Sustainable biomass and bioenergy in the Netherlands:

Report 2014

Colophon

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Abbreviations

CBS	Centraal Bureau voor de Statistiek (Statistics Netherlands)
CN	Combined nomenclature
COMTRADE	United Nations Commodity Trade Statistics Database
DBI	The Sustainable Biomass Import programme
DBM	The Global Sustainable Biomass programme
EBB	European Biodiesel Board
EEC	European Economic Community
EUROSTAT	The Statistical Directorate-General of the EC
FAME	Fatty Acid Methyl Ester
FAOSTAT	The Statistics Division of the FAO
GGL	Green Gold Label
GHG	Greenhouse Gas
GSP	Generalized System of Preferences
HVO	Hydro-treated Vegetable Oils
ISCC	International Sustainability & Carbon Certification
IDH	Initiatief Duurzame Handel (Sustainable Trade Initiative)
MVO	The Product Board for Margarine, Fats and Oils
MT	million tonnes
NEa	Dutch Emission Authority
PME	Palm Methyl Esters
RED	Renewable Energy Directive
RSPO	Roundtable on Sustainable Palm Oil
RTRS	Round Table on Responsible Soy
SME	Soy Methyl Esters
UCO	Used cooking oil
USDA	United States Department of Agriculture
VVAK	Voedsel- en Voederveiligheid Akkerbouw
WTO	World Trade Organization

1 Introduction

1.1 Project overview and background

Between 2010 – 2014, Utrecht University has conducted work for the "Sustainable Biomass Import" project of NL Agency with the following aims:

1. To provide a quantitative and qualitative overview of past and current solid and liquid biomass import flows, and assess (as far as possible) to what extent this biomass was produced sustainably; and
2. To identify trade and market barriers for sustainable biomass in the Netherlands, and identify possible solutions.

This work has resulted in a first report published in 2010 (Jonker and Junginger, 2010), and an updated report in 2011 (Jonker and Junginger, 2011). In these two reports, the first objective was achieved with the main focus on the energy use of biomass, particularly on the trade and consumption of wood pellets, biodiesel and bio-ethanol in and to the Netherlands. The studies also provide a concise overview of market development, current trade barriers and the status of sustainability certification, by conducting a number of interviews with the market actors.

A study on monitoring of (sustainable) biomass flows for various end-uses was conducted in 2012 and 2013 to gain insight into the market mechanism and trade dynamics (Goh and Junginger, 2013). This series of reports has a wider scope (covering both energy and non-energy use of biomass) and uses an extended methodology to assess quantitatively and qualitatively past and current solid and liquid biomass flows in the Netherlands, and the share of certified biomass in the market, focusing on three categories – woody biomass, oils and fats, and carbohydrates. In the 2013 report, an overview of global biomass trade flows was also presented to screen large biomass importers and examine their trade flows. Workshops was organised on 25 Oct 2012 and 22 December 2013 to discuss the preliminary results to the experts for confirmation and comments.

1.2 Aims and scope

Update of the previous report: Focuses on analyzing the trends for 2010-2013, and possibly for 2008-2013 based on data availability. It pays particular attention to describe the market trends, and underlying reasons and drivers. Note that the overview of global biomass trade flows in the previous report is not updated in this report.

1.3 Methodology and scope of study

The same methodology as previous reports is used.

This study limited the scope to three main categories,: (i) woody biomass; (ii) oils and fats; and (iii) carbohydrates. "Woody biomass" includes timber, wood products, paper and cardboard, wood fuels, and their waste streams. "Oils and fats" includes oil seeds, vegetable oils, animal fats, and biofuels (Fatty Acid Methyl Ester (FAME) and hydrotreated vegetable oils (HVO)). "Carbohydrates" includes grains, starch, sugars and possible connection to bio-ethanol. Only biomass that falls under these three categories was investigated. This selection was based on three characteristics:

a. they are relatively large streams with clear distinction compared with other biomass groups;
b. their relevance to the bio-based economy – they are either long-chain polymers (such as starch and lignocellulose) or high-quality monomers

(such as fatty acids and sugars) and have high potential to substitute fossil materials;

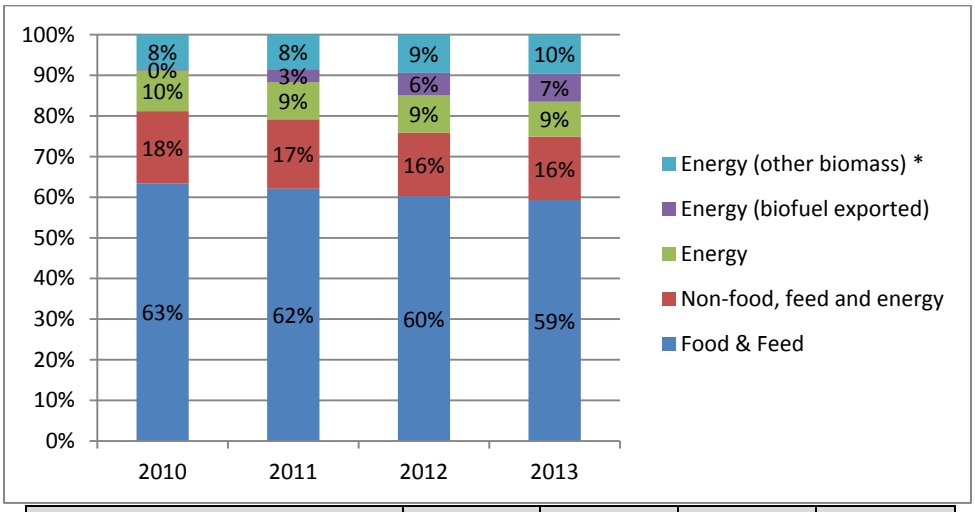
c. they are closely related to bioenergy carriers – wood pellets, biodiesel and bio-ethanol (and also considering their large share in waste streams that may end up in energy production).

The three categories are also included within the “Biobased economy (BBE)” framework described in Meesters et al. (2013). The other biomass categories with large volumes in the Dutch economy that falls under the “Bioeconomy”, e.g. flowers, vegetables, fruits, meats, and processed food are not included here.

The concept introduced in Meesters et al. (2013) for measuring the volume of bio-based economy is followed in Chapter 2.

2 Summary of monitoring biomass flows in the bioeconomy

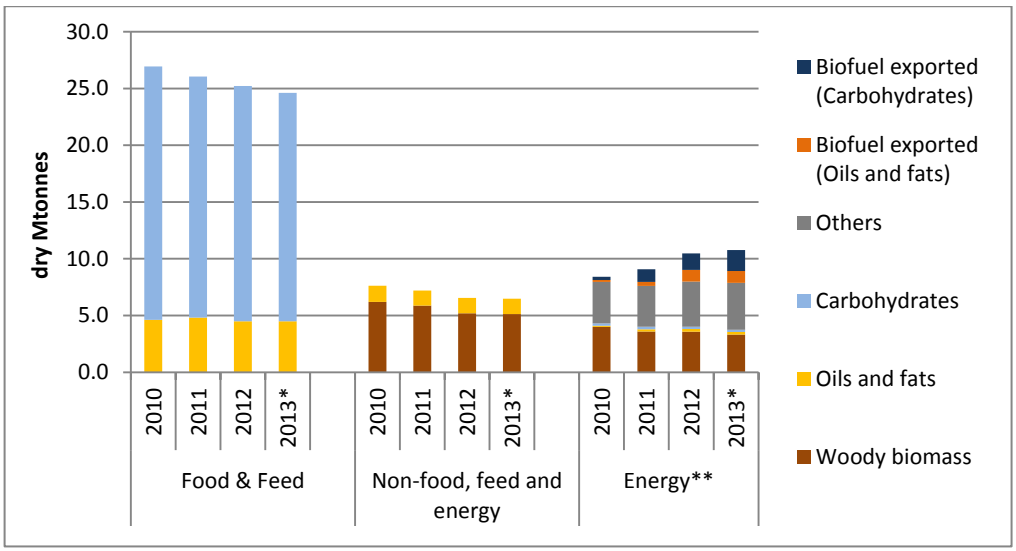
The calculation in this chapter is based on the figures collected in the other chapters followed later. Figure 2-1 shows the overview of the bio-economy and bio-based economy in the Netherlands under three major categories. The utilization of bio-based materials from the three major categories are examined by sectors, i.e. food and feed, non-food, feed and energy application and energy application (bio-energy). Measuring takes place at points of entry for three sectors, i.e. including local supply and net import, covering three major types of materials: woody biomass, oils and fats, and carbohydrates. Figure 2-2 shows the breakdown of each category in different end-uses, based on the quantity measured at entry points.



(Mtonnes)	2010	2011	2012	2013
Food & Feed	27.25	26.21	25.37	24.65
Non-food, feed and energy	7.63	7.21	6.56	6.49
Energy	4.28	3.86	3.88	3.59
Energy (biofuel exported)	0.16	1.35	2.32	2.85
Energy (other biomass)	3.65	3.59	3.96	3.99
Total	42.97	42.20	42.08	41.56

Figure 2-1. Overview of the bio-economy and bio-based economy in the Netherlands under three major categories, measuring at materials supply entry points.
* Other biomass includes biomass quantifiable in weight terms used for energy that is not included in the three categories, provided data is available, e.g. manure and other biomass from agriculture and agro-industry, as well as organic matter in waste incineration

Figure 2-3 shows the energy use of biomass in the Netherlands 2010 – 2013. This graph follows the protocol monitoring renewabele energy and therefore excludes energy production exported. The consumption of renewable electricity from imported biomass for co-firing in 2013 has dropped substantially. Note that other biomass combustion was excluded. The consumption of biofuels remains rather stable in the past three years. Note that a high percentage of biofuel are counted double to fulfil the obligation, however the values shown in the figure are physical volumes. These data will be compared with other dataset later when they are available.



	Food & Feed				Non-food, feed and energy				Energy**			
(Dry Mton)	2010	2011	2012	2013*	2010	2011	2012	2013*	2010	2011	2012	2013*
Woody biomass	0.0	0.0	0.0	0.0	6.2	5.9	5.2	5.1	3.7	3.3	3.3	3.1
Biofuel exported (Oils and fats)									0.2	0.4	1.0	1.0
Oils and fats	4.6	4.8	4.5	4.5	1.4	1.3	1.4	1.4	0.1	0.2	0.2	0.2
Biofuel exported (Carbo-hydrates)									0.0	1.0	1.3	1.8
Carbo-hydrates	22.6	21.4	20.9	20.2	0.0	0.0	0.0	0.0	0.5	0.4	0.4	0.2
Others									3.6	3.6	4.0	4.0
Total	27.2	26.2	25.4	24.6	7.6	7.2	6.6	6.5	8.1	8.8	10.2	10.4

Figure 2-2. End use of bio-based materials for three different categories, measuring at supply entry points

* Estimation due to incomplete data

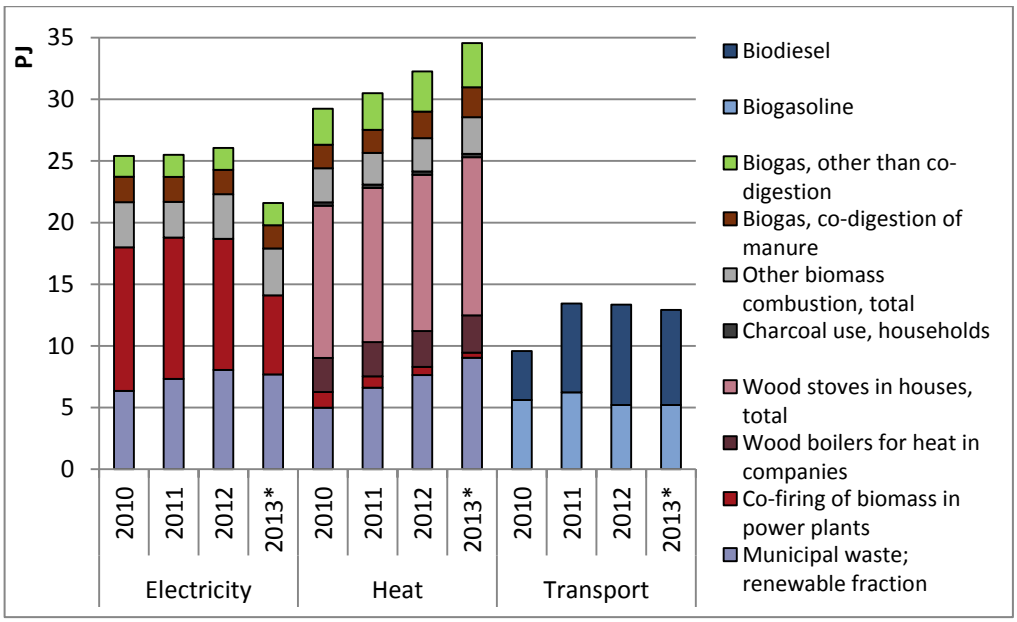
** Materials entry for production of biofuels, heat and energy

Note 1: For woody biomass, the quantity allocated to "energy" includes domestic waste wood, round fuel wood (excluded from "non-food, feed and energy"), wood chips and pellets.

