether or not there are other support measures targeted at bio-energy installations.

It is clear that many Member States have witnessed new bio-energy projects in the past few years as a result of the RES Directive being implemented. However, current statistics do not permit analysis of the relationship between the RES strategy and the increase in bio-energy projects.

Because each Member State has implemented different support mechanisms for bio-energy, resulting in different tariffs for different types of biomass, the RES Directive has created market distortions. Biomass is thus being exported to countries where prices are high owing to the national support mechanism from countries where the mechanism results in lower prices (for an example, see Section 2.3.3).

Box: Opposition to bio-energy

The use of biomass to generate useful energy is not entirely uncontested. In the Netherlands, NGOs oppose the use of several categories of biomass, for the following reasons:

- Emissions of heavy metals, NOx and dust.
- Animal welfare problems in the intensive farming industry associated with the incineration of manure.
- The use of biomass for energy that can also be used for animal feed or products.
- Biodiversity and problems associated with production of biomass in developing countries (e.g. palm oil from Indonesia).
- A low net CO_2 emission effect because of market shifts in the biomass market, energy usage in the chain and carbon balances in the soil.

2.4 Emission Trading Scheme Directive (2003/87/EC)

The Emission Trading Scheme (ETS) Directive aims to reduce greenhouse gas emissions by limiting the total emissions of large installations, each of which receives a limited number of emission allowances. Installations may not emit specified greenhouse gases without an allowance, and may emit no more than covered by the number of allowances held. If emissions exceed this level, a penalty must be paid.

The ETS Directive also aims to reduce emissions cost-efficiently, by enabling installations to exchange emission allowances, at a price set by the parties exchanging them. In practice, the maximum price will be governed by the penalty for excess emissions, set at € 40 for the first period and € 100 for each subsequent period. The actual price will of course be lower than this penalty. Last year it fluctuated between € 20 and € 30 per tonne of CO_2.

Each Member State allocates emission allowances within the framework of its *national allocation plan*, which must be approved by the European Commission. Installations receive the allowances for free.

The first period of the ETS lasts from 2005 through 2007. From that year on, allowances will be issued for five-year periods (2008-2012, 2013-2017, et cetera).

2.4.1 Impact on bio-energy projects

Emissions are either measured or calculated, on the basis of fuel consumption, for example. Annex IV to the Directive states that 'the emission factor for biomass shall be zero'. In other words, installations need not surrender allowances for carbon dioxide emissions generated by incinerating biomass. This creates an incentive to replace fossil fuels by biomass, either by co-incinerating biomass or by replacing existing capacity in fossil fuel-fired installations by biomass-fired plant.

2.4.2 Transposition status

All Member States have transposed the directive into their national legislation.

2.4.3 Implementation status

Allowances traded under the EU ETS are not printed, but held in accounts in electronic registries set up by Member States. All such registries are to be overseen by a Central Administrator at EU level who, through the Community-independent transaction log, will check each transaction for any irregularities. In this way the registries system keeps track of allowance ownership in the same way a banking system keeps track of money ownership.

This means that implementation of the directive consists of several steps, including:

- Submission of a national allocation plan to the European Commission for approval.
- Establishment of a registry of exchange of allowances and linkage to the Community transaction log.
- Registry linkage to the International Transaction Log of the UNFCCC.

By July 2005, the Commission had approved the *national allocation plans* of all Member States for the period 2005-2007[6]. This means that all installations covered by the Directive have been allocated emission allowances.

As of October 2005, 11 Member States had operational *registries* (see Table 4). This means that installations in these countries can now exchange emission allowances. Installations in the remaining 14 Member States will have to wait until their national registry becomes operational.

[6] *'Emissions trading: Commission approves last allocation plan ending NAP marathon', EC Press Release IP/05/762, 20.6.2005.*

Table 4 *Status of registries for exchanging emission allowances, October 2005*

Member State	Registry operational	Internet address
Austria	Yes	http://www.emissionshandelsregister.at
Belgium	Yes	http://www.climateregistry.be
Cyprus	No	
Czech Republic	No	
Denmark	Yes	http://www.kvoteregister.dk
Estonia	No	
Finland	Yes	http://www.paastokaupparekisteri.fi
France	Yes	https://www.seringas.caissedesdepots.fr
Germany	yes	https://www.register.dehst.de/
Greece	No	
Hungary	No	
Ireland	Yes	http://www.etr.ie/
Italy	No	
Latvia	No	
Lithuania	No	
Luxembourg	No	
Malta	no	
Netherlands	Yes	http://www.nederlandse-emissieautoriteit.nl
Poland	No	
Portugal	No	
Slovakia	No	
Slovenia	No	
Spain	Yes	http://www.renade.es
Sweden	Yes	http://www.utslappshandel.se/
United Kingdom	Yes	http://emissionsregistry.gov.uk

Source: http://europa.eu.int/comm/environment/ets/, accessed 3 October 2005.

The *International Transaction Log* is to be maintained by the UNFCCC. According to UNFCCC policy documents, it will not become operational before the third quarter of 2006.

2.4.4 Assessment of impact on bio-energy availability

The ETS Directive may have an impact on demand for biomass, but this depends on the price of emission allowances. At the time of writing, the price was around € 27. At that price, coal-fired plants must surrender allowances worth € 2.5 for every GJ of thermal input or 2,5 ct/KWhe (coal = 94 kg/GJ CO_2, with an efficiency of 40% this results in an emissions of coal fired power stations of 840 gr CO_2 /kWhe). Considering that in the Netherlands some waste wood (grade A) costs € 18 per tonne[7], equivalent to about € 1.20 per GJ, it becomes profitable to co-incinerate wood even in the absence of

[7] *Price list SenterNovem, 2005.*

feed-in tariffs. In the Netherlands problems with permits, the cost of shipping and treatment, and the other investments involved in co-firing mean that energy companies are not currently in a position to respond quickly to this relatively high ETS price (although this may well fall considerably in the future, of course).

In Finland, with a much more mature bio-energy sector and large volumes of cheap biomass available, the ETS is spurring expansion of bio-energy, according to the Finnish government (Ms. Sirkka Vilkamo, Finnish Ministry of Trade and Industry). In particular, bio-energy projects using wood previously left in the forest have now become profitable.

Mr. Bernard Dreher of the German environment ministry, BMU, reports that a number of coal-fired power plants have started co-firing biomass with the support of the ETS. It is unclear whether this is the main reason, though, because in Germany co-firing of biomass in power plants is also afforded priority status in central power capacity planning. This leads to more hours of production and thus a better business case. The conclusion is that the ETS combined with the priority system is encouraging co-firing of biomass in Germany.

2.5 Landfill Directive (99/31/EC)

The objective of the Landfill Directive is to prevent, or reduce as far as possible, the negative environmental impacts of landfilling waste. It sets technical requirements for waste and landfills and permit requirements for landfill operation. The directive also requires the amount of biodegradable waste going to landfill to be reduced by 25% in 2006 (taking 1995 as a reference year), by 50% in 2009 and by 65% in 2016. Member States that landfilled more than 80% of their municipal waste in 1995 may postpone each of these targets by a maximum of four years. The directive requires Member States to set up a national strategy for reducing the amount of biodegradable waste sent to landfill. The directive had to be transposed and implemented by Member States on 16 July, 2001, with national strategies completed by 16 July, 2003.

2.5.1 How the directive affects bio-energy projects

The Landfill Directive affects the disposal of municipal waste. As many Member States consider municipal waste to consist of 50% biomass, a directive affecting the disposal of such waste may well affect supply and demand for biomass.

By requiring Member States to establish a national strategy for reducing the amount of biodegradable waste going to landfill, furthermore, the directive stimulates other methods of disposing of biodegradable waste. One such method is incineration in heat or power plants, though the directive allows other methods such as composting or mechanical-biological treatment.

2.5.2 Transposition status

After a slow start, by the end of 2004 the majority of Member States had transposed most of the Landfill Directive into their national legislation. The main exception was France, which has been condemned by the European Court of Justice for failing to do so[8]. Furthermore, some countries/regions (the Netherlands, Flanders) have not transposed Annex II concerning the Waste Acceptance Criteria and Procedures[9].

In transposing the directive, several Member States (Austria, Germany) have introduced bans on the landfilling of untreated waste. France has endeavoured to do the same, but had to revoke the ban owing to the limited capacity of waste treatment plants.

2.5.3 Implementation status

Implementation of the Landfill Directive is not without its problems. In a recent report, the European Commission stated that only 12 of the 15 Member States had submitted national strategies for reducing landfilling of biodegradable waste[10]. The 10 new Member States were not required to submit such a strategy.

In these strategies, a number of countries or regions claim to have already achieved the 2016 targets in 2004. These include the Netherlands, the Flemish region, Austria and Denmark. Other countries, notably Greece

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[8] *Sixth Annual Survey on the implementation and enforcement of Community environmental law 2004, Commission Staff Working Paper, 17.8.2005, SEC(2005) 1055.*

[9] *Wim van Gelder, 2005: 2nd working document of the Commission for Sustainable Development on the implementation of the Directive on the landfill of waste (1999/31/EC) at regional and local level, EU Committee of the Regions, 07.07.2005.*

[10] *Report from the Commission to the Council and the European Parliament on the National Strategies for the reduction of biodegradable waste going to landfills pursuant to Article 5(1) of Directive 1999/31/EC on the Landfill of Waste, COM(2005)105 final, 30.03.2005.*

and the UK, will apply for the four-year postponement. For the generation of useful energy from biomass it is relevant that a number of Member States have announced construction or enlargement of waste incinerators, including France, Italy and Portugal. Other Member States, such as Austria, the Walloon region and Germany, are encouraging incineration of waste. Most Member States are increasing landfill taxes or banning the landfilling of untreated waste altogether.

To meet the targets of the directive, many countries are employing a mix of economic incentives, like charges and taxes, and bans. As Table 5 shows, in most countries incineration charges are much lower than landfill charges. Indeed, in many countries only landfilling is taxed. This is understandable, for in the majority of countries it costs less to landfill waste than to incinerate it and under the Landfill Directive most countries are supporting a shift from landfilling to incineration with energy production. However, there is still a very wide spread in landfill taxes, from zero in Portugal to 84 €/t landfilled waste in the Netherlands. Countries with a high landfill tax (>50 €/t) or a landfill ban have a substantially higher rate of energy production from biogenic waste.

Table 5 *Landfill and incineration taxes and landfill bans in selected countries, 2004*

COUNTRY	Landfill tax/fees implemented (€/t)	Landfill tax planned (€/t)	Landfill ban implemented	Landfill ban planned	Incineration tax (€/t)
Austria	44	65 from 1.1.2004 up to 87 from 1.1.2006	From 1.1.2004 for wastes with TOC> 5%, calorific value > 6,000 kJ/kg dry substance		7 from 1.1.2006 for incin., prod. of RDF and transport of waste for these activities
Belgium, Flanders	58.6				10
Belgium, Wallonie	35		Since 3/2004	Extensions: 1.7.2004, 1.1.2006, then each year until 2010	
Czech Republic	7	Increasing to 17 in 2009			
Denmark	50.49		1.1.1997		44.43
Finland	23			To be introduced in 2005	
France	7.32 – 9.15		Introduced in 2002		
Germany				From 1.1.2005 for non pre-treated waste	

COUNTRY	Landfill tax/fees implemented (€/t)	Landfill tax planned (€/t)	Landfill ban implemented	Landfill ban planned	Incineration tax (€/t)
Italy	10 – 25 for municipal solid waste		Yes	Combustible waste	Tax on incin. without energy rec. 20 % of landfill tax
Netherlands	84 for combustible waste		For 32 categories of waste	For more categories of waste	
Portugal	NO		NO		
Spain	NO, but legislation in Madrid: 7 €/t domestic waste	Cataluna 1.1.2004: 10	NO		
Sweden	41		Sorted combustible waste 1.1.2002	Organic waste 1.1.2005	
Switzerland	9.66 - 32.19		Since 2000; effective since 2002		
UK	19.94	21.37 rising to 49.86	NO		

Source: Cewep.

