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Development of ecological standards for biomass in the framework of green electricity labelling

WP 2.2 report from the CLEAN-E project

A report prepared as part of the EIE project "Clean Energy Network for Europe (CLEAN-E)"

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Written by
Ines Oehme (oehme@ifz.tugraz.at)
IFZ

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The CLEAN-E project

Quality labels which define a minimum standard for green electricity products assist consumers to verify the ecological performance of green products. National labelling programmes which have emerged in some European countries are important and powerful instruments to strengthen consumer confidence in the voluntary green electricity market.

Objectives

The CLEAN-E project will accompany the establishment of new and the improvement of existing green electricity product labels in selected EU Member States. In this regard the CLEAN-E project will support the efforts of the European Green Electricity Network Eugene[1], a non-profit approach which has set up a minimum standard for green electricity labelling schemes. The Eugene standard will serve as the major point of orientation throughout the project.

The establishment of new labels will be accompanied by a wide range of activities. This includes the development of ecological minimum standards for the two key renewable technologies hydropower and biomass. The project also investigates the feasibility of widening the scope of green power labelling towards the integration of energy efficiency as well as renewable heat. CLEAN-E analyses the interface of green power labels with RES related policies on the national and the EU level including the Guarantee of Origin for renewable electricity and Electricity Disclosure. Furthermore, the project will include a wide range of activities aimed at disseminating and sharing best practices for green power procurement.

Expected key results

- New green power labelling schemes in France, Italy and Spain including the establishment of sound labelling structures and the development of label criteria. Existing labels (e.g. in Sweden and Austria) are intended to be improved towards a harmonised European standard.
- Guidelines how to implement ecological minimum standards for hydropower and biomass in the scope of green power labels.
- Procedures and methodologies how to integrate measures in the field of energy efficiency and RES-H into the scope of green power labelling schemes.
- Guidelines how to integrate new policies on the EU and Member States' level (e.g. Guarantee of Origin, Electricity Disclosure) and private sector initiatives (such as RECS) in green power labelling schemes.

[1] Eugene (www.eugenestandard.org) is an independent network bringing together non-profit organisations such as national labelling bodies, experts from environmental and consumers organisations, and research institutes. The Eugene network pursues no commercial interest. Some of the Eugene activities have been partly funded by the EU Commission (DG Environment).

Executive Summary

To combat climate change and to increase the share of renewable energy sources biomass will play an important role. However, it has to be assured that the increase in use of biomass for energy purposes goes hand in hand with the conservation of biodiversity and local environment, because biomass production may create additional environmental pressures, such as on biodiversity, soil and water resources. The optimisation of all steps from biomass cultivation or collection over transport and processing may contribute to get the maximum greenhouse gas emissions reductions and to reduce emissions affecting air quality.

Surveys in different EU countries have turned out that electricity from biomass is not necessarily perceived as 'green'. Awareness of bioenergy or biomass is generally rather low and wind energy or solar power are the main types of energy identified as renewable energies by a wider public. Compared to those homogenous energy sources, the range of available fuels and feeding material which we encounter in the bioenergy sector may also be perceived in remarkably different ways.

What is urgently needed for electricity production from biomass are common standards and guidelines for green electricity from biomass, which are acceptable to a wide range of stakeholders.

In that context the report provides support at three levels:

- for the further development of the biomass criteria applied in the context of the Eugene Standard set up by the European Green Electricity Network Eugene,
- for the development of biomass criteria in the course of the establishment of new national green electricity labels,
- for the possible certification of biomass.

Not all identified issues might be realisable within certification schemes for and will have to be tackled at other policy levels.

After a short literature overview about supply chains of biomass and calculated supply and demand potentials a comparison of definitions and criteria applied for biomass of some of the existing green electricity labels is presented. The comparison comprises the following labels: Eugene Standard, Austrian Ecolabel, Bra Miljöval (Sweden), Ecoenergia (Finland), Gruener Strom Label (Germany), ok-power (Germany), Milieukeur (Netherlands), naturemade (Switzerland), Green Power (Australia), Green-e (USA), Environmental Choice (Canada).

There are significant differences in the conditions required for certain types of biomass, e.g. criteria for forestry and agriculture, but also according to waste types which are permissible as biomass source and if co-firing of biomass in existing coal-fired power plants is allowed.

In principle, two approaches in defining green electricity from biomass can be found:

1. Definition of the allowed feeding material in the first place and additional criteria defining the ecological quality of the biomass and exclusion of certain technologies or types of biomass.
2. Specification of the technologies (plant types) and assessment of the individual plant, which applies for certification. Criteria regarding the feeding material are additionally applied.

Mainly two labels use the second approach, namely 'naturemade star' in Switzerland and the Australian 'Green Power' label. In both cases the plants are individually assessed. The Green Power label provides a general framework for the individual assessments of plants on the basis of Key Environmental Sustainable Development Considerations. naturemade star defines as basic principle, that the overall environmental impact of the plant may not exceed 50 % of the impact of a modern gas and steam electric power plant, which needs to be approved by a key-parameter model based on life cycle assessment data.

The naturemade label is based on an interesting concept, as it recognizes two distinct qualities of electric power: 'naturemade basic' stands for electricity from renewable sources. 'naturemade star' is a designation reserved for green power with superior ecological standard. The criteria for the certification with naturemade star take into consideration effects at the local and the global level. In principle, such an approach of two levels could also be useful for the Eugene standard, because at a basic level renewable resources are generally promoted, without limiting the potential by further criteria. And on the other hand, environmentally especially advantageous fuels or plants are honoured by the second level. However, it is also known, that it might be confusing for consumers, if the same label is applied for different levels of criteria, as in practice the difference is hard to communicate at the point of sale.

Especially for systems, which work with different levels of criteria, like naturemade basic and naturemade star, it is recommendable to introduce such a system of individual generator assessment for the advanced levels.

The following proposals of biomass criteria for application by Eugene within the Eugene Standard are deduced and argued in the report. As the proposed criteria differ according to the possibilities of their operationalisation, they are divided into two groups:

- criteria which can be easily operationalised and proven,
- criteria for which operationalisation and means of proof need to be further elaborated within the second phase of the work package.

Criteria which can be easily operationalised and proven:

Proposal 1: Eligibility of Sources

Eligible biomass sources for the production of green electricity are defined as follows:

- Solid biomass according to CEN/TS 14961:2005, comprising
  - Woody biomass (forests and plantation wood; wood processing industry, by-products and residues; used wood, blends and mixtures),
  - Herbaceous biomass (agriculture and horticulture herb including cereal crops, grasses, oil seed crops, root crops, legume crops, flowers and landscape management herbaceous biomass; herb processing industry, by-products and residues; blends and mixtures),
  - Fruit biomass (orchard and horticulture fruit; fruit processing industry, by-products and residues, blends and mixtures),
  - Blends and mixtures.
- Furthermore, the following sources are admissible:
  - Separated biodegradable waste,
  - Animal excrements, e.g. manure or chicken litter etc. (but no animal body or parts of it),
  - Sewage gas is admissible as far as the label organisations applying for the accreditation by Eugene provide a sound argumentation, why and under which conditions sewage gas is eligible.

Proposal 2: Wood fuel

As a general principle: All wood fuel including wood fuel from thinning and residues from harvesting operations shall originate from forests that are managed so as to implement the principles and measures aimed at ensuring sustainable forest management.

For wood fuel from plantations and imported wood fuel: sustainable forest management shall be certified according to FSC (Forest Stewardship Council). Other certificates or standards should be accepted, as far as it can be proven that an equivalent quality is secured.

National certification schemes of green electricity in countries with a sufficient area of certified sustainably managed forest, should for all fuel wood demand a third party certification, thereby referring to the FSC label. Other certificates or standards should be accepted, as far as it can be proven that an equivalent quality is secured. The argumentation has to be provided by the national label applying for Eugene accreditation and need to be accepted by the Eugene Board. The availability of certified wood fuel shall be regularly reviewed according to the reviewing period of the national certification scheme of green electricity, however at least every fourth year and third party certification shall be required as soon as there is sufficient supply.

For wood fuel from non certified forest, the criteria as given in proposal 8 shall be applied (not applicable for wood fuel from plantations and imported wood fuel, as the need to come from certified forests).

Proposal 3: GMO

The use of genetically modified organisms (GMO, agricultural crops as well as trees) for electricity production is not permitted.

Proposal 4: Energy crops

Energy crops shall not be produced on arable land which has been gained by conversion of pasture or grassland.

Short rotation tree plantations should not be established on forest areas or on arable land which has been gained by conversion of pasture or grassland.

Proposal 5: Biogas plants using manure

Emissions of CH_4, N_2O and NH_3 by usage of manure have to be reduced by covering the storing tank and by applying manure with accurate methods at appropriate time (e.g. trailhose or similar device).

Proposal 6: Overall efficiency

In the annual average the plant need to met an overall efficiency of at least 60 %.

Proposal 7: Co-Firing

Co-firing of solid biomass according to CEN/TS 14961:2005 in coal-fired power stations is permitted. The generated electricity has to be mathematically allocated according to the caloric value of the biomass. The power plant need to provide an overall efficiency of at least 70 %.

Criteria for which operationalisation and means of proof need to be further elaborated in the second phase of the work package

Proposal 8: Wood fuel from non certified forest[2]

All wood fuel including wood fuel from thinning and residues from harvesting operations shall originate from forests that are managed so as to implement the principles and measures aimed at ensuring sustainable forest management. In Europe, the principles and measures referred to above shall at least correspond to the definition of Sustainable Forestry Management that was adopted in Resolution 1 of the 2nd Ministerial Conference on the Protection of Forests in Europe (Helsinki, 16-17 June 1993), the Pan-

[2] Not applicable for wood fuel from plantations and imported wood fuel, as the need to come from certified forests, see proposal 2.

European Operational Level Guidelines for Sustainable Forest Management, as endorsed by the 3rd Ministerial Conference on the Protection of Forests in Europe (Lisbon, 2-4 June 1998) and the Improved Pan-European Indicators for SFM, adopted at the MCPFE Expert Level Meeting of 7-8 October 2002 that were endorsed at 4th Ministerial Conference on the Protection of Forests in Europe (Vienna, 28-30 April 2003).

- Wood shall not originate from illegal harvesting
  - Illegally harvested wood: wood that is harvested, traded or transported in a way that is in breach with applicable national regulations (such regulations can for example address CITES species, money laundering, corruption and bribery, and other relevant national regulations).
- Wood shall not originate from High Conservation Value Forests

High Conservation Value Forests (HCVF) are forests that possess one or more of the following attributes:

- forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia)
- forest areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance
- forest areas that are in or contain rare, threatened or endangered ecosystems
- forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control)
- forest areas fundamental to meeting basic needs of local communities (e.g. subsistence, health)
- forest areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities)

Proposal 9: Maintenance of soil fertility

Forest: No removal of needles, foliage and roots. Also forest residues, like branches and others shall be left at the site as far as possible to maintain soil fertility and to reduce risk of erosion. Thereby measures have to be adapted to site characteristics. Or ash quality from conversion processes should be monitored and where possible nutrient-rich ash should be recycled back to the land. For both aspects national guidelines have to be taken into account as far as available.

Arable land: The withdrawal of straw or other agricultural residues for energetic use has to be adopted site-related according to the nutrient and humus level in accordance with Good Agricultural Practice to secure soil fertility in a sustainable manner. Soil fertility

can also be ensured by returning of fermenting residues from biomass production to the arable land.

Proposal 10: Integrated Farming

Biomass from dedicated cultivation on arable land need to comply with guidelines for integrated crop protection.

If livestock waste (manure, chicken litter, etc.) is used for energy production, the conditions under which animals are housed and reared should comply with the principles of Integrated Farming.

Proposal 11: Transport and auxiliary energy

The non-renewable proportion of the energy that is used for extraction, transportation and processing of fuel, processing energy at the plant, transportation of residual products, and also balancing, is not permitted to be greater than 10 percent of the electricity supplied with the label.

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Abbreviations

BAP	Biomass Action Plan
CAP	Common Agricultural Policy
CHP	Combined heat and power
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
dm	dry matter
ECCP	European Climate Change Programme
EEA	European Environment Agency
EISA	European Initiative for Sustainable Development in Agriculture
FERN	Forests and the European Union Resource Network
FAO	Food and Agriculture Organization of the United Nations
FMU	Forest management unit
FSC	Forest Stewardship Council
GMO	Genetically modified organism
HCVF	High Conservation Value Forest
ICM	Integrated Crop Management
IOBC	International Organisation for Biological and Integrated Control of Noxious Animals and Plants
IEA	International Energy Agency
IFS	Integrated Farming Systems
IP	Integrated Production
IPM	Integrated Pest Management
ITTO	International Tropical Timber Organisation
IUCN	The World Conservation Union
LCA	Life Cycle Assessment
MCPFE	Ministerial Conference on the Protection of Forest in Europe
MS	Member State
Mtoe	Mega ton oil equivalent (= 41868 TJ)
PEFC	Programme for the Endorsement of Forest Certification schemes
PEOLG	Pan European Operational Level Guidelines
RES-E	Renewable energy sources – electricity

RES-H	Renewable energy sources – heat
SFM	Sustainable forest management
SRC	Short rotation coppice
SRTP	Short rotation tree plantations
UAA	Utilised agricultural area
UNEP	United Nations Environment Programme
WWF	World Wide Fund for Nature

1 Introduction

To combat climate change and to increase the share of renewable energy sources biomass will play an important role. However, it has to be assured that the increase in use of biomass for energy purposes goes hand in hand with the conservation of biodiversity and local environment, because biomass production may create additional environmental pressures, such as on biodiversity, soil and water resources. The optimisation of all steps from biomass cultivation or collection over transport and processing may contribute to get the maximum greenhouse gas emissions reductions and to reduce emissions affecting air quality.

Surveys in different EU countries have shown that electricity from biomass is not necessarily perceived as 'green'. Awareness of bioenergy or biomass is generally rather low and wind energy or solar power are the main types of energy identified as renewable energies by a wider public. Compared to those homogenous energy sources, the range of available fuels and feeding material which we encounter in the bioenergy sector may also be perceived in remarkably different ways. While some fuels may be seen as clean (pellets, forest residues) others may be perceived as dirty fuels (e.g. waste). However, this separation is not always as expected, because in countries with little forest areas the use of waste for bioenergy may be more accepted than the idea of cutting trees (Rohracher et al. 2004).

What is urgently needed for electricity production from biomass are common standards and guidelines for green electricity from biomass, which are acceptable to a wide range of stakeholders.

The Communication on 'The share of renewable energy in the EU'[1] revealed that although progress has been made, the 2010 target of 21 % renewable electricity for EU25, corresponding to 22.1 % for EU15[2] will not be achieved under current policies and measures. Instead, currently implemented policies will probably result in a share of between 18 % and 19 % in 2010. In total, renewable energy accounted for about 15.2 % of total electricity generation in 2002. It has been identified that the main reason why the target is not being achieved is because the production of electricity from biomass has not been as high as initially foreseen.

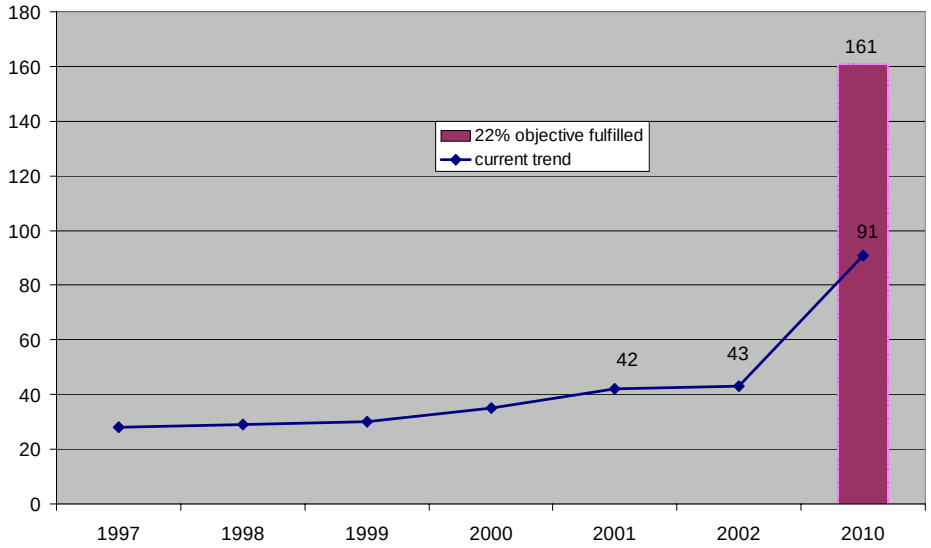
"In 1997, the Commission expected that 68 % of the growth in electricity from renewable energy sources would come from biomass. 24 % could come from wind power and 8 % from a mixture of hydro, geothermal and photovoltaic power. Now, the strong growth of wind power eans that it can be expected to contribute 50 % of the increase needed to achieve the target set in the Directive. Hydro, geothermal and photovoltaic power can be expected to contribute 10 %. Consequently, the target will only be

[1] COM(2004) 366 final: Communication from the Commission to the Council and the European Parliament. The share of renewable energy in the EU, 26.5.2004.

