IEA Bioenergy task 40 – Country report for the Netherlands

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Task 40: Sustainable
International Bio-energy trade

IEA Bioenergy

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Department of Science, technology and Society

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Executive summary and reading guide

Short-term objectives of the IEA Bioenergy Task 40 "Sustainable International Bio-energy Trade: Securing Supply and Demand" are amongst other to present an overview of development of biomass markets in various parts of the world and to identify existing barriers hampering development of a (global) commodity market (e.g. policy framework, ecology, economics). As in most countries biomass is a relatively new (though quickly growing) commodity, relatively little information is available on e.g. the traded volumes and prices of various biomass streams, policies and regulations on biomass use and trade, and existing and perceived barriers. This country report aims to provide an overview of these issues for the Netherlands, and also sets the first step to make an inventory of barriers as perceived by various Dutch stakeholders.

The information gathered in this report is to a large extend based on existing statistics and reports from Dutch institutions. The literature data is complemented by additional information obtained from stakeholders, such as utilities, biomass traders, the port of Rotterdam, policy makers and custom institutions. In some cases, the data source was left anonymous because of the confidential nature of the data concerned.

The Netherlands have a considerable domestic biomass potential, which may be sufficient to satisfy some of the ambitions for the short-term. However, the domestic potential may be not sufficient to reach the ambitious targets for 2010 for biofuels (5.75% of demand) and renewable electricity (9% of demand). Even more so, to realize the long-term vision of covering 30% of the total energy consumption of the Netherlands by biomass energy in 2040 (i.e. 600 to 1100 PJ), and covering 20-45% of the feed-stock requirements of the chemical industry with biomass, large-scale import of biomass is required. Currently, about 40 PJ of primary energy are avoided by the use of (partially imported biomass), mainly by co-firing of biomass and waste combustion. The current amount of liquid biofuels for transportation produced or utilized is negligible.

Until the year 2000, the Netherlands barely imported biomass for energy production. Over the last few years, both the import and export of biomass for energy purposes have been strongly increasing (see table A). The biomass imported is almost 100% used in Dutch power plants (mainly coal and two gas-fired plants), and can be roughly divided into the following categories: liquid bio fuels like palm oil and fats used in food production, agro residues like palm kernel expeller, wood and wood derived fuels or waste streams and waste streams like animal waste (see also Table A). The exported biomass consists mainly of waste wood and construction wood. In both cases, these trade flows have been mainly initiated by Dutch environmental and energy policy. A feed-in tariff for electricity from biomass has been the main driver for biomass import. A levy on using combustible material for land fills and difficulties to obtain permits to co-fire (contaminated) waste wood are main drivers for the export of biomass.

Table A Overview of imported and exported biomass streams for energy production for the Netherlands. Sources: Pfeiffer (2005), De Vos and Christan (2003) and own data collection. The data for 2004 should be considered (rough) estimates.

Import	2003		2004[a]	
	kton	PJ	kton	PJ
Wood pellets and other wood streams	80	1.4	420	6.3
Agro residues	55	0.9		
Bio-oil	5	0.2	90	3.4
Others (Bone meal, paper sludge, etc.)	0	0	15	0.15
Total	**140**	**2.5**	**525**	**9.85**

Export	2002-2003		2004[b]	
	kton	PJ	kton	PJ
Construction and demolition waste, wood waste	430	6.6	419	6.4
Remaining fraction from construction and demolition waste	503	4.5	475	4.3
Paper/plastic fraction from household waste	151	2.0	147	1.2
Pellets from RDF	107	1.5	76	1.1
Others	449	0.4	372	0.4
Total	**1639**	**15.1**	**1489**	**13.4**

a The exact composition of biomass fuels used in 2004 in coal power plants were considered confidential by some power producers. The numbers presented here are (rough) estimates.

b All export data on 2004 is based on the total export volumes, and the assumption that the share for use as fuel was the same as in 2002-2003

National (N) and international (I) (potential) barriers identified were:

- Limited financial governmental support (N)
- Problems with obtaining emission permits (N)
- Competition with application as fodder production or food production (N/I)
- Increasing international competition (I)
- Reluctance to use new biomass streams (N)
- Immature market(N/I)
- Lack of significant volumes and associated professional logistics (N/I)
- Lack of commitment of the Dutch government and energy producers (N)
- Import restrictions (N/I)
- Potential negative social and environmental effects linked to utilization of biomass streams such as palm oil (I)

On the short term, the first issue (limited financial support) is likely the most dominant factor to limit further biomass import to the Netherlands. The rapid growth of imported biomass has recently triggered a counter-reaction from the Dutch government to limit the amount of biomass co-fired on the short term. This incident displays how dependent the biomass trade is at this moment. A stable, long-term policy is required to increase market share.

On the longer term, it is crucial that such a policy is matched with policy abroad, creating a level playing field in terms of governmental support for electricity from biomass, equalizing and removing trade barriers, and solving the issue of competition with applications for food and fodder, and other social and environmental barriers.

The report organizes as follows. Section 2 and 3 presents a brief over of the policy setting on renewable energy and bio-energy in the Netherlands and the policy instruments deployed to stimulate renewable energy market penetration. In section 4, the achievements, the current status and the short-term expectations for the use of biomass energy in the Netherlands are described. Next, in section 5, the biomass market and biomass trade in the Netherlands are discussed, including the major biomass streams involved, conversion technologies, import and export volumes, biomass prices, barriers for further import and biomass certification efforts. Section 6 concludes with a general discussion and conclusions.

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IEA Bioenergy task 40 Country report for the Netherlands

1. Introduction and rationale

In the last years, the interest for international biomass trade ahs grown strongly. Various tasks active within the International Energy Agency (IEA) already raised the issue of international biomass trade and related subjects before. Within several international organizations (FAO, World Bank, UNECE, UNDP, UNFCCC, WTO, SGS, NGO's (Greenpeace, WWF) the interest for the concept of international bio energy trade is growing. Also industrial parties (Shell, Cargill, Nedalco, Vattenfall, Essent) are currently strongly involved or interested in biomass trade.

Due to this interest, a new task was started within the IEA bioenergy program: Task 40, Sustainable International Bio-energy Trade: Securing Supply and Demand. This proposal for a new Task under the IEA Bioenergy Agreement aims to investigate what is needed to develop towards a "commodity market" for biomass for energy. By means of the international platform of IEA combined with industrial parties, governmental bodies and NGO's, task 40 contributes to the development of sustainable biomass markets on short and on long term and on different scale levels (from regional to global).

In its activities, the task programme will take the several stages of development of biomass markets, in different regions of the world into account. Furthermore, the ambition is that this platform can set the agenda and initiate a host of new activities relevant for developing biomass potentials worldwide. The future vision on global bio energy trade is that it develops over time into a real "commodity market" which will secure supply and demand in a sustainable way; sustainability brings a key factor for long-term security. Task 40 investigates what is needed to create a "commodity market" for biomass. By means of this platform in which industrial parties, governmental bodies and NGO's participate, this task contributes to the development of sustainable bio-energy markets on short and on long term and on different scale levels (from regional to global).[1]

Short-term objectives of Task 40 are amongst other to present an overview of development of biomass markets in various parts of the world and to identify existing barriers hampering development of a (global) commodity market (e.g. policy framework, ecology, economics). As in most countries biomass is a relatively new (though quickly growing) commodity, relatively little information is available on e.g. the traded volumes and prices of various biomass streams, policies and regulations on biomass use and trade, and existing and perceived barriers. This country report aims to provide an overview of these issues for the Netherlands, and also sets the first step to make an inventory of barriers as perceived by various Dutch stakeholders.

The information gathered in this report is to a large extend based on existing statistics and reports from Dutch institutions. The literature data is complemented by additional information obtained from stakeholders, such as utilities, biomass traders, the port of Rotterdam, policy makers and custom institutions. In some cases, the data source was left anonymous because of the confidential nature of the data concerned. The authors would like to thank everyone who contributed information and data for this report.

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[1] For a more extensive description of task 40, including current activities, please visit the task 40 website at www.fairbiotrade.org.

stimulate renewable energy market penetration. In section 4, the achievements, the current status and the short-term expectations for the use of biomass energy in the Netherlands are described. Next, in section 5, the biomass market and biomass trade in the Netherlands are discussed, including the major biomass streams involved, conversion technologies, import and export volumes, biomass prices, barriers for further import and biomass certification efforts. Section 6 concludes with a general discussion and conclusions.

2. Policy setting on renewable energy and bio-energy in the Netherlands

2.1. Past and current policies

The major policy document of the last decade is the third energy white paper of the Netherlands, published in 1995. In the white paper, a policy goal of 10% contribution from renewable energy sources[2] in 2020 in the Netherlands was set (Ministry of Economic Affairs, 1995). Since then, a number of additional policy documents have been published by the ministry of economic affairs, which amongst others further specify (intermediate) targets for renewable electricity. For 2005, the Dutch government has set a target of 6% renewable electricity, and targets of 9% renewable electricity supply in 2010, and 17% in2020 (Ministry of Economic Affairs, 1995; Ministry of Economic Affairs, 1997; Ministry of Economic Affairs, 1999)[3].

Another important policy instrument is the coal covenant between the power producers and the Dutch Ministry of the Environment, signed in 2002, in which the Dutch electricity production companies committed themselves to CO_2-reduction of 3.2 Mton between 2008-2012. Possible measures to achieve this target were energy efficiency measures, switching from coal to natural gas, closing down a coal power plant or co-firing biomass.

Simultaneously, over the last decade the entire electricity market has been liberalized in the Netherlands in several steps. While large electricity consumers were able to choose their electricity provider as early as 1999, households were only able to choose since July 2004. A remarkable exception to this was the liberalization of the renewable electricity market, which occurred already in July 2001. This enabled energy distribution companies de facto to compete for households on the renewable ‘green’ market three years earlier than on the fossil ‘grey’ market.