A large number of Member States are under scrutiny from the Commission for having illegal landfills, i.e. landfills operating without a proper permit. France, Spain and Italy have been referred to the European Court of Justice.

For the AC-10 countries, implementing the Landfill Directive will entail considerable costs . Most of these Member States have developed plans to invest in waste incineration plants and waste treatment plants. On top of these investments, technical adjustments to existing landfills are necessary in a number of Member States.

Creation of new landfills and construction of waste incinerators both usually encounter major resistance from local environmental NGOs and/or local residents. This resistance may slow down implementation of the Landfill Directive.

2.5.4 Assessment of impact on bio-energy projects

The use of incineration as a means of managing and disposing of waste varies widely across Europe. Table 6 reviews the percentage of municipal waste landfilled in various Member States and then-Acceding Countries in 2000 and 2004, providing an indication of the fraction incinerated.

In the 4 years between 2000 and 2004, the percentage of waste landfilled fell, on average, from 77% to 72%. The Landfill Directive has clearly had some effect, though this varies widely across countries. In Austria, for example, the landfilled percentage dropped from 75% to 48%. Other countries with a sizeable improvement were Belgium, Denmark, the Netherlands and Sweden. In certain other countries like Cyprus, Estonia, Finland, Malta and Poland, though, the percentage did not fall at all, and in Hungary it even increased by 3%.

Table 6 *Share of municipal waste landfilled (excluding recycled and recovered waste)*

	% of total municipal waste (2000)	% of total municipal waste (2004)
Austria	75%	48%
Belgium	34%	23%
Cyprus	80%	81%
Czech Republic	90%	85%
Denmark	16%	8%
Estonia	100%	100%
Finland	85%	86%
France	57%	54%
Germany	55%	42%
Greece	68%	68%
Hungary	92%	95%
Ireland	94%	95%
Italy	90%	83%
Latvia	100%	96%
Lithuania	89%	85%
Luxembourg	33%	31%
Malta	100%	97%
Netherlands	23%	7%
Poland	100%	99%
Portugal	78%	77%
Slovakia	100%	97%
Slovenia	100%	94%
Spain	90%	90%
Sweden	37%	16%
UK	92%	90%
EU 25	77%	72%

Source: EUROSTAT.

For the EU 25 in total in 2000 129 Mtonnne of municipal waste was landfilled and 38 Mtonne was incinerated. In 2004 this has been changed to 113 Mtonne landfilling and 43 Mtonne incineration.

According to (Golder, 2005) 379 Mt of waste is still landfilled annually in the EU-15. This includes not only municipal waste but also waste from industry and the building sector.

Enormous energy potential

When only municipal waste is taken into account it is possible tot calculate the minimum of this enormous potential. The 113 Mtonne still landfilled could generate 95 TWhe (0,84 MWhe assuming 30% efficiency for new waste incinerators and 10 MJ/kg waste) This is 4% of the total electricity production in the EU (source Eurostat final electricity consumption EU25: 2611 TWh).

CE research12 indicates that in the Netherlands landfilling leads to emissions of between 0.4 and 1 tonne CO_2-eq. per tonne of waste, the latter figure for 1990. Multiplication of these figures results in an estimated 45 to 113 Mt of CO_2-eq. that can be avoided.

Above this energy potential of landfilled municipal waste also there is a potential for improvement of the efficiency of incinerators (Some incinerators do not produce energy at all) and also part of the non-municipal waste could be used for energy production. This could probably double the energy production calculated above but exact figures are not available for this calculation.

The Landfill Directive has effectively limited the amount of municipal waste landfilled throughout the EU. It has also led to an increase in waste incineration, the most

cost-effective alternative to landfilling. As a result, the directive has resulted in an increase in heat or power generation from waste. There is still very substantial scope for improvement, however, in the amount of energy recovered from (bio)waste. Conservative calculations[12] for the EU Member States indicate that:

- Shifting this waste from landfill to energy can at least reduce European CO_2 emissions by 45 to 113 Mt annually.
- This would at least cover 4% of European electricity demand.

As a climate measure, this biomass option is very important, because of the avoidance of methane emissions from landfills (methane is a 23 times stronger greenhouse gas than CO_2). Per kWhe generated, the CO_2 avoidance of this form of bio-energy is over 10 times that of other bio-energy options because only half of the methane produced is captured at landfill sites.

Current data on landfilling and incineration of municipal waste (see Table 6) indicate that across the EU there is still considerable scope for increasing incineration volumes. The amount of useful energy generated from waste is therefore still likely to increase.

2.6 Biofuels Directive (2003/30/EC)

The Biofuels Directive aims at 'promoting the use of biofuels or other renewable fuels to replace diesel or petrol for transport purposes in each Member State, with a view to contributing to objectives such as meeting climate change commitments, environmentally friendly security of supply and promoting renewable energy sources[13]. It does so by requiring Member States to set indicative targets for biofuel use. The Union as a whole has an indicative target of 2% (based on energy content) of total fuel consumption by the end of 2005, and 5.75% by the end of 2010.

2.6.1 How the directive affects bio-energy projects

Biofuels from domestically grown agricultural products use land that would otherwise have been available for other purposes, such as growing biomass. Farmers have a clear incentive to grow products that can be sold with the highest profit margin, and when prices for biofuel crops are high, they will opt to grow these rather than bio-energy crops. Promoting the use of biofuels may therefore lead to a decrease in the arable land available for growing bio-energy crops, thereby limiting domestic supply of biomass.

Moreover, some biofuels can be made from the same energy crops used for bio-energy (e.g. palm oil). By encouraging use of biofuels, the directive increases demand for these raw materials. In other words, the directive intensifies competition for raw materials that are suitable for both bio-energy and biofuels.

2.6.2 Transposition status

Most Member States have transposed the directive into their national legislation. Many of them have set indicative targets for 2005 below the 2% figure, though some have set higher targets. It is therefore unlikely that the EU target of 2% in 2005 will be met. Table 7 reviews transposition status and indicative targets.

[12] *Waste and climate, article in Dutch in Afval, March 2006, by Geert Bergsma and Jan Vroonhof, CE Delft.*

[13] *Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels and other renewable fuels for transport (OJEU L123 of 17 May 2003).*

Table 7 *Transposition status of Biofuels Directive and indicative national biofuel targets in 2005*

	Transposed	2005
Austria	Yes	2.5%
Belgium	Yes	(Flemish region only) 2%
Cyprus	Yes	1%
Czech Republic	Yes	(2006) 3.7%
Denmark	Yes	0%
Estonia	Yes	
Finland	No	0.1%
France	Yes	2%
Germany	Yes	2%
Greece	Yes	0.7%
Hungary	Yes	0.4% - 0.6%
Ireland	Not clear	0.06%
Italy	Not clear	
Latvia	Yes	2%
Lithuania	Yes	2%
Luxembourg	Not clear	
Malta	Yes	0.3%
Netherlands	Yes	(2006) 2%
Poland	Yes	0.5%
Portugal	Yes	1%
Slovakia	Yes	2%
Slovenia	Not clear	0.66%
Spain	Yes	2%
Sweden	No	3%
UK	Yes	0.3%
EU 25		2%

Sources: Country reports; Member State Reports in the framework of Directive 2003/30/EC, at http://europa.eu.int/comm/energy/res/legislation/biofuels_members_states_en.htm*, accessed on 3.10.2005; 'The European Commission notifies Member States on delays in implementing European legislation on biofuels', EC Press Release IP/05/318, 16.3.2005.*

2.6.3 Implementation status

Most Member States are currently using a mix of policy measures to promote the use of biofuels. The most popular measure is a tax exemption or reduction, already adopted by 16 Member States, with several others currently studying its impact. Many countries support R&D in this area and some have introduced an obligation for the sale of biofuels. Table 8 reviews the support measures in place.

Table 8 *Support measures for biofuels in place in 2005*

	Tax exemption or reduction	Obligation	R&D support	Other policy measures
Austria	Yes	Yes		
Belgium	Possible		Yes	Funds for public relations
Cyprus			Yes	Lower taxes for flexible-fuel cars
Czech Republic		Yes		
Denmark				
Estonia	Yes			

Finland	Yes		Yes	
France	Yes			
Germany	Yes		Yes	Funds for public relations
Greece	Possible			
Hungary				
Ireland	Yes		Yes	Support for energy crops in agriculture
Italy	Yes			
Latvia	Yes		Yes	Investment subsidy for plants
Lithuania	Yes	Yes		
Luxembourg				
Malta	Yes			
Netherlands	Yes	Yes		
Poland	Yes		Yes	
Portugal	Yes	Possible		Funds for public relations
Slovakia				
Slovenia				
Spain	Yes			
Sweden	Yes		Yes	Investment subsidy for plant; differentiated congestion charges
UK	Yes		Yes	Investment subsidy for plant

Sources: Country reports; Member States Reports in the frame of Directive 2003/30/EC on http://europa.eu.int/comm/energy/res/legislation/biofuels_members_states_en.htm*, accessed on 3.10.2005; 'The European Commission notifies Member States on delays in implementing European legislation on biofuels', EC Press Release IP/05/318, 16.3.2005.*

2.6.4 Assessment of impact on biomass availability

The Biofuels Directive has had a direct impact on biomass supply and demand. In particular, liquid biomass like palm oil as well as other vegetable and animal fats and oils can be used for either bio-energy or biofuels. The directive may also have significant indirect impacts, due to competition for agricultural raw materials as well as for arable land. When the second generation of biofuels becomes economically viable, competition for raw materials may increase. These biofuels (Fischer-Tropsch fuel from biomass, bio-ethanol from wood, Hydrothermal Upgrading (HTU) diesel from wet biomass) are made from biomass currently used to produce heat or power (CE, 2005). Strong incentives to use these materials may limit the amount of biomass available for the generation of useful energy.

The impacts of this Directive are not only potentially large; they are also potentially distortive. The market for biofuels is shaped mainly by public policy measures. As these differ across countries, the market for biofuels is distorted, which will have consequences for the raw materials from which biofuels are made.

2.7 IPPC Directive (96/61/EC)

The IPPC Directive aims to minimise pollution of air, water and soil from point sources (including bio-energy installations) throughout the European Union, by requiring Member States to apply the principle of integrated permitting. In order to achieve this, the directive sets out:

- The general principles governing the basic obligations of operators.
- Requirements for application for, and issuing, reconsideration and updating of permits.
- Minimum requirements to be included in any such permit.
- Measures to ensure compliance with permit conditions.
- Requirements relating to access to information and public participation in the permit procedure.

All installations covered by Annex I of the directive (typically large industrial installations) are required to obtain an authorisation (permit) from the authorities in the EU country in question. Without a permit they are not allowed to operate. The permits must be based on

the concept of Best Available Techniques (BAT), defined in Article 2 of the directive[14].

Annex IV of the directive contains considerations to be taken into account when determining BAT[15]. Furthermore, the European IPPC Bureau is drafting so-called BREFs (BAT reference documents) in collaboration with Member States and industrial and environmental NGOs. All BREFs are to be completed by the end of 2005, but several have already been finalised or formally adopted.