[2] Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market.

achieved if biomass contributes the remaining 40 %. It will need to grow from 43 TWh in 2002 to 162 TWh. This will require biomass electricity to grow by 18 % a year – compared with a rate of only 7 % a year over the past 7 years."[3]

Figure 1: Estimation of the Biomass electricity trend and comparison with the 22 % objective [TWh]



Source: COM(2004) 366 final

To ensure that biomass will contribute in the planned way to achieve the renewable energy goals for 2010 the European Commission presented an Biomass Action Plan[4] in December 2005. This action plan sets out measures to increase the development of biomass energy from wood, wastes and agricultural crops by creating market-based incentives to its use and removing barriers to the development of the market. With respect to electricity from biomass, only very general goals are given, namely:

"The commission will

- … pay close attention to the implementation of the directive on electricity from renewable energy sources;
- encourage Member States to harness the potential of all cost-effective forms of biomass electricity generation…"

However regarding cross cutting issues some important measures are planned, which are of relevance for the issues of this report too:

[3] COM(2004) 366 final.

[4] COM(2005) 628 final: Communication from the Commission: Biomass action plan, 7.12.2005.

"The Commission will:

- Assess the implementation of the energy crop scheme…
- Bring forward a forestry action plan in which energy use of forest material will play an important part.
- Review the impact of the energy use of wood and wood residues on forest based industries.
- Consider how the waste framework legislation could be amended to facilitate the use of clean wastes as fuel.
- Review how the animal by-products legislation could be amended in order to facilitate the authorisation and approval of alternative processes for the production of biogas and other bio-fuels.
- Encourage the European Committee for Standardisation to speed up work on standards for the quality of biomass fuels..."

2 Goal and structure of the report and methodology

2.1 Goal

The report on hand shall provide support at three levels:

- for the further development of the biomass criteria applied in the context of the Eugene Standard set up by the European Green Electricity Network Eugene,
- for the development of biomass criteria in the course of the establishment of new national green electricity labels,
- for the possible certification of biomass.

Not all identified issues might be realisable within certification schemes for and will have to be tackled at other policy levels.

2.2 Methodology

The report was compiled on the basis of a critical review of existing literature and especially on existing green electricity labels as well as available background documents thereof. Furthermore semi-structured interviews were conducted with experts from green electricity labels, biomass research and biomass organisations as given in Table 1. The input from all interviewed persons and especially the detailed feedback of WWF is gratefully acknowledged. However, the text lies in the full responsibility of the author and doesn't necessarily represent the positions of the interviewed persons.

The study represents an outline of important issues with regard to electricity production from biomass and proposes possible criteria of biomass for green electricity certification schemes. The practicability of the proposals will be assessed in a second step of Work Package 2.2 from the CLEAN-E project. At this next stage of the work requirements for means of assessment and verification will be elaborated as well and the results will be provided in a second report.

Finally, criteria for certification schemes need to be set up within a transparent process in which all relevant stakeholders have to be involved. The report on hand shall serve as an introductory basis for such a process.

Table 1: List of interviewed persons

Uwe Fritsche	Öko-Institut e.V., Germany
Satu Helynen	VTT Processes, Finland
Stefan Kastner	oekostrom AG, Austria
Heinz Koppetz	Austrian Biomass Association, Austria
Imke Lübbeke	WWF, Germany
László Máthé	WWF, Hungary
Andi Peter	VKI-Verein für Konsumenteninformation, Austria
Gerald Steindlegger	WWF, Austria
Sirkka Tepponen	Finnish Association for Nature Conservation, Finland
Herman Docters van Leeuwen	Milieukeur, The Netherlands
Ineke Vlot	Milieukeur, The Netherlands
Arthur Wellinger	Novaenergie, Switzerland

2.3 Structure of the report

As a starting point available studies have been identified to present important supply chains of biomass and expected developments of biomass supply, which are summarised in chapter 3. The biomass criteria of existing major certification schemes/labels for green electricity were compared (see Annex 1), to find out differences and similarities, innovative solutions as well as potentials for further development. The main findings are described in chapter 4. Based on inputs from chapter 3 and 4 as well as the interviews and available literature, criteria and indicators for biomass sources and conversion technologies for green electricity schemes are suggested in chapter 5 and summarised in chapter 6.

3 Important supply chains of biomass

3.1 Classification of biomass fuel resources

Compared to other kinds of renewable energy such as wind energy or hydropower, biomass is a very heterogeneous aggregation of different feeding materials, conversion technologies and end-uses with different traditions and connotations in different European regions.

Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market defines

- "renewable energy sources shall mean renewable non-fossil energy sources (wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases)" and
- "biomass shall mean 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".

While the definition of renewable energy sources can be formulated by objective criteria, an assessment of the environmental impact is needed when defining which sources are considered to be 'green' by the different green electricity labels.

The classification of biomass types and resources that has been suggested in the study 'Bio-Energy's role in the EU Energy market' (Siemons et al. 2004) is given in Table 2. This study makes a distinction between tradeable and non-tradeable bio-fuels (see Table 3). Non-tradeable bio-fuels include different kinds of waste such as manure, slaughter house waste, biodegradable wastes (such as biodegradable municipal waste and sewage sludge) and fibrous vegetable waste from pulp and paper production. Thereby it is indicated, that the supply of those fuels is not market driven, but rather policy driven, because waste disposal and processing are strictly regulated. Although legislation and support schemes exist for tradable bio-fuels they are subject more directly to classical supply and demand functions.

Table 2: Classification of biomass types

Supply Sector	Type	Examples
Agriculture	Agricultural residues	Straw, corn stems, cobs, haulm of potatoes or beets
	Livestock waste	Manure, poultry litter
	Dry lignocellulosic energy crops	Short-rotation plantations, perennial grasses
	Oil, sugar and starch energy crops	Oil crops for the production of biodiesel
		Sugar/starch crops for bioethanol production
Forestry	(Stem wood)	(At present almost material use as industrial roundwood and not used for energy purposes)
	By-products from loggings: fuel wood and residues	Wood blocks, wood chips, bark
	Wood from forestry thinning	Logs and chips from thinning
Industry	Industrial waste wood	Saw dust, wood chips, slabs and off-cuts from sawmills and timber mills
	Industrial residues from pulp and paper production	Fibrous vegetable waste from virgin pulp production and from production of paper from pulp, including black liquor
	Residues from food industry	Sugar bagasse
Waste		Separated biodegradable municipal waste
		Demolition wood
		Landfill waste (biodegradable fraction) → landfill gas
		Sewage sludge
Parks and gardens		Urban wood, pruning
		Grass

Source: based on Siemons et al. 2004 and Nikolaou et al. 2003, adapted

3.2 Bioenergy potentials

A variety of studies have proven the available potential of biomass in the European Union as well as in the OECD (Siemons et al. 2004, Thrän et al. 2004, Bauen et al. 2004, EEA 2005). Some data shall be provided in the following to get an idea about what are the most important biomass sources of the future.

The project 'Bio-Energy's role in the EU Energy Market' (Siemons et al. 2004) found a total availability of biomass fuels in the EU25 plus 2 candidate countries of 159 Mtoe/yr for the year 2000, growing to 210 Mtoe/yr in 2020.[5] More details are given in Table 3. According to the authors these overall figures should be regarded as indicative, as they imply an inaccuracy in the range of ± 10 % as a result of assumption on land use for energy crops.

[5] The 25 Member States of the EU currently consume around 1725 Mtoe of energy per year (Green Paper on energy efficiency or doing more with less, COM(2005) 265 final).

Table 3: Availability of bioenergy in Europe in 2000 and 2020 [Mtoe/yr]

	EU15			10 Accession States plus 2 Candidate Countries[6]		
	2000	**2010**	**2020**	**2000**	**2010**	**2020**
Tradeables:	**86**	**93**	**101**	**21**	**22**	**24**
Forestry byproducts & (refined) woodfuels	34	38	42	7,9	8,7	9,6
Solid agricultural residues	25	28	31	7,3	8,1	8,9
Solid industrial residues	11	12	13	2,1	2,4	2,6
Solid energy crops /a	16	16	16	3,2	3,2	3,2
Non-tradeables:	**40**	**53**	**66**	**7,1**	**9,4**	**13**
Wet manure	11	12	13	3,4	3,8	4,2
Organic waste						
- Biodegradable municipal waste	6,7	17	28	0,5	2,5	5,7
- Demolition wood	5,3	5,8	6,4	0,6	0,6	0,7
- Dry manure	1,9	2	2,3	0,4	0,4	0,5
- Black liquor	9,9	11	12	0,7	0,8	0,9
Sewage gas	1,7	1,9	2,1	0,4	0,4	0,5
Landfill gas	4,0	3,8	2,1	1,1	0,9	0,4
Transport fuels	**4,9**	**4,9**	**4,9**	**0,8**	**0,8**	**0,8**
Bio-ethanol	3,7	3,7	3,7	0,5	0,5	0,5
Bio-diesel	1,2	1,2	1,2	0,3	0,3	0,3
Total bioenergy	**131**	**151**	**172**	**28**	**32**	**38**

Source: Siemons et al. 2004

In order to analyse in how far available biomass might really be used depending on political and market developments demand curves for bio-fuels were generated by the SAFIRE model. SAFIRE is an equilibrium model that balances expected market demand for energy with a set of conventional and renewable supply options, according to economic payback criteria, and using extensive user-entered data on prices, installed capacities etc. The results in terms of primary energy for EU15 as well as for the 10 Accession and 2 Candidate Countries for the year 2010 for bioenergy in general and specifically for bio-electricity are given in Table 4 and Table 5. The authors state that the scenarios for the low-sustainability premium (low-S-premium) are the most realistic ones, as they are closest to the economic reality of today.

[6] The study has been published in April 2004 before the entry of the 10 Accession States into the EU on 1st of May 2004. The two candidate countries are Bulgaria and Romania.

Table 4: Comparison of scenarios and data of availability and use of biomass in 2020

	Avail-ability	Consumption *				
		Technology-Base Case			Non-Subsidised Innovative Technology	Subsidised Innovative Technology
		No S-premium	Low S-premium	High S-premium	Low S-premium	Low S-premium
EU 15						
Primary Energy [Mtoe/yr] Total bioenergy [7]	172	75	123	176	143	145,4
Secondary Energy [GW]:						
Bio Electr. & Heat (tradeable, dedicated plant)		187	169	357	191	193,4
Bio Electr. (tradeable, co-combustion)		8.5	11	16	10.7	10,7
Bio Electr. & Heat (non-tradeable)		23	31	40	36	36,2
10 accession + 2 candidate countries						
Primary Energy [Mtoe/yr] Total bioenergy	38	24	35	48	40	39,5
Secondary Energy [GW]:						
Bio Electr. & Heat (tradeable, dedicated plant)		34	31	69	33,8	33,4
Bio Electr. (tradeable, co-combustion)		3,0	3,8	5,6	3,8	3,8
Bio Electr. & Heat (non-tradeable)		4,3	5,4	6,9	6,3	6,3

Source: Siemons 2004, tables 59-69

* Scenario definition:

For the heat and electricity market a 'sustainability premium' was defined, to be taken as an add-up relative to pure energy prices. Ignorant of future price developments, various price levels were assumed for this sustainability premium based on a literature analysis.

	2010	2020
0-value sustainability premium scenario	0 €/t CO_2-eq.	0 €/t CO_2-eq.
Low-value sustainability premium scenario	25 €/t CO_2-eq.	50 €/t CO_2-eq.
High -value sustainability premium scenario	50 €/t CO_2-eq.	100 €/t CO_2-eq.

[7] For comparison: TERES II, one of the background papers for the EU's policy on renewables, estimates the technical potential for biomass and waste in the EU15 at 210 Mtoe/yr. The Best Practice Scenario of TERES II estimates an consumption of 160 Mtoe/yr from crops, residues and wastes in 2020.

For testing the role of subsidies and learning two scenarios have been distinguished, one with capital subvention for certain type of power plants and one without, as given in the following table:

Scenarios for electricity only plant (typically 100 MWe): Specific investment (€/kWe) Net Caloric Value efficiency (%)			
	2000	2010	2020
Base Case Technology scenario			
Solid clean fuels –all sectors	1.628 34 %	1.628 34 %	1.628 34 %
	CS	CS	CS
Solid dirty fuels – all sectors	2.556 18 %	2.556 18 %	2.556 18 %
	CS	CS	CS
Liquid dirty fuels (biogas) – all sectors	3.250 25 %	3.250 25 %	3.250 25 %
Bio-oil	1.628 34 %	1.628 34 %	1.628 34 %
	CS	CS	CS
Non-Subsidised Innovative Technology scenario			
Solid clean fuels –all sectors	1.628 34 %	2.491 44 %	1.343 44 %
	CS	Introduction of GCC	
Solid dirty fuels – all sectors	2.556 18 %	2.556 18 %	1.343 27 %
	CS	Continued use of CS	Introduction of GCC
Liquid dirty fuels (biogas) – all sectors	3.250 25 %	3.250 38 %	2.680 38 %
Bio-oil	1.628 34 %	927 52 %	927 52 %
	CS	Introduction of CC	
Subsidised Innovative Technology scenario			
Solid clean fuels –all sectors	1.628 34 %	1.343 44 %	1.343 44 %
	CS	Introduction of GCC	
Solid dirty fuels – all sectors	2.556 18 %	2.108 27 %	2.108 27 %
	CS	Introduction of GCC	
Liquid dirty fuels (biogas) – all sectors	3.250 25 %	3.250 38 %	2.680 38 %
Bio-oil	1.628 34 %	927 52 %	927 52 %
	CS	Introduction of CC	

CC: Combined cycle technology (bio-oil fired in gas turbine, coupled to a steam a cycle)
CS: Combustion furnace coupled to steam cycle
GCC: Gasifier coupled to CC.

Table 5: The role of bio-electricity in achieving the targets for RES electricity by 2010

	0 sustainability premium			Low sustainability premium			High sustainability premium		
	TWh	Share of target	Share of total electricity	TWh	Share of target	Share of total electricity	TWh	Share of target	Share of total electricity
Technology Base Case									
Bio-electricity (excl. co-combustion)	36	5,4 %	1,2 %	43	7 %	1,4 %	77	12 %	2,6 %
Bio-electricity (co-combustion)	21	3,1 %	0,7 %	35	5 %	1,1 %	49	75	1,6 %
Total bio-electricity	57	8,5 %	1,9 %	78	12 %	2,6 %	126	19 %	4,2 %
Non-subsidised Innovative Technology									
Bio-electricity (excl. co-combustion)	36	5,5 %	1,2 %	49	7 %	1,6 %	83	12 %	2,7 %
Bio-electricity (co-combustion)	21	3,1 %	0,7 %	35	5 %	1,1 %	49	7 %	1,6 %
Total bio-electricity	57	8,6 %	1,9 %	83	13 %	2,8 %	131	20 %	4,3 %

Source: Siemons et al. 2004, table 77

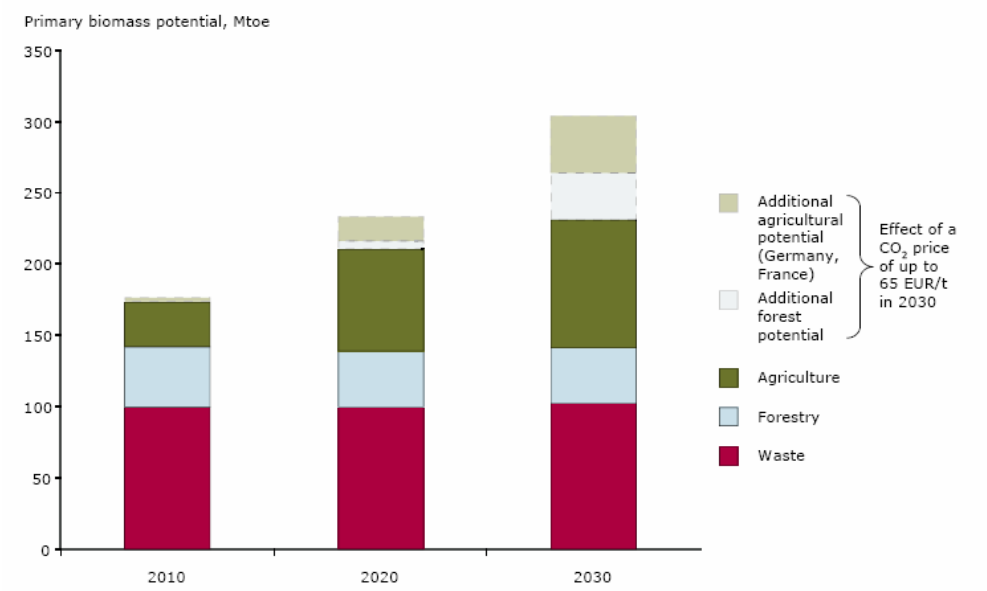
The European Environment Agency is currently assessing an environmentally-compatible[8] primary bioenergy potential in Europe for 2010, 2020 and 2030 (EEA

[8] The following environmental criteria were applied:

- Maintain extensively cultivated agricultural areas. Grassland is not to be transformed into arable land.
- At least 30 % of the agricultural land dedicated to 'environmentally-oriented farming' in 2030 in the Member States. This would comprise organic farming and high nature value farmland (i.e. farmland with special importance for biodiversity).
- Approximately 3% of the intensively cultivated agricultural land to be set aside for establishing ecological 'stepping stones' in intensive farming areas.
- Bioenergy crops used that minimize soil erosion and compaction, nutrient inputs into ground and surface water, pesticide pollution and water abstraction. Regional climatic, soil and landscape considerations and available energy conversion technologies were also taken into account.
- No residue removal or complementary fellings in protected forest areas.
- Maintain current protected forest area.
- No removal of foliage and roots at all.
- Adaptation of the forest residue removal rate to local site suitability. The site suitability was determined by soil fertility, soil acidity, the risk of soil erosion and soil compaction, using the European Soil Database and elevation data.
- Complementary fellings restricted by an increased share of protected forest areas (5%) to account for more nature conservation.
- Forest management was assumed to be less intensive: 5% of the harvestable volume from complementary fellings was left behind as retention trees, thus increasing the amount of large old trees and deadwood.
- Ambitious waste minimisation strategies. For example, households apply waste prevention measures, and thus generate 25% less waste.