2.2. Long-term policies

More recently, the concept of transition management was introduced in the Netherlands. In order to achieve the renewable electricity targets, some major changes in the structure of current energy systems will have to occur. With the privatization and liberalization of energy markets, the governmental capabilities to steer these changes is limited, and depends to a large extend on the cooperation of a large number of stakeholders, such as national and foreign (energy) companies and other industries, local and regional public authorities, non-governmental organizations and other social organizations. Realizing these limitations, in 2002, the Dutch government decided to follow a new policy concept called transition management. The general aim of this program is to obtain a secure, economically efficient and sustainable energy supply for the longer term in the Netherlands,

[2] Defined as 10% of total domestic energy consumption in the Netherlands in 2020. In 1995, this contribution was about 0.7%, in 2004, it was 1.8% (CBS, 2005).
[3] These targets seem relatively modest in comparison to the European target of 22% in 2010. However, the Netherlands has basically no potential for large-scale hydro plants, which constitutes the bulk share in many European countries.

and to develop the position of the Netherlands as an innovative driving force for the transition towards a sustainable energy system by creating collaboration between government, business, research institutions and social organizations (Ministry of Economic Affairs, 2004a). In addition, this approach aims at improving the Dutch business position in the energy field, and at innovating Dutch energy policy itself. For the long term (2040) it is expected that the Dutch sustainable energy system will be based on four key elements: biomass, new gas services, sustainable industrial production and "towards a renewable Rijnmond" To get there, the stakeholders have formulated five main transition paths, which involve so-called experiments, in which new technologies can be developed within a protected environment in the short term[4].. These five routes are:

1. Efficient and green gas
2. Chain efficiency
3. Green raw materials
4. Alternative motor fuels
5. Renewable electricity

Each main route is again subdivided in several subtopics. Biomass resources are basically involved in each transition route, and play a major role in routes 3, 4 and 5. Therefore, a number of experts formulated a biomass vision for the long term, supported by government and the market (Ministry of Economic Affairs, 2004c). The potential use and ambitions levels are high: possibly 30% of the total energy consumption of the Netherlands may be covered by biomass energy in 2040, corresponding to a contribution ranging from 600 to 1100 PJ (van Herwijnen et al. 2003) mainly as primary fuel for electricity production and as liquid transportation fuels. Furthermore, biomass could also cover 20-45% of the feed-stock requirements of the chemical industry. These targets are considered as a good balance between realizing on the one hand a fundamental change in the Dutch energy supply (transition) and establishing realistic targets on the other.

3. Policy instruments deployed

Since the late 1970's, in the Netherlands, targets and research programs for a number of renewable energy technologies were formulated. An elaborate description of the history of renewable energy development in the Netherlands is given by Verbong et al. (2001). Various RD&D (Research, Development and Demonstration) programs, investment subsidies, electricity production subsidies, tax exemptions and other policy instruments have been formulated and applied over the last decades. An overview of past instruments is presented in Appendix 1.

3.1. Research, Development & Demonstration

The current program to stimulate R&D for energy technologies is called energy research strategy (EOS), and is subdivided in 4 topics: new energy research subsidies (NEO), long-term research subsidies (LT), innovation subsidies for international cooperation projects (IS) and Demonstration (Demo). Other demonstration programs are Sustainable energy Netherlands (DEN), which funded biomass and bioenergy feasibility studies and research, demonstration and implementation projects through subsidy schemes from 2001 - 2004, and Gaseous, and Liquid Climate neutral energy carriers (GAVE), to achieve market introduction in three phases from 2001-2008 (Ministry of Economic Affairs, 2004c). Furthermore, within the frame of transition management, the so-called

[4] More information on the concept of transition management, the different transition paths and experiments can be found at the following web address: www.energietransitie.nl.

unique chances regulation (UKR) allows for ‘experiments’, i.e. demonstration projects in line with the five main transition routes.

3.2. (Niche) Market deployment

In the last 5 years, two main market deployment policy instruments have been used: fiscal measures / investment subsidies and feed-in tariffs / tax exemptions.

The Energy Investment Deduction’ (EIA) is a fiscal measure, allowing investment in certain technologies (including wind) to be deducted from taxable profit up to a percentage of investment costs in the first year. In 2002 this was 55%. With a taxation level of 35% for Dutch entrepreneurs, the EIA amounts to a discount of 19 % of investment costs if the entrepreneur can indeed use the full deduction. The maximum deduction is 99 million € per fiscal entity. The minimum investment (in the year of application) is 1900 € (ECN, 2005).

The Regulating Energy Tax (REB) is an energy levy on electricity and gas consumption by small and medium-size customers. From 2000-2004 energy from renewable sources was exempt for the tax. Furthermore, the proceeds from the tax were used for suppliers as a premium tariff for renewable energy producers (not mandatory). In 2002 this combination added up to 8.0 €ct/kWh (6.0 €ct/kWh tax exemption + 2.0 €ct/kWh production support, see also table 1). As renewable electricity was also eligible for both the tax exemption and production support, this relatively high support level caused high amounts of imported electricity. This was the main reason to phase out the REB tax exemption and production support over 2003-2004, and replace it by a feed-in tariff system (MEP). Since July 2003, the MEP is paid to producers of electricity from renewable sources who feed in on the Dutch electricity grid, and is guaranteed for a maximum of 10 years. The level of producer support is differentiated for technologies. For an overview of the feed-in tariff height, see table 1. The subsidy is financed by a levy on all connections to the electricity grid in the Netherlands. In figure 1, the combination of REB-tax exemption, REB production support and MEP feed-in tariff is shown from 2002-2007 for large-scale biomass (co-)combustion plants.

Due to strongly growing production of electricity from biomass, there was a deficit in the annual MEP-budget for 2004 and 2005. The Minister of Economic Affairs decided in May 2005 that newly built installations or added capacity of offshore wind farms and large bioenergy projects will receive no feed-in tariff from 2005-2007 Also, the annual levy for households will likely be increased from 51 to 100 €/ grid connection (Ministry of Economic Affairs, 2005). See also section 5.

For the stimulation of biofuels, so far no market diffusion instruments have been deployed. The Dutch government has considered a exemption of biofuels from taxes, but is not going to decide whether to implement this tax exemption or not before 2006 (Van Wijland, 2004).

Table 1 Governmental financial support measures for renewable energy sources. All amounts are nominal, i.e. not adjusted for inflation. Sources: (Ministry of Economic Affairs, 2001a; Ministry of Economic Affairs, 2002; Novem, 2001; Kwant and Ruijgrok, 2000; Ministry of Economic Affairs, 2001b; Ministry of Economic Affairs; 2001c; Ministry of Economic Affairs, 2002, Tweede kamer, 2002, Van Sambeek et al, 2004, EnerQ, 2005).

<table>
<tr><th>Financial instruments</th><th colspan="7">Description and magnitude</th><th>Governmental expenditure (M€)</th></tr>
<tr><td>R&DD support</td><td colspan="7">EOS:
new energy research subsidies
long-term research subsidies
innovation subsidies for international cooperation projects and
demonstration

UKR</td><td>
1.8
10
<= 20 per tender
5

12.5 (1st tender)</td></tr>
<tr><td>EIA</td><td colspan="7">Since 1997 the Energy Investment Scheme (EIA) and the Environmental Investment Scheme (MIA) make it possible since 1997 to offset investments in technologies against taxable profit. The tax credit offered varies from 52.5% to 40% (depending on the size of the investment). In order to apply the EIA, a building permit must be obtained first.</td><td></td></tr>
<tr><td>Taxes</td><td colspan="7">Regulatory energy tax (REB 36o): tax exemption for electricity from renewable energy sources, tariffs (€ct/kWh, value-added tax excluded).
1999: 2.25 | 2000: 3.72 | 2001: 5.83 | 2002: 6.01 | 2003: 6 ? 3 | 2004: 3 ? 0</td><td rowspan="2">> 2000 M€ [a] (1998-2004)</td></tr>
<tr><td>Generic production support</td><td colspan="7">All producers of renewable electricity received 2 €ct/kWh since 1998 until 2002 from the revenues of the REB-tax. (1 €ct/kWh for electricity from municipal solid waste).</td></tr>
<tr><td rowspan="6">Feed-in tariffs [c]</td><td colspan="7">MEP-tariffs (Environmental quality of the electricity production) in €ct/kWh</td><td></td></tr>
<tr><td></td><td>W_{on}</td><td>W_{off}</td><td>$B_{<50}$</td><td>$B_{>50}$</td><td>$B_{Wa, HE}$</td><td>HPTW</td><td></td></tr>
<tr><td>2003 [d]</td><td>4.9</td><td>6.8</td><td>6.8</td><td>4.8</td><td>2.9</td><td>6.8</td><td>258 [g]</td></tr>
<tr><td>2004</td><td>4.8</td><td>6.7</td><td>6.7</td><td>4.0</td><td>2.9</td><td>6.7</td><td>281</td></tr>
<tr><td>2005</td><td>7.7</td><td>9.7</td><td>9.7</td><td>7.0</td><td>2.9</td><td>9.7</td><td>298</td></tr>
<tr><td>2006 & 2007 [e,f]</td><td>6.5</td><td>9.7</td><td>9.7</td><td>6.6/0 [f]</td><td>3.6</td><td>9.7/0 [f]</td><td>600 (2006)</td></tr>
</table>

a Authors own estimate. No official statistic are known, but especially in 2002 and 2003, large amounts of tax income were lost due to large amount of imported renewable electricity

b W_{on} = Wind onshore, W_{off} = Wind Offshore, $B_{Wa,HE}$ = Biomass waste incineration, efficiency >= 26%, $B_{>50}$ = Biomass power plants > 50 MW_e, $B_{<50}$ = Biomass power plants < 50 MW_e, , HPTW = Hydropower < 15 MW, Photovoltaic power, tidal power and wave power.

c Feed-in tariff for installation built in the specific year. Installations from previous yeas may obtain different rates. The increase in levels from 2003-2005 is due to the phasing out of the REB-exemption. To complicate matters, even though the feed-in tariffs are supposedly fixed for installations built in one year, they have also been varied slightly in consecutive years. For a comprehensive overview, see EnerQ (2005).

d Due to the fall of the Balkenende I government, the MEP feed-in tariff only came into effect on July 1st, 2003.

e Suggested tariffs (Sambeek, 2004)

f See text section 2.

g These budgets are based on the number of grid connections in the Netherlands and the annual levy.

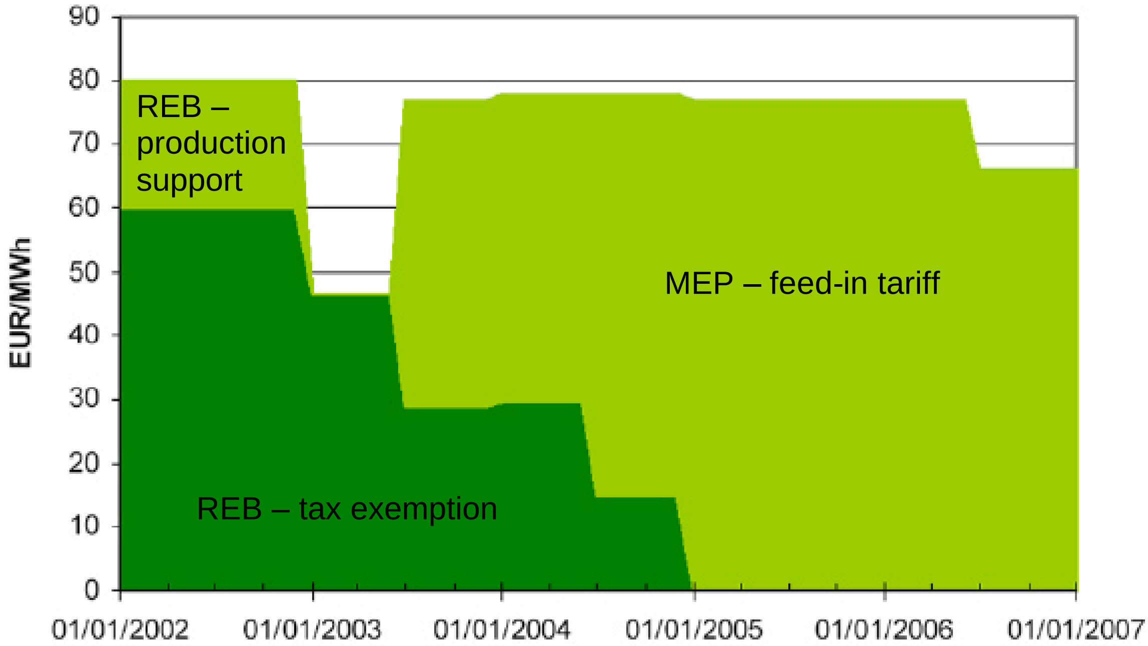

Figure 1. Phase-out of the REB-tax exemption and replacement by the MEP-feed-in tariff for (co-)firing clean biomass in large installations built before or in 2003. Adapted from Wagener (2005).