The IPPC Directive and transposing national legislation apply to large installations in specific sectors, including several types of bio-energy installations. These include (FFact, 2005):

- Combustion installations with a rated thermal input exceeding 50 MW.
- Installations for the incineration of hazardous waste with a capacity exceeding 10 tonnes per day.
- Installations for the incineration of municipal waste with a capacity exceeding 3 tonnes per hour.
- Installations for the fermentation of waste with a capacity exceeding 50 tonnes per day.
- Landfills receiving more than 10 tonnes per day or with a total capacity exceeding 25,000 tonnes, excluding landfills of inert waste.
- Installations for the production of cement clinker in rotary kilns with a production capacity exceeding 500 tonnes per day or lime in rotary kilns with a production capacity exceeding 50 tonnes per day or in other furnaces with a production capacity exceeding 50 tonnes per day[16].

The directive entered into force in 1999 for new installations. By 2007, all existing installations will need to have an integrated permit based on BAT.

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[14] *'Best available techniques' shall mean the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole:*

- *'Techniques' shall include both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.*
- *'Available' techniques shall mean those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator.*
- *'Best' shall mean most effective in achieving a high general level of protection of the environment as a whole.'*

[15] *'Considerations to be taken into account generally or in specific cases when determining best available techniques, as defined in Article 2 (11), bearing in mind the likely costs and benefits of a measure and the principles of precaution and prevention:*

1 *The use of low-waste technology.*
2 *The use of less hazardous substances.*
3 *The furthering of recovery and recycling of substances generated and used in the process and of waste, where appropriate.*
4 *Comparable processes, facilities or methods of operation which have been tried with success on an industrial scale.*
5 *Technological advances and changes in scientific knowledge and understanding.*
6 *The nature, effects and volume of the emissions concerned.*
7 *The commissioning dates for new or existing installations.*
8 *The length of time needed to introduce the best available technique.*
9 *The consumption and nature of raw materials (including water) used in the process and their energy efficiency.*
10 *The need to prevent or reduce to a minimum the overall impact of the emissions on the environment and the risks to it.*
11 *The need to prevent accidents and to minimize the consequences for the environment.*
12 *The information published by the Commission pursuant to Article 16 (2) or by international organizations.'*

[16] *This category was not mentioned in (FFact, 2005), but since many cement kilns co-fire biomass, it is relevant to this report.*

2.7.1 Impact on bio-energy projects

As indicated, the IPPC Directive covers certain bio-energy installations as well as waste treatment, incineration and landfill. In all cases, it requires installations using biomass to apply Best Available Techniques, often described in the relevant BREFs.

In the Netherlands and many other EU Member States, most heat and power from biomass (in terms of energy content) is produced in waste incineration plants or large power stations where biomass is co-fired with other fuels (Country Report, The Netherlands, 2005). Most of these waste incineration plants and all large power stations need IPPC permits.

2.7.2 Survey of the relevant BREFs

BREFs facilitate both permit applications and the granting of permits. Table 9 shows the status of relevant BREFs as of September 2005. There will be no BREF for landfills, since the requirements for landfills laid down in the Landfill Directive (99/31/EC) are considered the BAT (FFact, 2005).

By the end of 2005, all BREFs are to be finalised and formally adopted by the European Commission. As far as the BREFs relevant to biomass use are concerned, this deadline looks likely to be met. Each of the BREFs and the way they affect bio-energy projects will be discussed below.

Large Combustion Plants BREF

The Large Combustion Plants BREF describes the BAT for large combustion plants. These techniques depend on fuel type, and the BREF explicitly covers both biomass used in co-firing and biomass used as main fuel. Requirements for thermal and electrical efficiency and emissions also vary for different fuel types and different plants. The electrical efficiency for biomass may be lower than for coal-fired plants, but SO_2 emissions must also be lower. The BREF sets out levels for the thermal efficiency of biomass-fired combustion plants, as well as emissions of dust and NOx from these plants.

As all the emission limits laid down in the BREF for existing installations can be achieved using end-of-pipe technologies, the BREF is unlikely to result in uneconomical alterations to existing plants (unless the plant currently performs very poorly). For new plants, all technologies recognised as BAT are economically viable. It is not therefore to be expected that biomass projects will be impeded by the LCP BREF. This conclusion is rather general, though, and certain individual biomass plants may possibly have to be modified or even closed down because they are not using BAT in 2007.

Table 9 *Status of BREFs relevant to biomass use, November 2005*

Installation	BREF	Status
Combustion	Large Combustion Plants	Finalised (May 2005) but not yet formally adopted
Incineration of hazardous waste	Waste Incineration	Finalised (July 2005) but not yet formally adopted
Incineration of municipal waste		
Treatment of waste, other than incineration	Waste Treatment	Finalised (August 2005) but not yet formally adopted
Production of cement clinker or lime	Cement and Lime Production	Formally adopted (December 2001)

*Source: European IPPC Bureau (*http://eippcb.jrc.es*).*

Waste Incineration BREF

The Waste Incineration BREF deals with dedicated incineration of waste, not with co-firing in cement kilns or large combustion plants. It does not lay down specific emission limit values, but prescribes specific techniques. It does set minimum values for the efficiency of power generation from municipal waste incineration.

The waste incineration BREF favours, but does not require, combined heat and power generation (CHP) whenever possible. In that sense, it stimulates the useful application of biomass.

Waste Treatment BREF

The Waste Treatment BREF deals with all forms of waste management except incineration of municipal waste. It covers the use of waste as a fuel or other means of generating energy. By doing so, it encourages the useful application of biomass[17].

Other BREFs

Other BREFs, such as that on Cement and Lime Production, make scarcely any reference to biomass[17]. They are therefore not expected to affect biomass projects.

2.7.3 Transposition status

All Member States but two claim to have transposed the IPPC Directive into their national legislation, as can be concluded from Table 10. However, the European Commission takes the view that 11 of the 15 old Member States did so incorrectly. Three of these have amended their legislation, but eight face infringement cases, viz.: Belgium, Denmark, France, Germany, Greece, the Netherlands, Luxembourg and Spain.

Table 10 *Transposition of IPPC Directive into national legislation*

Member State	Transposed	Remarks
Austria	Yes, but incompletely according to European Court of Justice(1)	Federal: transposed into several laws, including Waste Management Act, Trade Regulation Act and Clean Air Act for Boiler Plants Länder: some have created their own IPPC Acts (Vorarlberg, Kärnten, Oberösterreich, Wien), while others have transposed the directive in existing regulations (Burgenland, Niederösterreich, Steiermark, Tirol)
Belgium (a)	Yes, but incorrectly according to Commission	Brussels: existing regional permitting legislation amended (in 1999 and 2001) to more closely reflect directive requirements Flemish region: minor adjustments to existing legislation Walloon region: transposed into regional legislation in October 2002
Cyprus	Yes	New laws enacted in 2002
Czech Republic	Yes	Transposed by Act 76/2002 S.B. (in effect from 1 January, 2003)
Denmark (a)	Yes, but incorrectly according to Commission	Existing legislation adapted to incorporate several procedural provisions from the Directive previously lacking in national system
Estonia	Yes	Transposition achieved by IPPC Act of 2001 and imple menting regulations of June 2002
Finland	Yes	Implemented in Environmental Protection Act (86/2000)
France(a)	Yes, but incorrectly according to Commission	Minor amendments to existing legislation

[17] *When they do, they sometimes use unconventional definitions. The Cement and Lime Production BREF, for example, considers wood, sawdust and biomass as three separate categories.*

Member State	Transposed	Remarks
Germany	Yes, but incorrectly according to Commission	Implemented in Gesetz zur Umsetzung der UVP-Änderungsrichtlinie, der IVU-Richtlinie und weiterer EG-Richtlinien zum Umweltschutz of 27 July, 2001
Greece (a)	Yes, but incorrectly according to Commission	Integrated into existing legislation in 2003, amending and complementing Framework Law for the Environment
Hungary	Yes	Introduction of IPPC Decree in 2001
Ireland (a)	Yes	Had already introduced an integrated permitting system shortly prior to the IPPC Directive covering many of the latter's requirements; new legislation subsequently introduced in 2003 to bring national legislation in line with the rest of the Directive's requirements
Italy	Yes	Transposed in new legislation
Latvia	Yes	Implemented in Pollution Act (2001) with ministerial regulations July 2002; during accession negotiations, Latvia has been granted an exemption for existing installations until 2010
Lithuania	Yes	Implemented in IPPC Act of February 2002
Luxembourg (b)	Incorrectly according to Commission	In 2003 Luxembourg was the only country in the EU-15 that had not transposed the IPPC Directive into national law
Malta	Yes	Transposition achieved by IPPC Regulation of June 2002
Poland	Yes	Transposition in Environmental Protection Act of 27 April, 2001 and two Environment Ministry decrees concerning later deadlines for granting integrated permits (September 2003); Poland was granted an exemption for existing installations until 2010
Portugal	Yes	Transposition achieved by National law 194/2000 of 5 August, 2003
Slovakia	Yes	Transposition achieved by national law in 2003; Slovakia has been granted an exemption for existing installations until 2011
Slovenia	Not clear	Not yet transposed as of 2003
Spain	Yes, but incorrectly according to Commission	Transposition achieved by IPPC Act 16/2002 of 1 July, 2002
Sweden (a)	Yes	Already had a long-standing integrated permitting system; introduced minor changes to national environmental legislation (itself revised to make it more integrated in 1999) to comply with IPPC Directive
The Netherlands	Yes, but incorrectly according to Commission	Long-standing permitting system based on ALARA (As Low As Reasonably Achievable), according to the Dutch government a suitable interpretation of 'BAT' in the IPPC Directive. The Commission did not consider BAT and ALARA identical, however, a view shared by the Dutch Supreme Court. In response, an amendment to the Dutch Environmental Protection Act is being prepared to implement the IPPC Directive more explicitly
United Kingdom	Yes	Already had an integrated permitting system in place prior to IPPC Directive; has since integrated any new requirements stemming from the directive into regional legislation

Sources: EUBIONET II country reports, 2005; (a) LDK ECO environmental consultants 2004; (b) IEEP, et al. 2003.
Notes: (1) C-78/04 Commission / Austria (Judgment of 18.11.2004, OJ C 6 of 08.01.2005 p.18).

Many of the Member States currently facing infringement cases had an integrated permit regime prior to the IPPC Directive, and the incomplete transposition of the terms thereof may well stem from the relatively small changes made to their respective existing regulation.

Some countries have adopted requirements that were stricter. Thus, Finland and Germany require more installations to have an IPPC permit than those covered by the directive.

2.7.4 Implementation status

Most stakeholders agree that implementation of the IPPC Directive is slow in many European countries. The European Commission has stated that some Member States 'appear to be late in establishing a fully operational permitting system' (EC, 2005). Moreover, many existing installations currently have no IPPC permits. This may constitute a problem when the 2007 deadline comes up, by which time all installations must have an IPPC permit.

At a recent conference on IPPC, a number of implementation problems were mentioned by various speakers:

- Some Member States will face a manpower shortage when the bulk of existing installations start to apply for new permits by the end of 2006 or even later (Horvath, 2005).
- Permit writers in many Member States face the difficulty of mastering new legislation and a new way of issuing permits at a time when they have a heavy workload (Horvath, 2005), (Volná, 2005).
- Industry is not always well prepared for the new permits (Demoulin, 2005).
- The required cooperation between permit applicants, permit writers, experts and NGOs requires a new 'IPPC culture', more demanding than the previous regime (Demoulin, 2005).