2005). Preliminary results are given in Figure 2, which shows that the potential of environmentally compatible primary biomass increases from around 180 Mtoe in 2010 to about 300 Mtoe in 2030.

Figure 2: Environmentally-compatible primary bioenergy potential in the EU-25 – preliminary results



Source: EEA 2005

Explanation CO_2-price: If a CO_2 permit price rises up to 65 €/t in 2030, the market value of energy would increase further. As a result, substantial amounts of wood biomass resources would be used for bioenergy and not in competing industries.

In comparison to the findings of Siemons (2004) this studies provides even higher figures. The main difference lies in a considerable higher potential from agriculture in the EEA study. While agricultural residues and solid industrial residues are presented separately by Siemons (2004), they are summarized under waste in the EEA study.

Priority in the EEA study was "given to domestic food production needed to satisfy the EU-25 food demand. It was therefore assumed that only the land released from food and feed production could become available for bioenergy production. The released land area is expected to increase significantly after 2010 as a result of increases in agricultural crop yields and the liberalisation of the agricultural market … Another reason for the large increase of agricultural bioenergy potential is the assumed introduction of advanced biomass conversion technologies. This would allow the use of a wider range of agricultural feed stocks, especially productive lignocellulosic materials" (EEA 2005). As details of the EEA study are not yet published, no more detailed explanation according to the differences can be given here. As details of the EEA study are not yet published, no more detailed explanation according to the differences can be given here. As

details of the EEA study are not yet published, no more detailed explanation according to the differences can be given here.

The potential of biomass provided by forestry consist of residues from harvest operation and complementary fellings (i.e. the difference between the actual harvest and the sustainable harvest level). This potential strongly depends on assumptions made about the market demand for stem wood.

In case of forests, residues are considered, while the potential strongly depends on the market demand for stem wood. The forestry potentials in t dry matter (t dm) for EU 28 have also been analysed by Thrän et al. (2004) as given in the following table.

Table 6: Forestry Potentials of EU 28[9]

	Unit in 1.000	
Forest area	**ha**	**156.905**
Commercial forest area	ha	133.579
Annual increment or theoretical wood potential	**t dm**	**348.847**
Loggings, consisting of	t dm	240.604
Roundwood	t dm	166.343
Wood fuel	t dm	26.141
Rest wood	t dm	30.076
Technical wood potential from loggings	t dm	56.216
Technical wood potential from unused increment	t dm	108.418
Technical wood potential total	**t dm**	**165.446**
Technical wood potential total	TJ	3.046

Source: Thrän et al. 2004

Thus, the further increase of biomass utilisation from European Forest will mainly be covered by increased use of wood residues and also by increased harvesting of the increment.

3.3 Conclusion

As shown in the tables and figures before the potential of waste is most striking. This is mainly the result of the EU wide implementation of the EC directive on the landfill of waste,[10] discouraging the landfilling of biodegradable waste. Furthermore agricultural residues are a major source of biomass fuels that is still underutilised in most countries.

[9] EU28 = EU25 plus Romania, Bulgaria and Turkey.

[10] Council Directive 1999/31/EC on the landfill of waste.

Considering the biomass sources separately (see Table 3) forestry by-products & wood fuels are the most important source which still provides considerable potential. However as shown in Figure 2 agricultural biomass may get bigger importance in the future.

The scenario calculation of Siemons et al. (2004) revealed that of the given supply potentials especially those of forestry by-products & wood fuels and of organic waste will most probably only be partially exploited.

4 Comparison of biomass criteria of major certification schemes for green electricity

4.1 Survey of existing definitions and criteria for biomass by labels and certification schemes for green electricity

The definitions and criteria applied for biomass of some of the existing green electricity labels were compared. All biomass criteria are given in Annex 1. In chapter 5, which provides proposals for extended biomass criteria applicable for green electricity labels, it is referred to some of the criteria.

The following labels and standards are covered by the comparison:

Eugene Standard (abbr. EUG): www.eugenestandard.org

Austrian Ecolabel – Austria (abbr. A): www.umweltzeichen.at

Bra Miljöval – Sweden (abbr. SE): www.snf.se/bmv/english.cfm

Ecoenergia – Finland (abbr. FI): www.ekoenergia.info/english/

Gruener Strom Label – Germany (abbr. GS-D): www.gruenerstromlabel.de[11]

ok-power – Germany (abbr. Ok-D): www.ok-power.de

Milieukeur – Netherlands (abbr. NL): www.milieukeur.nl

naturemade basic and naturemade star – Switzerland (abbr. CH): www.naturemade.ch

Green Power – Australia (abbr. AU): www.greenpower.com.au

Green-e – USA (abbr. US): www.green-e.org

Environmental Choice – Canada (abbr. CA): www.environmentalchoice.ca

There are significant differences in the conditions required for certain types of biomass, e.g. criteria for forestry and agriculture, but also according to waste types which are permissible as biomass source and if co-firing of biomass in existing coal-fired power plants is allowed.

In principle, two approaches in defining green electricity from biomass can be found:

- Definition of the allowed feeding material in the first place and additional criteria defining the ecological quality of the biomass and exclusion of certain technologies or types of biomass.
- Specification of the technologies (plant types) and assessment of the individual plant, which applies for certification. Criteria regarding the feeding material are additionally applied.

[11] Criteria as of October 2005, they have been revised in November 2005.

Mainly two labels use the second approach, namely 'naturemade star' in Switzerland and the Australian 'Green Power' label. In both cases the plants are individually assessed. The Green Power label provides a general framework for the individual assessments of plants on the basis of Key Environmental Sustainable Development Considerations. naturemade star defines as basic principle, that the overall environmental impact of the plant may not exceed 50 % of the impact of a modern gas and steam electric power plant, which needs to be approved by a key-parameter model based on life cycle assessment data (Frischknecht & Jungbluth 2000). The methods and criteria of both labels are described in more detail in chapter 4.2.

The naturemade label is based on an interesting concept, as it recognizes two distinct qualities of electric power: 'naturemade basic' stands for electricity from renewable sources. 'naturemade star' is a designation reserved for green power with superior ecological standard. The criteria for the certification with naturemade star take into consideration effects at the local and the global level. In principle, such an approach of two levels could also be useful for the Eugene standard, because at a basic level renewable resources are generally promoted, without limiting the potential by further criteria. And on the other hand, environmentally especially advantageous fuels or plants are honoured by the second level. However, it is also known, that it might be confusing for consumers, if the same label is applied for different levels of criteria, as in practice the difference is hard to communicate at the point of sale.

The following table gives a comparison about the included types of waste for the compared labels and if co-firing is allowed.

Table 7: Comparision of included waste types and co-firing in several green electricity labels

	Type	EUG	A	SE	FI	GS-D	Ok-D	NL	CH	CA	AU	US
Waste	Biodegradable part of unseparated urban solid waste	N	N	N	N[c]	N	N	N	N	(Y)[l]	(Y)[m]	(N)[o]
	Separated biodegradable waste	Y	Y	Y[b]		Y	Y	Y	Y	Y	Y	Y
	Demolition wood	N[a]	N	N	N	(Y)[e]	(Y)[g]		Y[k]	N		(Y)
	Landfill gas		N	Y	Y[c]	N	N	Y	N	Y	Y	Y
	Pit gas					Y						
	Sewage sludge – thermochemical	N	N			N	(N)[h]	N	N	N		
	Sewage gas, digestion of sewage sludge	Y	N		Y	(Y)[f]	N	N	Y	Y		
Co-Firing		Y	N	N	Y[d]		Y	Y[i]	N		Y[n]	Y

Y = Yes, N = No, no entry = source is not explicitly included or excluded.

a Urban waste wood collected separately (unpainted, untreated, or unpressurised wood, not containing plastics, or metals).

b In order for waste material to be counted as bio-fuel it must consist of more than 90 percent biomass and be free of substances that are environmental and health hazards, or substances that are poisonous, have low degradability or that are stored in living organisms.

c However waste treatment plant biogas is allowed.

d A multi-fuel power station is required systematically to reduce its carbon dioxide emissions (fossil fuels, including peat). Reductions must apply to those multi-fuel plants for the power generation of which a company is seeking an eco-label. In the construction of new power stations the problem of carbon dioxide emission must be given priority.

e According to biomass regulation demolition wood is excluded, if polychlorinated biphenyls or polychlorinated terphenyls > 0.005 % (mass), mercury > 0.0001 % (mass).

f Sewage gas explicitly allowed, however this is in contradiction with biomass regulation (Federal Law Gazette I 2001, 1234), to which the label refers to with respect to eligible biomass. Biomass regulation just allows 10 % of sewage sludge in digestion plants, however excludes sewage gas.

g Demolition and waste wood may only be used if untreated or if it is a recycling product according to RAL quality label 428. These criteria also apply for the production of wood gas. In individual cases quality assurance procedures equivalent to RAL may be accepted.

h According to biomass regulation (Federal Law Gazette I 2001, 1234) no sewage sludge, except up to 10 % of sewage sludge in digestion plants, no sewage gas.

i Special emissions standards need to be fulfilled.

k Plants with multiunit cyclone without more far-reaching cleaning filter shall only use natural finish wood or wood residues of first process level.

l Biogas means gaseous products (primarily methane and carbon dioxide) produced by the anaerobic decomposition of organic wastes.

m Excluding incineration.

n The proportion of eligible renewable energy input must exceed 50 % average over the settlement period.

o The California Green-e standard also includes Municipal Solid Waste conversion facilities using a non-combustion thermal process, as long as they meet California Energy Commission requirements.

With regard to the definition of eligible biomass resources the following types are missing in the Eugene Standard, they are neither explicitly allowed nor excluded:

- Landfill gas,
- Livestock waste (manure, chicken litter),
- Agricultural residues beside straw,
- Industrial residues, others than from food and wood industry,
- Biodegradable municipal waste.

Criteria, which might supplement the existing criteria to secure that biomass is provided in a sustainable manner are proposed in chapter 5.

4.2 Approaches of individual generator assessments

4.2.1 naturemade star

The criteria for certification with the label naturemade star take into consideration effects at the local and the global level. The basic principle for the global considerations has been laid down in the study of Frischknecht and Jungbluth (2000), which suggested that the overall environmental impact of the plant may not exceed 50 % of the impact of

a modern gas and steam electric power plant. The comparison is based on a life cycle assessment (LCA) using the methodology of 'Ecoindicator'99'. This criteria does not only apply for biomass but also for hydropower plants, wind power plants and photovoltaic power plants. For the verification of compliance with this requirement key-parameter models based on life cycle assessments have been developed. Findings of life cycle studies and their application in the key parameter models for electricity production from agricultural biogas; wood fuels and waste wood; digestion, composting and incineration of solid organic waste and sewage gas are described in more detail in the following chapters. The developed key-parameter models serve for the individual generator assessment supported by excel-programmes.

4.2.1.1 Electricity produced from agricultural biogas

Edelmann et al. (2001) investigated if electricity from farm biogas may be ecologically sound enough to fulfil the standards of naturemade star. Life cycle assessment (LCA) was done based on the methodology of Ecoindicator'99 Results of Ecoindicator'95 and 'UBP' (environmental impact points, in German Umweltbelastungspunkte) have been presented additionally for comparisons.

It has been shown that the production of electricity from agricultural biogas (even without any technical improvement) is environmentally sounder than electricity generated by fossil sources or an electricity mixture such as produced conventionally in Europe. naturemade star allows actually at the most 3875 Ecoindicator'99-points/TJ electricity as weighted by the so-called 'Hierarchist'.[12] This corresponds to the requirement that the environmental impact of the plant may not exceed 50 % of the impact of a modern gas and steam electric power plant.

Biogas production was compared to ordinary storing of undigested manure, i.e. only surplus emissions caused by biogas production were taken into account. A benefit was given for that part of the generator waste heat, which is used on the farm for room heating and warm water production: The environmental impact was calculated for producing the same amount of heat by a Low-NOx-burner (condensation) powered with natural gas.

The amounts of CH_4, N_2O and NH_3-emissions may vary considerably. At the same time, these gaseous emissions have a very large influence on the result of the LCA (ammonia surplus emissions of the slurry while being stored and brought to the fields count for over 50 % of the environmental impact). This remarkable effect of ammonia emission on the calculated environmental impacts however, is governed by the weighting of ammonia emission within the applied methodology of Ecoindicator'99.

[12] The Ecoindicator methodology adds up the impact categories of LCA to three main impacts, namely damage to ecosystem quality, damage to human health and damage to energy resources. Three different approaches of weighting the three impacts to provide one single indicator have been established, which are Individualist, Egalitarian and Hierarchist, representing different value concepts.

To reduce the emissions technical measures need to be applied, which have been introduced into the criteria of naturemade star.

CH_4 and N_2O-emissions are reduced considerably, if covering the storing tank by a plastic foil in order to take profit of the biogas generated in the storage tank. This improvement (in comparison to the reference, i.e. ordinary storing of undigested manure) compensates for a large part of the surplus emissions of biogas production.

Ammonia emissions may be reduced considerably by applying manure with accurate methods at good times (cool and humid weather, no wind, optimal growth stage of the plants, etc.). If a farmer changes his manure management, the savings may be up to 2-3 times larger than the total impact caused by biogas production. The ammonia emissions may be reduced especially, if the manure is not sprinkled (with a huge amount of tiny droplets and thus a huge surface for evaporation), but if applied directly to the soil with a trailhose or a similar device.

The following table summarises the results and sensitivity investigation according to measures of optimisation and plant types.

Table 8: Surplus emissions caused by the production of 1 TJ electricity with agricultural biogas and different types of combined heat and power station in a 300 m^3 cement plant including the benefit for the heat used on site, Ecoindicator'99 Points, Hierarchist

Prod. of 1 TJ_{el}	**MM**	**MM CH_4, N_2O opt.**	**MM opt. tot.**	**MM+Cos**	**MM+Cos CH_4, N_2O opt.**	**MM+Cos opt. tot.**
60 kW_{el}	4.890	3.600	820	4.240	3.080	1.270
70 kW_{el}, ignition, 7 % oil	5.980	4.690	1.910	5.380	4.220	2.410
70 kW_{el}, ignition, 10 % oil	6.350	5.060	2.390	5.780	4.620	2.810
160 kW_{el}	4.710	3.420	750	4.070	2.910	1.100

Source: Edelmann et al. 2001, table 18

MM: mixture of pig and dairy manure (50/50); Cos: co-substrate; CH_4 + N_2O opt.: using the biogas generated in the storage tank by installing a covering; Opt. tot.: Additional improved manure management while bringing the manure out to the fields.

Plants for which the environmental impacts calculated on the basis of EI'99 (hierarchist) are below the threshold level of 3875 Ecoindicator'99 points are marked in grey.

The following data need to be provided for the key-parameter model calculation: type of fermenter [e.g. cement, steal], size of fermenter [m^3], amount of pig manure [livestock unit], amount of dairy manure [livestock unit], amount of co-substrate [t/yr], transport distance of co-substrate [km], time which animals spend outside of cowshed or pigsty [%], auxiliary energy [kWh/yr], amount of starter oil [l/yr], use of biogas according to counter [m^3/yr], power production [kW_{el}], type of CHP station, net electricity production without power consumption of the plant [kWh/yr], used waste heat [kWh/yr].

4.2.1.2 Electricity production from wood

Jungbluth et al. (2002) established a life cycle assessment of electricity production from wood also using the methodology of Ecoindicator'99. A life cycle inventory has been compiled for the three existing combined cycle power plants in Switzerland and a fourth power plant in operation in the Netherlands. Additionally three standard technologies have been modelled. These standard plants describe the production of electricity from wood in a combined cycle power plant with multi-cyclone waste gas purification or an advanced filter technology with nitrogen oxide reduction and electrostatic particle filter. Electricity production using waste wood in a plant with advanced waste gas treatment has been assessed as the third standard possibility.

It has been found that the main parameters for the environmental impacts are the direct emissions of particles and NOx. Further on, emissions of the heavy metals lead, cadmium and zinc are important while burning waste wood. The energy efficiency of the plant, calculated from the amount of wood used and the produced electricity and heat, is another important entry to the inventory. In addition, the type of wood and its transports and the waste management for ashes and filter residues are important for the total Ecoindicator'99 (Hierarchist) points.