4. Biomass potential, past achievements and short-term expectations

4.1. Domestic biomass potential and overview of past achievments

While the Netherlands are a relatively densely populated country, the theoretical biomass potential, consisting of biomass waste streams, residues and dedicated crops is not negligible. A number of studies on the available amount of waste streams, biomass residue streams and biomass cultivation in the Netherlands In table 2, an estimate of this potential is presented, based on the Marsroute study (Zeevalking and Koppejan, 2000), with additional data for biomass residue streams (Faaij, 1997) and for assumptions for possible biomass cultivation in the Netherlands (Londo, 2002; Faaij et al., 1998). In theory, up to 150 PJ of various (semi-)[5]domestic biomass streams may be available for energy purposes. However, the actual market potential is smaller, due to several reasons, such as the fluctuating availability and quality of some streams, the decentralized availability of many waste streams, associated logistical efforts and relatively high costs of dedicated crop production in the Netherlands.

In utilized fraction of this potential is still small, but has strongly increased from 15 PJ of avoided primary energy in 1990 to 40 PJ[5] in 2004 (about 70% in the form of electricity, and about 30% heat). As a result of the policy measures described in the previous paragraph, the domestic renewable electricity supply has even increased by almost a factor of eight from 1989 to 2005 (see Figure 2). The total contribution of renewables to Dutch gross electricity production increased by about a factor of four in the same time period, given the simultaneous increase in electricity demand. The contributions of different sources to the renewable electricity supply changed over

[5] Parts of some biomass streams (e.g. municipal solid waste) may consist of indirectly imported organic matter. In addition, in the 40 PJ avoided primary energy, about 10 PJ directly imported biomass are included. On the other hand, the Netherlands exported about 13 PJ in 2004 for energy purposes (see also section 5).

time. While Municipal Solid Waste (MSW)- combustion was dominant in 1989, today onshore wind energy and the especially the large-scale co-combustion of biomass have also gained large shares. By the end of 2004, about 4.5% of gross electricity consumption was covered by domestic renewable electricity production. Almost 60% of the renewable electricity production is covered by various biomass energy technologies.

In contrast to this strong increase in electricity production from biomass, no (significant) amounts of biofuels has so far been produced or used in the Netherlands.

In the following sections, the different biomass technologies currently deployed in the Netherlands and expectations until 2010 are described in more detail (for an overview, see table 3).

Table 2. Overview of various kinds of biomass streams and available quantities. Sources: (Zeevalking and Koppejan, 2000; Faaij, 1997; Londo, 2002).

biomass	examples	quantity (PJ_{th})
Cultivation	poplar, willow miscanthus and SRC crops	11.7
Biomass residues	verge grass, wood prunings, various agricultural residues	39.7
Waste streams	contaminated demolition wood, chicken manure, sewage sludges,	50.3
Organic fraction of waste streams	Municipal solid waste, industrial wastes	52
Total		**Ca. 150**

Table 3. Maximum expected contribution of biomass energy technologies in 2010 (Ministry of Economic Affairs, 2003a).

Biomass technology	Biomass fuel	Electricity (TWh)	Avoided primary energy (PJ)
Waste combustion	Municipal solid waste	1.81	20
Cofiring in coal power plants	Secondary fuels with high heating content Import of biomass	3.8	34
Landfill gas	Municipal solid waste	0.15	2
Wood combustion for heat production	Wood residues		0 7
CHP digestion plants	Manure, wet organic waste, household organic waste and sewage water	0.6 - 0.7	4 – 6
CHP combustion and gasification plants	Wood thinnings, food processing wastes, chicken manure, wood residues, waste wood	2	8 – 18
Biofuels	Various	------	8-10
Total biomass contribution		**8.36-8.46**	**83 – 97**

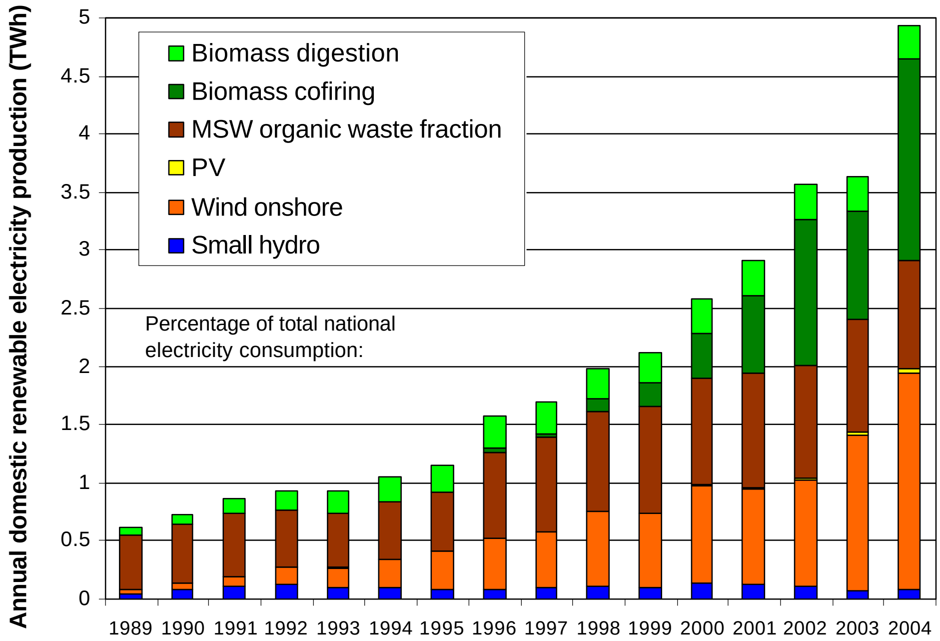

Figure 2. **Annual renewable electricity production in the Netherlands during 1989-2004, and contributions per technology (CBS, 2005). The percentages refer to the share in gross Dutch electricity consumption. The target for 2010 is 9 %. The data for 2004 are preliminary.**

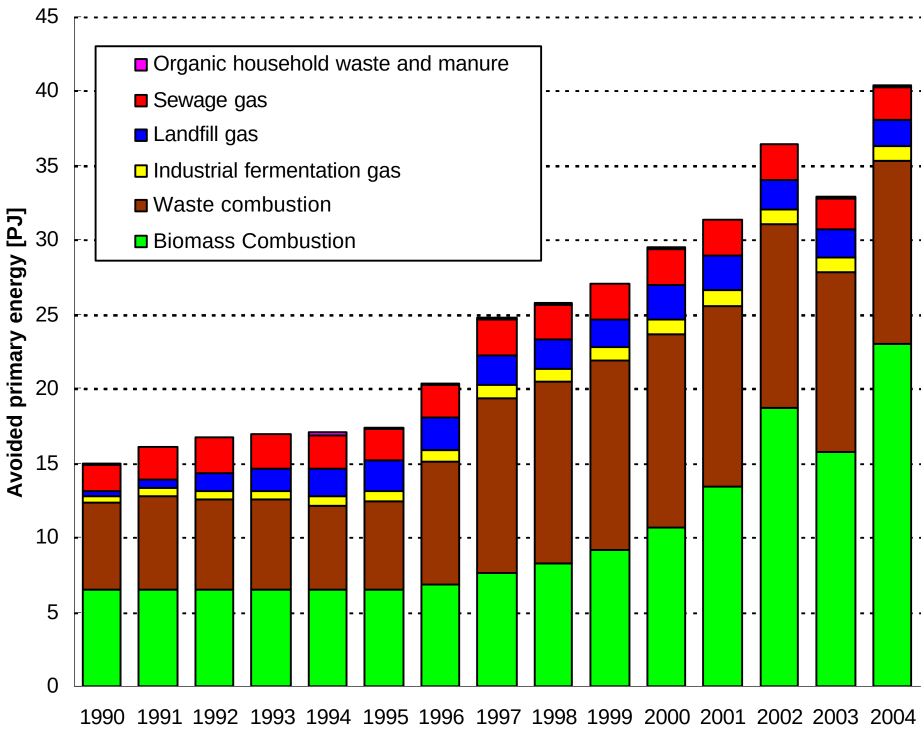

Figure 3. **Avoided primary energy consumption by production of electricity and heat from biomass. Biomass combustion includes co-firing in coal- and gas power plants, combustion of biomass in stand-alone plants for electricity, and industrial and household combustion of wood for heat production. The contribution from organic household waste and manure digestion is too marginal to be visible (about 0.09 PJ in 2003) (CBS, 2005).**

4.2. Waste combustion

Waste combustion was the main backbone of renewable energy in 1990. From 1990 to 1997 the production of renewable electricity and heat has increased, but since 1997, these contributions have remained more or less stable at about 12 PJ (see figure 3). In total, 11 waste incineration plants are currently operational in the Netherlands. Total energy production is about twice as high, as only half of the energy produced is contributed to organic waste, i.e. renewable sources.

In the future, a covenant with the waste combustion facilities was made to increase the renewable energy production by 5.3 PJ. However, given the current MEP-feed-in tariffs and the available waste streams, a total renewable energy production of up to 20 PJ is deemed feasible (Ministry of Economic Affairs, 2003a).

4.3. Co-firing in coal and natural gas plants

Dutch energy companies began to co-fire biomass and coal in the early 1990s, mainly waste streams such as paper sludge and (demolition) wood. Power companies combusted specific fuel types, in particular demolition wood and sewage sludge, because there was a surplus of these fuels rather than because there was a demand for renewable energy, and the focus was on experimenting with direct and indirect co-firing of small amounts of biomass. In the late 1990s, the focus shifted towards larger amounts of biomass and permanent co-firing. After 2000, all production companies intensified their co-firing activities, the main reason being a covenant between the power producers and the Dutch Ministry of the Environment, signed in 2002, and the increasingly high REB-tax exemption (and later on MEP feed-in tariffs for co-firing clean biomass). Energy companies also investigated more advanced technologies like gasification and pyrolysis, while the size of the co-firing niche further increased, but mainly by increasing biomass amounts in existing (in)direct co-firing plants. While in the early 1990s, solely domestic biomass waste streams were used for – cofiring, increasing amounts of biomass have been imported over the last five years. This will be further discussed in section 4. For an elaborate description of the historic development of co-firing in the Netherlands, see Raven (2005).