None of these issues have specific implications for bio-energy installations. From the country reports and the interviews we held with various experts, we do not get the impression that such installations have any difficulty obtaining IPPC permits in most EU countries.

The only Member State where the IPPC Directive is said to have hampered the permitting of bio-energy installations seems to be the Netherlands (FFact, 2005). The Council of State (Raad van State), the Netherlands' highest administrative court, has ruled in several instances against permits for co-incineration of biomass in power plants. One of the motivations for these verdicts was negligence in applying Best Available Techniques. For this reason, some observers blamed IPPC for preventing or hampering the use of biomass in the Netherlands.
On closer inspection, however, the verdicts prove to have had other grounds apart from failure to establish BAT[18]. In many cases, the process of issuing permits seems to be flawed. For example, standard technologies such as exhaust gas scrubbers were often not required. Some permits granted higher emission limit values than the plants had applied for. Environmental NGOs involved in legal proceedings against these permits have stated that they were not against IPPC permits, but cited failure to comply with IPPC as one of the many objections to permits they considered environmentally harmful (Vollenbroek, 2005).

From this we conclude that IPPC is not the real problem in the Netherlands either and that the IPPC Directive is not currently hampering use of biomass, whether for dedicated power or heat generation or co-firing in other plants. The example does show, however, that the Netherlands could improve its permitting practice.

2.7.5 Assessment of impact on bio-energy projects

As yet, the IPPC Directive has scarcely affected bio-energy development across Europe, with the exception of the Netherlands. It has taken years for the Dutch authorities to accept that the IPPC regulations cannot be adequately covered by general emissions legislation. Instead, each permit must be checked against Best Available Technique requirements. This gives a clear message to the Dutch government and power industry:

- The Netherlands should solve its problems in permitting power plants and power plants should operate according to BAT.

[18] *For example, in case 200203258/1 the Council of State ruled against a permit for co-incineration of biomass by E.ON, one of the grounds being that the permit had not been tested against the IPPC Directive. However, the permit was rejected on other grounds as well. For example, no exhaust gas scrubber for NOx was prescribed, emission limit values for various heavy metals were not adequately determined, and some requirements were phrased in violation of Dutch environmental law.*

By October 2007 existing installations must also have an IPPC permit and operate according to BAT. This is also important for many bio-energy installations across Europe. This prompts a general recommendation:

- Industry should work towards applying Best Available Techniques by 2007 and extend permit applications for existing plants, and Member States should prepare for an increase in workload when the 2007 deadline approaches.

If the first condition is not met, many existing plants will not operate according to BAT and will not have a valid IPPC permit as of 2007. Ultimately, this may result in plants being shut down.

2.8 Large Combustion Plant Directive (2001/80/EC)

The Large Combustion Plant (LCP) Directive applies to combustion plants with a rated thermal input of 50 MW or more, including plants using biomass as a fuel. The LCP Directive requires Member States to reduce emissions of sulphur dioxide (SO_2), nitrogen oxides (NOx) and particulate matter (PM) from combustion plants within several industries.

For existing plants (licensed before 1 July, 1987), Member States may choose either to apply emission limits that are at least as strict as those stated in the Directive (Table 11) or implement a national emission reduction plan. This plan should result in the same emissions reduction as application of emission limits, but now on a national level, and not necessarily per plant. The compliance date for existing plants is 1 January, 2008.

New plants (licensed from 1 July, 1987) must comply with LCP emission limit values when they become operational. The limit values for new plants are stricter than for existing plants, and all plants with a thermal capacity exceeding 300 MW receive equal treatment (see Table 12). Furthermore, for new plants a specific fuel category has been introduced for biomass.

Table 11 *Emission limits for existing plants (licensed before 1 July, 1987) under the LCP Directive (mg/Nm3)*[13]

Thermal input	NOx	SO_2	Dust
Solid fuels			
50-100 MW	600	2000	100
100-300 MW	600	500 – 2,000	100
300-500 MW	600		100
> 500 MW	500	500	50
Liquid fuels			
50-100 MW	450	1,700	50
100-300 MW	450	1,700	50
300-500 MW	450	400 – 1,700	50
> 500 MW	400	400	50
Gaseous fuels			
50-100 MW	300	35	5
100-300 MW	300	35	5
300-500 MW	300	35	5
> 500 MW	200	35	5

Table 12 *Emission limits for new plants (licensed from 1 July, 1987 onwards) under the LCP directive*

Thermal input	NOx	SO_2	Dust
Solid biomass			
50-100 MW	400	200	50
100-300 MW	300	200	30
> 300 MW	200	200	30
Other solid fuels			
50-100 MW	400	850	50
100-300 MW	200	200	30
> 300 MW	200	200	30
Liquid fuels			
50-100 MW	400	850	50
100-300 MW	200	400-200	30
> 300 MW	200	200	30
Natural gas			
50-100 MW	150	35	5
100-300 MW	150	35	5
> 300 MW	100	35	5

[13] *Emission limits are expressed in mg/Nm3, i.e. milligrams per cubic metre at normal temperature (273 K) and pressure (101.3 kPa) after correction for water vapour content.*

It should be stressed that these emission limits are maxima. In most cases the Best Available Techniques requirement of the IPPC directive results in stricter emission limits for power plants.

Several countries have submitted national emission reduction plans, including the Czech Republic, Finland, France, Greece, Ireland, the Netherlands and the UK (Entec, 2005).

2.8.1 Impact on bio-energy projects

The LCP Directive applies to combustion plants with a rated thermal input of 50 MW or more. When biomass is co-incinerated in coal or gas power plants, these often exceed this 50 MW limit and thus fall under the LCP Directive. By setting emission limit values for these plants, the directive may affect demand for biomass by these installations.

Incineration of biomass is excluded from the scope of the Waste Incineration Directive because it falls under the scope of the Large Combustion Plants Directive.

The LCP Directive partly overlaps with the IPPC Directive, which requires large combustion plants to apply Best Available Techniques (see Section 2.7). One of the consequences of this is emission limit values that are generally lower than those laid down in the LCP Directive. The difference between the LCP and IPPC Directives is that under IPPC, plants may have permits with higher emission limit values if they can show that the standard limits cannot be achieved even by applying BAT. Emission limit values higher than those in the LCP Directive, on the other hand, are illegal, unless they are part of a national emission reduction plan.

2.8.2 Transposition status

All Member States have transposed the LCP Directive into national law. As mentioned above, several have opted not to apply emission limits to existing plants individually, but rather to submit a national reduction plan. Some Member States have introduced legislation limiting emissions further than required by the Directive (Table 13).

Several new Member States have been granted temporary exemptions, for specific installations and for a limited period. These include Cyprus, the Czech Republic, Estonia, Hungary (exemptions ended in 2004), Lithuania, Malta (exemptions to end in 2005), Poland and Slovakia (Entec, 2005).

Table 13 *Member States that have introduced stricter emission limits for large combustion plants*

Member State	Stricter limits for existing plants	Stricter limits for new plants
Austria	SO_2, NOx and dust	SO_2, NOx and dust
Czech Republic	SO_2, and NOx	
Finland	NOx and dust	NOx
France	NOx and dust	
Germany	SO_2, NOx and dust	SO_2 and dust
Italy	SO_2, NOx and dust	
Sweden	Probably SO_2, NOx and dust	
The Netherlands(a)		SO_2, NOx and dust

Source: Entec, 2005; (a) EUBIONET Country Report, The Netherlands, 2005.

2.8.3 *Implementation status*

Neither the country reports nor any other sources indicate major shortcomings in implementation of the LCP Directive (Entec, 2005).

2.8.4 *Assessment of impact on bio-energy projects*

Any direct impact of the LCP Directive on bio-energy projects is very unlikely. Compliance with all the emission limit values can be achieved by applying end-of-pipe technologies that are readily available.

Neither the country reports nor any other sources have revealed any direct influence of the LCP Directive on bio-energy projects, because of problems achieving certain emission limit values, for example.

2.9 Waste Incineration Directive (2000/76/EC)

The Waste Incineration Directive (WID) aims to prevent, or reduce as far as possible, negative effects on the environment caused by the incineration and co-incineration of waste. It does so by setting requirements for permitting and operating waste incinerators and by limiting emissions to air and water.

The emission limit values set by the WID are shown in Table 14.

It should be stressed that for most of these installations, too, the Best Available Technique requirements of the IPPC Directive result in stricter emission limits than the general limits of the WID.

The directive covers both waste incineration plants and co-incineration plants whose main purpose is not waste combustion but generation of energy or production of material goods. Co-incineration plants may be cement kilns, steel furnaces or coal-fired power plants. Categories of plant excluded from the scope of the directive include facilities exclusively treating certain types of vegetable waste, wood and cork waste and animal carcasses.

The regulations of the directive apply to all new plants from the end of 2002 and to all waste incineration plants from 28 December, 2005.

The WID does not encourage or discourage waste incineration but merely regulates it.

Table 14 *Emission limit values for waste incinerators*

Dust	10 mg/m3
Gaseous and vaporous organic substances	10 mg/m3
Hydrogen fluoride	1 mg/m3
Hydrogen chloride	10 mg/m3
Sulphur dioxide	50 mg/m3
Nitrogen oxides	200 – 400 mg/m3
Cadmium and thallium and their compounds	0.1 mg/m3 (8-hour average)
Mercury and its compounds	0.1 mg/m3 (8-hour average)
Various heavy metals, arsenic and antimony and their compounds	1 mg/m3 (8-hour average)
Dioxins and furans	0.1 ng/m3
Carbon monoxide	50 mg/m3

Source: Waste Incineration Directive (2000/76/EC).

2.9.1 Impact on bio-energy projects

Although many types of biomass are not covered by the Waste Incineration Directive (excluded are most vegetable wastes, wood and cork wastes and animal carcasses), it does affect the incineration of municipal waste. Many Member States consider municipal waste to consist of 50% biomass.

The Directive requires incineration plants to recover, 'as far as practicable', any heat generated by the incineration process. In this way the directive encourages use of biomass to generate useful energy. This does not seem to constitute a significant deviation from current practice, however. In most Member States, waste incinerators already recover heat and/or electricity: in 2003, 18 of the 25 Member States and Accession Countries had at least one waste-to-energy plant[20].

2.9.2 Transposition status

Most Member States had transposed the Waste Incineration Directive into national legislation by the end of 2004. The only two exceptions are Portugal and Italy, which have been condemned by the European Court of Justice for not doing so[21].

Some countries, such as the Netherlands, have emission limit values that are stricter than those set out in the

directive. This has given rise to permitting problems, in the case of a new installation claiming to comply with European legislation but not meeting national standards. The High Court of the Netherlands judged that in this case national standards should be met.

2.9.3 Implementation status

None of the country reports mentions problems with implementation of the WID. A brief survey of other sources only brings to light one possible problem with implementation[22]. A report by Sweden's national audit office highlights 'serious deficiencies' in routines for disposing of ash from household waste incineration plants[23]. However, it is not clear from the report whether these deficiencies constitute a breach of the directive.

Implementation of the directive may be hampered by the controversial nature of waste incineration in some Member States where citizens and NGOs consider incinerators a pollution source and favour landfilling or waste prevention; see the boxes below.

Dutch NGOs, on the other hand, are campaigning against landfilling and promoting recycling and energy production from waste. In the Netherlands waste incineration is generally seen as clean and not particularly controversial.