Plants with an advanced waste gas purification technology cause normally much lower impacts than allowed for the labelling. Good plants with multi-cyclone filter can also achieve the label if they do not have too high emissions of particles and NO_x, if they use partly wood residues and if they have very good overall energy efficiency.

Based on the results, a key-parameter model has been developed to assess single plants for naturemade star. The following table summarises the results for the investigated plants.

Table 9: Results of assessment with Ecoindicator'99 (Hierarchist) in EI99 points per kWh electricity

Plant type	**EI'99 (H) points, Plant per year**	**EI'99 (H), electricity kWh**
CHP Wood (plant Meiringen)	7,71E+4	-2,64E-2
CHP Wood (plant Biere)	1,47E+5	1,81E-1
CHP Wood (plant Lengwil)	9,59E+4	-1,34E-2
Wood power plant (plant Cuijk) fluidized bed combustion	3,84E+6	2,13E-2
CHP wood, multi cyclon	1,27E+5	2,77E-2
CHP wood, further exhaust gas cleaning	6,01E+4	-4,29E-2
CHP waste wood, further exhaust gas cleaning	7,31E+4	-2,90E-2
CHP wood (plant Lengwil) plus additional emissions	9,67E+4	-1,28E-2

Source: Jungbluth et al. 2002, table 29

Plants for which the environmental impacts calculated on the basis of EI'99 (hierarchist) are below the threshold level of 0,014 EI99(H) per kWH are marked in grey.

The following data need to be provided for the key-parameter model calculation: type of plant, (waste) wood consumption [m³/yr], transport distance [km], boiler energy efficiency [%] and heat production [kWh/yr], emission factors for particles, NOx, (lead, cadmium and zinc for waste wood boilers), production of electricity [kWh/yr] and heat [kWh/yr], type of ash management and amount of ashes [kg].

4.2.1.3 Electricity production from sewage gas

Electricity produced from sewage gas can also be labelled with naturemade star, because in Switzerland, sewage sludge may not be spread anymore on green land (since 01.01.2004) and on arable land (since 01.01.2005). To prevent that, for economic reasons, the plants are closed down and treatment of sewage sludge will mainly shift to incineration, the plants shall get the opportunity to sell a part of the produced electricity as green electricity.

Thus, naturemade intends to support the use of the produced sewage gas. The model of the established life cycle assessment is a comparison of a sewage treatment plant with digestion and power generation and a sewage treatment plant of same size with digestion only. Certified plants need to provide an ecological surplus value of 14 Ecoindicator'99 points per MWh at the minimum for such a difference consideration.

A plant may sell certified green electricity as long as the difference of the life cycle assessment based on the developed key-parameter model is 14 Ecoindicator'99 points. In most cases just a part of the produced electricity may be sold as naturemade star electricity.

Ronchetti et al. (2002) compared 6 types of waste water cleaning plants, the results for 4 types are shown in the following table.

Table 10: Results of assessment with Ecoindicator'99 (Hierarchist) in EI99 points per MWh electricity of waste water cleaning plants

State of the art[13]	**TOP**	**NEW**	**OLD**	**OLD**
Variant	0	1	3	4
CHP station type	2x150 kW_{el} lean	2x120 kW_{el} lean	2x70 kW_{el} lean	1x70 kW_{el} cat
Flaring [%]	2	5	20	31
CHP station efficiency [%]	35	32	30	30
Losses of methane [MWh]	0,29	0,44	0,58	0,58
Production of electricity [MWh/1.000 inhabitants yr]	20	18	9	4
Power consumption plant total [MWh/1.000 inhabitants yr]	34	34	41	41
Degree of coverage with self produced electricity [%]	59	52	22	11
Environmental impact [Ecoindicator'99 points/MWh]	-3	-1	14	42

Source: Ronchetti et al. 2002, table 0

The following data need to be provided for the key-parameter model calculation: type of pollutant elimination, size of waste water cleaning plant [inhabitants], volume of digester [m³], volume of gasometer [m³], annual production of sewage gas [m³], annual consumption of sewage gas [m³], annual consumption of CHP station of sewage gas [m³], annual consumption of boiler of sewage gas [m³], annual sale of sewage gas [m³], annual electricity consumption [kWh], annual electricity production of CHP station [kWh], total installed electrical power of CHP station [kW], annual full load operating hours [h], annual consumption of lubrication oil [kg], emission of NOx (< 400 + 10 % mg/Nm³) [mg/Nm³], emissions of CO (< 650 + 10 % mg/Nm³) [mg/Nm³], annual consumption of fuel oil [l].

4.2.2 Australian Green Power Accreditation Programme

To be eligible for the Australian Green Power approval, an electricity generator must result in greenhouse gas emission reduction, result in net environmental benefits, be based primarily on a renewable energy source, and meet the eligibility requirements set in the accreditation document.

[13] The environmental impacts of several plants have been calculated. Thereby plants have been clustered into three categories, namely 'Top', 'New' and 'Old'. From 'Old' to 'Top' the capacity and efficiency is increasing and methane losses are decreasing.

All projects are individually assessed and considered for approval against the eligibility criteria given in the accreditation document.

Beside basic criteria which biomass needs to fulfil, as given in Annex 1, a 'Statement of Environmental Effects' needs to address key environmental issues including potential impacts of the project and proposed mitigation, and how the project complies with the principles of Ecological Sustainable Development. Issues which have to be considered for biomass embrace:

- Compliance of generator with relevant 'best-practice' environmental pollution requirements (i.e. noise, air emissions).
- Air quality impacts/improvements – assessment of air emissions levels (e.g. NOx, SOx, dioxins, particulates, ash).
- Water quality impacts – surface and groundwater pollution. On-going monitoring and treatment/control measures proposed.
- Use or disposal of by-products (e.g. ash recycling, landfilling).
- Diversion of material from other disposal mechanisms e.g. pit-burning, landfill.
- Noise, visual amenity, odour and health impacts during construction and operational stages.
- Effect on existing industries or activities (e.g. will the project support marginal activity or encourage expansion?).
- Transmission lines and road access considerations e.g. visual intrusion, habitat fragmentation, and disturbance of historical sites, land-use changes.
- Consideration of production of biomass in a landscape context, with farm management practices linked to regional targets for sustainable environmental and natural resource management.
- Fuel transport – energy used and distance travelled to site.
- Plans for decommissioning stage e.g. rehabilitation of site to its original state, disposal/reuse of materials. Appropriate and transparent community consultation process throughout project development.

4.2.3 Conclusion

Both schemes provide the advantage, that generators are individually assessed and thus a more differentiated assessment is performed. Especially the Australian Green Power Program allows to take site specific issues into account. On the other hand, an accurate and detailed assessment is quite time-consuming and costly. Naturemade provides a very clever system based on the described key-parameter models, which are supported by Excel-based calculation schemes. Thus, the individual plant assessment is not very time consuming. But of course the establishment of the system needed rather extensive scientific support. However, as the system is already established it is recommendable to

make use of the principle in other countries too. According to information provided by naturemade it would be possible to adapt the model. Preferably the adaptation should be accomplished by the developers of the system, which would probably be the most time efficient way, thereby the effort necessary for the adaptation very much depends on the available national data.

Especially for systems, which work with different levels of criteria, like naturemade basic and naturemade star, it is recommendable to introduce such a system of individual generator assessment for the advanced level.

However, it has not been the intention of this study to develop a system based on individual generator assessments, rather to propose general applicable criteria for biomass, which are given in the following chapter.

5 Criteria and indicators for the eligibility of biomass sources and conversion technologies for green electricity schemes

5.1 Introduction

Biomass supply should be consistent with the following general principles:

- Biomass must be derived from renewable sources.
- Bioelectricity costs must be kept low to ensure economic efficiency.
- Non-renewable energy inputs to bioelectricity chains must be kept low to ensure low carbon emissions. (This includes non-renewable energy inputs for extraction, transportation and processing of bio-fuels as well as auxiliary energy for starting operation or maintenance of the electricity plant).
- Best available logistics and conversion technologies must be used to reduce emissions affecting air quality.
- Sustainable forestry and agricultural management practices must be followed to avoid negative impacts on soil and water and to foster biodiversity.
- Biomass to electricity schemes must be designed to benefit rural development and gain broad acceptance by the general public.

However, those principles need to be operationalised by concrete criteria and indicators. Biomass is produced using widely varying strategies related to site-specific parameters, the scope of which makes it difficult in some cases to provide European wide applicable guidance.

For some issues strategies and guidelines need to be developed at a national or regional level. Especially the contribution forestry and dedicated energy crops can provide for increased biomass supply very much depends on area potentials and sustainability goals like increase in area for organic farming and nature conservation. Germany shall serve as one example for a national strategy. The goals of the German government for increase in organic farming, areas for biotope interconnection according to nature conservation act and the planting of erodable arable land with perennial cultures limits the potential of available area for dedicated energy crop plantation in 2010 from 2.5 million ha to 0.2 million ha. However, also on the area for nature conservation biomass can be produced under certain conditions and contribute in considerable amounts to biomass supply (Nitsch et al. 2004). Thus, for Germany in the first place the increased use of available residues is of importance. Green electricity labelling schemes should strive to be consistent with such national goals and strategies to back each other.

Consumers must have confidence that labelled green electricity offers genuine environmental benefit and value for money. In this light, some biomass sources – especially different types of waste – need to be supported by and included in national and Euro-

pean biomass strategies, but they should not necessarily be supported by green electricity labels. This issue will be discussed in more detail in the next chapter.

5.2 Definition of eligible sources

Current umbrella criteria applied by Eugene within the Eugene Standard:

"Biomass sources may include: dedicated energy crops, where crops are grown for energy; residual straw from agriculture; forestry and arboricultural material (wood from existing plantations, natural and semi-natural woodland and urban forestry); biomass residues from landscape and park management; urban waste wood collected separately (unpainted, untreated, or unpressurised wood, not containing plastics, or metals); vegetable processing biomass residues from food industry; woody waste products of the wood industry (e.g. sawdust); and sewage gas. Electricity from all forms of thermochemical processing of unseparated urban solid wastes and sewage sludge is not eligible."

A starting point is provided by Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market, which defines

- "renewable energy sources shall mean renewable non-fossil energy sources (wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases)" and
- "biomass shall mean 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".

This rather broad definition is useable to set up national strategies for increased and improved use of biomass, but should be narrowed to some extend for the purpose of green electricity labels.

In 2005 the draft for development of technical specification CEN/TS 14961 has been issued by CEN defining solid bio-fuels (fuel specifications and classes). Table 1 of the technical specification defines the following classes, which are further divided into third and fourth level subgroups:

- Woody biomass (forests and plantation wood; wood processing industry, by-products and residues; used wood, blends and mixtures);
- Herbaceous biomass (agriculture and horticulture herb including cereal crops, grasses, oil seed crops, root crops, legume crops, flowers and landscape management herbaceous biomass; herb processing industry, by-products and residues; blends and mixtures);

- Fruit biomass (orchard and horticulture fruit; fruit processing industry, by-products and residues, blends and mixtures);
- Blends and mixtures.

The standard shall be used as a core for defining eligible biomass sources. However the following sources shall also be admissible:

- Separated biodegradable waste,
- Animal excrements including manure or chicken litter etc., but no animal body or parts of it.

The following sources shall be excluded:

Landfill gas: Landfill gas is a renewable energy source, since the methane is produced from the organic content of the waste. The use of landfill gas is an important measure according to the savings in methane emissions, but it should be part of waste management. Therefore it can be reasoned that landfill gas, like large hydro power plants, do not need the support of a green tariff. Furthermore, some certification organisations (e.g. ok-power) bring forward the argument that problematical emissions (such as dioxins and furans) are caused by these kind of power plants. Anyway, it can be expected that amounts of landfill gas will decrease, because according to the directive on the landfill of waste[14] the deposition of municipal degradable waste has to be reduced.[15]

The acceptability of liquid biofuels like bioethanol and biodiesel need to be assessed in more detailed, what could not be done within this work package. At least Eugene shouldn't accept imported bioethanol or biodiesel until a solid certification system is in place.

[14] Council directive 1999/31/EC of 26 April 1999 on the landfill of waste.

[15] Article 5 of the directive states, that Member States shall set up a national strategy for the implementation of the reduction of biodegradable waste going to landfills. This strategy shall ensure that:
(a) not later than five years after the date laid down in Article 18(1), biodegradable municipal waste going to landfills must be reduced to 75% of the total amount (by weight) of biodegradable municipal waste produced in 1995 or the latest year before 1995 for which standardised Eurostat data is available
(b) not later than eight years after the date laid down in Article 18(1), biodegradable municipal waste going to landfills must be reduced to 50% of the total amount (by weight) of biodegradable municipal waste produced in 1995 or the latest year before 1995 for which standardised Eurostat data is available;
(c) not later than 15 years after the date laid down in Article 18(1), biodegradable municipal waste going to landfills must be reduced to 35 % of the total amount (by weight) of biodegradable municipal waste produced in 1995 or the latest year before 1995 for which standardised Eurostat data is available.
Article 18(1): Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive not later than two years after its entry into force.

Controversial issue:

Sewage gas respectively the digestion sewage sludge is treated very different by the existing green electricity labels in Europe.

Positions about sewage gas span the range from:

- Sewage gas should be part of waste management and don't need the support of a green tariff;
- As in the case of naturemade (see chapter 4.2.1.3): digestion of sewage sludge is preferable to incineration and existing facilities should be supported within given limits by green electricity labels;
- Digestion of sewage sludge is environmental preferable compared to incineration and should thus be fully included in green electricity labels.

Thus, it is recommended that sewage gas shall not be excluded. However for the accreditation by Eugene national labels shall provide a sound argumentation, why and under which conditions sewage gas is eligible.

Proposal for the Eligibility of Sources:[16]

Eligible biomass sources for the production of green electricity are defined as follows:

Solid biomass according to CEN/TS 14961:2005, comprising

- Woody biomass (forests and plantation wood; wood processing industry, by-products and residues; used wood, blends and mixtures);
- Herbaceous biomass (agriculture and horticulture herb including cereal crops, grasses, oil seed crops, root crops, legume crops, flowers and landscape management herbaceous biomass; herb processing industry, by-products and residues; blends and mixtures);
- Fruit biomass (orchard and horticulture fruit; fruit processing industry, by-products and residues, blends and mixtures);
- Blends and mixtures.

Furthermore, the following sources are admissible:

- Separated biodegradable waste (only for use in biogas plants),
- Animal excrements, e.g. manure or chicken litter etc. (but no animal body or parts of it).
- Sewage gas is admissible as far as the label organisations applying for the accreditation by Eugene provide a sound argumentation, why and under which conditions sewage gas is eligible.

[16] Each of the eligible sources underlie additional criteria which are described in the following chapters.

5.3 Forestry

5.3.1 Introduction

As it has been shown in chapter 3 forestry byproducts & wood fuels are an important biomass source and they provide still unused potential.

The most recent Wood Energy Barometer (2005) stated that the primary energy wood production (taken in the large sense to include wood waste, black liquors and solid waste from crop harvest) in the EU25 has been 55.4 Mtoe in 2004. Also the use of wood and wood by-products to produce electricity is growing rapidly reaching 35 TWh in 2004.

Woody biomass for energy purposes may come from:

- Short rotation plantations,
- Plantations (= long rotation plantations),
- Forest – Semi-natural or natural forest,
- Other wooded land.

The forest resources in Europe are increasing both in area and in growing stock. Presently the share of forest and other wooded land of the total area in Europe (MCPFE) is 47 % ranging from 1 % in Malta to 68 % in Finland or Sweden, whereby the annual increase in area is about 0.1 %. The annual increment amounts to 2287 million m³. Of this increment only about one quarter is annually felled in Europe, while excluding the Russian Federation it is more than half. More than two-thirds of Europe's forest are semi-natural (MCPFE 2003). While in some countries the utilisation rate of the annual increment is already rather high, e.g. 82 % in Finland or 70 % in Sweden it is moderate in others, e.g. 52 % in Spain or 35 % in Greece (Máthé & Pollard 2005). However, despite the high utilization rate in Finland or Sweden, their theoretical technical potential of unused increment and unused rest wood of fellings is still high compared to other European countries.

Current umbrella criteria applied by Eugene within the Eugene Standard:

"Dedicated energy crops used in new generating stations shall come from FSC (Forest Stewardship Council) certified sources. A generation station is 'new' if it has entered operation after January 1, 2001. For existing generating stations using wood (from dedicated energy crops and forestry and arboricultural material), the plant will have to draw an action plan to ensure that the wood used will be purchased from FSC certified sources within a time of 4 years."

5.3.2 Sustainable forest management

5.3.2.1 Sustainable forest management certification

Forests per se are not dealt with at the level of EU policy, however there are a variety of EU legislation and policy initiatives, e.g. the EU Forestry Strategy adopted in 1998, which puts forward as its overall principles the application of sustainable forest management and the multifunctional role of forests.