In the coming years, co-combustion of biomass is expected to further increase its role as major contributor to total biomass energy production. On the short-term (2010), an increase of 3.8 TWh is expected (Ministry of Economic Affairs, 2003a)[6]. On the longer term (2040), a contribution of 200 PJ to the primary energy consumption is envisioned (Ministry of Economic Affairs, 2004b).

4.4. Stand-alone biomass plants

A small number of stand-alone biomass combustion plants have been built in the Netherlands over the last decade (see also table 5). The largest one is a 25 MW_e bubbling fluidized bed boiler plant in Cuijk, operated by Essent. A few other small CHP-plants are currently in operation. All stand-alone plants in the Netherlands are fuelled by local, clean woody biomass, i.e. thinning, prunings and residue products form the wood industry. There have been plans for several more stand-alone plants, but their realization has so far been hampered by difficulties to acquire the necessary permits.

[6] In fact, Essent announced that they alone are planning to realize 3 TWh of electricity from biomass in 2005, so possibly this target may even be reached before 2010.

The contribution of stand-alone combustion plants is expected to increase to approximately 13 PJ avoided primary energy, roughly 40% as electricity and 60% heat. Main fuel sources are expected to be chicken manure, forest residues, clean waste wood and waste from the food processing industry (Ministry of Economic Affairs, 2003a).

4.5. Biomass digestion

There are several forms of biomass digestion in the Netherlands:

- Digestion of sludge from industry and wastewater treatment facilities (sewage gas)
- Landfill gas
- Digestion of organic household waste
- Manure digestion

Regarding the first two, little increase in energy production is expected. Regarding the energy production from wastewater facilities, a constant energy production over the next years is expected. The production of landfill gas is expected to decline slowly over the next 20 years, as it is currently forbidden to use combustible materials for landfills.

The availability of organic waste from the food processing industry is currently negligible (0.03 PJ), as only two digestion plants currently exist in the Netherlands. However, as a number of new plants are expected to come into operation over the next years, the production is expected to increase strongly to 0.3 PJ.

Experiments with the digestion of manure for energy production started in the late 1970's in the Netherlands, but has not been very successful. Since the late 1990's, a number of centralized manure digestion plants are operating in the Netherlands, but share in the total contribution of domestic biomass energy is marginal. For an elaborate description of the historic development of manure digestion in the Netherlands, see Raven (2005). However, for 2010, about 7500 kton could be available, theoretically sufficient for 2 PJ electricity and 1 PJ of heat (Ministry of Economic Affairs, 2003a). The realization of both manure and organic waste digestion is strongly depending on a changing regulatory framework, which has so far limited the application of these biomass streams.

4.6. Small Heat production from biomass

Estimates show that wood combustion in the wood-processing industry and in households contribute about 7.4 PJ fossil energy savings. This contribution is expected to remain constant. However, in order to achieve this, open hearths in households will have to be replaced by more efficient wood-burning stoves. Also, new installations as a consequence of stricter emission requirements for industrial wood combustion will be required (Ministry of Economic Affairs, 2003a).

4.7 Transportation fuels

Currently, basically no biomass-based transportation fuels are produced or used in the Netherlands. Given the current motor fuel consumption of 400 PJ (370 without LNG), about 21 PJ are required to meet the European biofuels directive target. This is seen as an ambitious target, and may partially be covered by importing biofuels (Ministry of Economic Affairs, 2003a).

Due to the postponement of the decision on the tax exemption for biofuels until 2006, only few initiatives exist in the Netherlands both for biofuel production and use. A few initiatives have been implemented in different parts of the Netherlands for a handful of busses, trucks, agricultural vehicles ands boats to be (partially) fuelled by biodiesel or pure vegetable oil (PVO). An overview of these pilot projects is given by SenterNovem (2005). In terms of biofuel production capacity, a number of more large-scale initiatives are planned for the short term, see table 4 for an overview.

Table 4. Overview of biofuel production capacity in the Netherlands as of June 2005 (SenterNovem, 2005).

Company & location	Source / Source country	Output	Annual production capacity (1000 m^3)	Status
ATEP Produktie B.V., Willemstad	Rapeseed, import from Germany	Biodiesel	128	Planned
Biofuels, Neede	Rapeseed, grown in the Netherlands	PVO	2.5 tons (2004)	Operational
Biovalue B.V. Eemshaven	Rapeseed, import from Germany	Biodiesel	17	Under development
Coöperatie Carnola. Oirlo	Rapeseed, Netherlands	PVO	3	1st prod in sept 2005
OPEK Nederland B.V, Zeewolde	Tapeseed, grown in the Netherlands	PVO	0.5	Under development
Solaroilsystems B.V., Boijl	Rapeseed, grown in the Netherlands (?)	PVO	3.5	Under development
Nedalco, Bergen op Zoom / Terneuzen	molasses, potato peels and c-starch (?)	Ethanol	200	Planned

4.8 Summary

In the previous sections it was shown that the Netherlands have a considerable domestic biomass potential, which may be sufficient to satisfy some of the ambitions for the short-term. However, the domestic potential may be not sufficient to reach the ambitious targets for 2010 for biofuels and renewable electricity. Even more so, to realize the long-term vision of covering 30% of the total energy consumption of the Netherlands by biomass energy in 2040 (i.e. 600 to 1100 PJ), and covering 20-45% of the feed-stock requirements of the chemical industry with biomass, large-scale import of biomass is required. Even if all agricultural areas currently in use in the Netherlands would be deployed for dedicated crop plantations (which is unrealistic), this would only suffice to cover approximately two-thirds of this ambition.

5. The biomass market and biomass trade in the Netherlands

5.1. Definitions of import and export

Biomass energy may be traded in different forms: physical transport of biomass or biofuels, physical transport of electricity from bioenergy, or biomass/bioenergy certificates. Furthermore, the physical import of biomass may be differentiated between direct and indirect import. These issues are discussed below.

Trade of electricity certificates vs. trade of biomass

The Netherlands only have a limited amount of cheap biomass potential. Though it is in theory possible to reach the 10% target in 2020 by only using domestic renewable energy sources (Junginger, 2003), it is likely more attractive from an economical point of view to import renewable energy.

In the past, the eligibility of foreign-produced renewable electricity for both the REB-tax exemption and a production support of 2 €ct/kWh caused a massive import of renewable electricity from 2000-2004 (see Figure 4). In 2003, approximately 9% of the total electricity consumption of the Netherlands was covered by imported renewable electricity, of which about 90% was from biomass, mainly imported from Finland and Sweden[7].. In 2004, the share of electricity from biomass has dropped slightly to about 75%. The import of renewable electricity has remained stable from 2002-2004. With the switch from the REB-tax exemption to the MEP-feed-in tariffs, for which only renewable electricity produced in the Netherlands is eligible, it is generally expected that the focus will shift somewhat to the import of biomass and conversion to electricity in the Netherlands. But given the current price of renewable electricity certificates on the European market of approximately 0.1 €ct/kWh (1 €/MWh), an estimated demand for renewable electricity in the Netherlands of over 15 TWh, and a limited domestic production capacity, it is likely that import of renewable electricity certificates will cover an important share of the total demand for renewable electricity at least on the short term[8].

[7] Currently, only certificates can be imported and sold as ‘green electricity’ in the Netherlands, from countries, whose system of issuing Guarantees of Origin has been approved by the EU. Currently, these countries are Sweden, Finland, Denmark, Austria and the UK (and the Netherlands) (CertiQ, 2005).

[8] It should be noted that currently, it is under debate whether renewable electricity production or consumption should be used for measuring the commitments for e.g. the Kyoto protocol and the 2001 EU Renewable electricity directive. In the case that this is decided to be on production basis, the Netherlands will probably have to rely even more on biomass imports to fulfill their obligations.

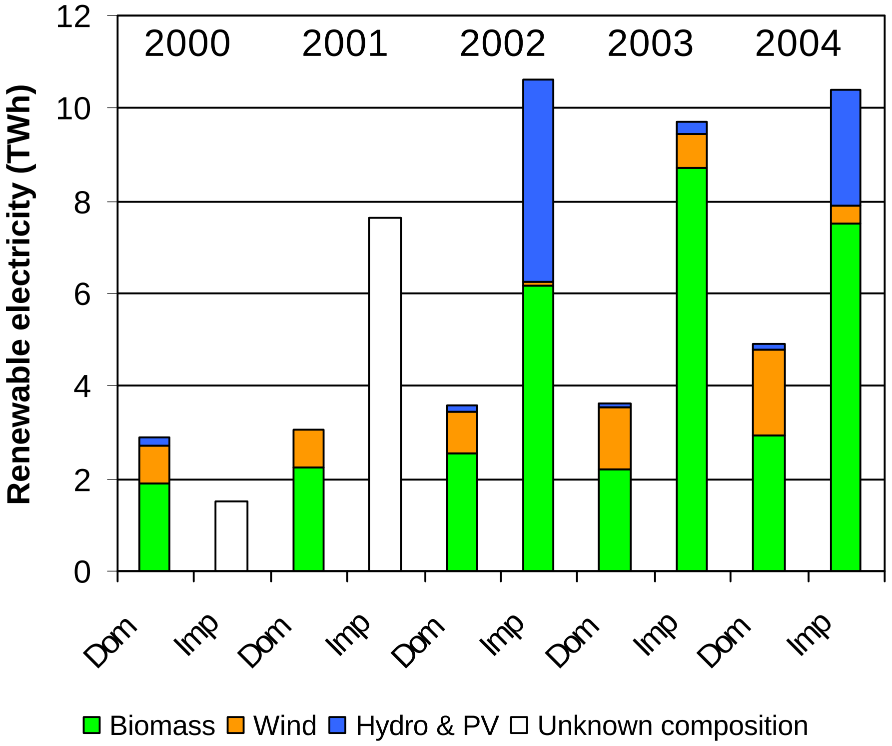

Figure 4. **Comparison of domestic renewable electricity production and import of renewable electricity. Before 2000, basically no renewable electricity was imported. The REB tax exemption caused massive import of renewable electricity from 2001 onwards. The largest share of this imported electricity was from (Scandinavian) biomass plants. No data on the composition of the imported renewable electricity is available before 2002. The data on import was based on physical import of renewable electricity from 2000-2002, and on import of certificates from 2003 until 2004. Sources: CBS (2004), CertiQ (2005).**

Direct and indirect trade

Biomass trade can be considered as a direct trade of fuels and as indirect flows of raw materials, that end up by fuels in energy production during or right after the production process of main product. For example, in Finland the biggest international biomass trade volume is comprised of indirect trade of round wood and wood chips. Round wood is used as raw material in timber or pulp production. Wood chips are raw material for pulp production. One of the waste products of the pulp and paper industry is black liquor, which is used for energy production (Heinimö, 2005).

In the Netherlands, indirect import only plays a minor role, mainly in the waste incineration sector. While a potentially large part[9] of the organic waste may be have been produced outside the Netherlands (and thus it is indirectly imported biomass), it is rather difficult to determine the exact amount of indirectly imported organic matter in this fraction. As the contribution from waste combustion is small compared to the contribution from co-firing, and it is not expected to increase strongly in the future, this issue will not be further discussed here.