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[20] *www.cewep.com.*

[21] *Sixth Annual Survey on the implementation and enforcement of Community environmental law 2004, Commission Staff Working Paper, 17.8.2005, SEC (2005) 1055.*

[22] *These sources include Sixth Annual Survey on the implementation and enforcement of Community environmental law 2004, Commission Staff Working Paper, 17.8.2005, SEC (2005) 1055; and Ends Environment Daily, 2002-2005.*

[23] *Ends Environment Daily ISSUE 1832 - Wednesday 2 March, 2005.*

BOX: NGOs hold global anti-incineration protests

(Environment Daily 1935, 07/09/05)

Some 200 environmental groups marked the fourth global day of action against waste incineration on Wednesday. In Europe, NGOs in Germany, France, Italy, Norway, Czech Republic and other countries are participating. In France, campaign groups are demanding a five-year moratorium on the development of new incinerators. They argue that government spending in the sector prevents investments in alternatives such as recycling. In Norway, a protest will run throughout the week outside the environment ministry. Dozens of groups are holding public information workshops and meetings with government officials.

BOX: Ireland's first waste incinerator approved

(Environment Daily 1397, 04/03/2003)

Ireland's planning appeals board today approved construction of the country's first municipal waste incinerator, sparking outrage from opponents of waste burning. One opposition MP called the project 'this monster in our midst'.

2.9.4 Assessment of impact on bio-energy projects

As stated above (Section 2.9.1), the Waste Incineration Directive could have two opposing impacts on biomass availability. However, neither the country reports nor any other documents or experts consulted have indicated that it has had any effect on the incineration of waste or the generation of energy from waste. It would not therefore seem to have any significant impact on the availability of biomass.

2.10 Conclusion

Recalling the scheme of Figure 1, two directives are currently creating a significant incentive for bio-energy projects across the EU: the Renewable Energy Sources Directive and the Landfill Directive. Under the RES Directive, many Member States have adopted policies to encourage generation of useful energy from biomass. Available statistics show that in countries like Germany and the Netherlands, for example, there is growing use of biomass for this purpose. Both these countries have relatively high incentives for bio-electricity, which may explain this increased use of biomass.

Some Member States have chosen not to stimulate bio-energy as such, but to provide uniform incentives for all electricity from renewable sources, often by introducing tradable renewables obligations. In some of these countries, like the UK and Sweden, bio-energy generation is growing significantly. In a few Member States, such as Poland and Malta, the effect of the RES Directive is limited. Poland has failed to enforce its renewables obligation and Malta has not yet drafted a strategy.

The Landfill Directive is currently effectively reducing the amount of biodegradable waste being landfilled. Waste incineration is one of the most popular options for processing biodegradable waste, together with mechanical-biological treatment and composting. Because of the required capital investments in incinerators, however, the volume of waste incinerated will only grow when landfill taxes are raised or landfilling otherwise restricted. New incinerators are being built in countries like France, Italy and Portugal. Generation of electrical power and often heat has become a standard technology for waste incinerators. Other countries, like Germany and Austria, while also encouraging the incineration of waste, do not support mixed municipal waste as biomass. There is ample scope for increasing the volume of waste incinerated within the EU, especially among southern and eastern Member States. Shifting biogenic waste from landfilling to energy production could reduce the CO_2-eq. emissions of the

EU15 by 300 Mt CO_2 annually. This is more than the Netherlands' total annual emissions. As a climate measure, this biomass option is very important because of the avoidance of methane emissions from landfills (methane is a 23 times stronger greenhouse gas than CO_2). If the non-biogenic fraction is included, the extra energy from this waste could deliver 4 to 5% of European electricity demand.

In the future, two other directives may have an growing impact on the use of bio-energy: the Emission Trading Scheme (ETS) Directive and the Biofuels Directive. They work in opposite directions.

The first directive encourages the use of biomass in installations covered by the ETS. The Finnish government reports that it has encouraged generation of bio-energy from wood that would otherwise have been left in the forest. In Germany the combination of the ETS and the priority status afforded to biomass-co-firing power plants has led to increased co-firing of biomass. In the Netherlands, without such a priority system, the ETS price still seems too low and too uncertain to have had any major impact. However, the ETS is yet to develop into a mature market and it is too early to tell whether current prices are a good indication of future supply and demand. It is hard if not impossible to predict prices the coming year, let alone in the second phase of the ETS, which starts in 2008. By that time new allocations will have been made, which may affect supply and demand. Because of the unstable market, installation owners may be reluctant to invest in provisions for co-incinerating biomass. Once they perceive market conditions as stable, this will change, though. At that stage, and provided prices do not fall below current levels, the ETS may give a considerable boost to bio-energy generation in Europe, especially to co-incineration of biomass.
The Biofuels Directive, on the other hand, is leading to a considerable increase in demand for biomass for conversion to biofuels. This is especially true of energy crops from which biofuels can be synthesised, such as rapeseed, other vegetable oils, sugar beet and starch crops. At the moment these crops are rarely used for generating electricity or heat. The only major exception is palm oil, which in the Netherlands and the UK is used both to generate power and synthesise biodiesel. In the near future, it may become feasible to make biofuels from wood and wet biomass, which are currently used to generate heat and power. By then, competition will have emerged between biofuel policies and bio-energy policies. This may lead to an increase in the price(s) of biomass. From the broader sustainability perspective, an additional sector using biomass is positive, of course, but if only the electricity sector is considered, more competition can be expected.

The Waste Incineration Directive, the Large Combustion Plant Directive and the IPPC Directive are all important for restricting emissions from bio-energy plants. The Netherlands, in particular, has had problems implementing the Best Available Technique restrictions in allowances for cogeneration. Other countries have reported no problems with these directives. October 2007 represents a test case in this respect, because by then all larger energy and waste plants must have an IPPC permit.

3 German legislation affecting supply and demand

In Germany, legislation has been recently introduced or amended with a potential impact on biomass supply and demand. Because of its proximity to the Netherlands, any changes in German market conditions could easily affect the Dutch market. This chapter assesses the consequences of two recent developments on the markets for biomass. The first is the change to the 'EEG', the German law that establishes the feed-in tariffs to be paid for electricity from renewable sources. This issue is considered in Sections 3.1 and 3.2. The second is the German ban on landfilling untreated municipal waste, dealt with in Section 3.3.

3.1 The EEG

3.1.1 General description of the EEG

The main legal instrument for promoting bio-energy in Germany is the Act on Granting Priority to Renewable Energy Sources (abbreviated to EEG, after its German short form[24]). It was first introduced in 2000 and was updated in 2004. The EEG established a feed-in tariff and has four main features[25]:

1 Priority connection to general electricity supply grids for installations generating electricity from renewable sources.
2 Priority purchase and transmission of this electricity.
3 A consistent fee for this electricity to be paid by grid operators, generally for a 20-year period, for commissioned installations.
4 Nationwide equalisation of the electricity purchased and the corresponding fees paid.

The EEG encourages decentralised power generation by limiting the capacity of power stations that can apply for feed-in tariffs. Larger installations are entitled to prioritised grid connection and prioritised purchase of power, but not to the consistent fee.

With respect to bio-energy, the new EEG introduced several new features[26]:

- Bonuses were introduced for so-called 'self-regenerating' raw materials[27] (for example untreated agricultural waste and manure).
- A bonus was introduced for combined heat and power generation (CHP).
- Bonuses were introduced for innovative technologies (such as thermo-chemical gasification, fuel cells and gas turbines).
- The tariffs for very small installations (≤ 150 kW) were raised.

Table 15 shows the tariff structure for power generated from biomass. The basic feed-in tariff varies from € 0.115 per kWh for very small installations to € 0.084 per kWh for installations between 5 and 20 MW. The bonuses can be used cumulatively, resulting in maximum feed-in tariffs of between € 0.215 and € 0.105 per kWh for CHP installations using innovative technologies and self-regenerating raw materials.

If the bonuses are included, the new tariffs are higher than those holding in 2000, sometimes even considerably so. This tariff increase may have spurred greater demand for biomass in Germany, but only if the new EEG has actually led to greater output of bio-electricity. One possible outcome of increased biomass use in Germany would be that country attracting biomass from neighbours like the Netherlands. This will only be the case if prices are higher in Germany than in the Netherlands and the price differential is sufficient to cover transport costs.

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[24] *In German, Gesetz für den Vorrang Erneuerbarer Energien, or Erneuerbare Energien Gesetz (EEG) for short.*

[25] *Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), 2004: 'The main features of the Act on granting priority to renewable energy sources (Renewable Energy Sources Act) of 21 July, 2004'.*

[26] *Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), 2004: 'Amending the Renewable Energy Sources Act (EEG) Key provisions of the new EEG as amended on 21 July 2004'.*

[27] *In German: nachwachsende Rohstoffe, defined as 'plants or parts of plants which have originated from agricultural, silvicultural or horticultural operations or during landscaping activities and which have not been treated or modified in any way other than for harvesting, conservation or use in the biomass plant' and 'manure (...) or vinasse generated at an agricultural distillery (...) if that vinasse is not subject to any other recovery requirements (...)'.*

Table 15 *Feed-in tariffs for bio-electricity in Germany, 2005 (€ct/kWh)*

	≤ 150 kW	≤ 500 kW	≤ 5 MW	≤ 20 MW
Basic tariff	11.5	9.9	8.9	8.4
Exception: waste wood categories AIII and AIV	3.9	3.9	3.9	3.9
Bonus for self-regenerating raw materials	6	6	4	0
Exception: bonus for wood	6	6	2.5	0
Bonus for CHP	2	2	2	2
Bonus for innovative technologies and CHP	2	2	2	0
Maximum tariff	21.5	19.9	16.9	10.4
Feed-in tariff 2000		10.23	9.21	8.7

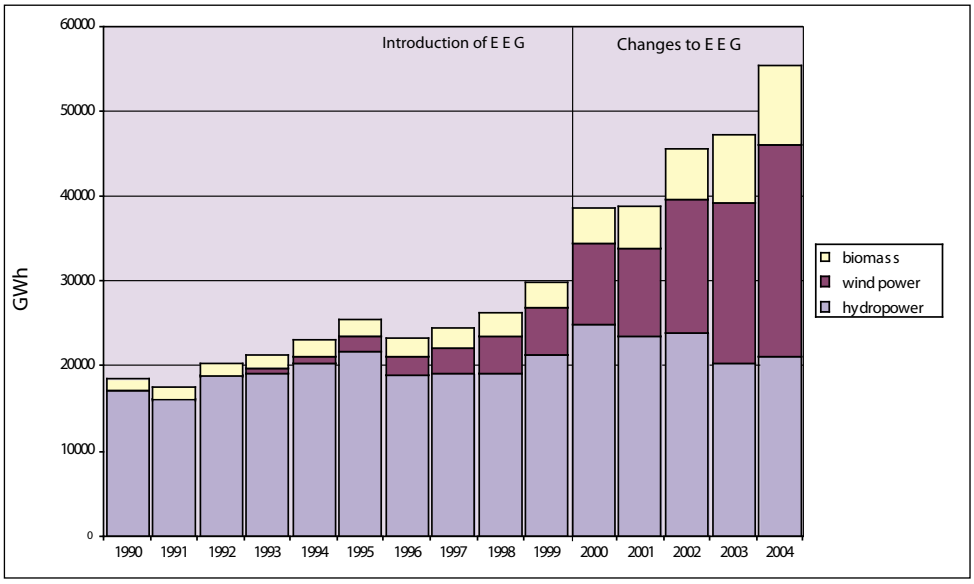
Source: Erneuerbare Energien Gesetz.

To assess whether the new EEG has actually resulted in greater demand for biomass and/or higher exports of biomass from the Netherlands to Germany, the following sections analyse first the development of biomass installations in Germany, and second the price differential between Germany and the Netherlands for different categories of biomass.

