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International bioenergy trade in the Netherlands

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ABSTRACT

The international biomass trade in the Netherlands has been growing strongly over the last few years, but information on the corresponding volumes, origins and prices is barely available. The objectives of this paper are to quantify imported and exported biomass volumes and origins, and identify drivers and barriers behind the trade flows. Data collection was based on existing statistics and information obtained from biomass traders and end-users. Net import of biomass for energy purposes has been increasing from 2.5 PJ in 2003 to above 20 PJ in 2005–2006, consisting mainly of vegetable oils, agricultural residues and wood and wood-derived fuels, used to almost 100% in Dutch coal- and gas-fired power plants. Biomass exports (mainly of waste wood and construction wood) were high in 2004 (an estimated 13.2 PJ) but have probably strongly declined by the end of 2006, while (re)-export of wood pellets has been increasing in recent years, estimated at 5–7 PJ in 2005–2006. The main driver for biomass imports were the Dutch MEP feed-in tariff for electricity from biomass, while difficulties to obtain permits to co-fire (contaminated) waste wood were a main driver for the export of biomass. Rapidly changing feed-in tariff levels and support systems were seen as one of the largest barriers for the development of a stable biomass trade. Other major issues include concerns regarding the sustainability of biomass production, competition with biomass applications for food and fodder and import restrictions. Major additional imports of liquid transportation fuels are expected until 2010, which could possibly increase the import of biomass to over 50 PJ.

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1. Introduction and rationale

In the last years, the interest for international biomass trade has 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), NGOs (Greenpeace, WWF) the interest for the concept of international bioenergy 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 Bioenergy 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 NGOs, 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).

Short-term objectives of Task 40 are amongst others 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

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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 paper aims to provide an overview of these issues for the Netherlands, and also makes an inventory of barriers as perceived by various Dutch stakeholders.

The information gathered for this paper is to a large extent 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 paper.

The paper is organized as follows. Sections 2 and 3 presents a brief over of the policy setting on renewable energy and bioenergy 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.

2. Policy setting on renewable energy and bioenergy in the Netherlands

2.1. *Long-term policy goals and frameworks*

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[1] in 2020 in the Netherlands was set [1], which is still the leading target. 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 2010, the Dutch government has set a target of 9% renewable electricity. For 2020, a target of 17% renewable electricity was mentioned in 2020 in the past (as part of the overall 10% renewable energy target in 2020) [1–3].[2] However, it is currently unclear whether this goal will be pursued further. Furthermore, the EU targets set for biofuels (5.75% in 2010, 10% in 2020) are also supported by the Dutch government, though.

[1] Defined as 10% of total domestic energy consumption in the Netherlands in 2020. In 1995, this contribution was about 0.7%, in 2005, it was 2.4% [51].

[2] These targets seem relatively modest in comparison to the European target of 20% renewable energy in 2020. However, the Netherlands has basically no potential for large-scale hydro plants, which constitutes the bulk share in many European countries.

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 Mt between 2008 and 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.

To achieve these goals, in the last years, the concept of "transition management" or "transition approach" was introduced in the Netherlands. In order to meet Kyoto obligations and to achieve the transition to a sustainable energy supply, a new approach—in addition to the existing policy—was developed. The approach aims to involve key actors such as companies, citizens, cities, regions and technical institutions who are ambitious about achieving a sustainable energy economy. These stakeholders play a key role to bring about fundamental changes towards a sustainable energy infrastructure, so-called "system changes". System changes may for example take place in the future during the transition to hydrogen or to a biobased economy. While in technical terms, major changes are already possible, these are often impeded by factors such as acceptance by civil society, economic issues, and powerful stakeholders who oppose the required changes. In the transition approach, public–private cooperation plays a major role in this process. The Dutch government structures and facilitates this cooperation in the form of public–private "platforms." These platforms enable the leaders to form networks and exchange views and ideas. The government directs and stimulates this process, but does not make (technology choices); these are left to the market [4].

To initiate the transition to a sustainable energy system, six themes were selected:

1. Biobased raw materials
2. Sustainable mobility
3. Chain efficiency
4. New gas
5. Sustainable electricity
6. Energy in the built environment.

