BIOENERGY PRODUCTION AND INTERNATIONAL 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. Import of biomass for energy purposes has been increasing from 2.5 PJ in 2003 to 23.5 PJ in 2005, 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) declined from 15.1 PJ to 13.4 PJ between 2003-2004. 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 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.
Keywords: Biomass trade, barriers to bioenergy, biomass resources

1 INTRODUCTION AND RATIONALE

As in most countries, biomass in the Netherlands is a relatively new (though quickly growing) commodity. Due to its limited domestic resources, and its strategic logistic location (with the harbour of Rotterdam) both import and export of biomass for energy have been rapidly developing over the past years. However, 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. Also barriers for trade as perceived by various Dutch stakeholders are summarized. The Netherlands are a prime example how renewable energy/electricity targets can be met by importing biomass, thus highlighting the importance of international bioenergy trade. The paper is based on the Dutch country report written for IEA Bioenergy Task 40.

2 APPROACH

The information gathered in this report 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.

3 DOMESTIC BIOMASS POTENTIALS, PAST ACHIEVEMENTS AND SHORT-TERM EXPECTATIONS

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 (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-) 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.

The utilized fraction of this potential is still small, but has strongly increased from 15 PJ of avoided primary energy in 1990 to 58 PJ9 in 2005 (about 85% in the form of electricity, and about 15% heat). As a result of policy measures, the domestic renewable electricity supply has even increased by a factor of eleven from 1989 to 2005 (see Figure 1). 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 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 2005, about 6.2% of gross electricity consumption was covered by domestic renewable electricity production. Almost 70% 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. The different biomass technologies currently deployed in the Netherlands and expectations until 2010 are described in more detail in Junginger et al. (2006). For an overview, see table 2.

Table I 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 II 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**

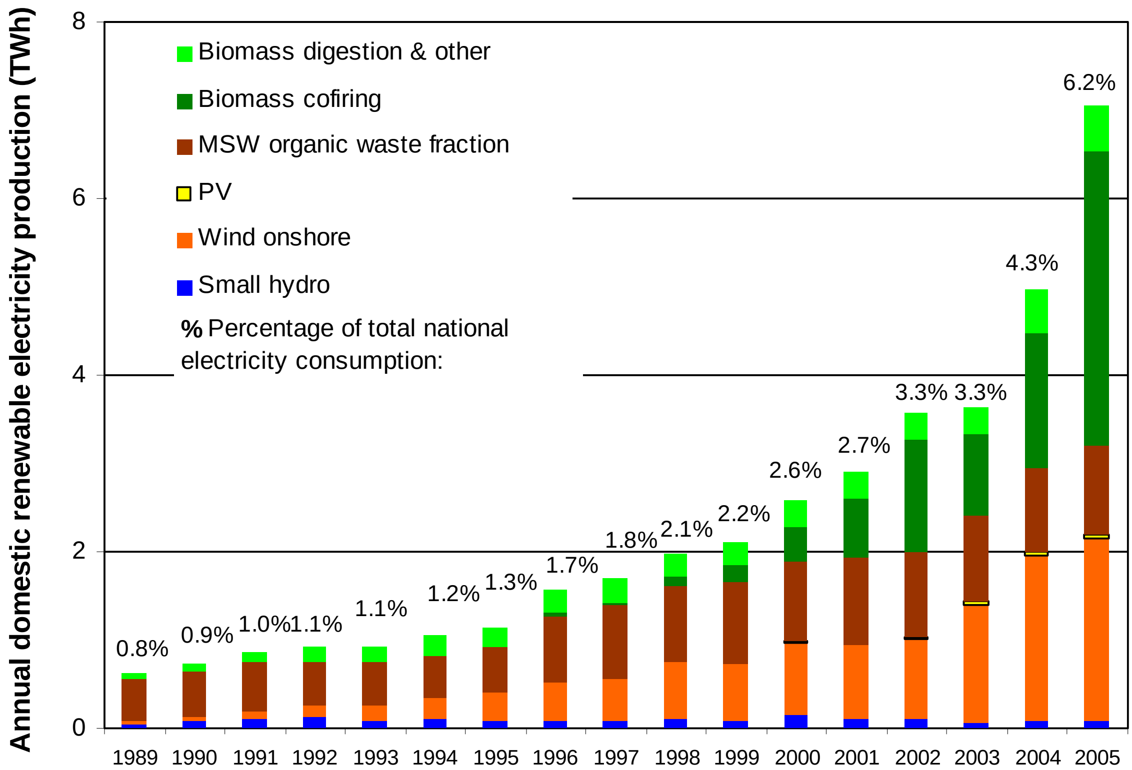

Figure 1. Annual renewable electricity production in the Netherlands during 1989-2005, and contributions per technology (CBS, 2006). The percentages refer to the share in gross Dutch electricity consumption. The target for 2010 is 9 %.