Principles and measures of Sustainable Forest Management in Europe have been defined by the 2nd Ministerial Conference on the Protection of Forests in Europe (Helsinki, 16-17 June 1993), the Pan-European Operational Level Guidelines for Sustainable Forest Management, as endorsed by the 3rd Ministerial Conference on the Protection of Forests in Europe (Lisbon, 2-4 June 1998) and the Improved Pan-European Indicators for SFM, adopted at the MCPFE Expert Level Meeting of 7-8 October 2002 that were endorsed at 4th Ministerial Conference on the Protection of Forests in Europe (Vienna, 28-30 April 2003). Outside of Europe UNCED Forest Principles (Rio de Janeiro, June 1992) and, where applicable, the criteria or guidelines for sustainable forest management as adopted under the respective international and regional initiatives (ITTO, Montreal Process, Tarapoto Process, UNEP/FAO Dry-Zone Africa Initiative) provide guidance for sustainable forest management.

Criteria of certification schemes for sustainable management of forests go beyond those established principles respectively make them operational by giving specific targets for performance based indicators. In Europe wood may be certified by two schemes, namely PEFC[17] (Programme for the Endorsement of Forest Certification schemes formerly Pan European Forest Certification scheme) or FSC[18] (Forest Stewardship Council). In September 2005 32,848,396 ha[19] have been certified by FSC within Europe, the largest areas being in Sweden, Poland and Russia.[20] PEFC certified forest area in Europe amounted to 56,185,258 ha, with largest areas being in Finland, Norway, Germany and Sweden.[21]

The only comparison between the two certification schemes in general is provided by Forests and the European Union Resource Network (FERN 2004).[22] However, there might be comparisons available or in preparation (e.g. Austria) on a national basis, due to the fact, that there are considerable variations between the national PEFC schemes.

The main conclusions of the FERN-study regarding FSC and PEFC are:

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17 www.pefc.org

18 www.fsc.org

19 Forest area in Europe (undisturbed by man, semi-natural forest and plantations) amounts to 190.008.000 ha without Russian Federation, which has 810.367.000 ha (MCPFE 2003).

20 www.certified-forests.org/data/eur_table.htm, 29.9.2005

21 www.pefc.cz/register/statistics.asp, 29.9.2005

22 www.fern.org/media/documents/document_1890_1900.pdf

"FSC remains by far the most independent, rigorous and, therefore, credible certification system. Its national standards are performance-based and their development requires full participation of all interest groups. The FSC's baseline prohibits the conversion of forests to plantations. GMO trees are explicitly excluded and the standard includes forest protection measures. FSC is also most advanced in recognition of forest peoples' rights. It rightfully uses a consumer label. For the FSC to retain the confidence of the environmental and social movement for the future, however, it needs to enforce stricter implementation of its procedures and seriously address the problems associated with the certification of plantations" (FERN 2004, p. 21).

"Given the variability in the national programmes admitted, the PEFC does not represent a consistent and credible performance-based standard for forest certification. It is, therefore, not suitable for a product label. Lack of participation of other stakeholder groups in standard-setting procedures and lack of transparency are also problematic. Although PEFC seems to be trying to improve its procedures and over time, hopefully, its standards, it remains to be seen whether this process will continue if it starts endorsing many of the less credible schemes outside Europe" (FERN 2004, p. 22).

According to the variations between the national PEFC schemes it is stated, that "the PEFC is the most difficult scheme to assess properly because of the large variations between the national schemes. It is a great weakness of the PEFC scheme that the threshold for endorsement is so low, that most certification schemes can qualify. The PEFC umbrella, therefore, includes certification schemes such as PEFC Sweden, which certifies at FMU[23] level and has clear minimum performance standards – even though they are seen as insufficient by environmental NGOs and Indigenous Peoples. The PEFC umbrella also includes PEFC France, which has no clear minimum performance standards, does not certify at FMU level and does not require any field visits. This does not bode well for the forests certified by tropical certification schemes that now want to accede to the PEFC. Transparency is a problem as summaries of certification reports are in most cases not available. The certification process itself is also limited, as field visits are not in all cases required" (FERN 2004, p. 22).

The study has been strongly criticised by PEFC[24], including the following points (PEFC 2004):

"FERN itself is a member of FSC, and funded the study, it would have been more honest if the report had declared these facts to the readers."

"FERN's criteria are inviting schemes to contravene international rules on certification and accreditation. As a professional forest certification scheme PEFC will always prefer to follow international certification and accreditation rules to ensure credibility."

"FERN knows that all PEFC endorsed schemes have been assessed against the Pan European Operational Level Guidelines (PEOLG) of the Ministerial Conference on the

[23] FMU = Forest management unit

[24] www.pefc.org/internet/resources/5_1184_1228_file.1355.pdf

Protection of Forests of Europe (MCPFE), which the FERN report agrees, include performance-based criteria. Therefore FERN's claim, that PEFC schemes do not include performance-based criteria, is wrong."

Within the study on hand it is not possible to compare the FSC standard with the different national PEFC systems. Thus, it has to be concluded, that the FSC standard shall be set as the reference. However, if the equivalence of other certifications (e.g. PEFC) or the national forest law standard can be proven at a national basis, it shall be accepted as well in the course of the accreditation of national green electricity labels by Eugene.

International Energy Agency (IEA) Bioenergy task 31, Biomass Production for Energy from Sustainable Forestry, is dedicated to the development of sustainable forest bioenergy production systems, and to the dissemination of technical information to key stakeholders. However, there is not yet detailed information or guidance available, a first outline has been presented at the World Renewable Energy Congress in May 2005 in Aberdeen, UK (Richardson et al. 2005). Studies and recommendations of this task might help in the future to further improve biomass standards.

5.3.2.2 Plantations

For the time being plantations play only a minor role in Europe, covering 3 % of the forest area, while excluding Russian Federation the area of plantations is about 9 % of forest area (MCPFE 2003). They are defined as forest stands established by planting or/and seeding in the process of afforestation or reforestation. They are either of introduced species (all planted stands), or intensively managed stands of indigenous species, which meet all the following criteria: one or two species at plantation, even age class, regular spacing. (FAO 2004).

European countries which reported high percentages of their forests as plantation forests in Forest Resources Assessment 2000 included Ireland and Malta, with 100 percent; Denmark, 92 percent; United Kingdom, 57 percent and Belgium, 46 percent. In contrast, Finland, Austria, Germany, Czech Republic and Liechtenstein reported having no plantation forests. Presumably, significant areas of forests in these countries were considered semi-natural forests and thus, not reported as plantation forests. Conversely, neighbouring countries with seemingly similar forestry practices and philosophies reported significant plantation forest areas (FAO 2000). This refers probably to a different interpretation of the definition.

Well-managed plantations can supply sustainable sources of fuel and raw materials, thus taking the pressure off natural forests and non-renewable resources like fossil fuels. Unfortunately, many plantations established today are causing a range of environmental and social problems, including loss of biodiversity, soil erosion and displacement of local people. IUCN and WWF have identified the need to develop and implement strong guidelines and codes of practice regarding plantation establishment (IUCN & WWF 2000).

The FSC certification scheme also involves the certification of plantations. Criteria therefore are laid down in principle 10 of the FSC Principles and Criteria.[25] 6 million hectares of plantation and a further 17 million ha of mixed plantation and natural forest have been certified worldwide by FSC. As some FSC plantations certificates have been strongly criticised, FSC launched the FSC plantation review process.[26] It shall provide clear guidance and/or standards for their future implementation and shall be finalised in 2006.

Short rotation tree plantations (SRTP) on former agricultural land have an intermediate position between agriculture and forestry. Although they are covered by the FAO forest definition,[27] due to the potentially non permanent nature of land use they may not be considered as forest nor as Other Wooded Land. "Moreover their re-conversion into cropland may be in accordance with the MS law … It was also mentioned that SRTP classification as forest or as cropland may differ depend on national systems for classification of land use" (ECCP-Working Group on Forest Sinks). Thus they are treated in chapter 5.5.

5.3.2.3 Conclusion

Woody bio-fuel at present consists mainly of residual wood from industrial manufacturing processes, logging operations and thinnings. However, there exist also forests with low quality wood, which is used to the main extend as fuel wood. Nevertheless, under normal circumstances the amount and prices of fuel wood do not govern how a forest is managed, as the forest industry's raw materials are generally more valuable than energy

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[25] FSC Principles and Criteria for Forest Stewardship, FSC reference code: FSC-STD-01-001 (April 2004)

[26] www.fsc.org/en/work_in_progress/plantations_review

[27] Forest: Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.

Explanatory notes:

1. Forest is determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 meters in situ. Areas under reforestation that have not yet reached but are expected to reach a canopy cover of 10 percent and a tree height of 5 m are included, as are temporarily unstocked areas, resulting from human intervention or natural causes, which are expected to regenerate.
2. Includes areas with bamboo and palms provided that height and canopy cover criteria are met.
3. Includes forest roads, firebreaks and other small open areas; forest in national parks, nature reserves and other protected areas such as those of specific scientific, historical, cultural or spiritual interest.
4. Includes windbreaks, shelterbelts and corridors of trees with an area of more than 0.5 ha and width of more than 20 m.
5. Includes plantations primarily used for forestry or protection purposes, such as rubberwood plantations and cork oak stands.
6. Excludes tree stands in agricultural production systems, for example in fruit plantations and agroforestry systems. The term also excludes trees in urban parks and gardens (FAO 2004).

wood. Industry's raw materials thus govern demand and the obtaining of wood from the forests.

There is a need to guarantee the consumers of labelled green electricity, that all used wood fuel is coming from sustainably managed forests, which is guaranteed by third party certification. But according to the reasons given above the demand for fuel wood from certified sustainable forestry might not be powerful enough – according to the considerable price differences between fuel wood and industrial wood, to encourage the certification of forests. On the other hand in some countries the area of certified forests is still very limited, thus for the time being the requirement of a certification for all used fuel wood, would limit the supply too much. Therefore a multilevel approach is suggested in the following proposal taking into account the specific situations of the respective countries.

Proposal:

As a general principle: All wood fuel including wood fuel from thinning and residues from harvesting operations shall originate from forests that are managed so as to implement the principles and measures aimed at ensuring sustainable forest management.

For wood fuel from plantations and imported wood fuel: sustainable forest management shall be certified according to FSC (Forest Stewardship Council). Other certificates or standards should be accepted, as far as it can be proven that an equivalent quality is secured.

National certification schemes of green electricity in countries with a sufficient area of certified sustainably managed forest, should for all fuel wood demand a third party certification, thereby referring to the FSC label. Other certificates or standards should be accepted, as far as it can be proven that an equivalent quality is secured. The argumentation has to be provided by the national label applying for Eugene accreditation and need to be accepted by the Eugene Board. The availability of certified wood fuel shall be regularly reviewed according to the reviewing period of the national certification scheme of green electricity, however at least every fourth year and third party certification shall be required as soon as there is sufficient supply.

For wood fuel from non certified forest, the criteria as given in chapter 0 shall be applied.

5.3.3 Wood fuel from uncertified forests

For wood fuel coming from not certified forest – for reasons given in the chapter above, the criteria proposed in chapter 5.3.3.1 and 5.3.3.2 shall be applied. Chapter 0 raises further important issues, however those criteria are difficult to operationalise and to prove for the time being. The following chapters are not valid for wood fuel from plantations and imported wood fuel, as they need to come from certified forests.

5.3.3.1 Sustainable management and excluded sources

Proposal:

All wood fuel including wood fuel from thinning and residues from harvesting operations shall originate from forests that are managed so as to implement the principles and measures aimed at ensuring sustainable forest management. In Europe, the principles and measures referred to above shall at least correspond to the definition of Sustainable Forestry Management that was adopted in Resolution 1 of the 2nd Ministerial Conference on the Protection of Forests in Europe (Helsinki, 16-17 June 1993), the Pan-European Operational Level Guidelines for Sustainable Forest Management, as endorsed by the 3rd Ministerial Conference on the Protection of Forests in Europe (Lisbon, 2-4 June 1998) and the Improved Pan-European Indicators for SFM, adopted at the MCPFE Expert Level Meeting of 7-8 October 2002 that were endorsed at 4th Ministerial Conference on the Protection of Forests in Europe (Vienna, 28-30 April 2003).

Proposal:

- Wood shall not originate from illegal harvesting
  - Illegally harvested wood: wood that is harvested, traded or transported in a way that is in breach with applicable national regulations (such regulations can for example address CITES species[28], money laundering, corruption and bribery, and other relevant national regulations).
- Wood shall not originate from High Conservation Value Forests

High Conservation Value Forests (HCVF) are forests that possess one or more of the following attributes:

- forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia)
- forest areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance
- forest areas that are in or contain rare, threatened or endangered ecosystems
- forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control)
- forest areas fundamental to meeting basic needs of local communities (e.g. subsistence, health)

[28] CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora, www.cites.org/

- forest areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities)

Detailed guidance about HCVF is available from ProForest.[29]

5.3.3.2 Soil fertility and soil protection

Needles, leaves and branches contain the majority of nutrients compared to stems. Thus increasing removals of logging residues would be accompanied by a loss of nutrients and reduce soil organic matter. Furthermore good logging technique "would require a proportion of branches to be used as 'mats' on forwarder routes to protect the soil, therefore limiting total removals. In most of the cases logging residues also contribute to the physical protection of the soil by decreasing the direct exposure of the soil to rainwater, direct sun or wind reducing the effects of factors producing erosions" (Máthé & Pollard 2005).

Thus, certification schemes for sustainable forestry restrict the removal of needles, leaves and branches (e.g. PEFC – Austria: a systematic removal of leaves and branches at the same place is permitted every fourth year at the maximum; FSC Germany: Removal of unused biomass is minimized; branches and bark pieces remain in the forest, as far as possible.)

In Finland guidelines for harvesting of wood have been established, which are accepted by all parties involved. Soil types with poor nutrient level are listed and it is not allowed to take forest residues from those types (Helynen 2005). In general 30 % of all energy wood should be left into the forest to take care of the nutrients balance (Tepponen 2005).

Another way to secure soil fertility is returning of ash, which however has not been regarded as useful measure by some of the interviewed experts. Up to now only the Swedish green electricity label requires returning of ash:

"After burning bio-fuel, the nutrients in the ash must be returned to the type of ground from which it has originated. The proportion returned must be sufficient to reasonably compensate for the fuel that has been removed. The ash must be returned in a form that allows it to be released slowly. The guidelines on methods and limit values laid down by the Swedish National Environment Protection Board and the Swedish National Board of Forestry are to be followed, or the equivalent laws and guidelines in the country in which the electricity is produced.

The content in the ash of nutrients, trace elements, metals and other environmentally hazardous substances shall be checked regularly. Biomass that has been derived from land that is acidified or contaminated can be exempted from the requirement to return

[29] www.proforest.net/index3.htm

ash. If the ash does not fulfil the limiting values for spreadable ash set by the Swedish National Board of Forestry or equivalent in the country where burning takes place, the electricity production can still be approved for Good Environmental Choice (Bra Miljöval) labelled supplies. If possible the ash should be cleaned and subsequently returned or dealt with in the best possible way" (The Swedish Society for nature Conservation 2001).

The Finnish Association for Nature Conservation does not at present set any terms and conditions for the returning of ash however it is possible that the next generation of criteria will include such requirements (The Finish Association for Nature Conservation 2000).

Proposal:

No removal of needles, foliage and roots. Also forest residues, like branches and others shall be left at the site as far as possible to maintain soil fertility and to reduce risk of erosion. Thereby measures have to be adapted to site characteristics. Or ash quality from conversion processes should be monitored and where possible nutrient-rich ash should be recycled back to the land. For both aspects national guidelines have to be taken into account as far as available.

5.3.3.3 Further ecological and environmental concerns of forest biomass use for energy production

There are some studies available, which identify ecological and environmental constraints of forest biomass utilisation or consider them in the calculation of available potential of forestry biomass for energy use (e.g. Máthé & Pollard 2005, Fritsche et al. 2004, EEA 2005).

One important issue is the amount of dead wood. Deadwood in form of snags (dead standing trees) and logs (dead lying trees) is a habitat for a wide array of organisms and after humification an important component of forest soil. Many species are dependent, during some part of their life cycle, upon dead or dying wood of moribund or dead trees (standing and fallen), or upon wood-inhabiting fungi or other species. Because of lack of dead wood many of the dependent species are endangered (MCPFE 2002). According to MCPFE (2003) harmonised data on the volume of deadwood are so far not yet available in most European countries, but it is expected that appropriate data will be collected soon. A WWF report (Dudley et al. 2004) states on the basis of some country examples, that deadwood is at low level in many European countries (e.g. national average in Sweden 6.1 m^3/ha, national average in France 2.2 m^3/ha, national average in Switzerland 12 m^3/ha). However, figures are difficult to compare due to different sampling methods. The report recommends a deadwood indicator for European boreal and temperate forests between 20-30 m^3/ha or 3 to 8 % of total volume of wood as a reasonable amount, divided between standing dead trees and down logs.

A guide of Forest Enterprise (2002), an agency of the Forestry Commission of the UK, provides detailed guidance to manage deadwood with respect to 5 sub-categories of woodland. In general 6-10 % dead wood of total stems per ha are qualified as a moderate density, while 11 % or more are perceived as high density.