Each theme is again subdivided in several subtopics. Biomass resources are basically involved in each transition route, and play a major role in routes 1, 2 and 5. The platform for biobased raw materials aims to replace 30% of the raw materials in the total energy supply of the Netherlands with biobased raw materials by the year 2030 [5]. The platform estimates that about 600–800 PJ will have to be imported, as not enough domestic biomass will be available in the Netherlands to meet the demand. The platform believes that the intended replacement of 30% of fossil fuels by biobased raw materials in 2030 may take to shares of 60% biofuels, 25% chemicals/materials/products, 25% electricity and 17% heat in the respective markets. The target year of 2030 has been chosen deliberately. This year is far enough in the future to allow the full range of the possibilities and potential of biobased raw materials to emerge, but it is also close enough to allow us to make deliberate choices in transition paths and to begin the implementation of biobased raw materials.

3. Policy instruments deployed

Since the late 1970s, 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. [6]. Various Research, Development and Demonstration (RD&D) 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 Junginger et al. [7].

3.1. *Research, development and 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 to 2004, and gaseous, and liquid climate neutral energy carriers (GAVE), to achieve market introduction in three phases from 2001 to 2008 [8]. Furthermore, within the frame of transition management, the so-called unique chances regulation (UKR) allows for 'experiments', i.e. demonstration projects in line with the five main transition routes.

3.2. *Market deployment*

Recently, two main market deployment policy instruments have been used: fiscal measures to support investments in renewable energy capacity, and feed-in tariffs/tax exemptions to support renewable electricity production.

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. 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. 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€ [9]. Also other policy instruments have been used in the past, for an overview see Junginger et al. [7].

The second focus of policy support measures was to stimulate the production of renewable electricity. In the past decade, three different instruments were deployed:

(1) First of all, a tax exemption for all renewable electricity called REB was in place up until 2003, but was rapidly phased out during 2003, for more details see Junginger et al. [7].

(2) As follow-up mechanism, a feed-in premium called MEP (environmental quality of the electricity production), which was paid since July 2003 to producers of electricity from renewable sources who feed in on the Dutch electricity grid, and was guaranteed for a maximum of 10 years. The subsidy was financed by a levy on all connections to the electricity grid in the Netherlands. The MEP tariffs applied for a number of renewable energy technologies (e.g. onshore and offshore wind, hydro power, PV) and for various biomass options. For the biomass options, the height of the feed-in tariff was rather complicated: it depended on four factors: the capacity of the installation, the type of biomass used, the period when the electricity was produced and the point in time when the first request for subsidy was received. For a detailed overview and the most up-to-date situation, we refer to the website of EnerQ.[3]
However, due to a limited annual budget on the one hand, and a strongly growing production of electricity from biomass on the other, 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 large bioenergy projects and offshore wind farms will receive no feed-in tariff from 2005 to 2007. In September 2005, it was announced that from 1 July 2006 onwards, feed-in tariffs for electricity production from vegetable oils and agricultural residues were lowered drastically, from 6.6 to 2.5 €ct/kWh. In August 2006, the Dutch Minister of Economic Affairs announced that all feed-in (MEP) tariffs were reduced to zero for all new project (i.e. not existing capacity), which effectively ended the MEP support system. This triggered a strong negative response from many market parties, NGOs and other political parties. In spite of this, only for small-scale digester, a transitional arrangement was made.

(3) The latest instrument to support renewable electricity production is called SDE (stimulation of renewable energy production). The main outline was published in July 2007, though many details will only be published in the beginning of 2008 (Ministry of Economic Affairs, 2007), and it is expected that this system will come into operation in spring 2008. In a recent advice document, Van Tilburg et al. [10] suggest heights of feed-in tariffs for different renewable energy options. The main difference with the MEP system is that the height of the feed-in tariff will partly depend on the development of fossil fuel prices. Also, specifically for biomass, reporting obligations regarding the sustainability of biomass production will likely be included, as set by the Dutch framework on sustainable biomass production (see [11,12] elsewhere in this special issue). In total, 300 million € are available to support renewable electricity production between 2008 and 2011. From 2012 onwrads, annually between 300 and 350 million € are budgeted, which should be sufficient to meet the 20% renewable energy target in 2020 [13].

[3] See http://www.enerq.nl/informatie/Tarieven/default.asp#0 for information on the tariff heights.