Note 2: For oils and fats, measurement is made at consumption of primary materials (e.g. oilseeds before crushing), which may be re-exported in the form of processed products and by-products (e.g. meals). Similar measurement is used for biofuel production (e.g. vegetable oils for production of biodiesel).

Note 3: For bioethanol made by carbohydrates, the amount of grains consumed is measured, but they are very rough estimations only.

Note 4: "Others" includes biomass used for energy quantifiable in dry weight terms that is not included in the three categories, provided data is available, e.g. manure and other biomass from agriculture and agro-industry, as well as organic matter in waste incineration.



Energy application	Electricity				Heat				Transport			
(PJ)	2010	2011	2012	2013*	2010	2011	2012	2013*	2010	2011	2012	2013*
Municipal waste; renewable fraction	6.3	7.3	8.0	7.7	5.0	6.6	7.6	9.0	-	-	-	-
Co-firing of biomass in power plants	11.7	11.5	10.6	6.4	1.3	0.9	0.7	0.4	-	-	-	-
Wood boilers for heat in companies	-	-	-	-	2.8	2.8	2.9	3.0	-	-	-	-
Wood stoves in houses, total	-	-	-	-	12.3	12.5	12.7	12.8	-	-	-	-
Charcoal use, households	-	-	-	-	0.3	0.3	0.3	0.3	-	-	-	-
Other biomass combustion, total	3.7	2.9	3.6	3.8	2.8	2.6	2.7	3.0	-	-	-	-
Biogas, co-digestion of manure	2.1	2.0	2.0	1.9	1.9	1.9	2.2	2.4	0.0	0.0	0.0	0.0
Biogas, other than co-digestion	1.7	1.8	1.8	1.8	2.9	3.0	3.3	3.6	0.0	0.0	0.0	0.0
Biogasoline	-	-	-	-	-	-	-	-	5.6	6.2	5.2	5.2
Biodiesel	-	-	-	-	-	-	-	-	4.0	7.2	8.1	7.7
Total	25.4	25.5	26.1	21.6	29.2	30.5	32.3	34.6	9.6	13.4	13.4	12.9

Figure 2-3 Gross final energy produced from biobased materials and consumed in the Netherlands 2010 – 2013 (CBS 2014)
* For 2013 only preliminary figures.

3 Woody biomass

3.1 Overview

This chapter covers (almost) all woody biomass flows in the Netherlands, including timber, processed woods, paper and cardboard, furniture and energy use of woody biomass. Figure 3-1 illustrates the flows of woody biomass in the Netherlands in 2013. The box in the middle of the diagram indicating “wood products” represents storage of woody biomass in the form of buildings, furniture, and other types of wood products that are non-consumable or not short-lived. The Netherlands produced considerable amounts of round wood, but about half of that was exported. On the other hand, a relatively large amount of sawn wood and wood panels was imported, mostly originated from adjacent countries (Probos, 2013).

There was also a large import of paper and cardboard into the Dutch market, the volume has been declining from 2010 to 2012, but has increased again in 2013. Note that about 50% of paper and cardboard was imported products which may also be produced from recycled materials. A major update of the flow diagram is the realignment of the paper and cardboard streams considering their storage. It is assumed that 80% of the renewable fraction in waste streams incineration is of biomass origins, and 25% of that is paper and cardboards, with a moisture content of 40%.

For energy use, see Section 3.3.

3.2 Sustainability of woody biomass

In September 2013 more than 40 organizations, including government, industries, trade unions, nature and environmental organizations, other civil society organizations and financial institutions, have committed to the so-called “Energy Agreement for sustainable growth”. The parties agreed that the promotion of co-firing will not exceed 25 PJ final energy, which is equivalent to about 3.5 million tonnes of wood pellets. In addition, the promotion of large-scale use of biomass will be limited to new coal plants and plants built in the 1990s. Also, sustainability requirements will be further formulated for biomass, to be determined jointly by industry and NGO’s.

In March 2015, the Dutch socio-economic council (SER) announced that industry and NGO’s had – after long negotiations - reached an agreement on the sustainability criteria for biomass in order to receive SDE+ subsidy (SER 2015). The agreement includes the following criteria (NEA 2015):

- Climate & bioenergy criteria: reduction of net GHG emission (e.g. 70% relative to EU reference values), conserving carbon stock reservoirs and ILUC.
- Criteria for sustainable forest management, including criteria on legislation nd regulation, ecological aspects (including a.o. biodiversity, soil, water, ecological cycles and other aspects), economic aspects and management aspects
- Criteria on how to monitor the chain of custody
- An assessment table (i.e. a positive/negative list) to include/exclude materials with a low/high carbon debt risk

Especially the positive/negative list of feedstock to minimize the risk of carbon debt is so far unique in the EU. Other elements of the agreement include a differentiation of large forest management unit (i.e. more than 500 ha), which will have to meet the criteria earlier than small forest management units. Also, the intention is that utilities will create a fund (based on the revenues from co-firing

wood pellets) to increase SFM certification in the sourcing areas. At the time of writing (June 2015) there was no clarity how compliance will be tested and monitored, e.g. which existing SFM certification system will be approved as proof of meeting (which part of) the criteria. Currently, a working group of experts has been assigned by the Ministry of Economic Affairs to work further on this.

Table 3-1 shows the share of sustainability certified woody biomass in the Netherlands in 2011. In 2012 only data for wood pellets is available. It is expected that the share of certified wood products will grow further steadily. The use of woody biomass can be divided into two main markets based on end-uses:

- Non-energy use: The certified share of sawn timber and wood based panels has significantly increased from 65.7% to 73.1% in 2011-2013.
- Energy use: As reported by RVO (2014), about 72% of woody biomass used for energy purpose is certified in 2013, while the rest comes from waste streams. Green Gold Label has dominated the market in 2013.

Table 3-1 Market share of sustainability certification schemes for woody biomass in the Netherlands in 2011 and 2013

Type of biomass	**Sustainability schemes**	**Market share (% of certified biomass per particular products group in the market)**		
		2011	2012	2013
Sawn timber and wood based panels (Oldenburger et al., 2013)	*FSC*	23.7%	Unknown	40.0%
	PEFC	42.0%		33.1%
Paper and cardboard (Olderburger et al., 2013)	*FSC*	23.9%	Unknown	37.7%
	PEFC	8.9%		9.4%
Wood pellets used by utilities (Self collection; Agentschap NL, 2013; RVO 2014)	*Green Gold Label*	51.8%	50.1%	69.0%
	Laborelec Label	33.5%	27.2%	-
	FSC/PEFC/EUTR	-	-	2.8%
	NTA8080	-	-	0.1%
	Waste streams	-	-	28.0%

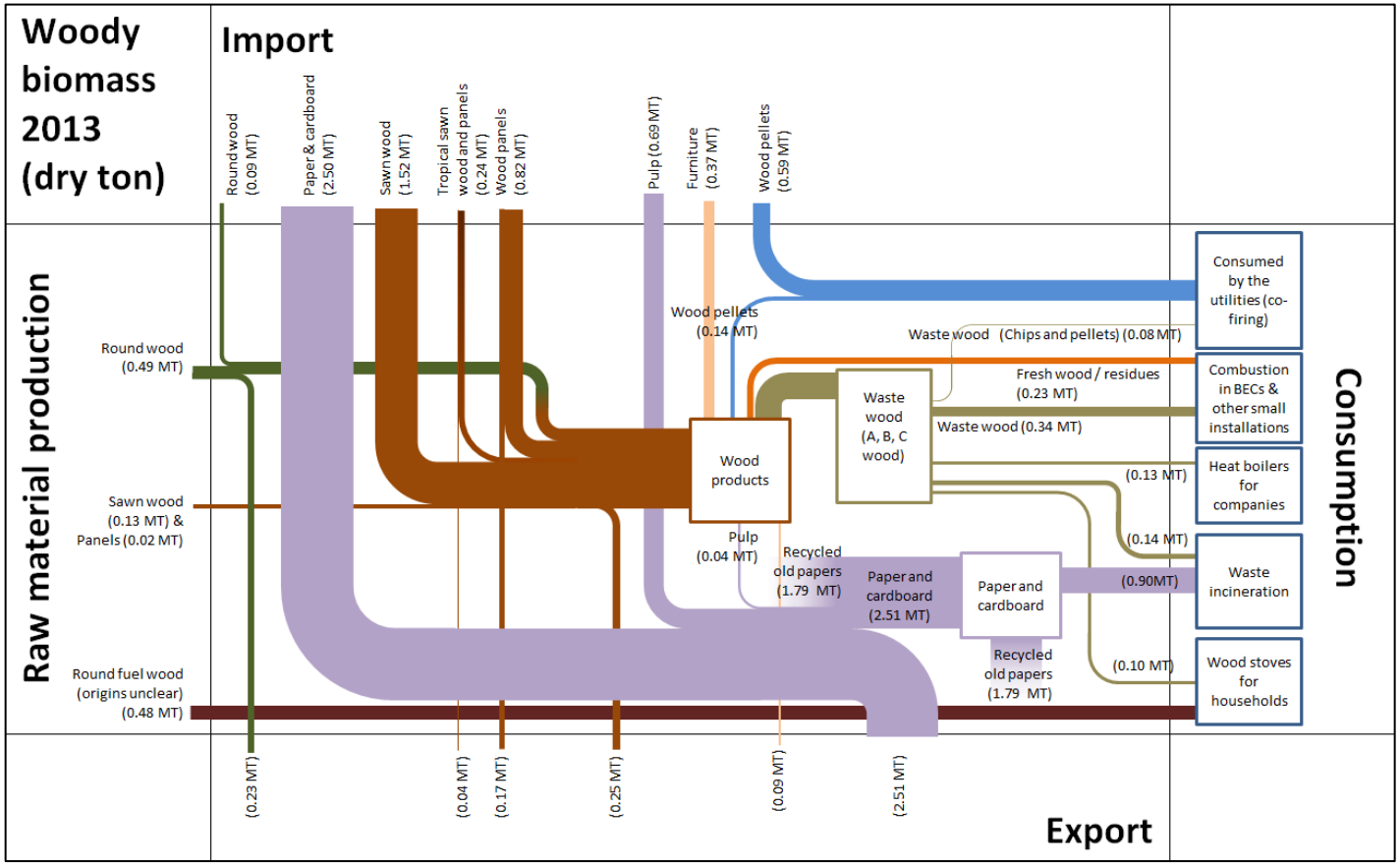


Figure 3-1 Mass balance for woody biomass flows in the Netherlands in 2013 (dry content)

3.3 Energy use of woody biomass

As shown in Figure 3-2, the import of wood pellets has decreased significantly in 2013, amounted to about 0.66 MT (0.59 dry MT) compared with 1.59 MT (1.44 dry MT) in 2010 and 1.05 MT (0.95 dry MT) in 2012. It is estimated that the throughput at Port of Rotterdam is 600 ktons of wood pellets in 2013 (in 2012 this was around 900 ktons) (Du Mez, 2014). Canada was the largest supplier in 2010, but was overtaken by US in 2011, and the gap become even larger in 2012. However the gap was narrowed down when the import from US has dropped substantially in 2013. The import from Southern Europe has doubled in 2011 compared to 2010, but dropped again in 2012, and remained rather stable in 2013. Gross consumption of biomass by the utilities for co-firing has dropped from 12.9 TJ in 2010 to 6.8 TJ in 2013 (CBS, 2014).

In general, the decreased demand for wood pellets is caused by the end of most of the MEP grants in the period 2012-2014. Another possible reason could be the explosion at the Gelderland coal plant of GdF Suez in Nijmegen in November 2012, causing the plant to close until March 2013 (on an annual basis the plant consumes 470 ktons of wood pellets for co-firing) (Du Mez, 2014). Besides that, due to the closure of the Tilbury plant in the UK, there were large stocks of wood pellets in several ports in the UK and the ARA range that has caused an impact on import trade flows. For example, at least one cargo of wood pellets has been transported to Denmark (for DONG energy) from ZHD in Dordrecht (Du Mez, 2014). Nevertheless, wood pellet is still the largest group of solid biofuels consumed by the utilities in the Netherlands, i.e. the Amer 8 and 9 plants of RWE Essent in Geertruidenberg, Gelderland 13 of GDF, and Maasvlakte of Eon. The Amer plant is supplied by barge from ZHD in Dordrecht up to about 400 ktons in 2013 (however this number may include some premium pellets delivered by ZHD for the heat market in Germany). In 2015, there was no co-firing of wood pellets in the Netherlands due to the end of the MEP subsidy.