Further issues are pest management and the use of fertilizers. Management systems shall promote the development and adoption of environmentally friendly non-chemical methods of pest management and strive to avoid the use of chemical pesticides (FSC criteria 6.6). In unavoidable cases use of pesticides shall be in compliance with FSC-IP-0001 (Chemical Pesticides in certified forests: interpretation of the FSC principles & criteria).

However it doesn't seem possible to operationalise these criteria within green electricity labels.

5.4 Genetically modified plants

Genetic engineering remains very controversial. As risk assessments prove, for certain species these genetically modified organisms (GMO's) can spread through nature and interbreed with natural organisms, thereby contaminating non 'GE' environments and future generations in an unforeseeable and uncontrollable way. It is not possible to provide a differentiated scientific discussion about this area within this report. However, as long as genetic engineering is such a controversial issue within EU member states and especially combated by large Environmental organisations, GMO's need to be excluded from green electricity label schemes.

Proposal:

The use of genetically modified plants (agricultural crops as well as trees) for electricity production is not permitted.

5.5 Agriculture

5.5.1 Introduction

The increased use of agricultural crops and residues for energy production may provide chances for nature conservation and positive impacts on flora and fauna. Examples of such positive effects are the improved maintenance of biotopes like hedges, boundary ridges, extensive grassland; improved structuring of landscape in areas with low biodiversity or protection against erosion by perennial energy crops. On the other hand, also adverse effects could be caused and should be limited. Improvement compared to the status quo is very much dependent on the actual use of the area, e.g. if energy crops are planted on farmland which has been used for intensive production or on set-aside land.

Energy plants also offer the possibility to be planted under extensive conditions as less requirements need to be fulfilled compared to the production of food, which could result in less use of pesticides or fertilizers.

Biomass used for electricity production at present is provided by agriculture in the following ways:

- Residues of agriculture:
  - Dry lignocellulosic agricultural residues used for combustion (e.g. straw),
  - Green agricultural residues, which can be used in digestion plants (e.g. beet leaf),
  - Livestock waste.
- Dedicated energy crops:
  - Woody biomass produced in short rotation plantations (mainly poplar and willow),
  - Dry Lignocellulosic biomass used for combustion (e.g. miscanthus, whole grain plants, etc.),
  - Biomass used in digestion plants (e.g. maize, grass, beets or silage thereof).

Energy crops may be cultivated on productive sites or on less productive sites (Rode et al. 2005). In the first case three variants are possible:

- Production of energy crops in rotation with food crops,
- Production of energy crops – one main crop,
- Production of energy crops – different crops.

On less productive sites mainly extensive production is used to balance the lower yield by lower material and work input. Extensive production may be applied by

- Cultivation of annual crops,
- Cultivation of perennial crops.

Current umbrella criteria applied by Eugene within the Eugene Standard:

"For bio-fuel such as straw, and their equivalent, which are cultivated on agriculture land, cultivation should be carried out with the goal to reduce water and pesticides use, and taking into consideration national best practices."

5.5.2 Sustainable Farming Practices

Agriculture is challenged to produce high quality food, materials used in industrial processes, energy, to keep rural economies alive while taking care of environmental impacts, conservation of finite resources, preserving biodiversity and traditional land-

scapes, animal welfare and social responsibility. Those objectives are supported by different measures and systems in the European Union.

The sustainability of both agriculture and the environment is a key policy objective of today's common agricultural policy (CAP). The 2003 CAP reform put greater emphasis on cross-compliance and the full payment of direct aid should be linked to compliance with rules that serve to incorporate basic standards for the environment, food safety, animal health and welfare and good agricultural and environmental condition.[30]

The most far reaching integration of sustainability issues is provided by organic farming. Since the EU rules on organic farming came into force in 1992, thousands of farms have been converted to this system with a growing rate between 25 and 30 % a year. However, of the total EU utilised agricultural area (UAA) organic farming just reached about 3 % in 2000.[31]

Integrated farming could be placed on the scale between responsible conventional production as defined by the Codes of Good Agricultural Practice on the one hand and organic farming on the other hand. In 1993 the International Organisation for Biological and Integrated Control of Noxious Animals and Plants (IOBC) redefined and published a conceptual framework for Integrated Production. More recently, a common codex for integrated farming was developed in January 2001 by the members of the European Initiative for Sustainable Development in Agriculture (EISA 2001).[32] To make this codex operational 'Integrated Farming Obligations' have been presented in 2003.[33]

In 2002 a report about the status on integrated crop management systems in the EU has been compiled on behalf of the European Commission (Bradley et al. 2002).[34] The relationship between Integrated Pest Management (IPM), Integrated Crop Management (ICM) and Integrated Farming Systems (IFS) / Integrated Production (IP) is explained in the report as follows:

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[30] From 2005, all farmers receiving direct payments will be subject to compulsory cross-compliance (Council Regulation No 1782/2003 and Commission Regulation No 796/2004). 19 legislative acts applying directly at the farm level in the fields of environment, public, animal and plant health and animal welfare have been established and farmers will be sanctioned in case of non-compliance (partial or entire reduction of direct support). Beneficiaries of direct payments will also be obliged to keep land in good agricultural and environmental conditions. These conditions will be defined by Member States, and should include standards related to soil protection, maintenance of soil organic matter and soil structure, and maintenance of habitats and landscape, including the protection of permanent pasture. In addition, Member States must also ensure that there is no significant decrease in their total permanent pasture area, if necessary by prohibiting its conversion to arable land (http://europa.eu.int/comm/agriculture/envir/index_en.htm).

[31] http://europa.eu.int/comm/agriculture/qual/organic/index_en.htm, 2.10.2005

[32] www.sustainable-agriculture.org/

[33] www.sustainable-agriculture.org/ -> obligations

[34] http://europa.eu.int/comm/environment/agriculture/pdf/icm_finalreport.pdf

Figure 3: Relationsship between ICM and related terms

Source: Bradley et al. 2002

IFS is often used interchangeably with ICM, however, if livestock are present, IFS or IP should be used, if not, ICM is the appropriate term. In the European Member States a variety of different systems have been established. The comparison of selected systems revealed, that "fertilisation and plant protection restrictions/guidelines are virtually universal (appearing in 95 % and 93 % of schemes respectively), while protocol elements referring to soil husbandry and tillage practices and crop rotation and varietal choice appear in more than half the examples. More than a third of the system protocols refer to harvest and post-harvest and irrigation restrictions" (Bradley et al. 2002, p. 106).

However, as it is the fact for organic farming the proportion of ICM in the EU is also small, under 3 % of Utilisable Agricultural Area (UAA).

Proposal:

Biomass from dedicated cultivation need to comply with guidelines for integrated crop protection.

5.5.3 Special requirements

Grassland

Since permanent pasture has a positive environmental effect European Member States must also ensure that there is no significant decrease in their total permanent pasture area, if necessary by prohibiting its conversion to arable land. Although this requirement is mainly secured by national regulations it should be reemphasized also by biomass standards.

Proposal:

Energy crops shall not be produced on arable land which has been gained by conversion of pasture or grassland.

Withdrawal of straw or other agricultural residues

Although cereal straw contains relatively low concentrations of nutrients compared to straw of rapeseed, maize or legumes, it nevertheless contains valuable nutrients which are of importance for crop nutrition. Furthermore, straw contributes to humus formation. Increased withdrawal of straw or other agricultural residues may thus lead in the long term to nutrient deficiency and decrease of humus content.

Proposal:

The withdrawal of straw or other agricultural residues for energetic use has to be adopted site-related according to the nutrient and humus level in accordance with Good Agricultural Practice to secure soil fertility in a sustainable manner. Soil fertility can also be ensured by returning of fermenting residues from biomass production to the arable land.

Especially advantageous cultivation methods

There exist a variety of measures to prevent adverse effects on soil fertility, soil erosion and soil compression by special methods of cultivation or the choice of cultivated crops. It seems to be to restrictive to require that such methods need to be applied for dedicated energy crops. However, it could be discussed if there are possibilities to honour the use of such methods within a certification scheme.

Especially advantageous cultivation methods / crops are:

- Recirculation of biogas slurry to keep the nutrients in the natural cycle and to reduce the use of fertiliser
- Multi-crop-cultivation ('Mehrkulturnutzung')[35]
- Extensive cultivation
- Perennial crops[36]

[35] Multi-crop-cultivation ('Mehrkulturnutzung'), (Rode et al. 2005, p. 124-127): In such a system two or more species are cultivated a year after each other, which are in the most cases two main crops or main crops in combination with intertillage. For energy purposes the first crop may be harvested in an unripe state. The second main fruit is seeded directly into the stubbles of the first crop. Although this cultivation method is not yet widely applied and an comprehensive assessment of effects is not yet available, the following advantages are reported: decreased potential of erosion; use of variety of useful plants; no need of use of fungicides and insecticides, as the crops are harvest at a stage where pest has just little effect on yields; the growth of wild plants may be tolerated to some extend.

5.5.4 Short rotation tree plantations

SRTC (short rotation tree plantations, or also SRC = short rotation coppice) consists of densely planted, high-yielding varieties of trees, e.g. willow or poplar, harvested on a 2-5 year cycle, although commonly every 3 or 4 years. A plantation could be viable for up to 30 years before re-planting becomes necessary, and in the fourth year before harvesting the crops may reach a height of about 7 to 8 metres. As already described in the chapter above, Reinhardt and Scheurlen (2004) investigated in a qualitative manner based on expert judgements the impacts of the cultivation of perennial crops (miscanthus, poplar in short rotation plantations) compared to permanent fallow and found a neutral overall appraisal of the impacts.

However, when established by conversion of existing, conventional forest the impacts of SRTC may be negative.

In detail the following potential effects have to be considered and limited (if necessary):

SRC has large areas of open ground between the crop during the phase of establishment, which might allow soil erosion.

According to weed control controversial statements have been given. Reinhardt & Scheurlen (2004, p.28) state that weed control is only necessary during establishment of plantation and can be performed by mechanical measures. In general no risk of burden by pesticides has been identified. In contrast the 'Best Practice Guide' from DEFRA (2002) gives recommendations for the use of herbicides and pesticides for establishment of willow or poplar plantations.

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[36] Reinhardt and Scheurlen (2004) investigated in a qualitative manner based on expert judgements the impacts of the cultivation of annual crops compared to rotation fallow and of perennial crops compared to permanent fallow. In the case of annual crops compared to rotation fallow mainly negative impacts have been found, while the cultivation of perennial crops (miscanthus, poplar in short rotation plantations) compared to permanent fallow has been appraised as neutral.

Furthermore a qualitative assessment of annual crops has been established.

Risk for nature/landscape	Wheat	Triticale	Rapeseed	Sunflower	Maize	Sugar Beet
Erosion	A	A	B	C	D	E
Densification of harm	A	A	A	A	C	E
Eutrophication	A	A	B	B	C	B
Load of pesticides	A	A	C	A	C	A
Impact on surface waters	A	A	B	B	C	B
Impact on ground water	A	A	B	C	C	C
Loss of habitat and biodiversity	B	B	A	A	B	B
Relative Assessment						
Nature and Environment	1	1	2	2	2-3	3

Legend:

Low risk: A -> High risk: E

Overall assessment: 1 = come off well, 2 = medium, 3 = unfavourable

Compared to fallow, meadow or farmland an increased number of species has been found in SRC contributing to an increased biodiversity (for a summary of detailed findings see Rode et al. 2005; Reinhardt & Scheurlen 2004).

SRC has an effect on natural scenery, as crops reach a height of about 7 or 8 metres and they are harvested, which means cut back to ground level, every 3rd or 4th year. Thus it should be carefully assessed in which way the plantation fits into the existing cultural landscape. A plantation close to existing forests provides advantages, whereby negative impacts on skirts of the forest should be avoided.

Although a detailed analysis of effects and recommendations can be found in the cited studies, no criteria could be identified which seem to be operational within green electricity labels.

The ECCP-Working Group on Forest Sinks states in its final report, that "there is a clear need to define best practice and develop guidelines" for short rotation tree plantation (ECCP-Working Group on Forest Sinks 2002).

Proposal:

Short rotation tree plantations should not be established on forest areas or on arable land which has been gained by conversion of pasture or grassland.

5.5.5 Livestock waste and animal husbandry

The conditions under which animals are housed, reared and transported in agricultural practice are sources of growing public concern. The Dutch Milieukeur label for green electricity is the only green electricity label which set requirement according to animal husbandry. It demands that animal or animal-related biomass is permitted for the label only if the biomass applied has been gathered from processes in which the main product fulfils the criteria of Organic Farming (EKO) or Milieukeur Farming, whereby Milieukeur works on the principle of integrated farming.

Beside animal welfare the criteria of Milieukeur consider also environmental effects and others relevant for animal husbandry. Specific criteria are defined for all relevant animal species. For example for pigs limits for nitrogen excretion, phosphate excretion and energy use of the stable as well as measures to reduce ammonia emissions need to be fulfilled. Further criteria which go beyond basic requirement are assessed by a point system. Very detailed guidance is also given for animal welfare including again basic requirements and facultative requirements assessed by points. In the case of pigs criteria include transport distances and conditions, space requirements, renunciation of castration and much more. However, this well established system is a national one and might not be applicable at a European level for the time being, but may provide an impression how detailed guidance may look like.

Thus, at least general principles of integrated farming for animal husbandry shall be demanded. Integrated Farming employs techniques of livestock management that main-

tain animals in good health, comfort and low stress, by feeding, handling, housing and transporting them under conditions that reflect proper care and concern for their welfare. It requires (EISA 2001):

- Health and Hygiene
  - Minimising risk of infection and disease by good husbandry practices in pasture management and stocking density.
  - Choosing clean feeding sites and provide adequate, clean bedding at all times.
  - Ensuring good hygiene standards in housing by proper cleansing and disinfection.
  - Complying with social needs of livestock in terms of group size and composition, movements and habits.
  - Monitoring disease incidence and treating sick or injured animals promptly.
  - Using only officially registered veterinary medicinal products in accordance with directions, and stored safely and legally, as directed.
  - Complying with withdrawal periods for antibiotics and other medications.
  - Implementing mandatory identification schemes and keeping up-to-date records of all animal movements.
  - Recording details of all medicinal treatments.
  - Seek appropriate veterinary advice to avoid disease and health problems.
- Nutrition
  - Providing a nutritional regime that contains all nutrients, minerals and vitamins needed for individual animal requirements, designed to meet performance targets.
  - Creating a feed plan to monitor and record nutritional requirements and complying with sound nutrition standards.
  - Checking and recording the source, composition and quality of all animal feeds.
  - Managing feed production and storage to maintain quality.
- Housing
  - Ensuring compliance with local legislation.
  - Providing adequate ventilation, lighting and space for the free movement of stock (in accordance with legislation and any local codes of practice).
  - Ensuring correct maintenance of temperature.
  - Providing access to sufficient fresh water.
  - Ensuring clean lying areas and adequate drainage.

- Ensure handling, loading and transport facilities are adequate and safe.

According to Edelmann et al. (2001) emissions of CH_4, N_2O and NH_3 are important environmental impacts of biogas production from manure. They can be considerably reduced by covering the storing tank and by applying manure with accurate methods at appropriate time (see chapter 4.2.1.1).

Proposal:

If livestock waste (manure, chicken litter, etc.) is used for energy production, the conditions under which animals are housed and reared should comply with the principles of Integrated Farming.

Emissions of CH_4, N_2O and NH_3 by usage of manure have to be reduced by covering the storing tank and by applying manure with accurate methods at appropriate time (e.g. trailhose or similar device).

5.6 Technology

5.6.1 Overall Efficiency

It is of importance that all forms of electricity are produced by high-efficiency plants. Co-generation of heat and electricity is environmentally favourable, however the use of biomass in facilities that produce electricity and heat together depends on the adequate heat demand and the development of heat distribution networks. However as the use of biomass with a low efficiency would be a underutilization of biomass fuel, the overall efficiency of facilities shall be 60 % at the minimum. Plants, where co-firing of biomass is applied shall provide a higher efficiency of 70 % (see also chapter 5.6.3).

Proposal:

In the annual average the plant need to met an overall efficiency of at least 60 %.

5.6.2 Emission standards

The Dutch Ecolabel Milieukeur for green electricity requires certain emission standards, while all other green electricity labels of Europe do not, except for CHP with natural gas (Eugene, ok power).

In the Netherlands NGO's have been proposed during the development of the national label criteria for green electricity (Bauen et. al 2004):

- 2 g/GJe for small particulates (PM 10)

- 30 g NOx/GJe
- 30 g SO2/GJe

The final criteria of Milieukeur for green electricity have been formulated as follows:

- In cases where Clean Biomass is applied, all plants must fulfil the Directive 2001/80/EG regarding the restriction of certain polluted matters in the air by large fuel plants. These requirements apply to all possible plants. And must fulfil national emission requirements. In cases where polluted biomass is used, all plants must fulfil the Waste Burning Directive.
- In the case of co-firing of polluted biomass: The daily average of the emission of sulphur dioxide must fulfil the Decree on the Burning of Waste Matters (BVA), on condition that in the A charts, in the daily average column, in the 'sulphur dioxide' row, the requirement of 50 mg/m³ must be replaced by 35 mg/m³. The daily average of the emission of the total dust particles must fulfil the BVA, on condition that in the A charts, in the daily average column, in the 'total dust particles' row, the requirement of 5 mg/m³ must be replaced by 2.3 mg/m³.

