NL Agency
Ministry of Economic Affairs, Agriculture and Innovation

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Sustainable biomass and bioenergy in the Netherlands: Report 2013

>> Focus on energy and climate change

Colophon

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Executive summary

Methodological conclusion

Data is collected through five sources:

i. Own data collection directly from the market actors
ii. Monitoring bodies and general statistics portals
iii. Trade statistics portals
iv. Mass balance deductions
v. Fragmented data, assumptions, and data aggregation

There are five major challenges identified in this study:

A. *Data definitions: administrative data versus actual physical data*. Data collected for administrative purpose does not necessary equal to the actual physical flows due to various administrative reasons. These phenomena are rather prominent for biofuels, reflected in the discrepancies found between data reported by different monitoring bodies. The reported consumption of liquid biofuels may be different from the actual physical situation.

B. *Lack of coherent cross-sectoral reporting system*. Each reporting system usually has a very specific scope and interest on certain biomass or specific products, and seldom covers cross-sectoral flows. Taking liquid biofuels as an example, although the origin of biofuel was reported, it is not known explicitly whether the biofuel was produced domestically using imported feedstock, or imported directly from the feedstock producing country, or imported from a third country. The timing of production and consumption, and their relationship with the feedstock flows remain unclear. Overall, the data consistency of biomass flows still needs improvement, and this requires more alignment between monitoring bodies from different sectors.

C. *Reliability of bilateral trade statistics*. Significant discrepancies between bilateral trade statistics of biomass reported by exporting and importing countries were noticed, especially for intra-EU trade statistics on the EUROSTAT portal. Vice versa, reconciliation of the bilateral trade statistics may cause inconsistency with other data reported in the country. Besides that, in this study, international trade statistics also shows significant discrepancies with other data sources. The reasons of these discrepancies are multi-fold, but similar to those listed in point (A). The situation is even more complicated in the Netherlands considering the large volume of transshipment and re-export. Moreover, more than one product might be included under one CN code.

D. *Lack of transparency in biomass supply chain*. Currently, the degree of transparency of supply chain is considered low, not only for bioenergy, but also conventional biomass chains, with only few companies willing to publicly identify their biomass suppliers. Most of the companies' reports are incomplete, for example revealing only the percentage of sustainable certified vegetable oil consumed by a company in its annual sustainability report, but without giving any concrete information in volumes, origins, destinations and timing. This is further exacerbated when it comes to the question of sustainability of biomass, which is regarded as a very sensitive issue to private companies.

E. *Disparity in sustainability requirements*. At present, numerous sustainability certification schemes are being developed or implemented by a variety of private and public organisations with different interests, purposes and target groups. However, the systems in this wide range of schemes, developed largely without coordination among the organisations involved, are incompatible in many aspects, especially the measurement of GHG emission reduction. There are also differences between schemes applied in different countries. These disparity in sustainability requirements make the comparison between supply chains, sectors and countries become difficult.

Overview of sustainability certification of biomass

Table ES-1 shows the market share of sustainability certification schemes in the Netherlands in 2011 and 2012.

Table ES-1 Market share of sustainability certification schemes in the Netherlands in 2011 and 2012