3.3. *The Netherlands biofuel policy*[4]

The Netherlands is currently working on implementing the European guideline (2003/30/EG) to encourage the use of biofuels. For the Netherlands, the 2010 transport fuel target of 5.75% amounts to around 900 million liters of biofuel, which means an increase of around 100 million liters per year, from 2006 onwards. In order to encourage biofuel usage, the government has announced that biofuel additives will be exempt from excise duty during 2006. This exemption means that up to 2% biofuel can be added to traditional petrol and diesel fuels without consumers having to pay extra. In practice, additives are either ETBE added to petrol, or biodiesel which is mixed with conventional diesel.

This duty exemption has ceased on January 1, 2007, when oil companies will be compelled to achieve 2% of their turnover from biofuels. This will occur in two phases. Phase one will only achieve minimum requirements under the EU guideline. All biofuel suppliers must ensure that, per calendar year, at least 2% (on an energy basis) of the petrol or diesel they sell in the marketplace must be attributed to biofuels. This requirement also applies at the macro-level. The percentage of biofuel may fluctuate over the various regions within that year, and oil companies may trade their surplus/shortage with other suppliers. This flexible approach allows high-percentage fuels, such as pure plant oil (PPO) and 85% ethanol (E85) to be used. It is also possible that biofuels not meeting minimum sustainability criteria will not be included in this legal requirement, e.g. biofuels that lead to large-scale deforestation.

Phase two will follow later, when the government's policy concerning innovation, sustainability and certification have been defined further. Biofuels achieving a better (CO_2) environmental performance will be rewarded, e.g. by allowing these advanced biofuels to weigh more heavily in the new legislation, or making it compulsory to use these fuels for meeting part of the criteria. An information system also needs to be developed to focus on sustainability criteria via certification. Tradable certificates will be used to monitor the system. The compulsory 2% biofuels will increase to 5.75% in 2010, conform the EU's biofuel guideline.

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

4.1. *Domestic biomass potential and overview of past achievements*

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 1, an estimate of this potential is presented, based on the Marsroute study [14], with additional data for biomass residue streams [15] and for assumptions for possible biomass cultivation in the Netherlands [16,17]. 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.

Table 1 – Overview of various kinds of biomass streams and available quantities

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

Sources: [14–16].

The utilized fraction of this potential is still small, but has strongly increased from 15 PJ of avoided primary energy in 1990–58 PJ (see footnote 5) in 2005 (about 85% in the form of electricity and about 15% heat). As a result of the policy measures described in the previous paragraph, the domestic renewable electricity supply has even increased exponentially between 1989 and 2006 (see Fig. 1). The total contribution of renewables to Dutch gross electricity production increased by about a factor of eight in the same time period (also taking into account the increase in electricity demand). The contributions of different sources to the renewable electricity supply changed over time. While municipal solid waste (MSW) combustion was dominant in 1989, today onshore wind energy and especially the large-scale co-combustion of biomass have also gained large shares. By the end of 2006, about 6.6% of gross electricity consumption was covered by domestic renewable electricity production. More than half 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

[4] The text in this section was integrally adopted from the GAVE program of SenterNovem, see http://www.gave.novem.nl/figuur025/accijnsvrijstelling_eng.html.

[5] Parts of some biomass streams (e.g. municipal solid waste) may consist of indirectly imported organic matter. In addition, in the 58 PJ avoided primary energy, about 10 PJ directly imported biomass are included.