[9] The largest fractions (in terms of heating content) in organic waste are paper and wood. (Ooms, 1999; Koppejan, 2000). The Netherlands are (net) importing both paper and wood (Hekkert, 2000).

5.2. Market description

As was shown in the previous section, most conversion technologies are currently fueled by domestic (or indirectly imported) biomass streams, which often have low or even negative costs. The major exception is the co-firing of biomass in coal power plants and gas power plants. In this sector, large amounts of biomass have been imported over the last years, and biomass prices are often substantial. In the remainder of this section, we will therefore mainly focus on biomass co-firing.

All coal- and gas-fired power plants in the Netherlands are currently owned by five utilities: Essent, Nuon, Electrabel, E.On and EPZ (a joint venture of Essent and Delta)[10]. However, biomass is currently only co-fired in eight out of twenty-five coal- and gas power plants. For an overview of the location of these plants, see figure 5, for a detailed plant description, see table 5.

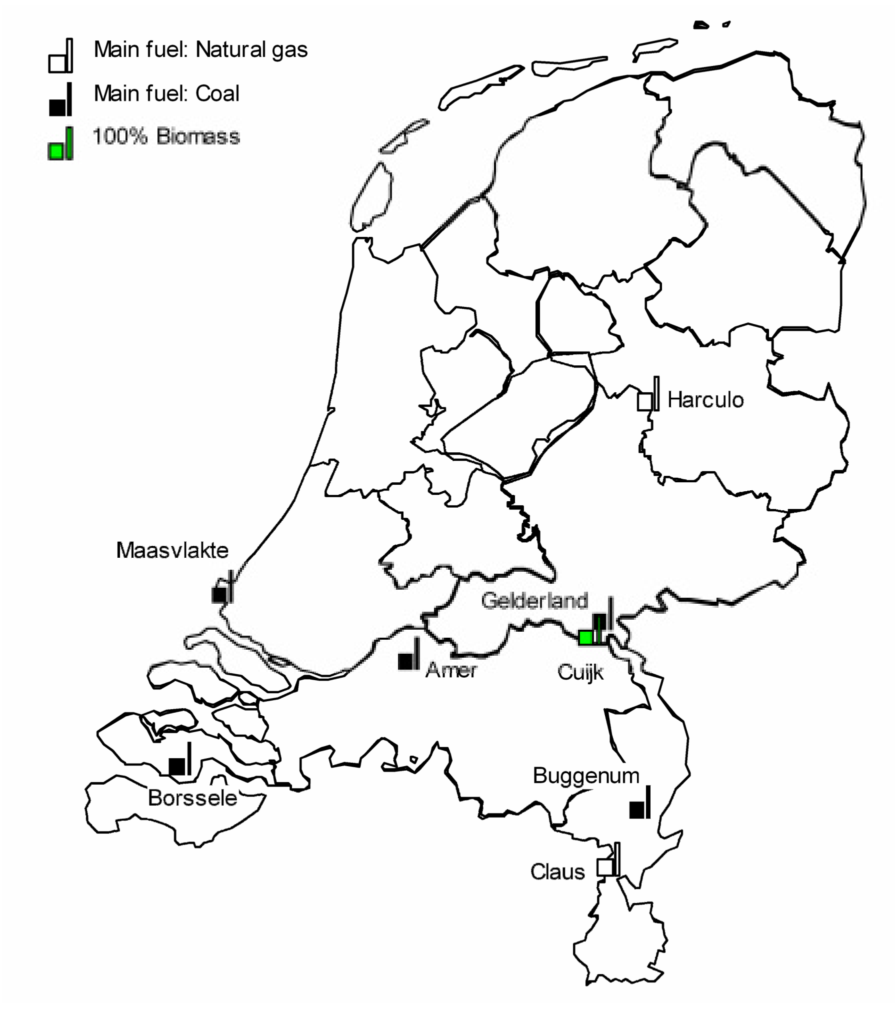

Figure 5. Overview of all plants in the Netherlands with a biomass (co-)firing capacity of over 20 MW_e in 2004. Source; www.energie.nl.

[10] Note that since the liberalization of the electricity market, the power production and power distribution are unbundled. There are far more utilities selling electricity to house-holds and industrial consumers.

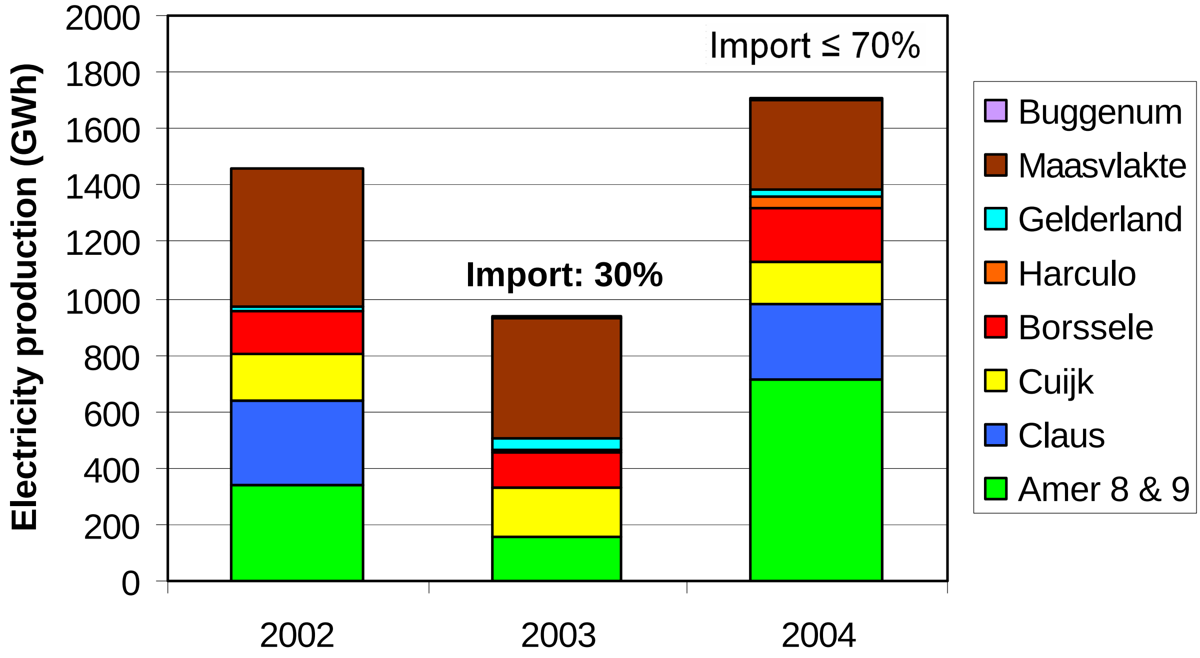

Figure 6. **Electricity production from biomass cofiring and stand-alone combustion plants from 2002-2004. For a detailed description of these plants, see table 5. Import percentages are on energy basis, i.e. electricity produced. Based on Jobse (2005), Marcus (2005), Prinsen (2005), Pfeiffer (2005), Wagener (2005).**

Table 5. Overview of (co-) combustion, CHP and gasification plants of biomass in the Netherlands. All data refers to 2004 unless stated otherwise. For the geographical location, see figure 5, for the electricity production, see figure 6. Data sources: Jobse (2005), Marcus (2005), Nuon (2005), Prinsen (2005), SenterNovem (2005).

Plant name (Location)	Owner	Electric capacity (MW_e)	Thermal capacity (MW_{th})	Main fuel	Cofiring concept[c]	Biomass fuels	Biomass source	(estimated) amount co-fired in 2004 (kton)
Cofiring								
Amer 8 And Amer 9 (Geertruidenberg)	Essent	650 600	n.a.	Coal	Indirect	Wood pellets, palm kernel expeller	100% Import	320
Borssele	EPZ (Delta & Essent)	406	n.a.	Coal	Direct	cocoa shells, wood, bone meal, sheanut shells, etc.	Ca. 80% import	108
Claus (Maasbracht)	Essent	2 * 600	n.a.	Natural gas	Direct	Vegetal oils & derivates	Ca. 98% import	78
Harculo (Zwolle)	Electrabel	350	n.a.	Natural gas	Unknown	Vegetal oils & derivates	100% import	12
Gelderland 13 (Nijmegen)	Electrabel	602	n.a.	Coal	Indirect	Olive residues Wood chips	import & domestic	4 10
Maasvlakte	E.On	1040	n.a.	Coal	Direct	Bone meal	5% Import	230
Hemweg (Amsterdam)	Nuon	630	n.a.	Coal	Direct	Clean waste wood, pellets	100% Domestic	Marginal
Willem-Alexander Buggenum (coal gasification)	Nuon	252	n.a.	Coal	Direct	Sewage sludge, chicken manure, other local waste streams	100% Domestic	Unknown (estimate < 5)
Amer 9 CFB (co-gasification).	Essent	n.a.	80	n.a.	Indirect	Demolition woodchips	Domestic	0
Stand-alone								
Cuijk (BFB comb.)	Essent	25	0	Wood chips	n.a.	Local wood residues	Domestic	240
Schijndel	Hout-industrie Schijndel BV	1.2	5.5	Wood	n.a.	Local wood residues	Domestic	7[a]
De Lange – de Lier	De Lange BV	0.75	3.5	Wood	n.a.	Local wood residues	Domestic	6[a]
Lelystad	Nuon	1.3	6.5	Wood	n.a.	Local wood residues	Domestic	4[a]
Total							Ca. 50% Import[b]	Ca. 1000

a Data from 2002

b On mass basis

c When suing direct co-firing, the biomass and main fuel are mixed and combusted or gasified in the same boiler. Indirect co-firing implies that these the conversion takes places separately, but that e.g. the steam cycle is integrated.

n.a. Not applicable

5.3. Biomass fuels used in the Netherlands[11]

The biomass used in Dutch power plants can be roughly divided into the following categories:

- liquid bio fuels like palm oil, soy oil, oil and fats used in food production
- agro residues like olive residues and palm kernel expeller
- wood and wood derived fuels or waste streams
- waste streams like animal waste, chicken manure, sewage sludge, RDF.

In table 6, these biomass types are briefly characterized. The prices are discussed in the section 4.3

Table 6. Characterization of biomass streams. Adapted from Pfeiffer (2005).