3.1.2 Bio-energy generation under the EEG

Since introduction of the EEG, the amount of electricity generated from renewable sources has risen in Germany. The most impressive rise has been recorded for wind power[28]. Between 2000 and 2004, production of electricity from biomass more than doubled: from 4,000 to 9,000 GWh annually (see Figure 4).

Figure 4 *Production of electricity from renewable sources in Germany, 1990 – 2004*



Source: BMU, 2005: Erneuerbare Energien in Zahlen - nationale und internationale Entwicklung - Stand: Juni 2005, Berlin.

[28] *In terms of relative growth, solar power grew much faster than wind energy: by 2400% between 1999 and 2004. In 2004, however, it still accounted for less than 1% of all electricity from renewable sources.*

Table 16 looks at the use of various types of biomass in greater detail. In Germany, biomass is predominantly used for heating. Solid biomass accounts for 83% of the energy produced from this source and 77% of the fossil fuels substituted. Use of liquid biomass is negligible. The biogenic fraction of municipal waste accounts for 8% of the energy produced and 11% of the fossil fuels substituted.

Biomass used for heat generation is not covered by the EEG. However, it receives various forms of investment support, ranging from grants for small installations (up to 100 kW) to loans on favourable conditions for larger installations. The most important is the Ordinance for a market incentive programme to encourage use of renewable energy sources[29].

It would be very interesting to know whether changes in the EEG have brought about changes in the mix of biomass used or the technologies applied – in other words, whether the bonuses have had any effect. As yet, however, there are no statistics available on either the use of individual categories of biomass (such as self-regenerating materials) or application of certain technologies (such as CHP). We therefore contacted a list of experts at the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, its agency DENA, the German trade association of the electricity supply industry VDEW, and the German trade association for bio-energy, the Bundesverband BioEnergie e.V. (BBE) (you can find a full list of contacts in chapter References).

From these interviews, we learned that the changes in the EEG have had four main effects in the field of bio-energy:

1 There is considerable growth in the use of small biogas installations. Many farmers have recently installed such plant or are planning to do so. These installations are used mainly to process manure, but are starting to process growing amounts of energy crops grown specially for this purpose. In the north-west of Germany, particularly, biogas is becoming very popular. One of the reasons for this is the support given to biogas plant by the regional energy company EWE. The trade association BBE expects the installed capacity of biogas installations to double in 2005. This could lead to an increase in the power produced from biogas from 1,350 GWh to 2,700 GWh annually.

Table 16 *Biomass use in Germany, 2004*

		Energy produced (GWh)	Substituted fossil fuels (PJ)	Share of total energy consumption (%)
Power generation	Solid biomass	3,900	32.4	0.22
	Liquid biomass	77	0.6	0.00
	Biogas	1,350	6.8	0.05
	Sewage treatment gas	820	11.2	0.10
	Landfill gas	1,050	8.7	0.10
	Biogenic part of waste	2,170	18.0	0.10
	Subtotal	9,367	77.7	0.57
Heat generation	Solid biomass	53,333	192.0	1.30
	Gaseous biomass	2,556	9.2	0.10
	Liquid biomass	222	0.8	0.01
	Biogenic part of waste	3,695	13.3	0.10
	Subtotal	59,806	215.3	1.51
Grand total		*69,173*	*293.0*	*2.08*

Source: BMU, 2005: Erneuerbare Energien in Zahlen - nationale und internationale Entwicklung - Stand: Juni 2005, Berlin.

[29] *In German: Richtlinie zur Förderung von Maßnahmen zur Nutzung erneuerbarer Energien.*

2 The use of solid biomass to produce electricity is growing at a steady pace. Unlike biogas, it does not seem that solid biomass has been given new impetus by the changes to the EEG. BBE expects the installed capacity of bio-energy plants to rise from 720 MWe to 900 MWe in 2005, an increase of 25%.
3 There has been an increase in the use of innovative technologies like thermo-chemical gasification and dry fermentation. CHP, which under the new EEG still figures as an innovative technology, has become a standard technology for installations whose main purpose is to provide heat.
4 There has been an increase in the use of self-regenerating raw materials. These materials are mainly home-grown energy crops.

On the basis of these effects of the new EEG, we expect there to have been an increase in the amount of heat and power generated from biomass since July 2004, due mainly to increased use of home-grown energy crops, often in biogas installations. Consequently, we do not expect imports of biomass to Germany to have changed significantly. This conclusion is supported by the fact that biomass prices seem to be stable: there is no shortage of biomass in Germany.

3.1.3 Comparison of German and Dutch feed-in tariffs

The Netherlands, like Germany, uses guaranteed feed-in tariffs as the main policy instrument for promoting use of biomass for power generation. The current tariffs are presented in Table 17.

As a comparison of Tables 15 and 17 shows, it is not only tariffs that differ between Germany and the Netherlands, but also the tariff structure. The main differences in structure are that:

- Germany only guarantees feed-in tariffs for installations up to 20 MWe, whereas in the Netherlands, there is no limit on installed capacity.
- Germany's tariff structure is much more complicated.

Furthermore, the Dutch and German definitions of biomass differ. The main difference is that in the Netherlands the biodegradable fraction of mixed waste is considered biomass, whereas in Germany it is not, at least not under the EEG.

Because of the difference in feed-in tariffs, tariff structures and definitions of biomass, either Dutch or German operators of bio-energy installations may be able to pay higher prices for biomass. Whether, and for whom, this is indeed the case depends not only on the feed-in tariffs, but also on capital costs, the cost of other fuels and overheads. None of these costs are public, so we have no information on these issues.

For the sake of clarity of the analysis, we assume that the cost structure of power generation is the same in the Netherlands and Germany. We can then analyse the effect of the different feed-in tariffs on the prices bio-energy plant operators are able to pay. These prices depend on two factors:

1 The category of biomass involved.
2 The alternative routes considered.

Table 17 *Feed-in tariffs for bio-energy power in the Netherlands, 2005 (€ct/kWh)*

	≤ 50 MW	**> 50 MW**
Pure biomass[30]	9.7	7
Exception: meat and bone meal	9.7	2.1
Other biomass	2.9	2.9

Source: EnerQ.

[30] *Pure biomass is defined as biodegradable products and waste containing not more than 3% of unavoidable contamination.*

Table 18 shows the differences in feed-in tariffs per tonne of biomass for several alternative routes.

Table 18 *Effect on biomass prices of differences in feed-in tariffs (€ per tonne of biomass)*

Category	**Price differential (€ per tonne)**
Biomass categories that can be incinerated more profitably in a Dutch installation:	
Waste wood type B (Germany: AIII, Netherlands: B)[31]	16 – 87
Waste wood type C (Germany: AIV, Netherlands: C)	16 – 87
Biodegradable fraction of municipal or similar waste	10
Biomass categories that can be incinerated more profitably in most German installations:	
Waste wood type A (Germany: AI, Netherlands: A)	10 – 51
Oil cake	12 – 58
Straw	9 – 44
Cocoa shells	7 – 32
Chicken manure	4 – 22
Sludge	8 – 11

Note: Price differentials depend on the actual alternatives, most notably on the size of the German installation and the possible use of innovative technologies. For most biomass categories, incineration in a Dutch installation ≤ 50 MW is more profitable than in a German installation of 5 – 20 MW without innovative technologies. Processing in Germany is almost always more profitable than in a large Dutch installation (> 50 MW).

3.1.4 German and Dutch biomass prices

There is very little information on biomass prices in Germany. However, the available information supports our analysis from the previous section that German operators of bio-energy plants are generally able to pay higher prices for their biomass.

Table 19 shows the price of wood pellets in several European countries. German prices for this uniform product are higher than in any other country in the EU. It is interesting, furthermore, that the price in a pellet-producing country like Sweden can be higher than in other countries. Under normally functioning economic laws, prices near the production site should be lower, pointing to a distortion of the pellet market by policy differences between Member States.

[31] *As waste wood is categorised differently in Germany and the Netherlands. only generalised conclusions can be drawn here. The German categorisation is as follows:*

- *Waste wood category A I: Waste wood in its natural state or only mechanically worked.*
- *Waste wood category A II: Bonded, painted, coated, lacquered or otherwise treated waste wood with no halogenated organic compounds in the coating and no wood preservatives.*
- *Waste wood category A III: Waste wood with halogenated organic compounds in the coating, with no wood preservatives.*
- *Waste wood category A IV: Waste wood treated with wood preservatives, with the exception of waste wood containing PCBs.*

Table 19 Prices of wood pellets, bulk, including delivery (€ per tonne)

Country	Price
Austria	160
Denmark	135
Finland	115
Germany	180
Poland	90
Sweden	140
The Netherlands	90
United Kingdom	150

Source: www.pelletcentre.info, August 2005. Dutch data: SenterNovem.

More information on biomass prices in EU Member States will become available under the EUBIONET II programme. A detailed comparison of prices with feed-in tariffs might reveal whether higher feed-in tariffs result in higher prices.

3.1.5 Conclusion

On the basis of the analyses presented above, we conclude that:

- The EEG has led to an increase in bio-electricity production in Germany. It has resulted in greater use of new technologies and 'self-regenerating' raw materials. The increased use of certain new technologies like biomass gasification has been such as to suspect that tariffs might be too high.
- The fastest growing bio-energy sector is biogas from energy crops. Most of these crops are grown domestically and will therefore not affect the availability of biomass in the Netherlands directly.
- The EEG enables German power plant operators to pay more for certain categories of biomass than Dutch operators can. On the other hand, there are some categories for which Dutch operators are able to pay more. This may lead to exports and imports of biomass driven solely or mainly by tariff differentials.
- On the basis of scarcely available price information, it seems likely that biomass prices in Germany are generally higher than in surrounding countries.

3.2 Possible changes to the EEG

In principle, many possible changes to the EEG are conceivable. Two changes would have a major impact on demand for biomass:

1 An extension of the EEG to larger installations and to co-incineration.
2 An extension of the EEG, or rather the Biomass Directive, to include more categories.

Both changes, their likelihood and their implications, are discussed in the following sections.

3.2.1 Extension to larger installations and co-incineration

One possible change to the EEG would be its extension to larger installations and co-incineration. At present, feed-in tariffs for electricity from biomass are available only for plants 'with a capacity of up to and including 20 megawatts using exclusively biomass', according to Article 8(1) of the EEG. On this point the German law distinctly differs from the Dutch, for example, which has feed-in tariffs for all installations, regardless of capacity, and also for co-incinerated biomass.

Such extension of the EEG could increase demand for biomass. In principle, it would open up the most economical ways of using biomass to generate useful energy, namely co-incineration in large coal-fired power plants. It would depend on the actual feed-in tariffs, however, whether or not this would actually increase demand. If, for example, the feed-in tariffs for large installations were low, the effect of the change could be negligible.

An extension to larger installations and co-incineration in Germany is not very likely. In the current circumstances, not many stakeholders would favour such a change. The trade association of the bio-energy sector, BBE, is happy with the law as it is[32]. The electricity supply sector association, VDEW, welcomes the effects of the EEG on the use of renewables, but questions its economic efficiency and social costs. It favours a different means of stimulating power generation from renewable sources, namely tradable quota[33]. It is therefore unlikely that VDEW would propose any changes to the EEG at present. Furthermore, there does not seem to be the political will to change it.

3.2.2 Extension to other biomass categories

Another possible change to the EEG would be its extension to other categories of biomass. Germany stands out in Europe for not including the biogenic part of municipal waste as biomass[34]. Including municipal waste would enhance the supply of biomass. It would also increase demand for municipal waste, which might possibly lead to importation of waste, should this be allowed.