4 BIOMASS USE AND TRADE IN THE NETHERLANDS

4.1 Biomass use in the Netherlands

Until the end of 2005 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) . 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 2.

Figure 2 Overview of all plants in the Netherlands with a biomass (co-)firing capacity of over 20 MWe in 2005. Source; www.energie.nl.

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

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). In 2005, prices were quoted by experts around 140 US$/tonne, i.e. 6.2 €/GJ. A number of other biomass fuels have been used in 2004 (see above), whose prices are generally below those of wood pellets, but their use requires higher investment- and operational costs.

4.2. Import volumes and logistics of biomass for electricity production

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 3, a minimum of 500 ktonnes biomass has probably been imported in 2004, and almost 1.2 million tonnes in 2005. An overview of the imported and exported biomass streams is given in table 3.

Essent, the largest user of biomass in the Netherlands, reported that in 2004 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 3. Notably, the share of imported biomass has increased from 30% in 2003 to 50% in 2004 and 72% in 2005 on mass basis. In terms of electricity produced, the share has increased from 30% in 2003 to 70% in 2004 and to almost 80% in 2005. This is due to the much larger amounts of bio-oils and derivates (mainly palm oil) imported in 2004 and 2005 compared to 2003, which has a much higher heating value than for example agricultural residues.

4.3. Export volumes of biomass for energy

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 (De Vos and Christan, 2005). About two-thirds of this volume consists 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

Table III 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 and 2005 should be considered estimates.

Import[a]	2003		2004		2005	
	kton	PJ	kton	PJ	kton	PJ
Solids (wood pellets, wood chips, agri residues & pellets, bone meal,et cetera)	135	2.3	435	6.45	853	12.6
Liquids (vegetable oils)	5	0.2	90	3.4	323	10.9
Total	**140**	**2.5**	**525**	**9.85**	**1176**	**23.5**

Export[b]	2003		2004		2005	
	kton	PJ	kton	PJ	Kton	PJ
Construction and demolition waste, wood waste	430	6.6	419	6.4	Not available	
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 2004-2005 in coal power plants were considered confidential by some power producers. In some cases they were calculated by using the amount of renewable electricity produced and the electrical efficiency of the power plant. Thus, the numbers presented here are 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