Pure vegetable oils	• Suitable for applications in gas or oil fired power plants due to the high heating value of around 37 to 40 MJ/kg, comparable with heavy fuel oil • Ash content and chemical composition can differ, special attention has to be paid to emission and flue gas cleaning. • Most expensive fuels, as their main application in food and pharmaceutical industry, mainly competitive during winter, due to higher natural gas and heavy fuel oil prices
Oils and fats used in food industry	• Availability is generally low and complex • Competes with applications in food and product chains and with small scale de-centralized applications (e.g. green house heating)
Agro residues	• Examples are palm kernel expellers and other palm residues, olive nuts, nut shells, cocoa husks, soy and sun flower residues • Available in considerable amounts on the world market • Main application is the animal feed industry, the compost and fertilizer industry
Wood and wood derived fuel	• Saw dust, not heavily contaminated milled wood waste (so called category B in the Netherlands) and wood pellets are used in co-firing • Some times the milling is done at the power plant itself by special equipment (Gelderland 13) but often the milling performance of the coal mill is enough • Wood pellets are used in case of import or when high quality fuel is needed to operate the plant in a safe way • Wood chips are generally not fired due to their high moisture content • Waste wood is also deployed, but special precautions (thermal conversion process, flue gas cleaning, ash applications) and pre-treatment is needed (gasification Amer, milling and classifying Gelderland 13) in order to minimize operational risks
Waste and waste derived fuel	• Sewage sludge, bone meal (animal wastes) and refuse-derived fuel (RDF) are currently used • Direct application of bone meal possible, but special caution has to be taken in storage and transportation • Use of dried sewage sludge s limited due to the relative high level of heavy metals and stringent emission limits. Main application in the Netherlands in dedicated plants (e.g. DRSH, Dordrecht, SMB, Moerdijk) or in waste-to-energy plants • Depending on emission permits, direct co-firing of pellets made from waste streams (e.g. RDF) is possible, but great care and control on the incoming fuel are required. Future use is expected in combination with the more costly indirect fired concepts • Application of other waste streams (e.g. Chicken litter; ONF, the wet fraction of the mechanical separated house hold waste) are limited due to operational risks.

[11] This section is largely based on Pfeiffer (2005).

5.4. Fuel prices

While the use of biomass fuels has increased strongly over the last years, the biomass market is still somewhat immature. No official statistics on biomass fuel prices and (imported) volumes are kept by Dutch authorities yet, but since 2003, biomass suppliers are interviewed twice a year on current prices of different biomass commodities (Hanssen, 2005). Fuel prices for wood pellets at the plant gate have been fluctuating between 7-7.5 €/GJ in 2004, (Sambeek et al. 2004), as opposed to 6.4 in 2002/2003 (EUBIONET, 2003). The higher prices are mainly due to increased transportation costs (about 1.75 €/GJ). On the mid-term, prices of wood pellets are expected to decline to 5.6-6.4 €/GJ due to increasing supply of wood pellets due to deployment of large-scale pellet factories, normalization of transportation costs and more efficient supply chains (Sambeek et al. 2004). A number of other biomass fuels have been used in 2004 (see table 5 and figure 7), whose prices are generally below those of wood pellets[12], but their use requires higher investment- and operational costs. For comparison, in table 7, an overview is presented of current techno-economic conditions and assumptions on the co-firing of clean biomass in power plant used to determine the height of the MEP-feed-in tariff. For an extensive discussion on biomass prices and long-term prospects, see Pfeiffer (2005).

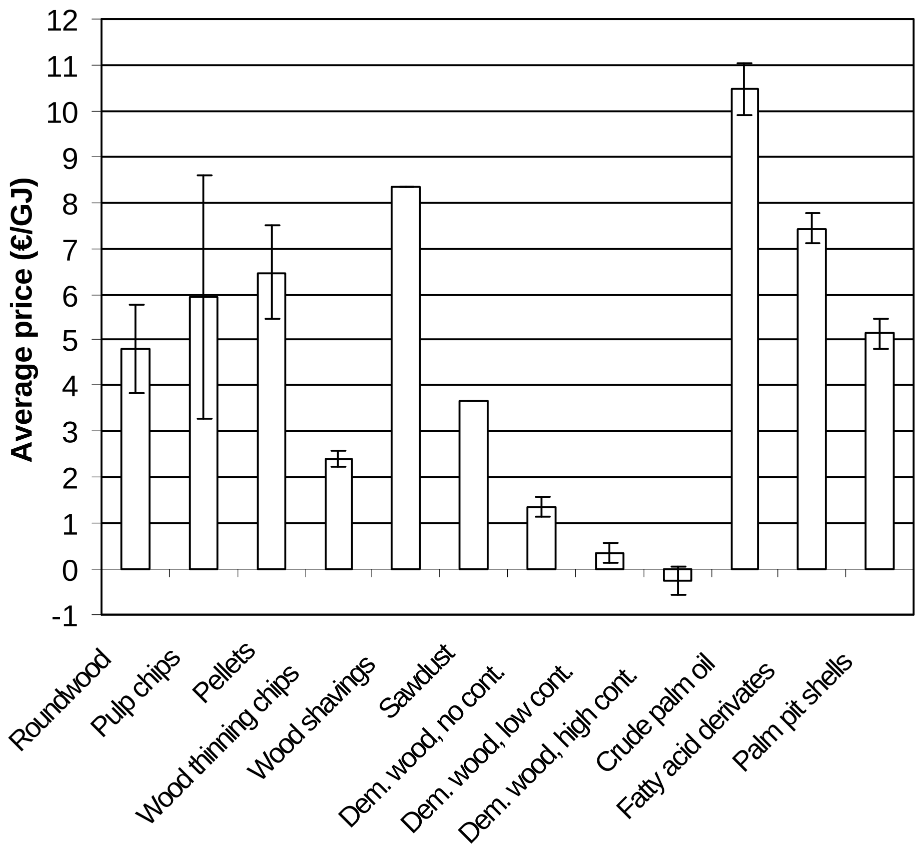

Figure 7. **Overview of various biomass prices in the Netherlands in 2004, on basis of LHV. For conversion to MWh: 1 MWh = 3.6 GJ. All prices are excluding transportation costs. Data from Hanssen (2005). The price levels should be considered as indicative, as they often are only based on a few observations per year. Also, the heating values and properties of the different biomass streams may vary. Note that highly contaminated demolition wood is not permitted as fuel in the Netherlands, and is currently exported, mainly to Germany and Scandinavian countries.**

[12] With exception of bio-oils.

Table 7. Current techno-economic conditions and assumptions on the co-firing of clean biomass in power plant used to determine the height of the MEP-feed-in tariff (Source: Sambeek et al., 2004). Fuel costs are based on wood pellet prices.

Reference assumptions				Advice for MEP-tariffs
		2003	2004/2005	2006/2007
Investment costs	[€/kW$_{th}$]	220	220	220
Annual full-load hours	[h/year]	7000	7000	7000
Variable O&M-costs	[ct/kWh$_e$]	0,25	0,25	0,25
Other operational costs	[ct/kWh$_e$]	0,95	0,95	0,95
Heating value of secondary fuel	[GJ/ton]	10	17	17,5
Fuel costs	[€/GJ]	6,0	6,5	6,0
Fuel costs	[€/ton]	60	110,5	102
Electrical efficiency	[%]	37,5	37,5	37,5
Heating value of primary fuel	[GJ/ton]	24,1	24,1	24,1
Economical lifetime	[years]	15	10	10
Avoided fuel costs	[€/ton]	40	40	40
Effectiveness of fuel substitution	[%]	93,3	93,3	93,3
Additional production costs[a]	*[€ct/kWh$_e$]*	*7,7*	*7,0*	*6,6*

a The varying feed-in tariffs per year are a consequence of the differing assumptions on fuel costs and economical life time (as the MEP feed-in tariff is only given for 10 years, the economic life time is also assumed to be 10 years). In the calculations for 2003, the economical lifetime was set at 15 years, implying that a power plant would actually make a loss during the last 5 years of operation.

5.5. Import volumes and logistics

Little information is available on the exact volumes and sources of the imported biomass, as this information is often treated as confidential, and no official statistics are kept. When adding up the numbers in table 5, a minimum of 500 kton biomass has probably been imported in 2004. An overview of the imported and exported biomass streams is given in table 8.

Essent, the largest user of biomass in the Netherlands, reported that approximately 30% of the biomass originated from North America, 25% from Western Europe and 20% from Asia, with the remainder from Africa, Eastern Europe, Russia and South America. (Essent, 2005). According to the port of Rotterdam and several biomass traders, biomass pellets mainly originated from South Africa, North America (mainly Canada) and South America (e.g. Chile and Brazil), while agricultural residues were imported from Malaysia, Thailand and Mediterranean countries. Main ports for the current import of biomass are the port of Rotterdam and Vlissingen, and to a minor extent Amsterdam (Van der Staaij, 2005, several biomass traders).

Both the total quantity of imported biomass and the share in the total biomass use in the Netherlands have increased, see figure 6. Notably, the share of imported biomass has increased from 30% in 2003 to 50% on mass basis. However, in terms of energy produced, the share has increased from 30% to 70% in 2004. This is due to the much larger amounts of bio-oils and derivates (mainly palm oil) imported in 2004, which has a much higher heating value than for example agricultural residues.

5.6. Export volumes

Overall, the export of combustible organic waste materials is well-documented, but no annual statistics are kept on how much is used for energy purposes, and how much for other applications (e.g. MDF-board production). A study carried out for 2002-2003 revealed that about 20 PJ (equivalent of approximately 1.6 Mton) were exported for direct use as fuel for energy production[13] (De Vos and Christan, 2005). About two-thirds of this volume consist of contaminated waste wood, demolition wood etc. Most of this material is exported to Germany and Sweden. In 2004, the amounts of exported combustible organic material have slightly declined since 2002-2003 (VROM, 2005). Therefore, it is estimated that about 13.4 PJ were exported for energy purposes in 2004. On top of these waste streams, clean waste streams such as untreated wood and paper waste may have been exported for energy purposes, but no data are available on these streams.

There are several reasons for this large export volume. The combustion of contaminated waste streams is problematic due to the strict air emission levels and the problems for obtaining emission permits (see also section 4.7). Also, a high tax has to be paid to use combustible material for landfills in the Netherlands. Exporting waste is allowed, if 50% or more of the waste streams are used for useful applications, e.g. as material or fuel. Given the relatively large waste combustion capacity in Germany and relatively low waste tariffs, the export levels have risen strongly from 2001 onwards, when the tax on landfills was introduced in the Netherlands (AD, 2003).

Table 8. Overview of imported and exported biomass streams for energy production for the Netherlands. Sources: Pfeiffer (2005), De Vos and Christan (2003) and own data collection. The data for 2004 should be considered (rough) estimates.

Import	2003		2004[a]	
	kton	PJ	kton	PJ
Wood pellets and other wood streams	80	1.4	420	6.3
Agro residues	55	0.9		
Bio-oil	5	0.2	90	3.4
Others (Bone meal, paper sludge, etc.)	0	0	15	0.15
Total	**140**	**2.5**	**525**	**9.85**

Export	2002-2003		2004[b]	
	kton	PJ	kton	PJ
Construction and demolition waste, wood waste	430	6.6	419	6.4
Remaining fraction from Construction and demolition waste	503	4.5	475	4.3
Paper/plastic fraction from household waste	151	2.0	147	1.2
Pellets from RDF	107	1.5	76	1.1
Others	449	0.4	372	0.4
Total	**1639**	**15.1**	**1489**	**13.4**

a The exact composition of biomass fuels used in 2004 in coal power plants were considered confidential by some power producers. The numbers presented here are (rough) estimates.
b All export data on 2004 is based on the total export volumes, and the assumption that the share for use as fuel was the same as in 2002-2003

[13] Only exports of organic material for energy production are listed here. The total export of combustible organic waste materials from July 2002- June 2003 was 38 PJ. Some of the minor waste streams are mixed, e.g. containing plastics or oil residues.