Extension to other categories of biomass is unlikely, however. Many stakeholders argue that exclusion of municipal waste is justified by the polluter pays principle[35]. The consumer of electricity causes pollution in the form of greenhouse gases, and pays for energy from renewable sources. The consumer disposing of municipal waste pays for removal of that waste. A bonus in the form of a feed-in tariff would complicate matters.

3.2.3 Likely changes to the EEG

The changes described above are unlikely to occur. Certain other changes are far more likely, though. A case in point is alteration of the tariff structure to slow down the boom in biogas installations, which is probably caused by tariffs being too high. Because of this boom, many new parties are entering the market, some of whom have no experience whatsoever with power generation or running a biogas plant. This is creating problems for electricity companies, which need to calculate power supply and demand in advance in order to maintain the electric potential of the grid. These changes will probably limit demand for domestic energy crops, but are not likely to affect biomass availability in the Netherlands.

3.3 The landfill ban

On June 1st, 2005 a landfill ban for untreated organic waste became effective in Germany. This ban is the German implementation of the European Landfill Directive, as well as the outcome of a debate with its origins in the 1980's[36].

The landfill ban means that untreated waste from households and commercial waste resembling household waste may no longer be landfilled. Many observers expected significant effects on imports and exports of waste across the Dutch-German border. The ban may possibly influence the availability of biomass. In the following subsections we describe the effects of the landfill ban as of November 2005. However, the market is still turbulent and the effects are not generally entirely clear.

3.3.1 Waste processing in Germany

Quantity of waste to be processed

According to estimates (LAGA, 2004), 20.371 Mtonne of municipal solid waste will be generated in Germany in 2005. On top of this comes approximately 5.0 Mt of commercial waste resembling municipal waste. A further 4.135 Mt of waste is expected from composting installations, separation plants and MBT (Mechanical Biological Treatment) plants. The total quantity of waste to be processed in 2005 is thus an estimated 29.5 Mt.

Capacity (all data from (LAGA, 2004))

Three different routes are available for processing this waste:

- Burning in waste incineration plants (WIPs). In 2004, German WIP capacity was 16.3 Mt. Together with new

[32] *Bernd Geisen, Bundesverband BioEnergie e.V., personal communication.*
[33] *VDEW: Proposal for a discussion on how to promote renewable energies in future: 'Achieving extension targets efficiently'.* www.strom.de
[34] *PWC, 2005: Bioenergy implementation in Europe: trendwatching, The Hague: SenterNovem.*
[35] *Dr. Bernhard Dreher, BMU, personal communication.*
[36] *BMU.* http://www.bmu.de/abfallwirtschaft/doc/1853.php.

capacity that has meanwhile come on line, total capacity in 2005 has been estimated at 17.9 Mt. The true figure turns out to be somewhat lower in practice, although it is not possible to provide an accurate current estimate.

- Processing in mechanical biological treatment facilities (MBTs), with the waste being aerobically composted (drying plus conversion of part of the biowaste) and subsequently separated into several fractions. One of these fractions is the composted organic waste, which may still be landfilled. The medium-to-high-calorific fraction is incinerated. German MBT capacity stood at 6.2 Mt in 2004. Together with newly built facilities, MBT capacity in 2005 is estimated to be 7.1 Mt.
- Co-incineration of higher-calorific waste and waste fractions in cement kilns and (brown-)coal-fired power plants. Co-incineration capacity was 2.3 Mt in 2004 and is expected to increase to an estimated 3.5 Mt in 2005.

In sum, total processing capacity was 24.9 Mtonne in 2004 and an estimated 28.5 Mtonne in 2005, but the latter figure will probably turn out somewhat lower.

Supply versus capacity

The planned capacity for 2005 of WIPs plus MBTs (25.0 Mt) is sufficient for the processing of municipal waste (20.4 Mt). Residues from composting installations, separation plants and MBTs and commercial waste resembling municipal waste (together 9.1 Mt) are partly incinerated in WIPs (estimated at 4.6 Mt) and partly co-incinerated (estimated at 3.5 Mt). According to these estimates, then, 1.0 Mt of waste processing capacity is currently lacking.

It turns out, however, that the actual combined capacity of WIPs, MBTs and co-incineration is in fact less than previous estimates. To address this problem, some MBT separation residues are now in temporary storage (SenterNovem, 2005), under storage permits for a maximum of one year. During that period, WIPs can be adjusted to allow co-incineration of certain higher-calorific waste.

For a sizeable fraction of the 5.0 Mt of commercial waste, it transpires there is currently no WIP capacity. The amount of waste to be incinerated is now being reduced by separate collection and mechanical separation. Separately collected fractions can be recycled. Mechanical separation is carried out in installations which used to process Dutch waste prior to the landfill ban.

Until now, the German national government has been against the export of waste to the Netherlands, because of the creation of extra jobs for processing it in Germany. However, export permits are not granted by the Federal government but by the Bundesländer, most of which do not seem to have export plans at the moment. Nord-Rhein Westfalen does allow exports to separation plants in the Netherlands on a small scale, though, and according to Schouten (2005) several hundreds kilotonnes are imported by the Netherlands.

Use of biomass from German waste

Most of the biomass in municipal solid waste is incinerated in WIPs. The lower-calorific fraction of the waste processed in MBTs is landfilled, while the higher-calorific fraction (partly biomass: paper and wood, partly non-biomass: plastics) is incinerated in WIPs or co-incinerated elsewhere. Part of the biomass in commercial waste is incinerated in WIPs or co-incinerated, too.

A minor quantity of biogenic residues from separation facilities is sold to coal-fired power plants. This material must be paid for, however, and contracts are short-term. Cement kilns and (brown-)coal-fired power plants use waste for co-firing that pays most: sewage sludge and old tyres, for example. There is currently no clear-cut, structural market for the co-incineration of biogenic wastes from municipal solid waste and such a market is not expected to emerge in the coming years, moreover (SenterNovem, 2005).

3.3.2 Effects on Dutch biowaste

In 2003, before the German landfill ban came into effect, 2.6 Mtonne of Dutch waste was exported to Germany (AOO, 2004). This comprised about 1.0 Mt wood

residues, 1.2 Mt construction and demolition waste and 0.4 Mt of RDF, paper/carton and small quantities of paper industry rejects, plastic wastes and dry commercial waste.

The landfill ban has had no effect on the export of wood residues: about 1.0 Mt of this is still exported to Germany for energy generation. Waste fractions such as RDF, paper industry rejects, paper/carton and fractions from separation plants (like paper and plastics mixtures) are still being exported to Germany (SenterNovem, 2005).

The export of construction and demolition waste from the Netherlands to Germany has almost totally halted because of the landfill ban, however. This waste must now be processed in the Netherlands. The quantity of biomass in this waste is unclear, but is estimated between at between 30% and 50%. Capacity for separating this waste is still limited and much of it is therefore still landfilled with a permit: it is estimated that between 1 and 2 Mt is involved. This means that between 0.3 and 1 Mt of biogenic waste is still being landfilled at present. Although this fraction can be converted to energy, the PVC and sand it contains make it unsuitable for co-firing in coal-fired plants. This means that either new capacity must be built, in the form of stand-alone installations, or a pre-treatment step introduced before co-firing (pyrolysis, for example).

Waste wood is still being exported to Germany, despite higher feed-in tariffs for this material in the Netherlands (see Section 3.1.3). The reason for this paradoxical situation is that capacity in the Netherlands is currently limited. In the Cuijk, Amer, Maasvlakte and Gelderland 13 power plants together, no more than 500 ktonne of wood residues is co-incinerated, mainly of quality A. At present, the Dutch supply of waste wood exceeds national capacity to co-incinerate it or usefully employ it in bio-energy plants[37]. Because of this capacity shortage for quality B waste wood, a number of projects are currently under development.

3.3.3 Conclusions

- The German landfill ban has had an effect on the export and processing of construction and demolition waste from the Netherlands. As result, between 0.3 and 1 Mtonne of Dutch biogenic waste is now being landfilled.
- There is no import of municipal solid waste from Germany.
- The export of wood residues to Germany is uninfluenced by the landfill ban, or may even have risen slightly. In the near future, more wood residues are likely to be exported to Flanders.
- The capacity for co-incineration in the Netherlands is too small for co-incinerating wood residues of quality B.
- Producing more bio-energy from construction and demolition waste is now possible in the Netherlands, but this requires investments in new installations or introduction of a pre-treatment step at current coal-fired power stations.

[37] *Since the autumn of 2005, new capacity has become available in Flanders for co-incinerating wood residues of quality B (capacity: about 0.5 Mtonne) and for chipboard production (capacity: 0.45 Mtonne) from quality A and B wood residues (Schouten, 2005). These facilities are likely to attract wood residues from the Netherlands.*

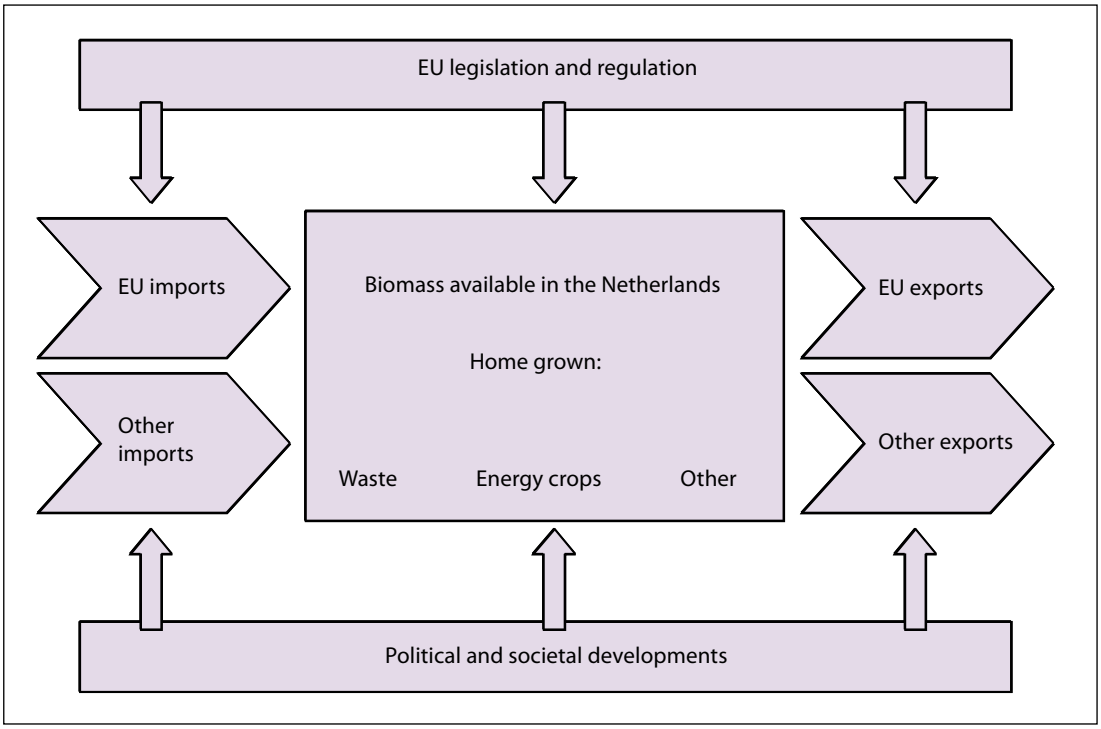
4 Consequences for bio-energy in the Netherlands

In this final chapter we analyse the consequences of the trends described in earlier chapters for bio-energy in the Netherlands, thereby proceeding from the following framework:

- The current availability of biomass in the Netherlands is known (Appendix A).
- The current imports and exports of biomass in the Netherlands are known (Appendix A and Section 3.3).
- The European legislation affecting supply and demand of biomass has been analysed for its impact on the availability of biomass in the Netherlands (Chapter 2).
- Other political and societal developments affecting supply and demand have not been thoroughly analysed here, and will therefore only be partly included in the analysis.
- Competition between different uses of biomass has not been addressed here, nor competition for arable land (see Section 2.6.1). Consequently, their significance for biomass availability is not analysed here.