In addition to co-firing in power plants, the waste wood, mainly treated B-wood (painted, chipboard and etc.) and C-wood (including sleepers) were consumed for energy generation in three main Bioenergie Centrale (BEC) in Alkmaar, Twente and Rotterdam (CBS, 2012c). Wood chips and other woody biomass were also used but in a relatively low amount (CBS, 2012c). Most of these woody biomass feedstocks are sourced domestically.

Wood consumption in private wood-burning stoves and wood boilers has remained stable since 2010, ranging from 15.1 – 15.6 TJ (CBS, 2014). The main source is locally collected wood from tree felling. A second source of household wood is waste wood from forest maintenance (Goh et al., 2012).

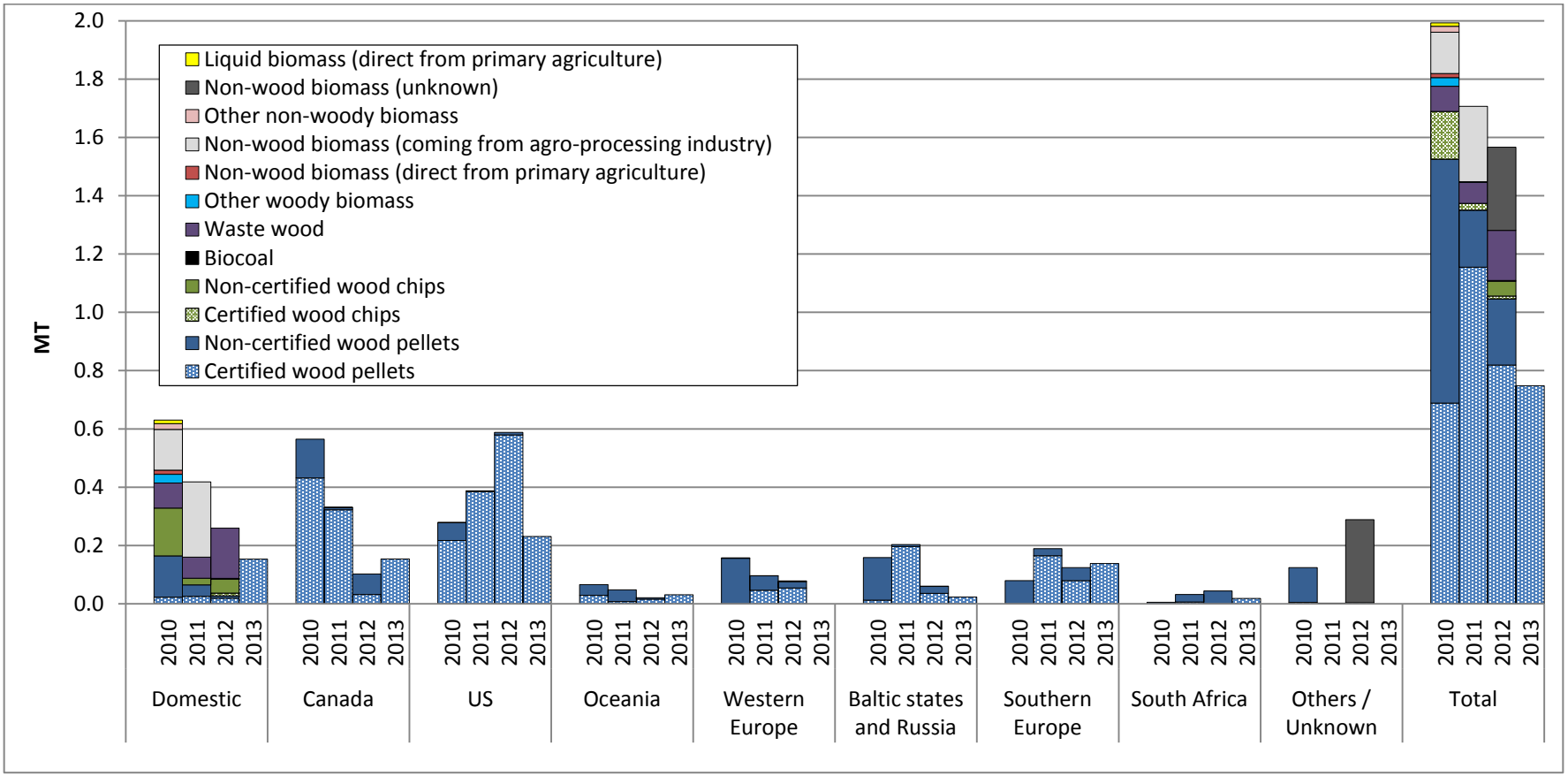


Figure 3-2 Biomass co-fired by the Dutch utilities in 2010 -2013*
(Source: Surveys with the utilities; Essent, 2011; Agentschap NL, 2013; RVO, 2014; CBS, 2013)
* For 2013, the wood pellets are either certified (about 72% of total consumption) or declared as originated from waste streams.

3.4 Prices of wood pellets

Figure 3-3 shows the prices of industrial wood pellet in comparison to coal price adjusted with GDP inflator by assuming the heating value of wood pellets and coal at 17 and 24 MJ/kg, respectively. The price of coal has been dropping since 2011, but the price of industrial wood pellet has remained stable since 2009 until 2014, with an average price of 7.5 EUR/GJ ± 10%. Recent increases of wood pellet prices in early 2015 are mainly due to the US$ gaining against the Euro from about 1.3 to about 1.1. Note that there is no clear correlation between coal and wood pellet prices. Over the same period, coal prices averaged around 2.9 Euro/GJ ± 40 %. As the volume of pellets used for small-scale residential heating in the Netherlands is negligible, no price data is available.

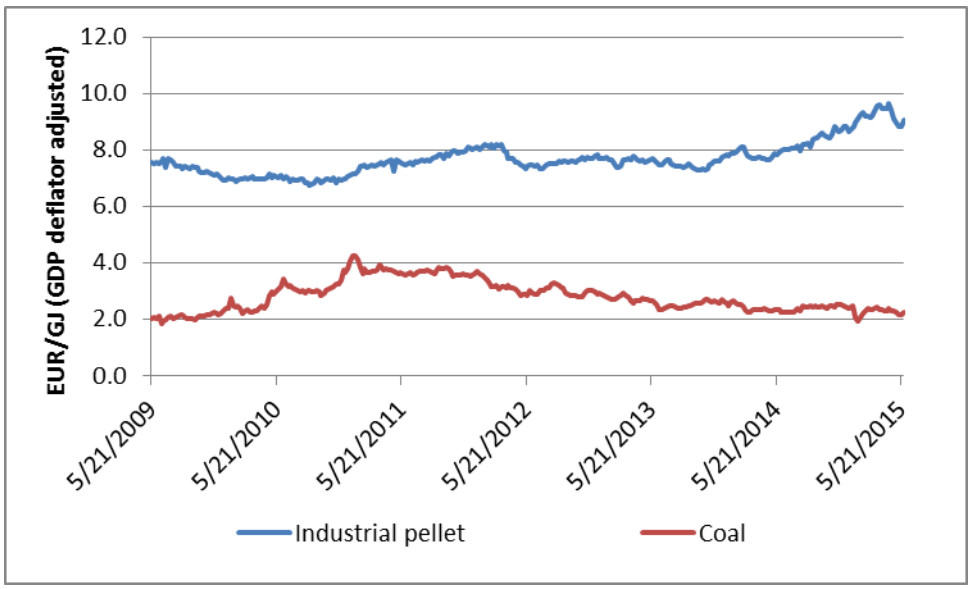


Figure 3-3 Industrial wood pellet spot prices CIF ARA in comparison to coal price (Source: Industrial data)

4 Oils and fats

4.1 Overview

This chapter covers oils and fats in the Netherlands. It covers oil seeds, vegetable oils, animal fats and biofuels (mainly FAME and hydro-treated vegetable oils (HVO)). Due to the fact that oils and fats are mainly used in food industries and processed with other materials, causing the mass flows highly complex, the mass balance is limited to only primary material flows.

Data from MVO is not available for the year 2013, therefore this section is only partially updated.

Figure 4-1 presents the trade flow of monoalkylesters, oil seeds and oils & fats by country or region. The connection between monoalkylesters trade flows and biodiesel trade flows is not entirely clear; it is assumed in this study that monoalkylesters trade flows are the main components of biodiesel flows. A code that covers fatty-acid monoalkyl esters (FAME) with an ester content >96.5%vol was introduced in 2008 (38249091), and changed in 2012 (38260010). In 2013, import under this code from Argentina and Indonesia has decreased significantly, partially replaced by import from Malaysia and other countries. This is probably due to the EU's trade policy to reduce Argentinean and Indonesian import by imposing tariffs on biodiesels from these countries, for the reason that they are allegedly selling it in the EU below cost. A new code is also used in parallel, 38260090 that represents biodiesel which contains less than 70 % by weight of fossil fuels. However, other forms of biodiesel could still enter under other codes depending on the chemical composition.

Diesel with a biodiesel component of less than 30% can also enter the EU under chapter 271020 at a tariff rate of 3.5 percent (Flach et al., 2013). However, from the statistics, the import to the Netherlands under this code is near to zero in 2012, but there is a remarkable volume exported to the EU and even Asia (the Asian countries are unknown). But, the trade flow has reversed in 2013 from the other countries.

For oil seeds, the EU has turned to a net export to the Netherlands in 2011, but the net trade has returned to near zero in 2013.

For oils and fats, a massive increase in palm oil import is observed since 2012, and they are mostly from Indonesia and Malaysia.

4.2 Sustainability certification

Figure 4-2 shows the share of certified vegetable oils in the Netherlands in 2011-2013. Figure 4-3 shows the use of certified and non-certified vegetable oils, UCO and animal fats, and fatty acids in the Netherlands for 2011-2012. To some extent the year 2011 can be regarded as the starting year for the significant use of sustainable certified vegetable oils in the Dutch market. In this year, the Dutch food and feeds industry imported the first batch of RTRS (Round Table on Responsible Soy) certified soy bean. Many Dutch food manufacturers also started to import RSPO (Roundtable on Sustainable Palm Oil) certified palm oil with ambitious target in the next few years. All vegetable oil used for biofuel production in the Netherlands is assumed to be 100% sustainable certified. In 2012, the use of palm oil for biofuel production has increased substantially, mainly by the Neste Oil plant in Rotterdam. Neste Oil has increased the use of crude palm oil certified by either or both RSPO and ISCC in all of its plants up to 91% in 2012 (Neste Oil

2013). This number has reached 100% in 2013, and Neste Oil was the first company in the world to receive a RSPO-RED Supply Chain certificate. RSPO-RED is a new, stricter certification system that complies with the requirements of the EU's RED system. For 2013, the actual data is not available, except the amount of RSPO certified palm oil and RTRS certified soy bean is known to be 183 kton and 417 kton (81 kton oil) respectively (The Dutch Taskforce Sustainable Palm Oil 2014, IDH 2014). The rest are estimated solely based on trade data on CBS statistics.