Type of biomass	Sustainability schemes	Market share (% of certified biomass per particular products group in the market)	
		2011	2012
Woody biomass: Sawn timber and wood based panels (Oldenburger et al., 2013)	*FSC* *PEFC*	23.7% 42.0%	Not available Not available
Woody biomass: Paper and cardboard (Oldenburger et al., 2013)	*FSC* *PEFC*	23.9% 8.9%	Not available Not available
Woody biomass: Wood pellets used by utilities (Self collection)	*Green Gold Label* *Laborelec Label*	51.8% 33.5%	50.1% 27.2%
Oils and fats: Total vegetable oils (Taskforce Duurzame Palmolie, 2013; RTRS, 2011)*	*RSPO (Palm oil)* *Biofuels (Palm oil)* *RTRS (Soy oil)* *Biofuels (Soy oil)* *Biofuels (Rapeseed)*	2.5% 2.7% 0.3% 0.9% 2.6%	4.3% 20.2% 1.5% 0.0% 1.5%
Carbohydrates: Grains	*VVAK* *Stichting Veldleeuwerik*	Starts in 2013 Starts in 2013	Not available Not available
Biodiesel (on weight basis) (NEa, 2011; 2012; 2013)	*ISCC* *2BSvs* *RTRS* *NTA 8080* *Biograce* *Others*	48.4% 4.9% 1.8% 0.0% 0.0% 9.6%	55.0% 15.0% 0.0% 10.5% 2.8% 16.7%
Bioethanol (on weight basis) (NEa, 2011; 2012; 2013)	*ISCC* *RBSA* *REDCert* *Others*	84.0% 3.9% 0.0% 11.1%	92.9% 0.5% 5.3% 1.3%

* Including vegetable oils used for biofuels production, assuming all of these vegetable oils are certified with biofuels schemes, but it is not known which schemes are used.
** FSC: Forest Stewardship Council; PEFC: The Programme for the Endorsement of Forest Certification; VVAK: Voedsel- en Voederveiligheid Akkerbouw; RSPO: The Roundtable on Sustainable Palm Oil; RTRS: The Round Table on Responsible Soy; ISCC: International Sustainability and Carbon Certification; RBSA: The RED Bioenergy Sustainability Assurance Standard

Woody biomass

Figure ES-1 shows the mass flow of woody biomass in the Netherlands in 2012. 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, but the volume has been declining since 2010. The recycled percentage has increased from 61% in 2010 to 74% in 2012. However, there was still a large portion of paper and cardboard could not be separated and end up in waste incineration. On the other hand, a large amount of wood pellets was consumed by the utilities, but the consumption has shown a decreasing trend, from 1.59 MT (1.44 dry MT) in 2010 to 1.05 MT (0.95 dry MT) in 2012. About 90% of the wood pellets were imported. A considerable amount of woody biomass and paper and cardboard were also incinerated to generate electricity and heat.

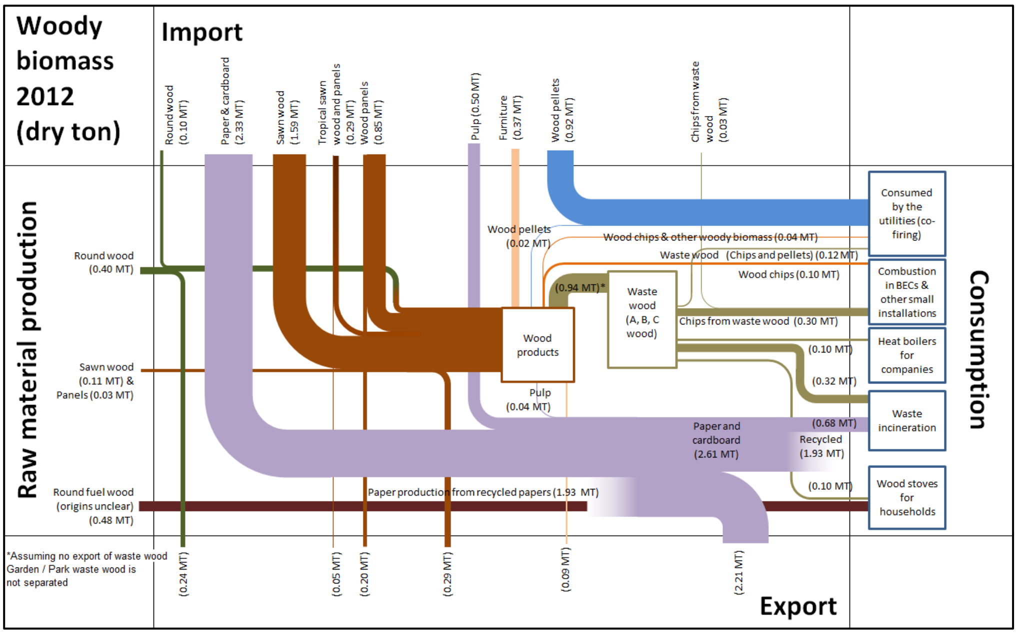


Figure ES-1 Mass balance for woody biomass flows in the Netherlands in 2012 (dry content)