5.7. Barriers to the further implementation of bioenergy and biomass imports

In terms of general barriers for the further market diffusion of biomass in the Netherlands, the Dutch Biomass Action Plan lists a number of barriers (Ministry of Economic Affairs, 2003a), such as:

- financial support for energy from biomass
- acquiring permits for new biomass energy plants
- absent knowledge on biomass with local authorities and consumers
- absence of a clear definition of sustainable biomass
- availability of biomass and absence of a level playing field

In order to identify the main barriers for the import of biomass, the five main producers of electricity from biomass, some biomass traders and Dutch NGO's were interviewed.

The interviews with the major biomass power producers revealed that four out of five producers consider obtaining emission permits *the* major obstacle for further deployment of various biomass streams for electricity production (Jobse, 2005; Marcus, 2005; Prinsen, 2005; Pfeiffer, 2005). The main problem is that Dutch emission standards are not conform European emission standards. In several cases in 2003 and 2004, permits given by local authorities have been declared invalid by Dutch courts[14] (Daey Ouwens, 2004).

Essent was the first power producers which started co-firing on a large scale between 1999-2000. Due to this 'first-mover' advantage, Essent experienced little problems with obtaining emission permits. However, also Essent may face difficulties if they want to extend their co-firing capacity at one of their plants.

Given this advantage, and their ownership of several coal- and gas-fired power plants. Essent is currently the largest producer of electricity from co-firing biomass, covering almost 75% of the total production in 2004 (see figure 5). However, the strong growth in electricity production from co-firing over the last years has caused the required financial amounts to increase as well. In May 2005, Minister Brinkhorst of Economic Affairs therefore decided to terminate any feed-in tariff support for all new large-scale biomass projects, and for new offshore wind farms. Clearly, this is a large-bottle neck for the near future. On the other hand, the Dutch government committed itself to the target of 9% renewable electricity in 2010, and Minister Brinkhorst has framed that the budget will be raised to almost 800 M€ in 2010 compared to 300 M€ in 2004 (Ministry of Economic Affairs, 2005). Therefore, there is a reasonable chance that new biomass projects will re-obtain a feed-in tariff, though likely linked to a maximum production quota per year.

The fact remains that it could easily been predicted that the slight increase of the available budget over the last three years (from 250 to 300 M€ from 2003-2005) was not sufficient to cover a strongly increasing production, and would not have been sufficient to cover the 9% target in 2010. By suddenly terminating the support for new biomass, the coal power plant owners feel that the Ministry of Economic Affairs has created uncertainty in the market. Also, coal power plants may now have difficulties in fulfilling their obligations for the coal covenant, and are forced to import

[14] The Dutch "Raad van state".

renewable electricity instead of producing it themselves to meet their obligations towards renewable electricity consumers.

In addition, a number of expectations and perceived barriers were gathered from biomass traders[15]:

- *Competition with application as fodder production or food production.* In case of a strong increase in combustion of agro-residues, scarcity of fodder products may occur , and thus a price increase. Also, the fodder industry sees the feed-in tariff for electricity from biomass as an indirect subsidy for agro-residues. On the other hand, also the fodder market is subsidized.
- *Increasing international competition*. Some traders expected a growing demand for cheap biomass streams in the mid-term (5-10 years) in developed countries, but also in developing countries (local production for local use).
- *Reluctance to use new biomass streams.* Power producers are generally reluctant to experiment with new biomass streams, e.g. bagasse or rice husks. As these streams often do not have the required physical and chemical properties, power producers are afraid to damage their installations, especially the boilers. On the longer term, the limited ability to use different fuels may lead to a restricted availability of biomass fuels.
- *Immature market.* Due to the small size of the biomass market and the fact that biomass waste streams are a relatively new commodity, the market is immature and unstable. This makes it difficult to include a risk for long-term, large-volume contracts. One trader estimated the current upper boundary for wood pellets of approximately 100 €/ton may significantly increase in the near future due to increasing demand and lacking capacity on the supply side to satisfy this demand.
- *Lack of significant volumes and associated professional logistics.* In order to achieve low logistics costs, larger volumes need to be shipped on a more regular basis. Only if this is assured, the there will be investment on the supply side (e.g. new biomass pellet factories).
- *Lack of commitment of the Dutch government and energy producers.* Large volumes can only be achieved, if the demand side (i.e. power companies) commit themselves to large-scale use. Given the current problems with obtaining emission permits and the missing financial security for co-firing biomass, this commitment is currently too small.
- *Import restrictions*. As some biomass streams have not been imported before, so far no specific import regulations exist. Also, most residues streams that contain (traces of) starch are considered potential animal fodder, and are thus subject to EU import levies. For example, rice residues (e.g. rice husk) containing 0-35% starch are levied 44 €/ton (i.e. about 3.1 €/GJ) (Birkhoff, 2005). For denaturated ethanol of 80% and above. The import levy is 102 €/ m^3 (i.e. about 4.9 €/GJ), i.e. quite substantial amounts compared to general biomass prices (compare to figure 7). Other biomass streams such as wood pellets are not taxed.

Finally, also some Dutch NGO’s are raising concerns regarding the sustainability of imported biomass. NGOs such as Solidaridad and Milieudefensie (Friends of the Earth Netherlands) are mainly that large-scale production of biomass may cause similar social and environmental effects as the production of soy beans in South America and Palm Oil in Malaysia / Indonesia have caused. These effects include amongst others competition for food production, restricted access to firewood for subsistence economies, land degradation or loss of forests, the illegal clearing of land for large-scale monocultures including driving off small-scale farmers, loss of biodiversity and increased soil

[15] Because of the partially confidential nature of the information, the traders preferred to be quoted anonymously.

erosion (Gilhuis, 2005, Milieudefensie, 2005). Especially the current use of palm oil as biomass in gas-fired power plants (and possible further increasing use in the future) is feared to cause an increased demand for palm oil, leading to an increased pressure on the already threatened sensitive ecosystems such as tropical rainforests in Southeast Asia.

5.8. Certification efforts

One way to avoid (or at least limit) the negative effects described in the previous paragraph may be the establishment of sustainable biomass certification. So far, only one biomass certification system is operational in the Netherlands, the Green Gold Label (GGL), developed by Essent. The GGL is currently owned by an independent foundation, which accompanied by a board of advice, with representatives from NGO's and industry. The biomass in order to be certified under the GGL system has to be sustainable and traceable throughout the entire supply chain, from the source in plantations or forest, to the customers for the electricity (i.e. the entire chain of custody). The sustainable sources in question have to satisfy certain minimum conditions. These conditions and the criteria are set as close as possible to -and partly uses and acknowledges- those of existing quality control systems in agriculture and, based on certification systems already in use such as the Organic Agriculture or Eurepgap criteria for agricultural products, or wood certified in accordance with FSC or several other forest management criteria. Where this was not possible, Essent and Skal International (an independent inspection and certification organization) [1] have developed new standards. One of the key conditions is that the biomass is renewable, i.e. that after harvesting, new plants are grown. Other environmental and social criteria are at this stage kept to basic requirements, but may be extended in the next years. The monitoring process includes annual audits of the producers and suppliers of biomass, as well as quality control inspections (Essent, 2005; CUWG, 2005), and is currently carried out by Skal International. There are plans to extend the GGL system to possibly to include CO2- and energy balances, and to develop tradable biomass certificates.

In addition, also a certification system for renewable electricity produced in the Netherlands has recently been introduced, which also includes specific criteria for eligible biomass streams. However, these criteria are currently mainly focusing on the exclusion of waste streams, and the conversion technologies of biomass to electricity. Criteria regarding the origin and sustainable (production) character of biomass streams may be implemented from 2008 onwards (SMK, 2005).

6. Synthesis & recommendations

Until the year 2000, the Netherlands barely imported biomass for energy production. Over the last few years, both the import and export of biomass for energy purposes have been strongly increasing. In both cases, these trade flows have been mainly initiated by Dutch environmental and energy policy, i.e. a feed-in tariff for electricity from biomass and a levy on using combustible material for land fills. It is a peculiar situation, that the Netherlands export large amounts of waste wood, and at the same time import clean biomass streams

National (N) and international (I) (potential) barriers identified were:

- Limited financial governmental support (N)
- Problems with obtaining emission permits (N)
- Competition with application as fodder production or food production (N/I)
- Increasing international competition (I)
- Reluctance to use new biomass streams (N)
- Immature market(N/I)
- Lack of significant volumes and associated professional logistics (N/I)
- Lack of commitment of the Dutch government and energy producers (N)
- Import restrictions (N/I)
- Potential negative social and environmental effects linked to utilization of biomass streams such as palm oil (I)

On the short term, the first issue (limited financial support) is likely the most dominant factor to limit further biomass import to the Netherlands. The rapid growth of imported biomass has recently triggered a counter-reaction from the Dutch Government to limit the amount of biomass on the short term. This incident displays how dependent the biomass trade is at this moment. A stable, long-term policy is required to increase market share.

On the longer term, it is crucial that such a policy is matched with policy abroad, creating a level playing field in terms of governmental support for electricity from biomass, equalizing and removing trade barriers, and solving the issue of competition with applications for food and fodder, and other social and environmental barriers.

References

AD, 2003. Chaos bij export van afval; Controle ontbreekt, Kamer eist ingrijpen kabinet. Renout, F., Wessels, K., Algemeen Dagblad, September 13, Den Haag, p.3.

Bergsma, G., Harmelynck, B.G., 2005. Certificering van duurzaamheid van import van groene grondstoffen. Notitie. Delft, 31 maart 2005. CE / Eostra. P. 20.

Birkhoff, 2005. Personal communication on import levies for various biomass streams. Ministerie van Financiën, Afdeling Douane, 15 juni 2005.

Boonekamp, P. G. M., Daniels, B. W., Van Dril, A. W. N., Kroon , P., Ybema, J. R. and Van den Wijngaart , R. A., 2003. Sectorale CO2 emissies to 2010 Update Referentieraming ten behoeve van besluitvorming over Streefwaarden. Petten, The Netherlands, ECN, RIVM, p. 70.

CBS, 2004. Duurzame energie in Nederland 2003. Voorburg, The Netherlands, Centraal Bureau voor de Statistiek, p. 33.

CBS, 2005. Voorlopige duurzame energie- statistieken voor Nederland 2004. Centraal Bureau voor de Statistiek. Gepubliceerd op Statline: www.cbs.nl.

CertiQ, 2005. Jaarverslag CertiQ 2004, and monthly statistical reports for 2002 and 2003, available at: http://www.certiq.nl.

CUWG, 2005. Green Gold label description. Control Union World Group, Available at: http://www.controlunion.com/certification/default.htm

Daey Ouwens, J. 2004. Statusdocument Bio-energie 2004. 9 december 2004, Actieplan biomassa, SenterNovem.