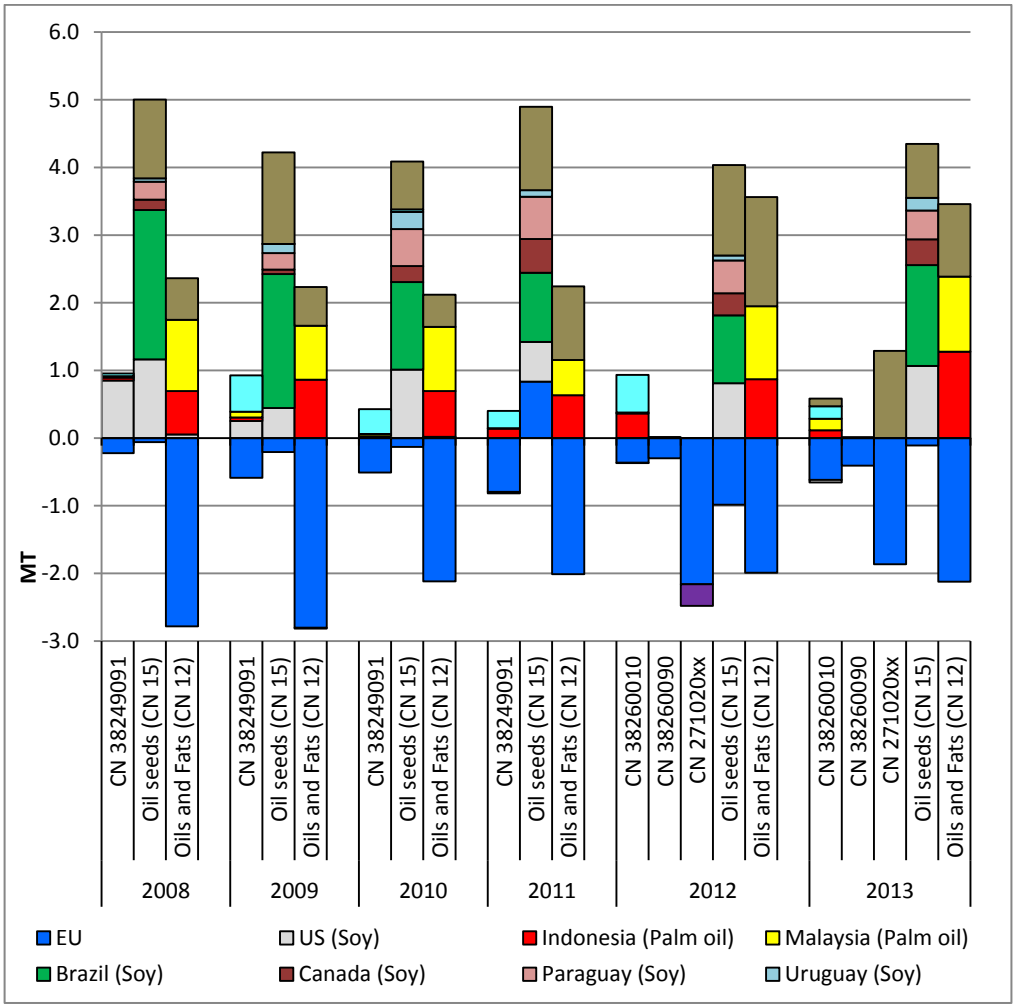


Figure 4-1 Monoalkylesters, oil seeds and oils & fats trade flows (net by regions) for the Netherlands from 2008 – 2011 (MT) (Source: CBS, 2012a)

a. Countries with small net trade volumes were omitted
b. CN 12xxxxxx: Oil seeds and oleaginous fruits
c. CN 15xxxxxx: Animal or vegetable fats and oils and their cleavage products; prepared animal fats; animal or vegetable waxes
d. CN 38249091: Monoalkylesters of fatty acids, with an ester content of 96.5%vol or more esters (FAMAE) (for 2008 – 2011)
e. CN 38260010: Monoalkylesters of fatty acids, with an ester content of 96.5%vol or more esters (FAMAE) (for 2012)
f. CN 38260090: Biodiesel and mixtures thereof, not containing or containing less than 70 % by weight of petroleum oils or oils obtained from bituminous minerals.
g. CN 271020xx: Diesel, fuel oil, oils, containing>= 70% weight of petroleum oils or oils obtained from bituminous minerals, containing biodiesel.
h. "Others" is derived from the balance of world total net flow

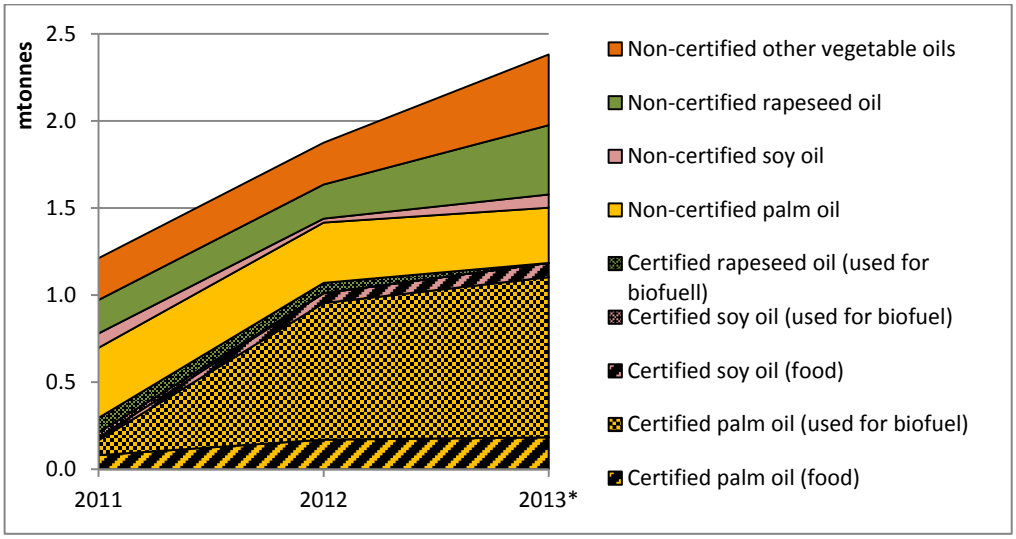


Figure 4-2 Share of certified vegetable oils processed in the Netherlands in 2011-2013
* Estimation

Palm oil: The annual production capacity of RSPO certified palm oil has increased from 5.6 MT in 2011 to 11.1 MT in 2014. About 47.85% of the world's current RSPO-certified sustainable palm oil production capacity comes from Indonesia, followed by 43.95% from Malaysia, and the remaining 8.2% from Papua New Guinea, Solomon Islands, Brazil, Thailand, Colombia, Cambodia and Ivory Coast (RSPO, 2014). In 2013, total consumption of palm oil in the EU is about 6.7 MT, of which 52% (43% in 2012) is from Indonesia and 30% (35% in 2012) is from Malaysia (UN Comtrade, 2014). The Dutch Task Force Sustainable Palm oil (2013) reported a strong growth in the share of sustainable certified palm oil in the Dutch food sector in 2011-2012, from 30% (about 0.08 MT) to 53% (about 0.16 MT) of total palm oil consumed for food purpose, followed by a smaller increase in 2013 to 61% (about 0.18 MT). Up to 2013, 114 Dutch companies (99 in 2012) have joined the RSPO. It is expected that the demand for sustainable palm oil in the Dutch market will continue to increase steadily to reach the goal of 100% certified in 2015. Besides the Netherlands, Belgium and UK have also started similar initiatives, while France and Germany are also expected to follow the pathway in the near future.

Soybean: Soy is an ingredient for animal feed, a source of protein, vegetable oil and biofuels. The Netherlands is the world's second largest importer of soy, mainly from Brazil, US, Paraguay, Uruguay and Canada. The net import amount is almost stagnant, maintaining at around 2.3-2.4 MT from 2010 to 2013. Soybeans are crushed in the Netherlands and most of the soy oils are exported to the other European countries. Similar to palm oil, the Dutch actors together with Belgian and Scandinavian buyers have expressed their commitment to build up sourcing of responsible soy. In 2010, sustainability standards for soy, Round Table on Responsible Soy (RTRS) were finalized and have been implemented by soy producers in 2011. The Dutch market actors in the soy chain aim for switching to 100% responsible soy for the production of meat, dairy, eggs and other food in 2015. In June 2011, the Dutch food and feed industry has bought the first batch of soy produced according to the principles of the RTRS, amounted to 85 ktonnes (RTRS, 2011). The share of RTRS continued to grow in 2013, approaching 410 ktonnes (IDH, 2013). The Netherlands intends to become the international leader

in the use of responsibly grown soy by supporting soy growers in South America and also other market actors along the supply chain.

Biodiesel: Figure 4-3 shows the application of sustainability schemes on biodiesel reported to fulfill obligation in the Netherlands. Although the application of NTA 8080 and 2BSvs has grown remarkably in 2012, ISCC has nearly dominated the whole market in 2013. As usual, a large portion of the biofuels falls under double counting in 2013, but it was not specifically indicated by the NEa report for which scheme was used (but it is quite clear that mostly ISCC was applied).

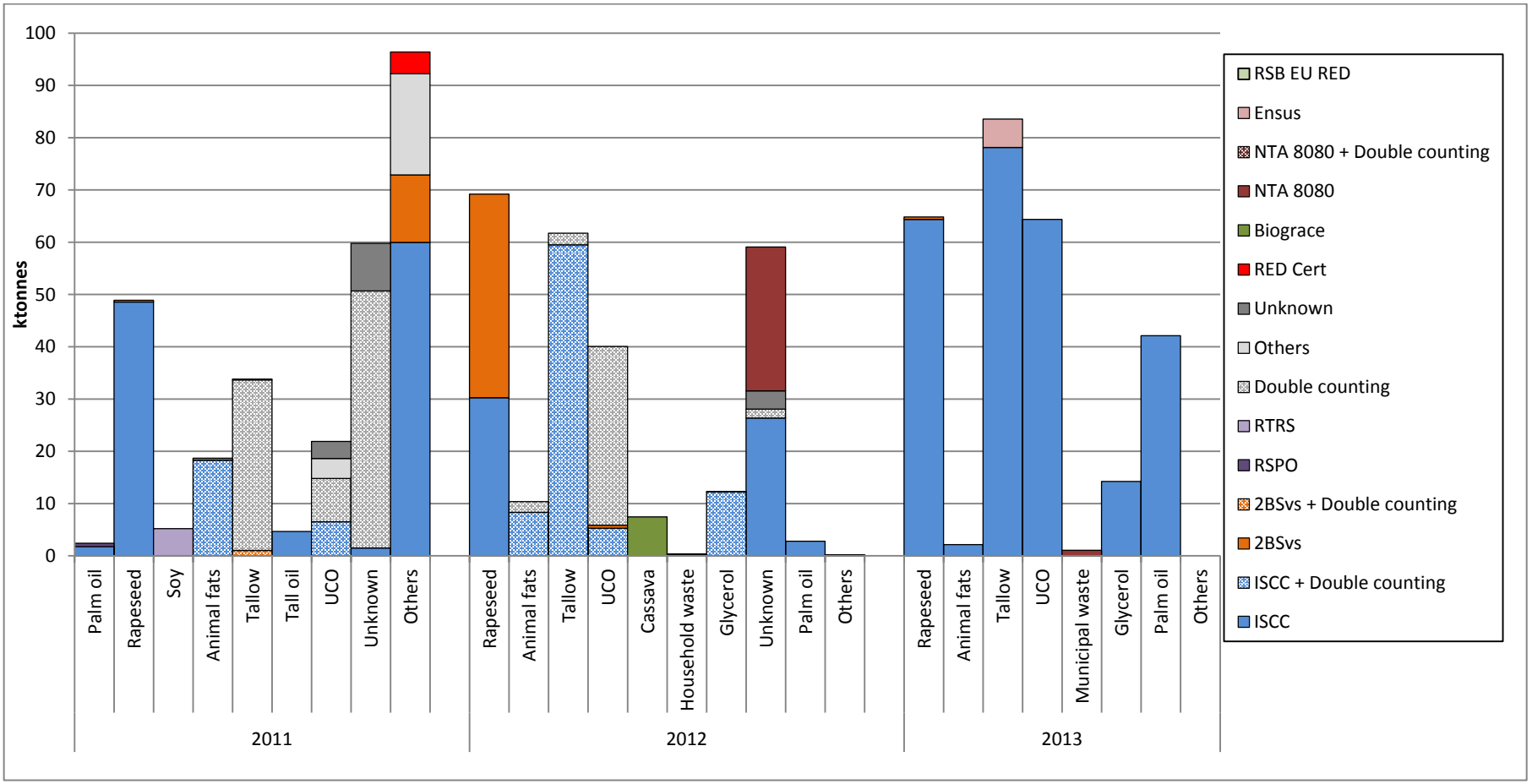


Figure 4-3 Biodiesel reported to NEa to fulfill blending obligation in the Netherlands in 2011-2012 by schemes (Source: NEa 2012; 2013; 2014)

4.3 Energy use of oils and fats

Figure 4-4 shows the quantity of biodiesels consumed in the Netherlands 1in 2010-2013. The total volume amounted to 0.1 MT, 0.29 MT, 0.26 MT and 0.27 MT respectively in the four consecutive years. Biofuels reported to fulfill blending obligation in the Netherlands is monitored by NEa (NEa 2011-2014). The reporting by the industry has shown improvement with more details after the first year of implementation.

The nominal share of biodiesel in total Dutch diesel consumption is 5.62% in 2013, but note that this includes double counting of certain biodiesels. The Netherlands biodiesel market still heavily focuses on double counting, as double-counted biodiesel contribute more than 50% of the compliance with the annual requirement of renewable energy in transportation in 2013. The double counting mechanism is generally applied for biofuels produced from wastes, residues, non-food cellulosic material and lignocellulosic material. These biofuels are counted double for the annual obligation of renewable transport fuels. The reports from NEa show that the largest share of biodiesel obligation is fulfilled by double counting. In 2012, this category was dominated by biodiesel made of domestic UCO and tallow from Germany. However, double counted biofuel made from feedstock from outside Europe has increased significantly in 2013. The country also consumed significant amount of biodiesel made of UCO from Spain, France and the US. Note that for the year 2011, it is unclear whether the “Unknown” category includes UCO or not, but more than 80% of this category was counted double. This double-counted “Unknown” diminished in 2012.