Figure ES-2 depicts the use of certified and non-certified woody biomass in the Netherlands. The market share of certified wood products (sawn wood and panels) for non-energy use increased substantially since 2008. The recent focus in this category is the energy use of woody biomass by utilities, particularly wood pellets. Most of the certified wood pellets came from Canada, U.S., Baltic States, Russia and Southern Europe. The amount of certified pellets has dropped significantly in 2012, in line with the overall decline in pellets consumption by the utilities, especially for the case of Canadian pellets. A few industrial sustainability schemes are currently available for solid biomass, particularly for wood pellets, but many of them serve primarily for companies which developed them, such as Green Gold Label and Laborelec Label. New systems such as NTA 8080 and ISCC PLUS were not yet being widely applied. The EC is currently in the process of finalizing a set of sustainability criteria for solid biofuels at the EU level, and it is likely that it will be comparable to the existing EU-RED criteria for biofuels and liquid biomass. Meanwhile, the industrial pellet buyers (mainly utilities) are also working together to develop a harmonized sustainability system for wood pellets, namely IWPB. It is expected that the harmonized system will comply with the upcoming criteria by the EC.

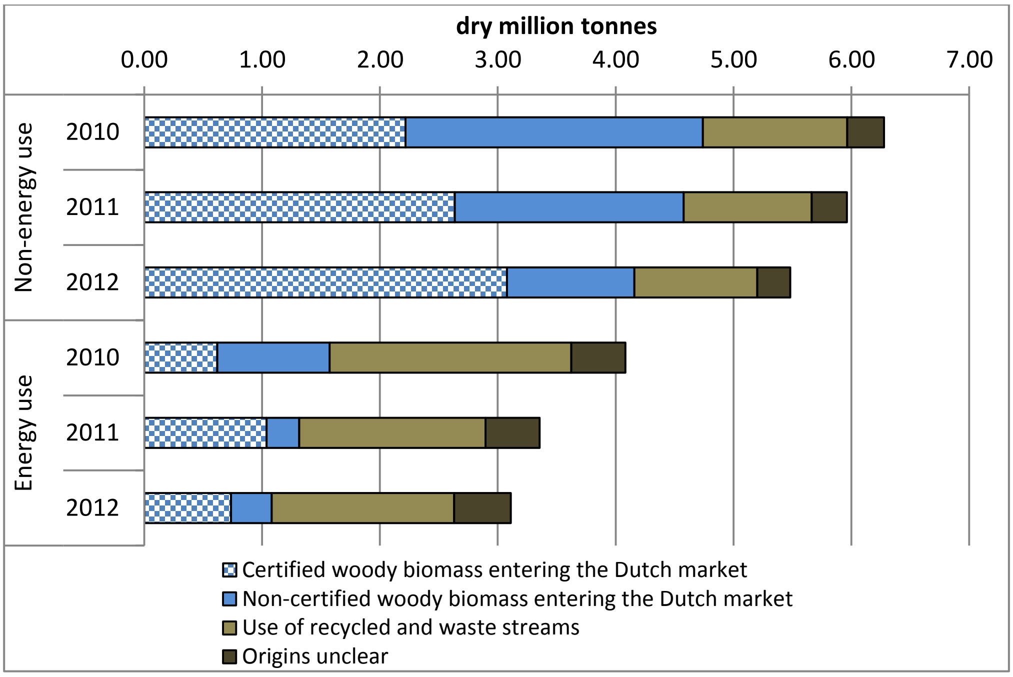


Figure ES-2 Use of certified and non-certified woody biomass in the Netherlands.