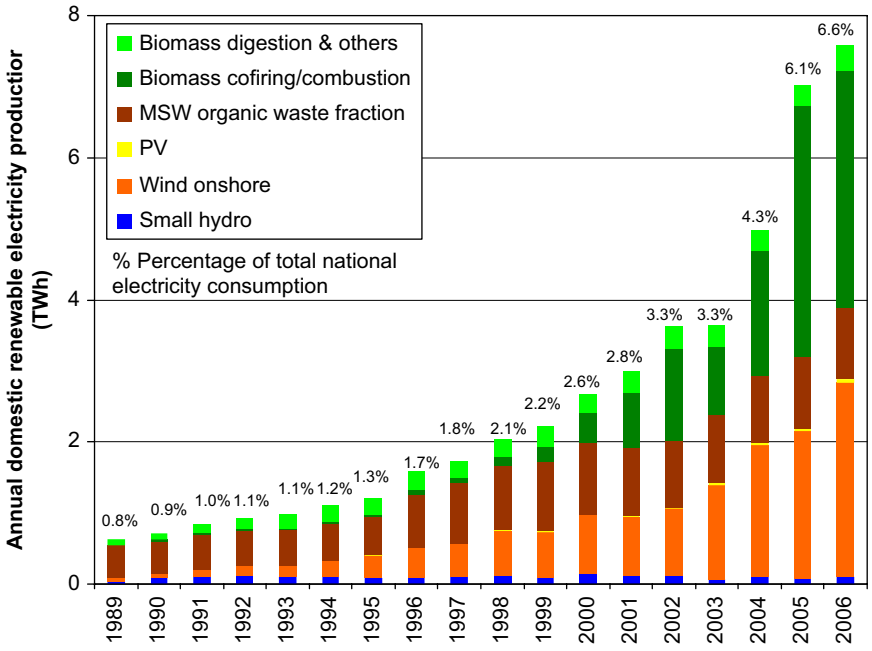

Fig. 1 – Annual renewable electricity production in the Netherlands during 1989–2005, and contributions per technology [18]. The percentages refer to the share in gross Dutch electricity consumption. The target for 2010 is 9%.

Table 2 – Maximum expected contribution of biomass energy technologies in 2010 [19]

Biomass technology	Biomass fuel	Electricity (TWh)	Avoided primary energy (PJ)
Waste combustion	Municipal solid waste	1.81	20
Co-firing 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

until 2010 are described in more detail (for an overview, see Table 2).

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 Fig. 2). 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 available waste streams, a total renewable energy production of up to 20 PJ may be feasible [19].

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

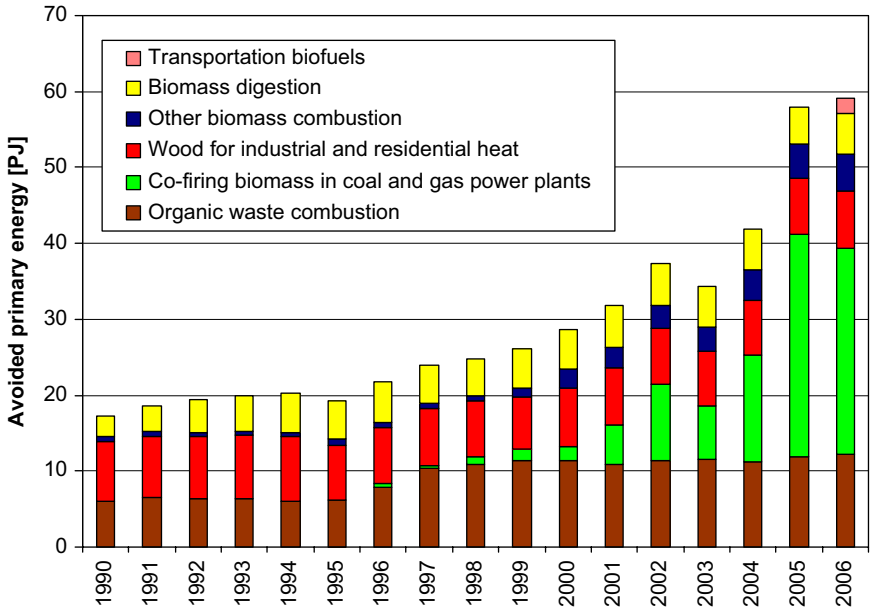

Fig. 2 – Avoided primary energy consumption by production of electricity and heat from biomass [18]. Numbers for 2006 are preliminary.

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 co-firing, increasing amounts of biomass have been imported over the last 5 years. This will be further discussed in Section 4. For an elaborate description of the historic development of co-firing in the Netherlands, see [20].

In the coming years, co-combustion of biomass is expected to further increase its role as a major contributor to total biomass energy production. On the short-term (2010), an increase of 3.8 TWh is expected [19].[6] On the longer term (2040), a contribution of 200 PJ to the primary energy consumption is envisioned [21].

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 3). 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] Note that this target has been reached in 2005.