The annual production capacity of biodiesel in the Netherlands has increased from 0.52 MT to 2.03 MT in 2011, but there is no additional capacity in 2012 and 2013 (CBS, 2013b, 2014). For 2012, MVO (2013) reported 1.27 MT of oils and fats consumption for the production of biodiesel, whereas CBS (2013b) reported 1.18 MT for the volume of biodiesel produced. For 2013, CBS (2014) reported 1.38 MT. It seems that the Netherlands still has a large unused production capacity for biodiesel, but the usage is still increasing every year. Neste oil is the largest producer with its Rotterdam plant which has a capacity of 0.80 MT per year. The facility is capable of using a variety of vegetable oils, by-products of vegetable oil refining (e.g. stearin), as well as waste oils and fats (Neste Oil, 2011). In 2012, there is a large increase in the import of palm oil for biofuel production, amounted to 0.78 MT, compared to 0.08 MT in 2011 (MVO, 2013). Although statistics from MVO is not available for the year 2013, the trade statistics from CBS shows that there is an increased in the net import amount of palm oil in 2013. This is mainly used by the Neste Oil plant in Rotterdam to produce hydro-treated vegetable oils (HVO). HVO like NExBTL renewable diesel is produced by hydro-treating various vegetable oils, animal-based waste fats, and by-products of vegetable oil refining. NEa (2013) reported that there is no report of palm-based HVO in the country to fulfill blending obligation in 2012 and 2013, but there is a large amount of palm-based biodiesel reported in 2013 which is amounted to 42 ktonnes.

1 The reported consumption of liquid biofuels may be different from the actual physical situation. First, for administrative purpose, companies are allowed to carry over their physical efforts to later years. Second, companies may administratively allocate a low blend biofuels to the Dutch market, but physically (part of) this low blend is exported.

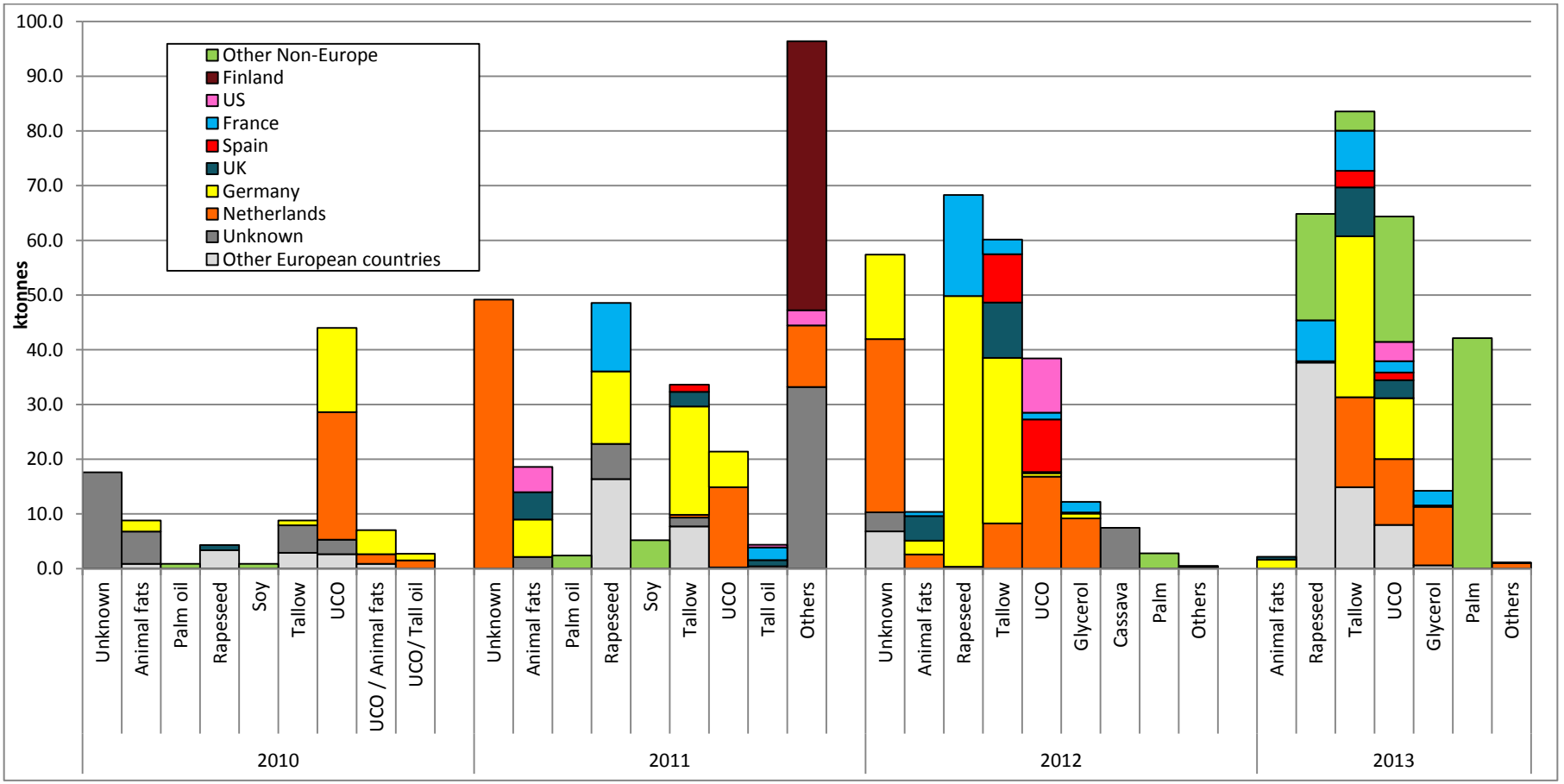


Figure 4-4 Biodiesel reported to NEa to fulfill blending obligation in the Netherlands in 2010 - 2013 by feedstock and country (Source: NEa, 2011; 2012; 2013; Table VI 2014)
Note: Tiny streams are omitted. 'Others' implies the feedstock is known to NEa but reported at aggregated level.

Figure 4-5 shows the trade balance of FAME and biodiesel reported by the Netherlands. This figure does not include the trade of feedstock (e.g. vegetable oils and oil seeds), so the trade balance does not represent consumption. It is also important to point out that the trade is also largely influenced by trade policies and the existing global vegetable oil and oilseed market. It seems that the US has changed from a net biodiesel exporter to net importer as a trade partner of the Netherlands. The large volume of import in 2008 – 2009 (including the import from Canada) is mainly due to the "splash-and-dash" effect described in the previous reports. Indonesia has turned out to be a large exporter of FAMAE (which can be assumed all are made from palm oil), but the trade has largely replaced by the Malaysian palm-based FAMAE in 2013. Similarly, the import of Argentinean FAMAE has dropped substantially in 2013. This is mainly because in 2013, the EU started to expand trade barriers to Argentina and Indonesia by imposing tariffs on biodiesels from these countries, for the reason that they are allegedly selling it in the EU below cost. As NEa (2013) indicates that there is no soy or palm-based biodiesel is reported in the country in 2012, these FAMAE is assumed to be re-exported. Previously, the EU has also hit the US with a 5-year anti-dumping duties in 2009. In contrast, with the recently reinstated tax credit of $1.00/gal for biodiesel in January 2013, these biodiesel is expected to flow into the US instead of the EU (ICIS, 2013; Bloomberg, 2013).

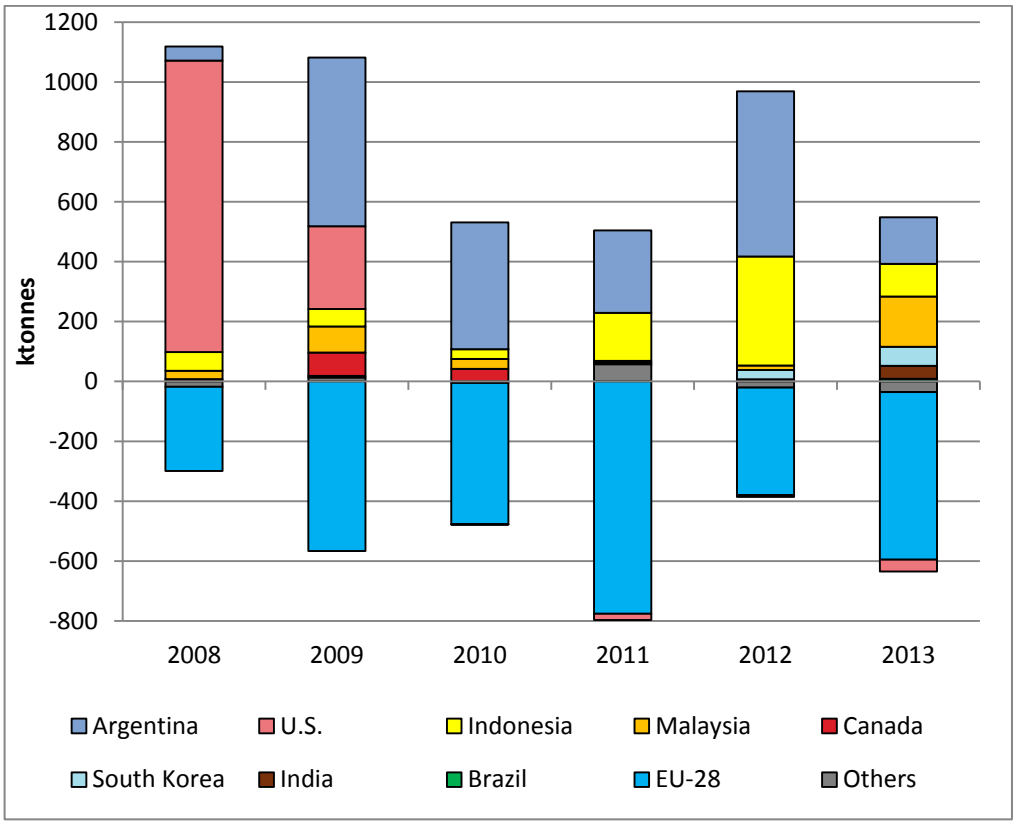


Figure 4-5 Biodiesel* trade balance reported by the Netherlands (Source: EUROSTAT)

* 38249091, 38260010 - Fatty acid mono-alkyl esters, containing by volume 96.5% or more of esters (FAMAE)

Another interesting emerging market to look at is the trade of UCO and animal fats as shown in Figure 4-6. The Netherlands biodiesel market still heavily focuses on double counting, as double-counted biodiesel contribute more than 50% of the compliance with the annual requirement of renewable energy in transportation in

2013. The double counting mechanism is generally applied for biofuels produced from wastes, residues, non-food cellulosic material and lignocellulosic material, but the main feedstock that was used in the past few years are used cooking oil and animal fats. Figure 4-6 shows the trade balance of UCO in the Netherlands 2010-2012. The trade flows of oils and fats mixture which is assumed to represent the trade flows of UCO. The trade flows of "other animal fats" are also included as a comparison. Germany has been the largest trade partner of the Netherlands in terms of UCO volume. However, in terms of net import, Belgium, UK and US are among the biggest suppliers. Interestingly, the import of oils and fats mixture from North America as well as Asia has grown remarkably from 2010. In 2009, the volume of these trade flows is negligible. ISCC is the main certification used for UCO (ISCC-DE) and animal fats (ISCC-EU). The prices of UCO and animal fats differ significantly based on certification, quality and volume, ranging from € 0.30 - 0.80/kg. Compared to virgin oil prices, the prices of UCO and animal fats basically remain lower.