The main opinion during the interviews has been, that no requirements, which go beyond legal standards shall be set. Thus, no proposal is made here.

5.6.3 Co-firing

"Co-firing can give a quick shove to the production of electricity and heat from biomass: already existing coal-fired power plants and boilers can be equipped with added stores and conveyors so that biomass can provide up to 10 % of their output. Coal is replaced by wood chips and straw, which reduces emissions of carbon dioxide and other emissions. Above all, logistics and the market for bio-fuels can be developed this way. …Because a sustainable climate protection policy leads, in the long term, to a drastic reduction of coal use, co-firing is only a interim solution" (Öko-Institut 2004, p. 21). From this point of view co-firing is an economical first step technology and should, for the time being, included in green energy labels, especially because this form of electricity production from biomass is not covered by green electricity support schemes in some Member States. However, only biomass according to CEN/TS 14961:2005 Solid Bio-fuels shall be eligible for co-firing. The plant shall meet an overall efficiency of at least 70 %, to ensure that the biomass is used in a very efficient way.

Status quo of requirements for Eugene:

"Co-firing of coal with biomass is permitted only if the biomass energy input is separately accounted for. Only the amount of energy generated from the biomass energy input is eligible for the label."

Proposal:

Co-firing of solid biomass according to CEN/TS 14961:2005 in coal-fired power stations is permitted. The generated electricity has to be mathematically allocated according to the caloric value of the biomass. The power plant need to provide an overall efficiency of at least 70 %.

5.7 Transport and auxiliary energy

The extraction, transportation and processing of bio-fuels consume fossil fuels. The amount of fossil fuels generally makes up only a few percent of the energy content of the bio-fuel supplied. For example, the energy input for the entire logistic chain to the new biomass CHP plant in Vienna-Simmering (Austria) is 7.5 % of the energy output of the plant. The plant provides a capacity of 65,7 MW using 190.000 t forestry biomass provided by the Austrian Federal Forests (kf 2005).

The Austrian Ecolabel (Österreichisches Umweltzeichen) restricts the auxiliary energy of the plant: "The use of fossil primary energy sources for starting operation or maintenance must not exceed 5 % of annual electricity production of a plant and is not allowed to be balanced as green electricity."

The Swedish label 'Bra Miljöval' and the Finish label 'Ecoenergia' restrict also energy used for extraction and transportation:

"The non-renewable proportion of the energy that is used for extraction, transportation and processing of fuel, processing energy at the plant, transportation of residual products, and also balancing, is not permitted to be greater than 10 percent of the electricity supplied with the label" (Bra Miljöval). Respectively: "The amount of auxiliary energy needed for the handling of bio-fuels before they arrive at power stations (e.g. transportation) must not exceed 10 % of the energy content of the bio-fuel brought to the power plant. For a supplier producing electricity from bio-fuels, the combined maximum amount of the net consignments of auxiliary energy and so-called balancing service electricity is 10 % of the total energy supplied" (Ecoenergia).

It is proposed, that the formulation of Bra Miljöval shall also be applied for Eugene. In the second phase of the work package it need to be checked, if plants of all sizes are able to provide the necessary data and how much effort is needed to provide and assess these data.

Proposal:

The non-renewable proportion of the energy that is used for extraction, transportation and processing of fuel, processing energy at the plant, transportation of residual products, and also balancing, is not permitted to be greater than 10 percent of the electricity supplied with the label.

6 Summary of criteria proposed for application by Eugene within the Eugene Standard

In the chapter above proposals of biomass criteria for application by Eugene within the Eugene Standard have been deduced and argued. However the proposed criteria differ according to the possibilities of their operationalisation. Thus, in the following the criteria proposals are summarised and divided into two groups:

- criteria which can be easily operationalised and proven,
- criteria for which operationalisation and means of proof need to be further elaborated within the second phase of the work package.

6.1 Criteria which can be easily operationalised and proven

Proposal 1: Eligibility of Sources

Eligible biomass sources for the production of green electricity are defined as follows:

- Solid biomass according to CEN/TS 14961:2005, comprising
  - Woody biomass (forests and plantation wood; wood processing industry, by-products and residues; used wood, blends and mixtures),
  - Herbaceous biomass (agriculture and horticulture herb including cereal crops, grasses, oil seed crops, root crops, legume crops, flowers and landscape management herbaceous biomass; herb processing industry, by-products and residues; blends and mixtures),
  - Fruit biomass (orchard and horticulture fruit; fruit processing industry, by-products and residues, blends and mixtures),
  - Blends and mixtures.
- Furthermore, the following sources are admissible:
  - Separated biodegradable waste,
  - Animal excrements, e.g. manure or chicken litter etc. (but no animal body or parts of it),
  - Sewage gas is admissible as far as the label organisations applying for the accreditation by Eugene provide a sound argumentation, why and under which conditions sewage gas is eligible.

Proposal 2: Wood fuel

As a general principle: All wood fuel including wood fuel from thinning and residues from harvesting operations shall originate from forests that are managed so as to implement the principles and measures aimed at ensuring sustainable forest management.

For wood fuel from plantations and imported wood fuel: sustainable forest management shall be certified according to FSC (Forest Stewardship Council). Other certificates or standards should be accepted, as far as it can be proven that an equivalent quality is secured.

National certification schemes of green electricity in countries with a sufficient area of certified sustainably managed forest, should for all fuel wood demand a third party certification, thereby referring to the FSC label. Other certificates or standards should be accepted, as far as it can be proven that an equivalent quality is secured. The argumentation has to be provided by the national label applying for Eugene accreditation and need to be accepted by the Eugene Board. The availability of certified wood fuel shall be regularly reviewed according to the reviewing period of the national certification scheme of green electricity, however at least every fourth year and third party certification shall be required as soon as there is sufficient supply.

For wood fuel from non certified forest, the criteria as given in proposal 8 shall be applied (not applicable for wood fuel from plantations and imported wood fuel, as the need to come from certified forests).

Proposal 3: GMO

The use of genetically modified organisms (GMO, agricultural crops as well as trees) for electricity production is not permitted.

Proposal 4: Energy crops

Energy crops shall not be produced on arable land which has been gained by conversion of pasture or grassland.

Short rotation tree plantations should not be established on forest areas or on arable land which has been gained by conversion of pasture or grassland.

Proposal 5: Biogas plants using manure

Emissions of CH_4, N_2O and NH_3 by usage of manure have to be reduced by covering the storing tank and by applying manure with accurate methods at appropriate time (e.g. trailhose or similar device).

Proposal 6: Overall efficiency

In the annual average the plant need to met an overall efficiency of at least 60 %.

Proposal 7: Co-Firing

Co-firing of solid biomass according to CEN/TS 14961:2005 in coal-fired power stations is permitted. The generated electricity has to be mathematically allocated according to the caloric value of the biomass. The power plant need to provide an overall efficiency of at least 70 %.

6.2 Criteria for which operationalisation and means of proof need to be further elaborated

Proposal 8: Wood fuel from non certified forest[37]

All wood fuel including wood fuel from thinning and residues from harvesting operations shall originate from forests that are managed so as to implement the principles and measures aimed at ensuring sustainable forest management. In Europe, the principles and measures referred to above shall at least correspond to the definition of Sustainable Forestry Management that was adopted in Resolution 1 of the 2nd Ministerial Conference on the Protection of Forests in Europe (Helsinki, 16-17 June 1993), the Pan-European Operational Level Guidelines for Sustainable Forest Management, as endorsed by the 3rd Ministerial Conference on the Protection of Forests in Europe (Lisbon, 2-4 June 1998) and the Improved Pan-European Indicators for SFM, adopted at the MCPFE Expert Level Meeting of 7-8 October 2002 that were endorsed at 4th Ministerial Conference on the Protection of Forests in Europe (Vienna, 28-30 April 2003).

- Wood shall not originate from illegal harvesting
  - Illegally harvested wood: wood that is harvested, traded or transported in a way that is in breach with applicable national regulations (such regulations can for example address CITES species, money laundering, corruption and bribery, and other relevant national regulations).
- Wood shall not originate from High Conservation Value Forests

High Conservation Value Forests (HCVF) are forests that possess one or more of the following attributes:

- forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia)
- forest areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where

[37] Not applicable for wood fuel from plantations and imported wood fuel, as the need to come from certified forests, see proposal 2.

viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance

- forest areas that are in or contain rare, threatened or endangered ecosystems
- forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control)
- forest areas fundamental to meeting basic needs of local communities (e.g. subsistence, health)
- forest areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities)

Proposal 9: Maintenance of soil fertility

Forest: No removal of needles, foliage and roots. Also forest residues, like branches and others shall be left at the site as far as possible to maintain soil fertility and to reduce risk of erosion. Thereby measures have to be adapted to site characteristics. Or ash quality from conversion processes should be monitored and where possible nutrient-rich ash should be recycled back to the land. For both aspects national guidelines have to be taken into account as far as available.

Arable land: The withdrawal of straw or other agricultural residues for energetic use has to be adopted site-related according to the nutrient and humus level in accordance with Good Agricultural Practice to secure soil fertility in a sustainable manner. Soil fertility can also be ensured by returning of fermenting residues from biomass production to the arable land.

Proposal 10: Integrated Farming

Biomass from dedicated cultivation on arable land need to comply with guidelines for integrated crop protection.

If livestock waste (manure, chicken litter, etc.) is used for energy production, the conditions under which animals are housed and reared should comply with the principles of Integrated Farming.

Proposal 11: Transport and auxiliary energy

The non-renewable proportion of the energy that is used for extraction, transportation and processing of fuel, processing energy at the plant, transportation of residual products, and also balancing, is not permitted to be greater than 10 percent of the electricity supplied with the label.

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Annex: Biomass criteria of major certification schemes for green electricity

	Eugene	Austrian Ecolabel UZ 46	Bra Miljöval	Ecoenergia
Country	Europe	Austria	Sweden	Finnland
Version, validity		Version of 1 January 2005	Version valid from 1 January 2002	Version of 2000
Eugene accredited		no	no	no
webpage	www.eugenestandard.org	www.umweltzeichen.at	http://www.snf.se/bmv/bmv-register/elektricitet.cfm	www.ekoenergia.info/english/
responsible body / organisation	Not-for-profit membership-based organisation, comprising leading green energy labelling bodies across Europe	Federal Ministry of Agriculture and Forestry, Environment and Water Management (guideline for green electricity within the national Ecolabel scheme)	The Swedish Society for Nature Conservation	Suomen luonnonsuojeluliitto (Finnish Association for Nature Conservation)
Biomass sources				
energy crops	dedicated energy crops, where crops are grown for energy	primary biomass: plants or parts of plants directly used for electricity generation without chemical conversion (wooden, cellulosic or oil-containing biomass)	energy forest	
forestry	forestry and arboricultural material (wood from existing plantations, natural and semi-natural woodland and urban forestry)	forestry biomass, free of halogenated organic compounds: wood from forests, open fields and energy wood fields	wood fuel	chipped wood, wood residue from the mechanical forest industry, bark and sawdust from the forest
products from biomass		products from biomass: firewood, chips, residues from scantling production, wood or bark pellets, gas produced from wood, charcoal, chopped straw		processed fuels originationg from wood (pellets and briquettes)
biogas or liquid fuel		biogas, ethanol and diesel from biomass	biogas	biogas from crop plants (flax, clover, reed canary-grass)
agriculture and agricultural residues	residual straw from agriculture	agricultural biomass: agricultural plants, crop residues, untreated or processed by-products (e.g. straw, oil seeds, etc.)	straw fuel and other fuels from agricultural land	biomass grown on fields ('energy willows', straw, reed canary-grass)
wood residues, waste wood	urban waste wood collected separately (unpainted, untreated, or unpressurised wood, not containing plastics, or metals); woody waste products of the wood industry (e.g. sawdust)	saw residues		clean wastewood
(industrial) biomass residues	biomass residues from landscape and park management; vegetable processing biomass residues from food industry	secondary biomass: residues of utilization of organic matter; especially for human or animal nutrition; utilization in households or industry, where organic matter has undergone a chemical alteration (e.g. manure and liquide manure, garbage of canteens or kitchens),	the pulp industry's so-called 'lutar' are also approved	biofuels from the pulp and paper industry (black liquor and tree bark),
others				natural vegetation harvested from shores and waterway areas / reed canary grass, common reed)
Sewage gas, sewage sludge	sewage gas, **no** thermochemical processing of sewage sludge	**no** sewage gas		electricity from sewage works
waste	**no** thermochemical processing of unseparated urban solid wastes		In order for waste material to be counted as biofuel it must consist of more than 90 percent biomass and be free of substances that are environmental and health hazards, or substances that are poisonous, have low degradability or that are stored in living organisms.	
landfill gas, pit gas and others		**no** landfill gas		landfill and waste treatment plant biogas, **no** peat

	Eugene	Austrian Ecolabel UZ 46	Bra Miljöval	Ecoenergia
Criteria				
biomass fuel general - GMO			Biofuel must not be derived from genetically modified organisms.	
biomass fuel general or wood fuel	Dedicated energy crops used in new generating stations shall come from FSC (Forest Stewardship Council) certified sources. A generation station is "new" if it has entered operation after January 1, 2001. For existing generating stations using wood (from dedicated energy crops and forestry and arboricultural material), the plant will have to draw an action plan to ensure that the wood used will be purchased from FSC certified sources within a time of 4 years.		Wood fuel should come from FSC-certified forestry operations or from forestry operations that do not fell in the following areas: · key biotopes, according to the Regional Forestry Board or the equivalent according to the particular country's definition and methodology cf. FSC 6.1.1b) · natural forests (FSC 6.1.1a); · waste land; · uncultivated meadow and pasture land (FSC 6.2.1a); · naturally leaf-dominated damp or wetlands (FSC 6.1.2b); · the mountainous zone above the nature conservation boundary as defined by the Swedish Society for Nature Conservation or the equivalent in other countries.	The Finnish Association for Nature Conservation requires a chain of custody (verification of origin) and the type of raw material used (chips from a regeneration cut, chips from small-sized stemwood from silvicultural cuttings, etc.) to be known.
			Returning ash After burning biofuel, the nutrients in the ash must be returned to the type of ground from which it has originated. (Details of the criteria see report.)	
agriculture / soil	For biofuel such as straw, and their equivalent, which are cultivated on agriculture land, cultivation should be carried out with the goal to reduce water and pesticides use, and taking into consideration national best practices.			For 'energy forests', straw fuels, and their equivalent, which are cultivated on agricultural land good water protection practices must be adopted (e.g. as far as applicable, the criteria set for an agricultural environment programme) during cultivation.
wood residues, waste wood		free of halogenated organic compounds		
Processes		The waste heat of thermal processes has to be used efficiently.		
Auxiliary energy		The use of fossil primary energy sources for starting operation or maintenace must not exceed 5% of annual electricity production of a plant and is not allowed to be balanced as green electricity.	The non-renewable proportion of the energy that is used for extraction, transportation and processing of fuel, processing energy at the plant, transportation of residual products, and also balancing, is not permitted to be greater than 10 percent of the electricity supplied with the label.	The amount of auxiliary energy needed for the handling of biofuels before they arrive at power stations (e.g. transportation) must not exceed 10 % of the energy content of the biofuel brought to the power plant. For a supplier producing electricity from biofuels, the combined maximum amount of the net consignments of auxiliary energy and so-called balancing service electricity is 10 % of the total energy supplied.
Co-firing	Co-firing of coal with biomass is permitted only if the biomass energy input is separately accounted for. Only the amount of energy generated from the biomass energy input is eligible for the label.		Electricity from district-heating power plants must be based on biofuel in order to fulfil the criteria. Biofuel must **not** be burned together with coal, peat, refuse or other fossil fuels. Ash from the burning of biofuel is to be separated from other types of ashes.	A multifuel power station is required systematically to reduce its carbon dioxide emissions (fossil fuels, including peat). Reductions must apply to those multi-fuel plants for the power generation of which a company is seeking an ecolabel. In the construction of new power stations the problem of carbon dioxide emission must be given priority.
Co-generation (CHP), fossil fuels	Natural gas-fired CHP is eligible up to a maximum limit of 50% of any consumption based green electricity product. Only that part of electricity generation from natural gas fuelled cogeneration is eligible, which is related to maximum heat production ("back pressure" operation). If cogeneration plants can operate in condensing mode, only that part of their generation is eligible, which corresponds to the power-to-heat ratio of back-pressure operation. The cogeneration part shall have an energy conversion efficiency of at least 85%, over the average of the year. The eligible cogeneration plant should display air emissions quality criteria as described in the following (depending on the volume of the exhaust stream).			
	NOx: < 200 mg/m3 (5% O2) / < 75 mg/m3 (15%O2) CO: < 150 mg/m3 (5% O2) / < 60 mg/m3 (15%O2) " NMVOC: < 50 mg/m3 (15%O2) / < 20 mg/m3 (15%O2) SO2: < 30 mg/m3 (15%O2) / < 12 mg/m3 (15%O2)			