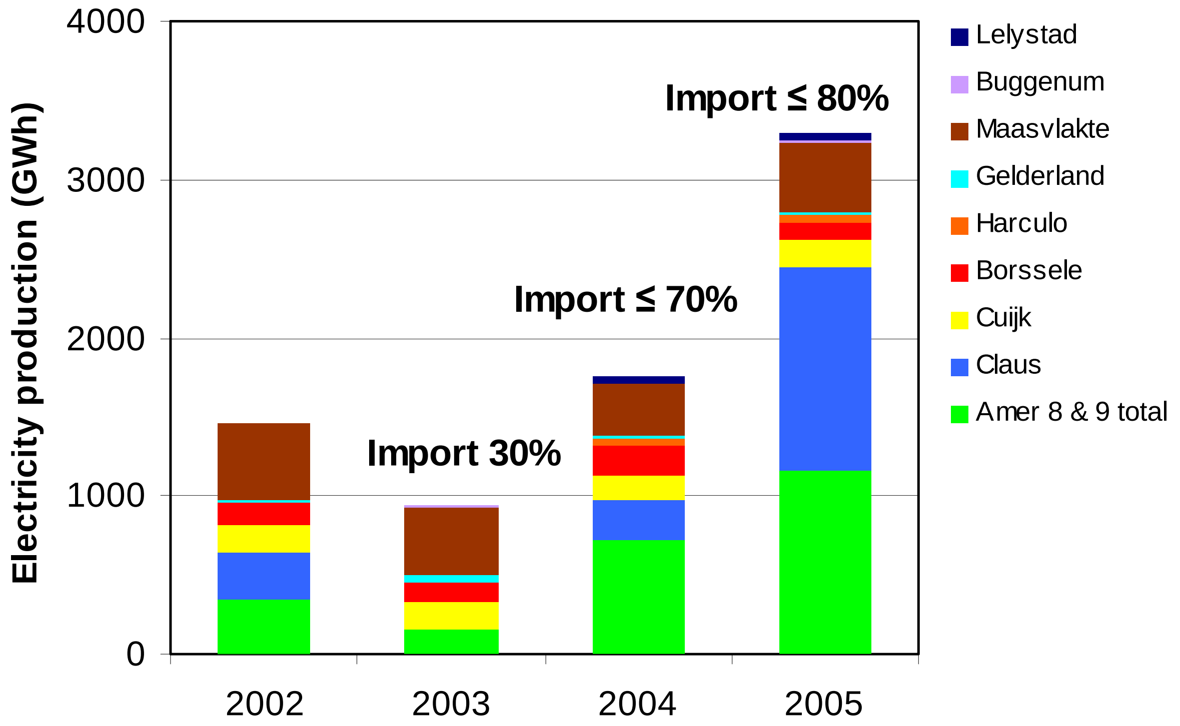

Figure 3. Electricity production from biomass cofiring and stand-alone combustion plants from 2002-2005. For a detailed description of these plants, see table 3. Import percentages are on energy basis, i.e. electricity produced. Based on Jobse (2005), Marcus (2005), Prinsen (2005), Pfeiffer (2005), Wagener (2005), Schouwenberg (2006), annual report Nuon (2006), Groeneveld (2006), annual report Electrabel (2006).

may have been exported for energy purposes, but no data are available on these streams. For 2005, no data on biomass export volumes were available, though Kwant (2006) estimates that exports may have amounted to about 12 PJ.

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. 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). Due to changing legislation in Germany from July 2005 onwards, export of wood wastes strongly declined and was increasingly land-filled in the Netherlands (SenterNovem, 2006). Furthermore, in November 2006, the Dutch assistant secretary of state for the environment announced in a letter that he expected that due to changing legislation, increasingly German waste wood was expected to be imported to the Netherlands for incineration in waste combustion plants (van Geel, 2006). So it is likely that in fact the situation has changed drastically from 2004-2007, and the Netherlands will become a net importer of waste wood for energy.

Summarizing, there are significant volumes of waste wood being traded in the Netherlands, these trends change due to policy changes, and it is hard to determine how much is of the traded waste wood is used for energy purposes. More research is required to get a clearer picture of the trade patterns.

5 BARRIERS TO FURTHER BIOMASS IMPORTS

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 (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 80% of the total production in 2005 (see figure 3). However, the recent drastic changes in feed-in tariffs, especially for non-woody biomass, it is very likely that the amount of electricity produced from co-firing of biomass in 2006 will be significantly lower than in 2005.

In addition, a number of expectations and perceived barriers were gathered from biomass traders and end users:

- 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.
- In addition, several Dutch NGO's and the Dutch

government have issued concerns regarding the sustainability of a biomass production. In special the sustainability of palm oil production in Malaysia and Indonesia has been questioned (Milieudefensie, 2006), as has the use of palm oil in small scale combustion units for electricity production (which results in very high NOx emissions) by the Dutch state secretary for the environment (VNO-NCV, 2006b).

6 SYNTHESIS AND OUTLOOK

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.

For the Netherlands, the 2010 transport fuel target of 5.75% corresponds to an estimated amount of 28 PJ, or about 900 million liters of biofuel. Until the end of 2005, the production of biodiesel was practically zero, and the domestic production capacity of ethanol about 6000 tonnes per year (i.e. also negligible on a European capacity of 700 ktonnes per year) (EurObserver, 2006). Given the required biofuel volumes, it is very likely that the Netherlands will have to import a substantial amount of either biofuels, or precursors of biofuels (such as vegetable oils or oilseeds). If 100% of the biofuels were to be covered by imports in 2010, this would thus require about 28 PJ, more than is currently imported for electricity production.

In addition, the growth in renewable electricity production was driven by the expansion of (onshore) wind capacity and import of biomass. Even when taking into account the further expansion of wind energy in the Netherlands, it is unlikely that this alone will cover the gap to meet the 9% renewable electricity target until 2010. Thus, also further increasing biomass imports are required to meet the renewable electricity and biofuels targets. If they are achieved, it is probable that the import of biomass for energy will more than double between 2005 and 2010 to above 50 PJ per year.

However, this further expansion could be impeded by a number of barriers. 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. Also in the case of export of (waste) wood, changing policies (and thus changing profit margins to combust, landfill or recycle waste wood) both in the Netherlands and aboard largely determine the current trade patterns. Therefore, on the longer term, we deem it essential that domestic policy support measures are matched with similar policies in other EU countries. Also, as the negative publicity around the use of palm oil for electricity production has shown, the guarantee of sustainable biomass production for import is vital, and policy to ensure this should be developed swiftly, especially in the light of rapidly rising import volumes. Finally, it has become clear that statistics and data on biomass trade volume, prices and drivers are poorly recorded and barely available. It is recommended to set up an (international) framework to collect such data on an annual basis and to develop standards how to deal with indirect biomass imports and other methodological issues.

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