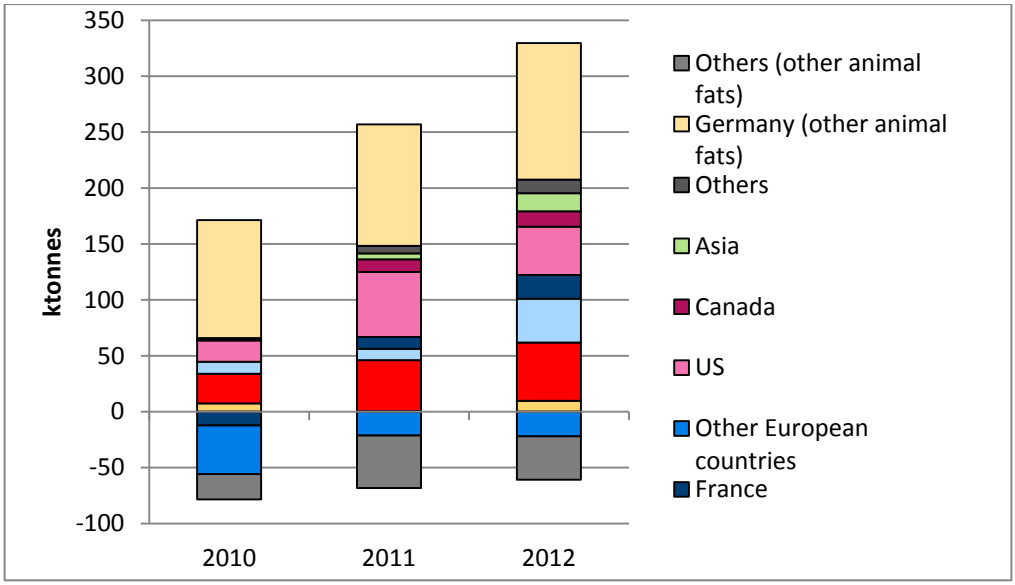


Figure 4-6 Trade balance of oils and fats mixtures (used cooking oil)* and other animal fats for the Netherlands (ktonnes) (Source: MVO, 2013)
* Category "vetmengsels, dierlijk, dierlijk / plantaardig", assumed to be used cooking oil

It is interesting to note that the high production capacity in the Netherlands (2.03 MT/y in 2012) has turned the country to become a processor and net exporter of biodiesel. Two evidences: (i) Since 2012, there is a large increase in the import of palm oil for biofuel production, amounted to 0.78 MT, compared to 0.08 MT in 2011 (MVO, 2013). This is mainly used by the Neste Oil plant in Rotterdam to produce renewable diesel, namely hydro-treated vegetable oils (HVO). The domestic consumption of HVO is relatively very low, meaning that most of the products are exported. (ii) Also, the Netherlands has attracted a large import of UCO, processed them to biodiesel and exported them to other EU countries. In 2012, a relatively large amount of UCO & AF have been processed to biofuels, however only a small percentage was being consumed domestically. This shows that the Netherlands has become a net exporter for both single- and double-counted biodiesel.

4.4 Prices of biodiesel

In Figure 4-7, prices of a number of internationally traded commodities are shown. As no biodiesel prices in the Netherlands were available, we show prices in the US and Germany for comparison. Form figure 4-7, the correlation between the prices of biodiesel, vegetable oils and crude oil is clear. Since 2010, significant price increases are observed for all commodities in Figure 4-7. While the prices of vegetable oils and crude oil are closely related, biodiesel does not fully correlate to them. For the US prices, there is a hike in SME's price in 2012 – 2013 while the prices of vegetable oils show a down trend. This is similar for the case of biodiesel (majority RME) in Germany: during 2013 the average price was 1,450 €/t, implying a price increase by 50 % compared to 2010. Nevertheless, all prices have started to fall since mid-2014.

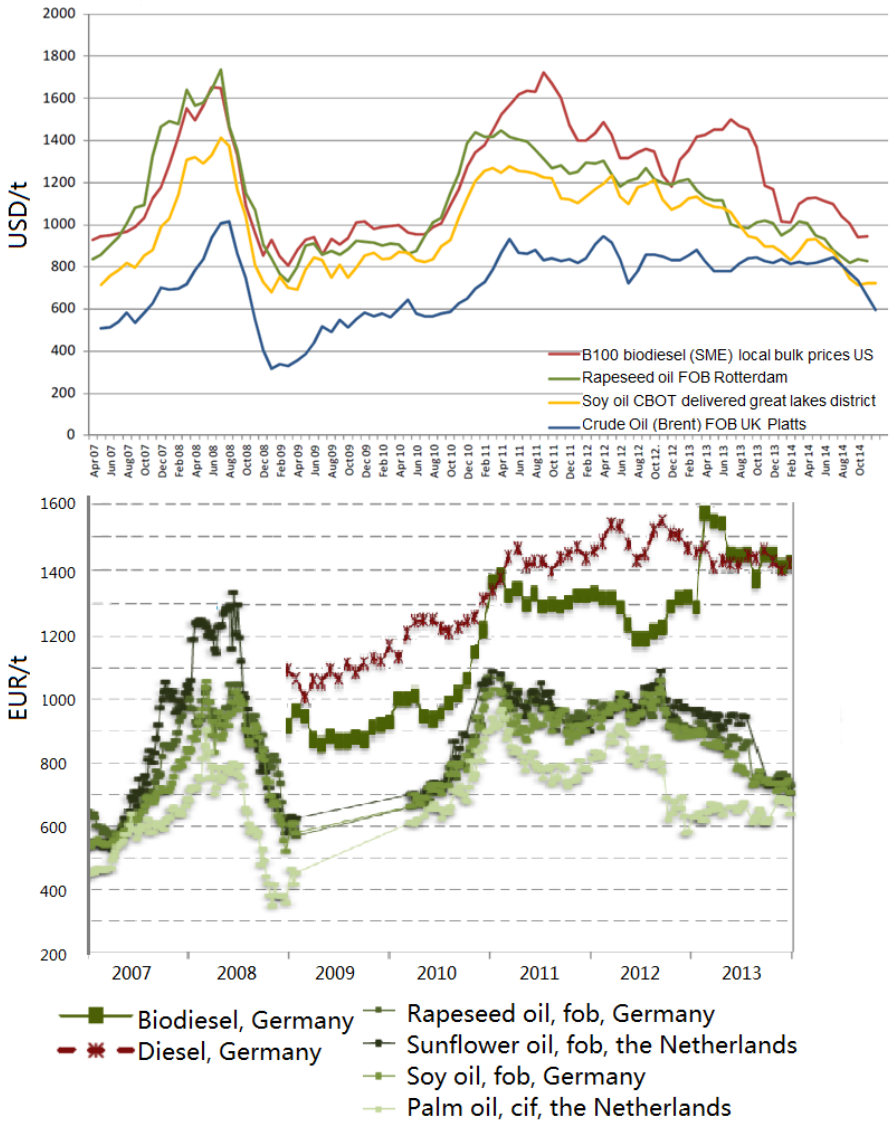


Figure 4-7 Prices of biodiesel, crude oil and vegetable oils in various locations (Adapted from de Laat and de Boer 2015, IEA Bioenergy Task 40 2014)

5 Carbohydrates

5.1 Overview

This chapter covers carbohydrate chains in the Netherlands. This includes grains and starch such as maize (maize), wheat barley, sugar beets, potatoes and etc. Due to the fact that carbohydrates are mainly used in food industries and processed with other materials, causing the mass flows highly complex, the mass balance is limited to only primary material flows.

Carbohydrates are widely used food staples, which can be directly used for food and animal feed, or processed to make food (bread, biscuits), beverages (beers) and feed, or industrial products such as ethanol. In addition to food and feeds, carbohydrates can also be feedstock for textiles, adhesives and energy. Figure 5-1 illustrate the quantified mass flows of carbohydrates in the Netherlands in 2013. Basically the Netherlands was able to self-supply more than half of its total carbohydrates consumption. Maize (corn) turned out to be the largest Dutch carbohydrates source. Although the Netherlands produced relatively large amount of maize, considerable amount of maize were imported. Potatoes, sugar beets and barley were the other important sources of carbohydrates. A significant change in 2011 could be the production of ethanol in the Netherlands - a new ethanol plant that capable to processed about 1.2 MT of maize and wheat was built. However, the connection shown in Figure 5-1 was only for indication because the actual feedstock and destination are unknown. See section 5.3 for more information.

Figure 5-2 depicts the Dutch grains and starchy crops production from 2008 to 2013. Potato has been the leading crop in domestic carbohydrates production, followed by sugar beets and green maize. There are no drastic changes over the years. The total carbohydrates production remains at a stable level of 17 – 19 MT (at 16% moisture). As shown in Figure 5-1, the Netherlands is a net exporter of potatoes. On the other hand, the country imports large quantity of wheat, maize and barley to fulfill domestic demand. Most imports come from Europe, but there are also imports of maize from South America. The EU in fact controls the entry of lower priced grains from third countries by means of a system of import duties and quotas (EC, 2013).

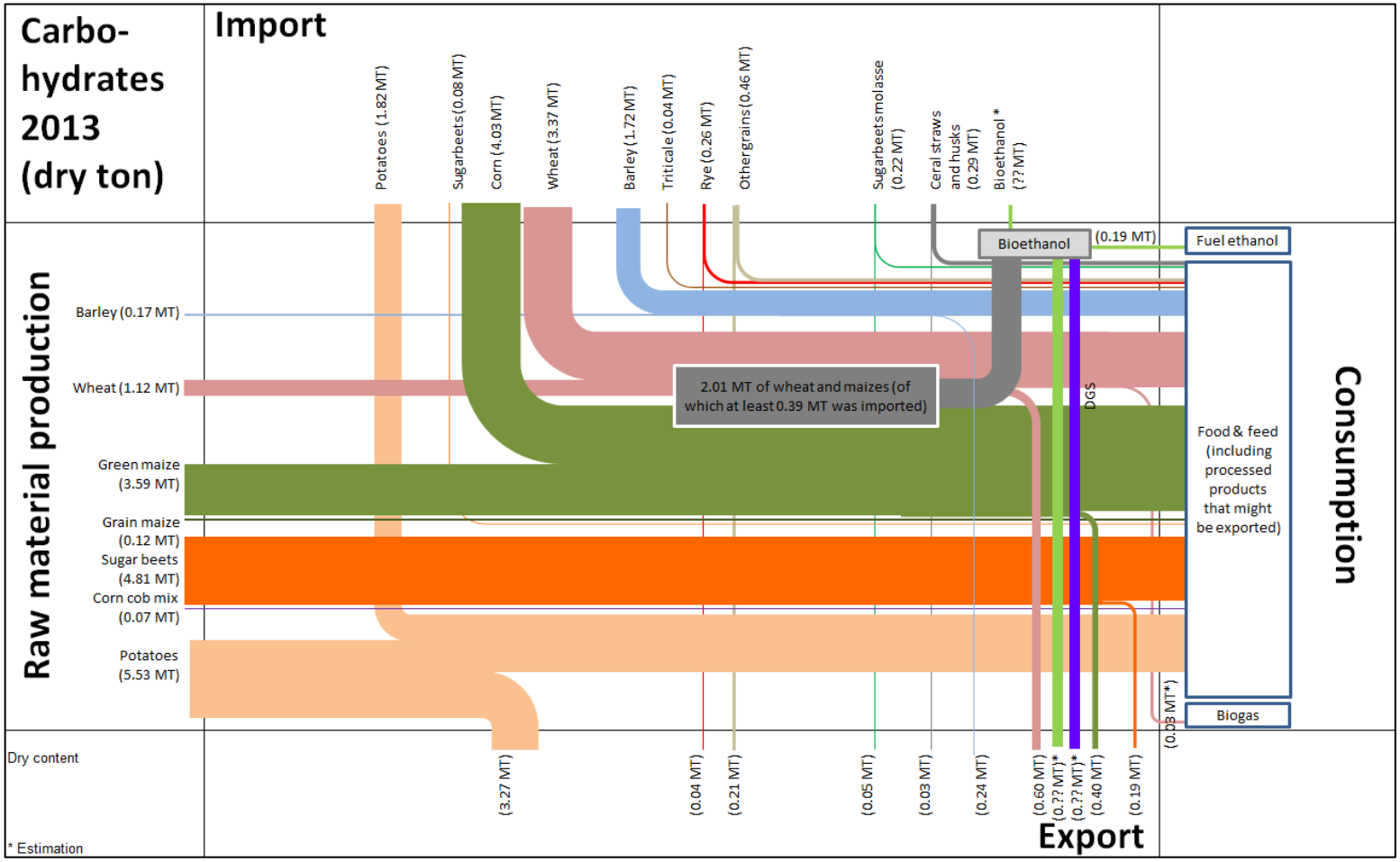


Figure 5-1 Mass balance for carbohydrates flows in the Netherlands in 2013 (dry content)