De Vos, F., Christan, E., 2003. Berekening energie-inhoud van geëxporteerd afval. Periode 1 juli 2002 tot en met 30 juni 2003. Meurs Uitvoeringsmanagement in opdracht van SenterNovem, Uitvoering Afvalbeheer, p. 11.

ECN, 2005. Renewable electricity fact sheets EU countries, Factsheet The Netherlands. Energy research Centre of the Netherlands. Available at: http://www.renewable-energy-policy.info/relec/netherlands/index.html.

EnerQ, 2005. Information on MEP feed-in tariffs, available ast :www.enerq.nl.

Essent, 2005. Track & trace. Available at: http://www.essent-finance.nl/knowledge/article3.jsp

EUBIONET, 2003. EUBIONET fuel prices in Europe 2002/2003. Jyväskylä, March 2003.

Faaij, A. P. C., 1997. Energy from Biomass and waste. Doctoral Thesis, Utrecht University, p. 180.

Faaij, A., Steetskamp, I., Wijk, A. v. and Turkenburg, W., 1998. Exploration of the land potential for the production of biomass for energy in the Netherlands. Biomass and Bioenergy, 14(5-6), p. 439-456.

Gilhuis, J. Presentation given on 29.6.2005, Towards certified responsible biomass. Building concrete export cases meeting responsible supply criteria. Solidaridad, Utrecht, The Netherlands. Available at: http://www.yes-dc.org

Hamelink, C., van den Broek, R., Niermeijer, P., Jager, H., 2004. Biofuels certification. Ecofys, December 2004, p .36.

Hanssen, D., 2005. Prijslijst Biobrandstoffen (online databse on biomass prices). SenterNovem, Available at: http://212.0.231.227/biomassa/prijzen/main.asp

Hekkert, M., 2000. Analysis of the paper and wood flow in The Netherlands. PhD thesis, Utrecht University.

Jobse. A. Personal communication on the use of biomass at Borssele power plant, the Netherlands in 2004. 3.5.2005. EPZ.

Koppejan, J. 2000. EWAB Marsroutes. TNO-MEP.

Kwant, K.W., 2002, EUBIONET, Biomass survey in Europe. Country report of the Netherlands. Novem, p. 15.

Kwant, K. W. and Ruijgrok, W., 2000. Deployment of Renewable Energy in a liberalised energy market by Fiscal Instruments in the Netherlands. Utrecht, the Netherlands, The Netherlands Agency for Energy and the Environment (Novem), p. 13.
Lewandowski and Faaij, 2004. Steps towards the development of a certification system for sustainable Bio-energy trade. NWS- E-2004, Copernicus Instituut, Universiteit Utrecht, July 2004.
Londo, M., 2002. Energy farming in multiple land use. An opportunity for energy crop introduction in the Netherlands. Doctoral thesis, Utrecht University, p. 143.
Marcus, 2005. Personal communication on the use of biomass in E.On power plants in the Netherlands in 2004. 3.5.2005. E.On.
Ministry of Economic Affairs, 1995. Derde Energienota. The Hague, The Netherlands, p. 199.
Minister of Economic Affairs, 1997. Duurzame energie in opmars, Actieprogramma 1997-2000. The Hague, The Netherlands, p. 58.
Ministry of Economic Affairs, 1999. Energierapport 1999. The Hague, The Netherlands, Ministry of Economic Affairs, p. 59.
Ministry of Economic Affairs, 2000. Energie en samenleving in 2050, Nederland in Wereldbeelden (Energy and society in 2050, The Netherlands in world scenarios), The Hague, the Netherlands, p. 56.
Ministry of Economic Affairs, 2001a. Energie Onderzoek Strategie. The Hague, the Netherlands, p. 67.
Ministry of Economic Affairs, 2001b. Interdepartementaal Beleidsonderzoek naar de kosteneffectiviteit van energiesubsidies. The Hague, the Netherlands, p. 56.
Ministry of Economic Affairs, 2001c. Publiek gefinancieerd energieonderzoek Samenvatting 1995-1999, prognose 2000. The Hague, the Netherlands, p. 16.
Ministry of Economic Affairs, 2002. Wijziging van de Electriciteitswet 1998 ten behoeve van de stimulering van de milieukwaliteit van de elektriciteitsproductie en subsidievergoedingen MEP 2003. The Hague, the Netherlands, p. 16.
Ministry of Economic Affairs, 2003a. Biomass action plan: working together on bio-energy. Publication number: 04EP06, The Hague, the Netherlands, p. 14.
Ministry of Economic Affairs, 2004a. Innovation in energy policy. energy transition: state of affairs and the way ahead (in Dutch). The Hague, The Netherlands, 29 april 2004, p. 62.
Ministry of Economic Affairs, 2004b. Transition to a sustainable energy supply. C5: Coal and biomass (in Dutch). The Hague, The Netherlands, 29 april 2004, p. 62.
Ministry of Economic Affairs, 2004c. Biomass: green tool for energy transition in the Netherlands. Gigler, J. (editor), The Hague, The Netherlands, 29 april 2004, p. 59.
Ministry of Economic Affairs, 2005. Letter of Minister Brinkhorst to the second chamber, 10 May 2005. The Hague, The Netherlands, p. 10.
Nuon, 2005. Duurzaamheidsverslag 2004. (Sustainability report 2004). p.70.
Novem, 2001. Financieringswijzer duurzame energie. Utrecht, the Netherlands, The Netherlands Agency for Energy and the Environment (Novem), p. 119.
Ooms, T. et al.,1999. Afvalverwerking in Nederland, gegevens 1998. Afval overleg orgaan (AOO).
Pfeiffer, 2005. Long term price development of solid bio fuels for application in Dutch power plants. Arnhem, 31 March 2005, KEMA Power Generation & Sustainables, p. 35.
Prinsen, H., 2005. Personal communication on the use of biomass in electrabel power plants in the Netherlands in 2004. 18.4.2005, Electrabel.
Ranta, T, and Heinimö, H. International Bioenergy Trade: Experience in Finland. Presentation at the Business Forum on International Bioenergy Trade, 28 - 29th October, 2004 Rome, Italy.
Raven, R. P. J. M, 2005. Strategic niche management for biomass. Doctoral thesis, Eindhoven Technical University, june 2005, p 323.

React, 2005. Country report: The Netherlands. Renewable Energy Action, Altener 2002-157. p3.

SenterNovem, 2005. Praktijkvoorbeelden biobrandstoffen. Available at: http://www.gave.novem.nl/figuur025/project/voorbeeld.html

SMK, 2005. Certificatieschema groene elektriciteit, Stichting Milieukeur, june 2005. Available at: http://www.smk.nl

Tweede Kamer, 2002. Wijziging van de Elektriciteitswet 1998 ten behoeve van de stimulering van de milieukwaliteit van de elektriciteitsproductie. Memorie van toelichting. Vergaderjaar 2002-2003, 28 665, nr 3.

Van Sambeek, E.J.W., de Vries, H.J., Pfeiffer, A.E. , Cleijne, J.W., 2004, Onrendabele toppen van duurzame elektriciteitsopties. Advies ten behoeve van de vaststelling van de MEP-subsidies voor de periode juli tot en met december 2006 en 2007. November 2004, ECN-C--04-101, p. 38.

Van der Staaij, 2005. Personal communication on imported biomass volumes in 2004 in Rotterdam harbour, 28 April 2005, Havenbedrijf Rotterdam.

Van der Tol, M., 2005. Personal communication on imported biomass volumes in 2004, 25 April 2005, Ecochip B.V.

Van Herwijnen, T., Schoof, A., Faaij, A., Bergsma, G., Loorbach, D., Schaeffer, G.J., de Keizer, I., Visie op biomassa. De rol van biomassa in de Nederlandse energievoorziening 2040 (Vision on biomass. The role of biomass in the Dutch energy supply 2040). Ministry of Economic Affairs, The Hague, The Netherlands, August 2003, p. 62.

Van Wijland, 2004. Europese productie biodiesel gestegen, Nederland blijft achter. Duurzame energie, sept/okt. 2004, p.44.

Verbong, G., van Selm, A., Knoppers, R. and Raven, R., 2001. Een kwestie van lange adem. De geschiedenis van duurzame energie in Nederland. Boxtel, The Netherlands, Aeneas, p. 423.

VROM, 2005. IN- en UITVOER van AFVALSTOFFEN: 2003 en 2004. Internationaal Meldpunt afvalstoffen. Ministry of Housing, Spatial Planning and the Environment.

Wagener, M. 2005. Experiences With Bio-fuel Trade. Manager Sustainable Portfolio & Development, Sustainable Trading & Operations, Essent Energy Trading, Business Forum IEA T40 – FAO, Rome, Italy. 28-29 Oktober 2004.

Ybema, J. R., van Dril, A. W. N., Daniels, B., Harmsen, R. and van den Wijngaart, R., 2002. Referentieraming energie en CO2 2001-2010. Petten, The Netherlands, ECN, RIVM, p. 77.

Zeevalking, J. A. and Koppejan, J., 2000. Availability of biomass and waste. EWAB Marsroute study, Task 1 (in Dutch). Utrecht, The Netherlands, TNO, p. 29.

Appendix 1 Overview of Past Policy instruments

Financial instruments	Description and magnitude	Governmental expenditure
R&D support	Support for research in solar-thermal, solar-PV, wind, biomass and other renewable energy technologies	200 M€ (1995-2000)
Green Funds	Investors in 'green projects' can obtain lower interest rates from **Green Funds**. These funds are created by savings of private persons, who are exempted from paying income tax on the interest received.	
Accelerated Depreciation	From 1996 until 2002 the **VAMIL scheme** offered entrepreneurs a financial advantage because accelerated depreciation was permitted on equipment, which was included in the VAMIL list. The accelerated depreciation reduced tax payments on company profit. However, all energy-related technologies were removed from the VAMIL list in 2003.	
Tax Credit	Since 1997 the **Energy Investment Scheme (EIA**) and the **Environmental Investment Scheme (MIA)** make it possible since 1997 to offset investments in technologies against taxable profit. The tax credit offered varies from 52.5% to 40% (depending on the size of the investment). In 2003, the MIA was abolished for energy-related technologies. Also, in order to apply the EIA, a building permit must now be obtained first.	Green Funds, VAMIL & EIA 65 M€ (1990-2000)
Investment credits	The **Subsidy Scheme for the Non Profit Sector (EINP)** consists of a subsidy of 14,5%-18,5% on the investment costs for the non profit sector (private persons, associations and denominations etc.) The **CO_2-Reductionplan** is a special kind of subsidy scheme. The subsidies are distributed on the basis of a tender system. The maximum amount of subsidy is 45% on the investment costs for renewable energy projects. **Decision Subsidies Energy programs (BSE)** aims at the development and application of innovative projects. Subsidy scheme for active solar thermal systems (ZON).	Unknown
Other financial measures	For energy companies and municipalities, so-called environmental action plan **(MAP)-funds** were made available until 2000. Investments for renewable energy projects were financed by allowing utilities to charge consumers an extra fee.	179 M€ (1990-2000, paid by consumers)