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 1970s in the Netherlands, but has not been very successful. Since the late 1990s, a number of centralized manure digestion plants are operating in the Netherlands, but share in the total contribution of domestic biomass energy is marginal. However, a number of new plants have recently been built, and more are under development, because of the MEP feed-in tariffs. For an elaborate description of the historic development of manure digestion in the Netherlands, see [20]. For 2010, about 7500 kt could be available, theoretically sufficient for 2 PJ electricity and 1 PJ of heat [19]. The realization of both manure and organic waste

Table 3 – Overview of (co-)combustion, CHP and gasification plants of biomass in the Netherlands larger than 20 MW_e, and biomass use during 2005

Energy company	Plant	Total net electric capacity (MW_e)	Net electric efficiency (%)	Main fuel	Biomass feedstock input
Essent	Amer 8 and Amer 9	650 (Amer 8) 600 (Amer 9)	40 41.3	Coal	Wood pellets Agricultural residues
	Amer 9 (co-gasification)	–			Wood chips
	Borssele[a]	406	40	Coal	Cocoa shells, wood, bone meal, sheanut shells, etc. Bone meal
	Cuijk (BFB comb. 100% biomass)	25	30	Wood chips	Wood chips, clean wood residues
	Claus	1200	40	Natural gas	Vegetal oils and fatty acids
Electrabel	Harculo	350	45.2	Natural gas	Palm oil derivates
	Gelderland 13	602	38	Coal	Wood chips, wheat husk
Eon	Maasvlakte	1040	40.6	Coal	A solid portfolio (incl. bone meal) and a small liquid portfolio
Nuon	Hemweg	630	40.6	Coal	Clean waste wood, pellets
	Buggenum (coal gasification)	252	43	Coal	Sewage sludge, chicken manure, other locale waste streams

For the geographical location, see Fig. 5, for the annual electricity production from biomass, see Fig. 6. Data sources, see [7].
[a] The Borssele coal power plant is owned by Essent (50%) and Delta (50%).

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 [19].

4.7. *Transportation fuels*

Currently, biomass-based transportation fuels are produced or used only marginally in the Netherlands. In 2003–2005, very small quantities of biodiesel were used (100–130 TJ). In 2006, this increased to almost 2 PJ (about half of which from biodiesel, and half from ETBE) [18]. This equaled about 0.43% of the total transportation fuel consumption in 2006. Given the current motor fuel consumption, about 27 PJ are required to meet the European biofuels directive target of 5.75% in 2010.

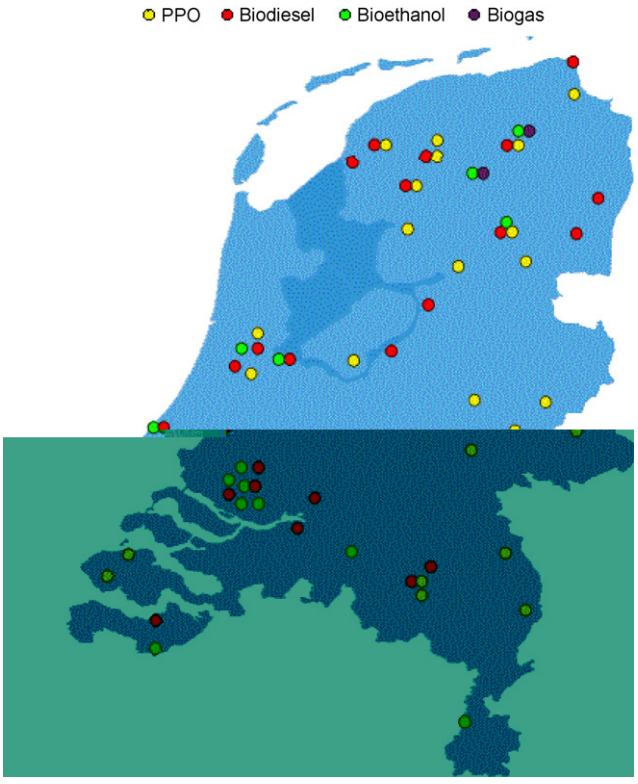

Fig. 3 – Overview of all project involved with the production, import, conversion or use of biofuels in various stages [22].