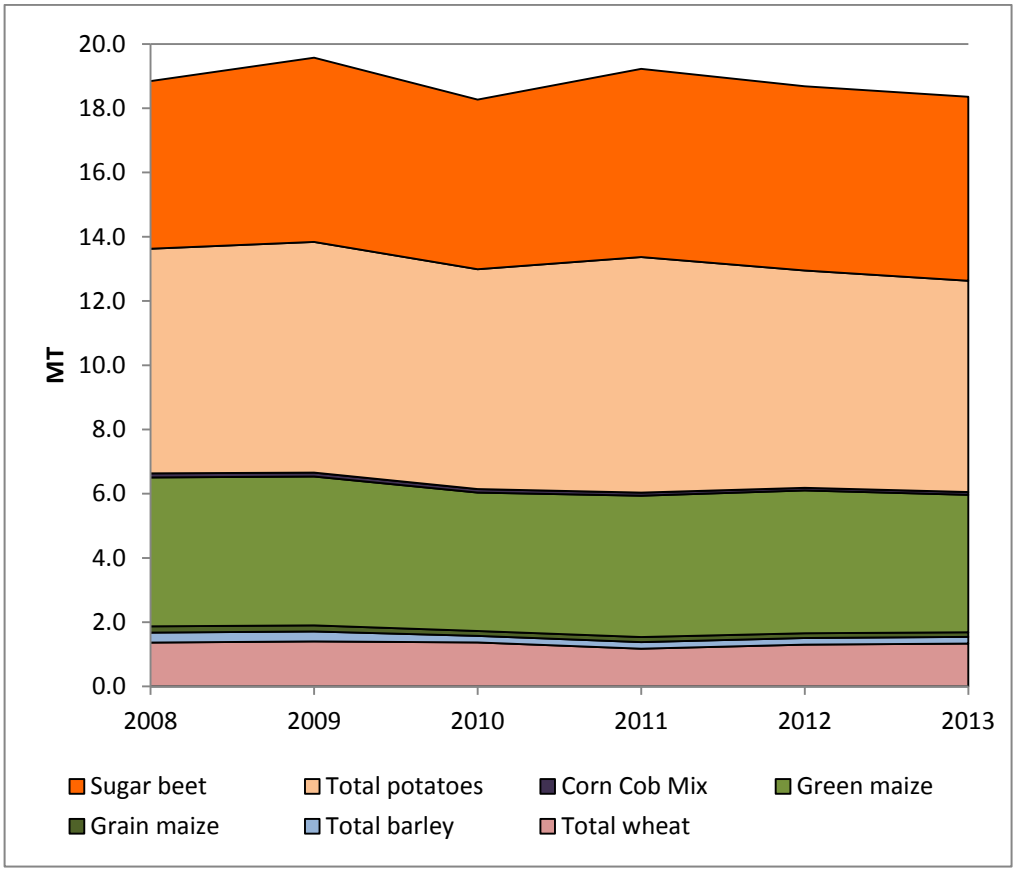


Figure 5-2 Grains and starchy crops production in the Netherlands from 2008 to 2011 (MT). (Source: CBS, 2014)
* Moisture content was harmonized to 16%

5.2 Sustainability of carbohydrates

Majority of carbohydrates consumed in the Netherlands originated from Europe. In recent years sustainability has been an important consideration in Dutch food industry, and included in procurement policies of many food companies. However, currently it is still unclear how sustainability certifications can be applied on grains in Europe. Companies generally purchase sustainable supplies through bilateral agreements by providing the suppliers a set of rules and criteria to follow. In addition, agriculture in Europe is largely monitored by environmental laws and regulations. Conventional certifications focus more on some other issues such as organic food. In 2012, Productschap Akkerbouw has developed a sustainability module within the VVAK system for farmers to show compliance with the EU-RED. It covers cultivation, harvesting, processing, storage and transport of open field crops. The scheme has been approved and accepted by the Dutch government to be used for the production of sustainable biofuels (NEa, 2012b). In the same year, another Dutch sustainability initiative, namely Stichting Veldleeuwerik, representing a large number of Dutch farmers and processors, has signed the Green Deal with the government. Through this foundation, a new sustainability certification system on the Dutch agricultural farming practices will be introduced in 2012. However, until 2013, there is no notable products with aforementioned certification in the market. Figure 5-3 show the share of schemes for bioethanol in the Netherlands between 2011 to 2013. ISCC remains as the most popular scheme, with its market share increased to near 97% in 2013.

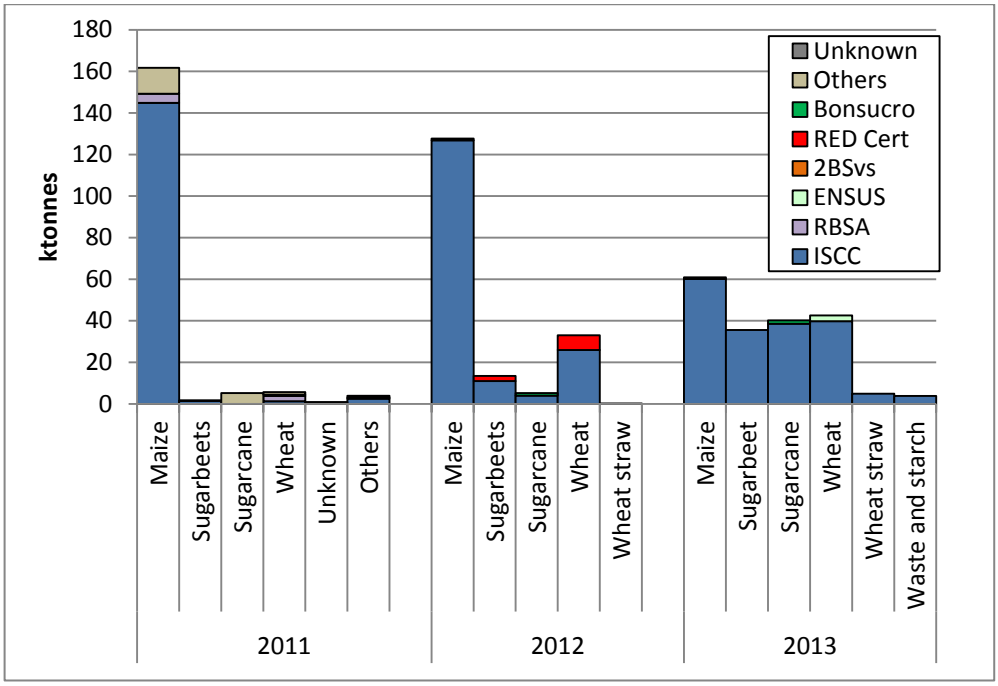


Figure 5-3 Sustainable certified bioethanol reported to NEa to fulfill blending obligation in the Netherlands in 2011 and 2012 by schemes (Source: NEa, 2012; 2013)

5.3 Energy use of carbohydrates

Figure 5-4 illustrates the Dutch bioethanol reported to NEa to fulfill blending obligation [2] from 2010 to 2013. The total consumption remains between 0.18–0.19 MT. Since 2011, the majority of the bioethanol consumed in the Netherlands originated from US maize and European wheat, but we have also seen the return of sugarcane ethanol to the European market in 2013, together with the substantial increase of sugarbeets ethanol. Maize ethanol dominates with 40% of market share in 2010 and even 90% in 2011, but the number dropped to 71% in 2012, and 34% in 2013. This is probably due to the reclassification of US ethanol to higher tariff rate (see the third paragraph). East Europe has emerged as the second largest supplier of maize for ethanol, followed by France and other European countries. The next important feedstock is wheat, which has plummeted drastically in 2011, but bounced back to 18% in 2012 and slightly increased to 21% in 2013. The decline of wheat ethanol in 2011 is probably caused by bad harvest in that year - feedstock price was high and production of bioethanol from cereal was less attractive (GAIN, 2012a; 2012c). For sugarcane ethanol, Brazil was once an important contributor, but it has experienced a large decline in 2011 and the trend continued in 2012. The reasons could be multifold: increasing domestic consumption, more attractive export to the US market where sugarcane ethanol is classified as “advanced biofuels”, and bad harvest in 2011. However in 2013, sugarcane has taken over about 21% of the market share. These sugarcane ethanol comes from Brazil and other Caribbean countries. Sugarbeets has become one of the four major feedstocks for ethanol consumed in the Netherlands in 2013. These ethanol mostly come from France.

2 The NEa reported consumption of liquid biofuels may be different from the actual physical situation. First, for administrative purpose, companies are allowed to carry over their physical efforts to later years. Second, companies may administratively allocate a low blend biofuels to the Dutch market, but physically (part of) this low blend is exported.

The Netherlands may continue to become a hub for biofuels blending and further distribution, as well as production since its large seaports provides easy access to feedstock. CBS (2014) has reported the production of bio-gasoline is 414 ktonnes in 2013. In terms of production capacity, there are two large bioethanol plants in the Netherlands operated by Abengoa (capacity 480 ktons) and Lyondell (ETBE, 400 ktons). The Abengoa Bioenergy's bioethanol plant in Rotterdam that started in September 2010 is the largest single facility in the world. It can produce 480 million litres of bioethanol (0.38 MT) annually from 1.2 MT of maize or wheat cereal as feedstock. It also produces 0.36 MT of distilled grains and solubles (DGS) which can be used an animal feed (Abengoa Bioenergy, 2012). However it has been shut down from December 2012 until March 2013 for maintenance. In 2013, in total overseas grain import used by the plant is about 462 ktons (388 dry ktons), but there is also some imports from the hinterland by barge. The total grain consumption by the Abengoa plant is about 2.4 million tons (2.01 dry million tons) (Du Mez, 2014). In June 2012, Cargill has also reportedly added 380 million litres of annual starch-based ethanol production capacity to its wheat wet-mill in Bergen op Zoom. The facility can process 0.6 MT of wheat annually. Ethanol will be produced from a side stream containing starch as raw material instead of the whole wheat grain (Ethanol producer magazine, 2012). However, it is not publicly known that how much they produce, where they source the raw materials and where they sell the bioethanol to.

Besides bioethanol, carbohydrates are also used as feedstock for biogas. About 0.36 MT of maize was fermented into biogas in 2010, but this figure dropped to 0.18 MT in 2011 and 0.03 MT in 2013 (CBS 2012; 2014). AVEBE, a company that works on innovation use of potato starch has signed the Green Deal with Drenthe (province) that involves an investment for biogas production in “Potato Power”, a large biogas project in Gasselternijveen using potato starch as feedstock. This project aims to produce 500 to 750 million m^3 of biogas by 2020 (Provincie Drenthe, 2012).

Figure 5-5 depicts the trend of ethanol trade flows. The major suppliers are American countries. The import of ethanol under the groups CN 22071000 and CN 22072000 have plummeted since 2008. The Brazilian ethanol has also disappeared in the Dutch market after 2009. Between 2009 – 2011, there was a steep increase of US ethanol entering the EU under the code CN 38249707. These products were found to leave the US as denatured (CN 22072000) or undenatured ethanol (CN 22071000), but most of those exports enter the EU as chemical compound (CN 38249097) with lower tariff. In 2012, these bioethanol blends was reclassified to the higher tariff rate, and trade of ethanol from US to Europe has declined significantly.

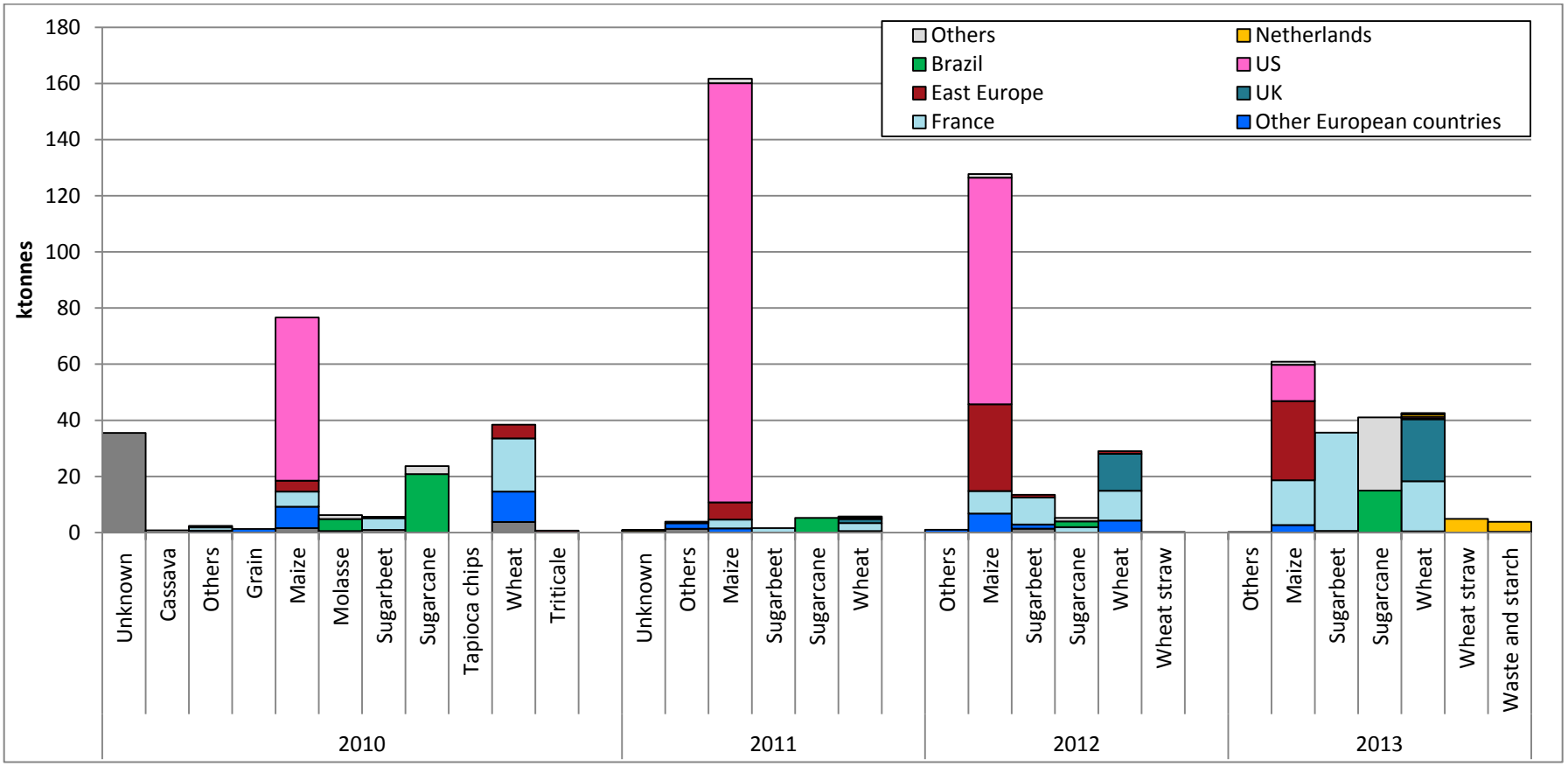


Figure 5-4 Bioethanol reported to NEa to fulfill blending obligation in the Netherlands in 2010 -2013 by feedstock (Source: NEa, 2011; 2012; 2013; 2014)