	Gruener Strom Label	Ok-Power	Naturemade Basic	Naturemade Star (additional criteria)
Country	Germany	Germany	Switzerland	
Version, validity	Version of May 2001	Version 6.1 of 30. October 2004	Version 1.1. of 1. January 2005	
Eugene accredited	no	yes	yes	yes
webpage	www.gruenerstromlabel.de	www.ok-power.de	www.naturemade.ch	
responsible body / organisation	Gruener Strom Label e.V. (EUROSOLAR e.V., BUND, Die VERBRAUCHER INITIATIVE e.V., IPPNW, Bund der Energieverbraucher e.V., NABU e.V., Deutscher Naturschutzring, Naturwissenschaftler Initiative "Verantwortung für den Frieden")	EnergieVision e.V. (Öko-Institut, Verbraucher-Zentrale Nordrhein-Westfalen, WWF Germany)	VUE (an association established to promote environment- friendly electricity) The association's advisory board consists of representatives from environmental organizations, renewable energy associations, association for water economy, electricity producers, distributors and suppliers, as well as bulk power users.	
Biomass sources				
energy crops	Biomass in accordance with biomass regulation (Federal Law Gazette I 2001, 1234)	All plants according to the EEG (Law regarding the Priority of Renewable Energy, Federal Law Gazette I 2004, 1918)		
forestry				
products from biomass				
biogas or liquid fuel				
agriculture and agricultural residues				
wood residues, waste wood	biomass regulation excludes waste wood, if PCB or PCT > 0.005% (mass), mercury > 0.0001% (mass)			
(industrial) biomass residues				
others				
Sewage gas, sewage sludge	Sewage gas explicitly allowed (however this is in contradiction with biomass regulation (Federal Law Gazette I 2001, 1234), which just allows 10% of sewage sludge in digestion plants, however excludes sewage gas)	According to biomass regulation (Federal Law Gazette I 2001, 1234) no sewage sludge, except up to 10% of sewage sludge in digestion plants, no sewage gas.		
waste				
landfill gas, pit gas and others	Pit gas, **no** landfill gas			

	Gruener Strom Label	Ok-Power	Naturemade Basic	Naturemade Star (additional criteria)
Criteria				
biomass fuel general - GMO			The use of genetically modified plants for electricity production is not permitted.	
biomass fuel general or wood fuel	Biomass fuel need to be comply with criteria of organic farming (AGÖL or EEC Regulation 2092/91). These criteria do not apply for cultivated biomass for cofermentation in rural biogas plants (< 500 kWe) and thereby contributes to energy output by 50% at the maximum.	Biomass from dedicated cultivation (rapeseed oil, whole plant, short rotation wood) shall come from certified organic farming or FSC (Forest Stewardship Council) certified forestry.		Tropic timber shall come from FSC (Forest Stewardship Council) certified forestry. Untreated wood comply with a standard which is oriented towards the FSC (criteria for plants using wood fuel or waste wood).
agriculture / soil		Biomass from dedicated cultivation (rapeseed oil, whole plant, short rotation wood) shall come from certified organic farming.	The long-term fertility and productivity of the soil used to produce the fuel has to be ensured.	Biomass from dedicated cultivation need to comply with guidelines for integrated crop protection (criteria for fermentation of green biomass).
wood residues, waste wood		Waste wood and wood residues may only be used if untreated or if it is a recycling product according to RAL quality label 428. These criteria also apply for the production of wood gas. In individual cases quality assurance procedures equivalent to RAL may be accepted.		
Processes				
Auxiliary energy				
Co-firing		Co-firing of biomass, which complies with the given biomass criteria, in thermal power plants is permitted. The generated electricity has to be mathematically allocated according to the caloric value of the biomass.		
Co-generation (CHP), fossil fuels		Natural gas-fired CHP is eligible up to a maximum limit of 50% for consumption based tariff (further requirements, emission standards are the same as for EUGENE).		
summary of explicitly named exclusions	Biomass plants above 20 MWe, landfill gas, (according to biomass regulation: peat, municipal waste, animal body or parts of it, etc.)	According to biomass regulation unseparated municipal solid waste, landfill gas, sewage gas.		
Criteria which will be considered in the future		EnergieVision reserves the right to restrict the use of waste wood for the retailer model in the future.		

	Gruener Strom Label	Ok-Power	Naturemade Basic	Naturemade Star (additional criteria)
Criteria				
Biogas			If beside organic residues other energy sources are used (e.g. natural gas), the total energy use of organic residues shall be 66% at the minimum. Only the amount of energy generated from the biomass energy input is eligible for the label.	The environmental impact of the plant may not exceed 50% of the impact of a modern gas and steam electric power plant (parameter model).
				Emissions of ammonia are controlled by a manure management.
				The use of starter oil must not exceed 10% of the feeded total energy.
				The use of co-substrate is limited by 15% (with respect to organic matter. If this limit is exceeded, VUE has to be contacted for individual calculations.
				Emissions of ammonia have to be reduced by covering of the liquid manure store or use of a trailhose or similar device.
Fermentation of green biomass				The environmental impact of the plant may not exceed 50% of the impact of a modern gas and steam electric power plant (parameter model).
				Emission of odour shall be avoided as far as possible. Measures of prevention of odour have to meet the state of the art.
				Waste gas emissions have to meet the requirements of the clean air regulation (LRV 1985).
				Nois emissions have to meet the requirements of the noise protection regulation (LSV 1986).
Plants using wood fuel and waste wood				The environmental impact of the plant may not exceed 50% of the impact of a modern gas and steam electric power plant (parameter model).
				Overall efficiency > 60%
				Energy concept for the reduction of electricity and heat requirement.
				Declaration of the origin of wood fuel and waste wood.
				Plants with multiunit cyclone wihout more far-reaching cleaning filter shall only use natural finish wood or wood residues of first process level.
Sewage Gas				The environmental impact of the plant may not exceed 50% of the impact of a modern gas and steam electric power plant (parameter model).
				Waste gas emissions have to meet the requirements of the clean air regulation (LRV 1985). In case of co-fermentation of organic waste the emissions of transport have to be taken into account.
				Nois emissions have to meet the requirements of the noise protection regulation (LSV 1986). In case of co-fermentation of organic waste the noise emissions of transport have to be taken into account.
				Emissions of odour connected with the delivery and processing of Co-substrate have to be avoided as far as possible. Measures for odour reduction have to meet the state of the art.
				Energy concept
				Effluent treatment has to be equipped with nitrogen sink.

	Milieukeur	Green Power	Green-e	Environmental Choice
Country	Netherlands	Australia	USA (New England, New York, Mid Atlantic, Ohio, Texas, Illinois and Michigan)	Canada
Version, validity	Version of 1. January 2005	Version 3.1. A of September 2004	Updated December 7, 2004	CCD-003 of 15 December 2003
Eugene accredited	no	no	no	no
webpage	http://www.milieukeur.nl	www.greenpower.com.au	www.green-e.org	www.environmentalchoice.ca
responsible body / organisation	Environmental Control Foundation (Stichting Milieukeur)	Australian Government, Department of Energy, Utilities & Sustainability	Non-Profit Center for Resource Solutions, California, In each state where Green-e is active, the Green-e Program works with diverse stakeholders to form Regional Advisory Committees	Environment Canada's ecolabelling program
Biomass sources				
energy crops	Biomass within the meaning of the Electricity Code 1998, 36a par.1 sub j. This law defines Biomass as "the biologically degradable fraction of products, waste matters and residues from agriculture, including plant and animal matter, forestry and related branches of industry, as well as industrial and household waste which is wholly biologically degradable.	Energy crops: The acceptability of various energy crops will depend upon the agricultural and harvesting practices used, and whether these are considered sustainable. Energy crops sourced from crop activities that clear, or have cleared after 1990, existing old growth or native forests, will not be accepted.	All energy crops	Dedicated energy crops (b)
forestry		Sustainably managed plantations		
products from biomass				
biogas or liquid fuel				Liquid fuels derived from biomass as defined in items (a) and (b), including inter alia ethanol, biodiesel, and methanol
agriculture and agricultural residues			All agricultural crops or waste	Agricultural wastes that are solid residues arising from the harvesting and processing of agricultural crops that might otherwise be sent to landfill and/or incinerated (a)
wood residues, waste wood		Wood waste from clearing specified noxious weeds	All woody waste including mill residues	Wood-wastes that are solid residues arising from the harvesting and processing of forestry products that might otherwise be sent to landfill and/or incinerated (a)
(industrial) biomass residues		Municipal green waste, industrial, commercial and municipal solid wastes (excluding incineration). Where a fossil fuel component is mixed in with the waste stream and cannot be reasonably removed from the fuel mix, the fossil fuel component will be netted out on a pro-rated basis (according to calorific value of fossil fuel component).	All animal and other organic waste	
others		Agricultural and Other Biomass Wastes		
Sewage gas, sewage sludge	**no** sewage sludge			
waste	only "Pure Biomass", thus biologically degradable fraction of industrial and household waste			Clean organically-sourced material that has been separated from municipal solid waste (MSW), and subsequently processed (e.g., pelletization, gasification) to serve as a combustion fuel.
landfill gas, pit gas and others	landfill gas	Landfill Gas Generation, Industrial/Commercial/Municipal Solid Wastes Direct Gasification/Pyrolysis	Landfill gas; The California Green-e standard also includes Municipal Solid Waste conversion facilities using a non-combustion thermal process, as long as they meet California Energy Commission requirements for California RPS eligibility.	Biogas means gaseous products (primarily methane and carbon dioxide) produced by the anaerobic decomposition of organic wastes. Facilities producing biogas include inter alia landfill sites, sewage treatment.

	Milieukeur	Green Power	Green-e	Environmental Choice
Criteria				
biomass fuel general - GMO				
biomass fuel general or wood fuel		Sustainably managed plantations, Utilisation of any materials (including wastes) from high conservation value forests, such as old growth forests, other native forests, and ecologically sensitive sites (for example, areas of remnant native vegetation) are not acceptable under Green Power.		"Clean biomass" means organic materials that have, at no stage in their lifecycle, been treated with organic and/or inorganic substances to change, protect or supplement the physical properties of the materials (including inter alia synthetic chemical pest-control products, fungicides, wood preservatives, paints, varnishes or other surfaces coatings, halogenated compounds and/or compounds containing heavy metals).
		Utilisation of any materials (including wastes) derived from forests other than sustainably harvested plantation forests is excluded. Plantation-derived wastes should not be sourced from plantations that clear, or have cleared after 1990, existing old growth or native forests.		If generated from dedicated energy crops: i) use only dedicated energy crops that have been sourced from operations that have implemented a sound environmental management system and are adhering to sound environmental management practices, and ii) ensure the rate of harvest does not exceed levels that can be sustained.
agriculture / soil	Animal or animal-related biomass is permitted for the label only if the biomass applied has been gathered from processes in which the main product fulfils the criteria of Organic Farming (EKO) or Milieukeur criteria for farming.			i) Use only wood-wastes and/or agricultural wastes that have been sourced from operations that have implemented a sound environmental management system and are adhering to sound environmental management practices, ii) ensure the rate of harvest does not exceed levels that can be sustained, and iii) not use wastes from species that are listed in the CITES Appendices.
wood residues, waste wood			New England, New York, the Mid Atlantic, Texas and Ohio exclude: • Wood that has been coated with paints, plastics, or formica; • Wood that has been treated for preservation with materials containing halogens, chlorine or halide compounds like CCA-treated materials, or arsenic (CCA = chromated copper arsenate) • There may be deminimus quantities of qualified wood fuel (<1% of total wood fuel) that can contain the above excluded contaminates. / The Mid Atlantic excludes: • Herbaceous agricultural waste • Forestry biomass waste other then mill residues. / Illinois exlude: • Waste wood from landscape trimming and other landscape waste, • Railroad ties and construction or demolition debris.	If generated from clean biomass fuel sources containing salt-laden wood, de-inking sludge or spent pulping liquors from mills using elemental chlorine bleaching, the facility must not emit polychlorinated dioxins and/or furans in excess of one of the following, whichever may be lower: i) 100 pg I-TEQ/m3; or ii) the limits for new pulp and paper boilers burning salt-laden wood as specified in the Canada Wide Standards for Dioxins and Furans.
Processes	In cases where Clean Biomass is applied, all plants must fulfill the Directive 2001/80/EG regarding the restriction of certain polluted matters in the air by large fuel plants. These requirements apply to all possible plant. And must fulfill national emission requirements.	To be eligible for Green Power approval, an electricity generator must result in greenhouse gas emission reduction, result in net environmental benefits, be based primarily on a renewable energy source. All projects are individually assessed and considered for approval against the above general definition and the eligibility criteria of the guideline and specific considerations outlined in Appendix A of the guideline, including stakeholder consultation and acceptability for the project.	Emissions: In New England and the Mid Atlantic: The average weighted NOx emissions from all biomass sources, except landfill gas or digester gas shall not exceed: o 2.9 lbs./MWh in 2000, 2001, 2002; o 2.63 lbs./MWh in 2003, 2004, 2005; and o 2.25 lbs./MWh in 2006, 2007, 2008. / In New York: The average weighted NOx emissions from all biomass sources, except landfill gas shall not exceed: o 2.9 lbs./MWh in 2002, 2003, 2004; 2005; o Standard(s) for subsequent years are adopted here, but will be reviewed based on the evolution of state-of-the art control technologies two years before they are to go into effect and adjusted if appropriate. o 2.63 lbs./MWh in 2006, 2007, 2008; and o 2.25 lbs./MWh in 2009, 2010, 2011. / In New England and New York: The average weighted NOx emissions from landfill gas facilities shall not exceed 3.5 lbs./MWh. Landfills not otherwise required to flare are exempted from the Landfill gas NOx emissions cap.	Biomass-fuelled electricity must be generated in such a manner that the total of load points assessed for operational air emissions of carbon monoxide (CO), particulate matter (PM), nitrogen oxides (NOX measured as NO2) and sulphur oxides (SOX measured as SO2) , as determined in Appendix 2 of the certification Criteria Document, does not exceed 6. In cases where the clean biomass is used as a partial substitute in a generation facility that is designed to primarily utilize non-renewable fuels, load point calculations will be based only on those operational air emission values that can may be allocated to the combustion of the clean biomass.
Auxiliary energy				

	Milieukeur	Green Power	Green-e	Environmental Choice
Criteria				
Co-firing	Co-Firing of Polluted Biomass in coal power stations must meet national emission standards. The daily average of the emission of sulphur dioxide must fulfill the Decree on the Burning of Waste (BVA), on condition that in the A charts, in the daily average column, in the "sulphur dioxide" row, the requirement of 50 mg/m³ must be replaced by 35 mg/m³. The daily average of the emission of the total dust particles must fulfill the BVA, on condition that in the A charts, in the daily average column, in the "total dust particles" row, the requirement of 5 mg/m³ must be replaced by 2.3 mg/m³.	The electricity generator must be based primarily on a renewable energy resource. As such the proportion of eligible renewable energy input must exceed 50% averaged over the settlement period. With the exception of minor contaminants, all renewable fuels used must be eligible under Green Power. Only the portion of the energy generated that is based on renewable energy resources (i.e. >50%) is eligible for Green Power approval. The annual generation of a generator shall be pro-rated on the proportion of renewable vs. non-renewable energy (i.e. fossil fuel) input, as detailed in the letter of approval.	Co-firing of Liquid and Gaseous forms of Biomass with Natural Gas: In New England, New York, the Mid Atlantic, Ohio, Illinois, Michigan and California: Co-firing of liquid and gaseous forms of eligible biomass with natural gas is permitted if the liquid and gaseous form(s) of eligible biomass is separately metered, and contracts are in place to allow CRS to verify that the liquid and gaseous form(s) of eligible biomass was converted to electricity. Only the amount of energy generated from the liquid and gaseous form(s) of eligible biomass may count towards the 50% renewable criteria. Liquid and gaseous form(s) of eligible biomass are the only renewable resources that can be co fired and still count toward the renewable percentage of a Green-e product. / Regional specifications / In New England and New York: Co-firing includes units permitted to burn oil no more than 60 days out of the year and the facility must meet the emissions criteria for landfill gas facilities.	
Co-generation (CHP), fossil fuels				
summary of explicitly named exclusions	sewage sludge	Generators that involve the incineration of industrial, commercial or municipal solid wastes; Coal Mine Waste Gas and Coal Seam Methane	Combustion of municipal solid waste.	Clean biomass does not include materials for which other diversion methods are a viable alternative (e.g., soil amending, farm land applications, horticultural applications), nor the treated by-products of manufacturing processes (e.g., treated chipwood or plywood, painted woods, pressure treated lumber).
Biogas				Biogas-fuelled electricity must be generated in such a manner that the total of load points assessed for operational air emissions of carbon monoxide (CO), particulate matter (PM), nitrogen oxides (NOX measured as NO2) and sulphur oxides (SOX measured as SO2), as determined in Appendix 2, does not exceed 6. In cases where the biogas is used as a partial substitute in a generation facility that is designed to primarily utilize non-renewable fuels, load point calculations will be based only on those operational air emission values that can may be allocated to the combustion of the biogas.