The analysis framework is sketched in Figure 5.

Figure 5 *Analysis framework for biomass availability in the Netherlands*



4.1 European legislation

Of the seven directives studied, two (IPPC, LCP) have had hardly any impact on the supply and demand of biomass for energy. In the Netherlands a number of permits for biomass co-incineration were recently retracted, in some cases partly on the grounds of failure to comply with the IPPC Directive. However, the verdicts suggest that the permits would have been retracted even in the absence of that directive, as they also violated other laws and regulations. Whatever the case, when the problems with these permits are resolved, this will probably result in more capacity for co-incinerating biomass and thus in more bio-electricity.

The two waste directives (Waste Incineration, Landfill) have increased the supply of waste available for generating heat and/or power. In the Netherlands, most municipal waste is already incinerated and most incinerators generate both heat and power. In this country, then, any further growth in the supply of domestic waste available for generating useful energy is unlikely.

In neighbouring countries, there is still considerable scope for increasing the amount of waste incinerated. Indeed, the waste directives may well lead to new waste incinerators being commissioned there. Such incinerators could in principle be used to burn Dutch waste, which, from the year 2007, may be exported, thereby effectively reducing the amount of waste available in the Netherlands. It seems that this is already happening on a small scale in parts of Germany and Belgium.

The renewable energy directives (RES, Biofuels) have enhanced demand for bio-energy. Since Member States have considerable freedom in transposing and implementing these directives, each country has a different incentive scheme to enhance supply. These differences are distorting the market for biomass, which may result in subsidy competition among Member States in order to attract biomass from other countries. The existence of such competition is suggested by the large price differentials for wood pellets in the EU. Also, our analysis of the German situation shows that this subsidy competition is likely to occur between the Netherlands and Germany. This may not have a major impact on the availability of biomass in either country, but it does increase the costs associated with the RES and Biofuels Directives.

The ETS Directive, finally, enhances demand for biomass by large emitters like power plants. When emission allowances rise above a certain price, it becomes profitable to replace fossil fuels by biomass, for which no allowances have to be surrendered. What this price level is, is as yet unknown. Current prices appear to be sufficient, at least for some operators. Because of the uncertainty about future price levels, however, actors are holding back from major investments.

In sum, European legislation is not having any major effect on bio-energy in the Netherlands. The waste directives may depress supply somewhat, but not significantly. The impact of European legislation on the cost of bio-energy may be greater, owing to subsidy competition. When the Netherlands solves its co-incineration permitting problem, this may result in a major increase of the amount of biomass being converted to useful energy.

It is likely that more pronounced competition will develop on the usage side of the biomass equation, especially as a consequence of the Biofuels Directive. At the moment, only fats and oil are used for both bio-energy and biofuels, and for these sources there is already competition. Most biofuels are currently based on agricultural crops that are too expensive for bio-energy purposes, but cost and environmental considerations are leading to development of biofuels made from wood and straw. When these second-generation biofuels are introduced, it will be harder for the bio-energy sector to obtain sufficient raw materials.

4.2 Developments in Germany

In this report, the effects of two new laws and regulations in Germany have been studied: the changes to the so-called 'EEG' of July 2004 and the landfill ban of June 2005.

The new EEG has led to an increase in bio-energy production in Germany. It has resulted in greater use of new technologies and use of regenerative raw materials. The fastest growing bio-energy sector is biogas from energy crops. Most of these crops are grown domestically and will therefore not affect the availability of biomass in the Netherlands.

Notwithstanding the lower tariffs for incinerating waste wood under the new EEG, considerable amounts of wood are being exported to Germany. The tariff structure suggests that prices for waste wood should be lower in Germany than in the Netherlands. The main reason for the considerable exports seem to be a lack of capacity in the Netherlands. If Dutch capacity is extended, then the availability of waste wood for energy in the Netherlands could increase.
The German landfill ban currently has no significant impact on the availability of biomass in the Netherlands. On a small scale, however, it seems that treated municipal waste is being exported to Germany. It would be worthwhile monitoring these exports to assess whether they might affect biomass availability in the future.

4.3 Recommendations

- Reducing the differences between EU Member States' bio-energy support policies could lead to a more predictable and rational market for biomass in Europe.
- Competition between the transport, energy and other sectors will become more problematical. A fair and level playing field for all biomass users would make such competition work in the right direction.

References

Afval 9, 2005
F. Noordhoek
De markt in onbalans
Vakblad afval no. 7, Sept. 2005

Afval 3, 2006
G.C. Bergsma en J.T.W. Vroonhof, CE
Klimaat en afval
Vakblad afval no. 3, March 2006

AOO, 2004
Afval Overleg Orgaan
De afvalmarkt: ontwikkelingen 2003
AOO 2004-08; April 2004

CE, 2005
Biofuels under development, An analysis of currently available and future biofuels, and a comparison with biomass application in other sectors
Delft : CE, 2005

EC, 2005
Commission of the European Communities, Report of the Commission on the implementation of Directive 96/61/EC concerning integrated pollution prevention and control, COM(2005)540 final, 3.11.2005

ECN, 2005
N.H. van der Linden, M.A. Uyterlinde, C. Vrolijk et al.
Review of international experience with renewable energy obligation support mechanisms
Petten : ECN 2005

Entec, 2005
Entec UK Limited
Preparation of the review relating to the Large Combustion Plant Directive: A Report for European Commission, Environment Directorate General, Draft Final Report
Northwich : 2005

FFact, 2005
FFact Management Consultants
Europese invloed op vergunningverlening van bio-energieprojecten in Nederland: Het effect van IPPC en BBT
The Hague : SenterNovem 2005

Golder Europe EEIG, 2005
Implementation of the landfill directive in the 15 member states of the EU
Report for the EC, REF ENV.A.2/ETU/2004/0016
Berkshire, Engeland, Golder Europe, October 2005

IEEP, 2003
A. Farmer, Eva Kružíková, Eva Adamová et al.
Progress in the Implementation of Five Environmental Directives in the Acceding Countries
Policy Brief for the EP Environment Committee
EP/IV/A/2003/09/01

LAGA, 2004
Landesamt für Umwelt, Wasserwirtschaft und Gewerbeaufsicht
Bericht der LAGA zur 63. Umweltministerkonferenz: Umsetzung der Abfallablagerungsverordnung, 3 Fortschreibung; August 2004

LDK ECO environmental consultants, 2004
LDK-ECO Environmental Consultants S.A.
Analysis of Member States' first implementation reports on the IPPC Directive (EU-15): Final Report
Athens : 2004

TNO, 2005
J. Koppejan, P.D.M. de Boer-Meulman
Beschikbaarheid van biomassa
Apeldoorn : TNO Industrie en Techniek

Interviews

- Annemarieke Grinwis, VROM
- Dr. Bernhard Dreher, BMU
- Bernd Geisen, Bundesverband BioEnergie e.V
- Dr. Maren Hille, VDEW
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- L. Hazen, Essent
- D. Schouten, Waste to Energy

Bio-energy in Europe 2005

Policy trends and issues

Annexes

A Availability of biomass in the Netherlands

A.1 Availability of biomass, 2004

In 2004 the Netherlands avoided using approximately 34.5 PJ of fossil fuels through use of biomass (TNO, 2005). Table 20 shows the various types of biomass used in the Netherlands in that year.

Table 20 *Use of biomass in the Netherlands, 2004*

Type of biomass	Technology	Amount (thousand tonnes per year)	Of which imported (thousand tonnes per year)	Avoided use of fossil fuels (PJ per year)
Wood chunks	Stoves and open hearths	600	0	5.4
Sawdust and wood chips	Industrial furnaces	150	0	2.0
Wood chips	CHP	175	0	1.8
Paper sludge	Co-firing	500	9	0.4
Waste wood (B-grade quality)	Co-firing	45	0	0.4
Wood pellets	Co-firing	400	320	4.3
Vegetable oils	Co-firing	90	90	1.9
Bone meal	Co-firing	100	10	1.3
Wet organic residues	Co-firing	112	6	0.2
Chicken manure	Co-firing	5	0	0
Landfill gas		1.8 PJ	0	1.8
Dried sewage sludge		2.3 PJ	0	2.3
Biogas		1.1 PJ	0	1.1
Municipal waste		4.975	0	11.5
Total		**6,712**	**535**	**34.5**

Source: TNO, 2005.

All wood residues together amount to 14.3 PJ per year, while municipal waste amounts to 11.5 PJ per year. Together, these categories make up almost three-quarters of the biomass used in the Netherlands.

In 2004, biomass imports amounted to the equivalent of almost 10 PJ. Table 21 shows that the main imports were wood and vegetable oils.

Table 21 *Imports of biomass, 2004*

Type of biomass	Imports (thousand tonnes)	Imports (PJ)
Wood, wood residues, pellets, etc.	420	6.30
Agricultural residues	6	-
Vegetable oils	90	3.40
Others	15	0.15
Total	**535**	**9.85**

Source: TNO, 2005.

The main exports are also wood and wood residues, as is shown in Table 22. These exports are oriented mainly towards Germany (TNO, 2005). Other exports, which are only partly of biological origin, are much smaller.

Table 22 Exports of biomass, 2004

Type of biomass	Exports (thousand tonnes)	Exports (PJ)
Waste wood (B-grade quality)	419	6.4
Residual demolition waste (mainly wood)	475	4.3
Paper and plastics in municipal waste*	147	1.2
RDF (refuse derived fuels) pellets*	76	1.1
Other	372	0.4
Total	**1,489**	**13.4**

*Note: * only partly biomass.*

Source: TNO, 2005.

A.2 Outlook to 2010

According to TNO (2005), it will be possible to avoid using a total of 88 PJ/year of fossil fuels in 2010 by utilising biomass. Of this biomass, 53 PJ/year will be of domestic origin and 35 PJ/year will be imported. This amount is well above the 70 PJ/year policy target for 2010. Another important question relates to exports in 2010. Today, exports exceed imports by 30%. The TNO estimate of 88 PJ/year assumes no exports and imports of 35 PJ/year.

Several factors may affect the availability of biomass in 2010, according to TNO (2005):

- The price power producers are willing to pay for biomass, which is related to the support regime in force for generating electricity from biomass.
- The price foreign power producers are willing to pay for biomass, which is related to the support regime for generating electricity from biomass in other countries.
- The price for international maritime transport, which affects the price of foreign biomass. The current trend is that transport tariffs are rising.

The bulk of the present report is devoted to analysing these and other factors and trends which may affect the availability of biomass in the Netherlands.

EUBIONET2

Programme information

This report entitled 'Bio-energy in Europe 2005 Policy trends and issues' was produced by CE under contract of SenterNovem, within the framework of the "Biomass Action Plan'. The 'Biomass Action Plan' is a short-term action plan carried out by the market and government. Both the market and government are working together to find solutions to bottlenecks, which currently delay or hinder bioenergy projects. The ultimate goal is to improve the investment climate for bioenergy, thus realising more bioenergy projects in the Netherlands. SenterNovem supports the implementation of the programme and provides the 'Biomass Action Plan' secretariat.

Utrecht, March 2006

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