As shown in the figure, US ethanol has returned to the Dutch market under CN 22072000 in 2012, however, the import has diminished in 2013. Due to the fact that the EU domestic production is insufficient even with the anticipated capacity expansion in 2013 and 2014, the import has increased substantially in 2013. The increase mainly from the other EU member states (particularly Hungary), Guatemala, Pakistan and other countries. The regulated demand in the EU is expected to raise domestic ethanol prices and will continue to attract bioethanol from the other major ethanol market i.e. Brazil and the United States (Flach et al., 2012).

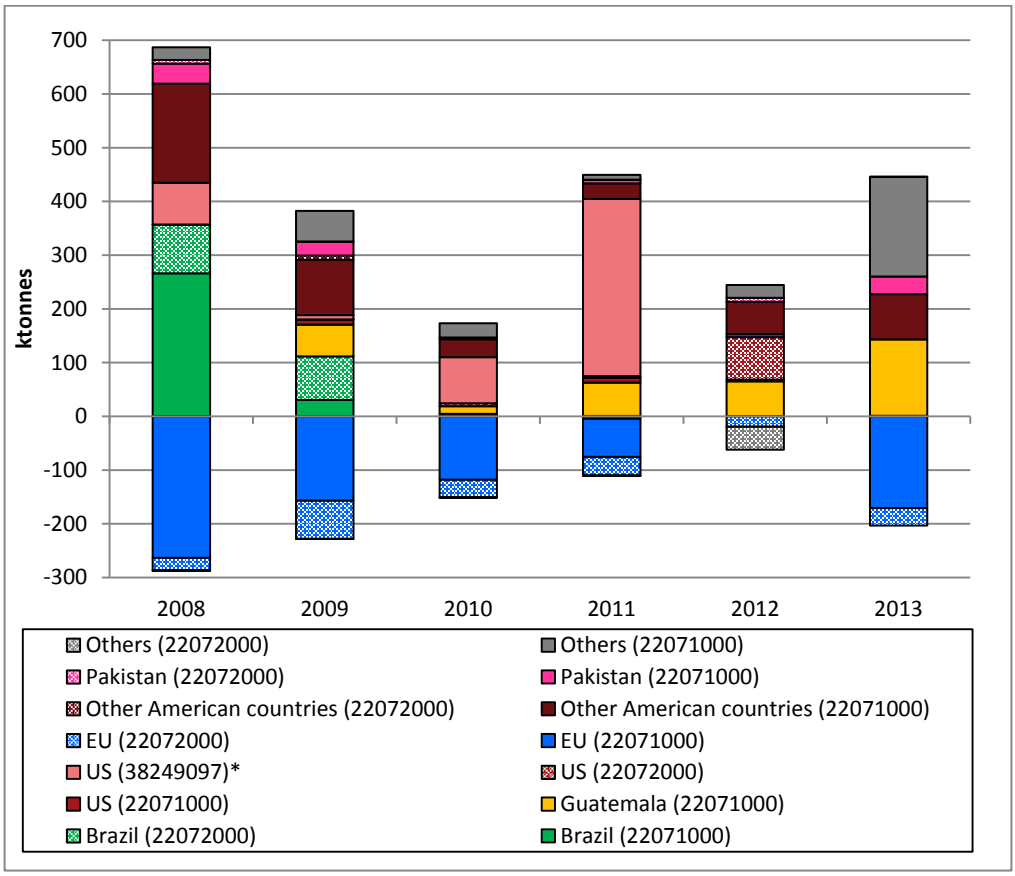


Figure 5-5 Ethanol trade balances (net) of the Netherlands for 2008 – 2012 (ktonnes). (Source: CBS, 2013)

* Note: Fuel ethanol from US was found registered as 38249097 upon arriving in the EU, but the number reported under this code may also contain other chemicals.

a.CN 22071000: Undenatured ethyl alcohol of actual alcoholic strength of >= 80%

b.CN 22072000: Denatured ethyl alcohol and other spirits of any strength

c.CN 38249097: Other chemical compounds (only shown up to 2012)

5.4 Prices of bioethanol

As no price data for ethanol was available in the Netherlands, Figure 5-6 shows the global prices of crude oil and sugar in comparison to the ethanol prices in Sao Paulo. The prices of ethanol seem to correlate with the world sugar price, but it is also affected by crude oil price, in particular in mid-2011 when it hiked suddenly together with the increase in crude oil price. Nevertheless, this was only a short-term shock and the price returned to the previous level very soon in a month or two.

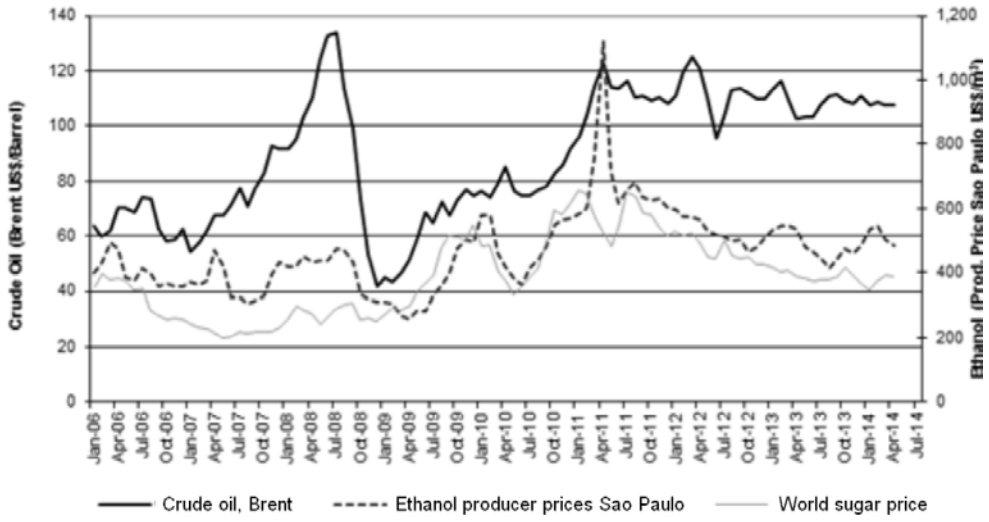


Figure 5-6 Trends of crude oil, ethanol and sugar prices (Adapted from de Laat and de Boer 2015)

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Appendix I Data sources

	Sources	Woody biomass	Oils and fats	Carbohydrates
i	Own data collection directly from the market actors	Wood pellet buyers (up to 2012)	-	-
ii	Monitoring bodies and general statistics portals	Probos, RVO	Product board Margarine, Fats, Oils (MVO); Task Force of Sustainable Palm Oil, Sustainable Trade Initiative (IDH); Liquid biofuels - Dutch Emission Authority	-
		Waste - Afval database van RVO; General - Central Bureau of Statistics of the Netherlands (CBS)		
iii	Trade statistics portals	• The Netherlands - Central Bureau of Statistics of the Netherlands (CBS); • EU level - EUROSTAT; • International level – FAOSTAT; UN COMTRADE; USDA Foreign Agricultural Service		
iv	Mass balance deductions	Derivations from the other sources		
v	Fragmented data, assumptions, and data aggregation	Various sources like press releases, news, reports by companies or other organizations, and scientific literature		

Appendix II CN code of biomass

CN Code	Description
Woody biomass	
CN 44xxxxxx	Wood and articles of wood; wood charcoal
CN 45xxxxxx	Cork and articles of cork
CN 47xxxxxx	Pulp of wood or of other fibrous cellulosic material; recovered (Waste and scrap) paper and paperboard
CN 48xxxxxx	Paper and paperboard; articles of paper pulp, of paper or paperboard
CN 49xxxxxx	Printed books, newspapers, pictures and other products of the printing industry; manuscripts, type scripts and plans
CN 44013020	Sawdust and wood waste and scrap, agglomerated in pellets
Oils and fats	
From CN 1201xxxx until CN 1209xxxx	Oil seeds and oleaginous fruits
CN 230400	Oil-cake & oth. solid residues, whether or not ground/in pellets, from extraction of soyabean oil
CN 15xxxxxx	Animal or vegetable fats and oils and their cleavage products; prepared animal fats; animal or vegetable waxes
CN 15200000	Glycerol, crude; glycerol waters and glycerol lyes
CN 29054500	Glycerol
CN 38249055	Mixtures of mono-, di- and tri-, fatty acid esters of glycerol (emulsifiers for fats)
CN 38249091 CN 38260010 (since 2012)	Monoalkyl esters of fatty acids, with an ester content of 96.5%vol or more esters (FAMAE)
CN 38260090	Biodiesel and mixtures thereof, not containing or containing less than 70 % by weight of petroleum oils or oils obtained from bituminous minerals.
CN 271020xx	Diesel, fuel oil, oils, containing >=70% weight of petroleum oils or oils obtained from bituminous minerals, containing biodiesel
Carbohydrates	
CN 10xxxxxx	Grains / Cereals
CN 11xxxxxx	Products of the milling industry; malt; starches; inulin; wheat gluten
CN 121291xx	Sugar beets
CN 12129300	Sugar cane
CN 1213xxxx	Cereal straw and husks, unprepared, whether or not chopped, ground, pressed or in the form of pellets
CN 17xxxxxx	Sugars and sugar confectionery
CN 19xxxxxx	Preparations of cereals, flour, starch or milk
CN 200410xx	Potatoes prepared or preserved otherwise than by vinegar or acetic acid, frozen, other than products of heading 2006:
CN 200520xx	Potatoes prepared or preserved otherwise than by vinegar or acetic acid, not frozen, other than products of heading 2006
CN 22071000	Undenatured ethyl alcohol of an alcoholic strength by volume of 80%vol or higher
CN 22072000	Ethyl alcohol and other spirits, denatured, of any strength
CN 38249097	Other chemical compounds

Appendix III Conversion factor for biomass

	Value	Unit
Woody biomass		
Density (Own estimation)	0.7	kg/m^3
Lower heating value [a]		
- Wood pellet	17	MJ/kg
- Wood chips	12	
- Waste wood and other woods	12	
Economic value [b,c]	Change with time	$/kg
Moisture content [d]		
- Air dry lumber (roundwood, sawn wood, wood panels)	12 – 15 (Assumed 15%)	%
- Paper and cardboard	5 – 12 (Assumed 10%)	
- Wood pellet [e, g]	10 – 13 (Assumed 10%)	
- Wood chips [f, g]	38 – 45 (Assumed 40%)	
- Waste wood	Assumed 30%	
Oils and fats		
Density		
- FAME [h]	0.88	kg/litre
Lower heating value		
- FAME [h]	37.1	MJ/kg
Economic value [i]	Change with time	$/kg
Moisture content	Negligible *	%
Carbohydrates		
Density		
- Ethanol [h]	0.79	kg/litre
Lower heating value		
- Ethanol [h]	26.7	MJ/kg
Economic value [i]	Change with time	$/kg
Moisture content	Moisture contents for crops are usually high and vary with crops, seasons and also reporting sources. This is described together with the data in Table 5-1. Moisture contents for other streams like sugars are considered negligible.	%

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* UCO and animal fats are assumed to be pretreated before they were fed into biofuel production