Oils and fats

Figure ES-3 shows the mass flow of oils and fats in the Netherlands in 2012. From 2011 to 2012, the Dutch (net) import has shown a remarkable increase from 0.72 MT to 1.63 MT, owing to the substantial growth of palm-based biofuel production. In 2012, about 0.78 MT of palm oil was processed for energy purpose (mainly to HVO), which is almost 10 times of the processed volume in 2011 (MVO, 2013; Bergmans, 2013). However, as NEa (2013) reported that there is only marginal consumption of palm-based HVO in the country in 2012, most of these palm-based HVO is assumed to be exported. On the other hand, there is also a substantial increase in animal fats import for energy purpose since 2011. The trends are relatively stable for human consumption, animal consumption and technical purpose. Figure ES-4 depicts the use of certified and non-certified vegetable oils, UCO and animal fats, and fatty acids in the Netherlands. 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. It should be noted that this figure takes the assumption that all vegetable oils used for biofuel production in the Netherlands are 100% sustainable certified. Data for certified vegetable oils used for biodiesel production in 2010 is not available. Since there was no mandatory requirement, it is assumed all vegetable oils used for energy purpose in 2010 were not 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). In the Dutch biodiesel market, ISCC is the most popular scheme with its dominance in most categories, but the application of NTA 8080 and 2BSvs is also growing remarkably. A large portion of the biofuels falls under double counting. There is a significant increase in the certification of double counted FAME in 2012 compared to 2011, mainly certified with ISCC.

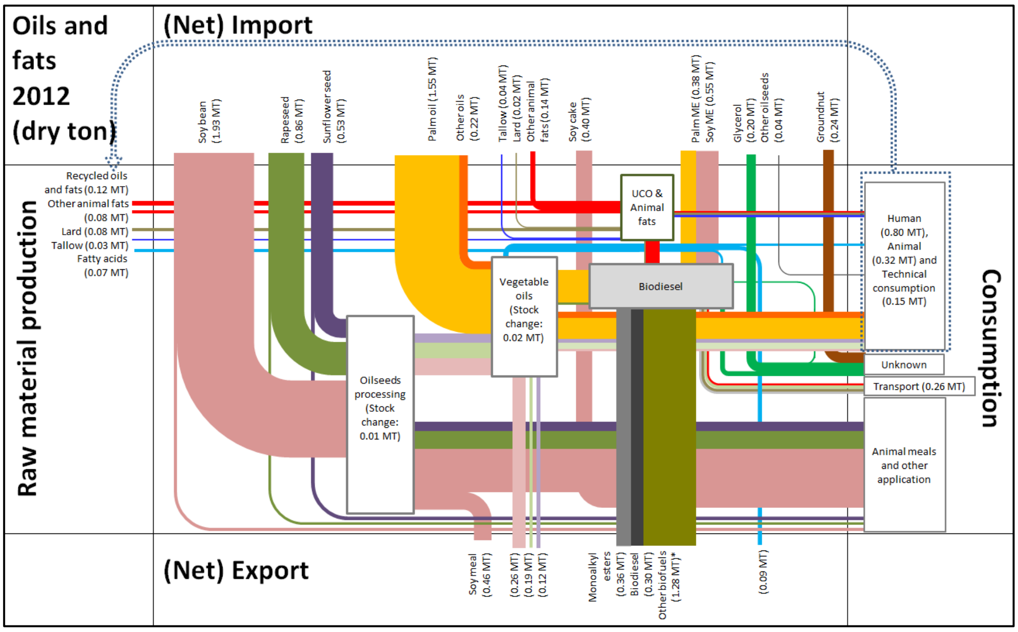


Figure ES-3 Mass balance for oils and fats flows in the Netherlands in 2012 (dry content)

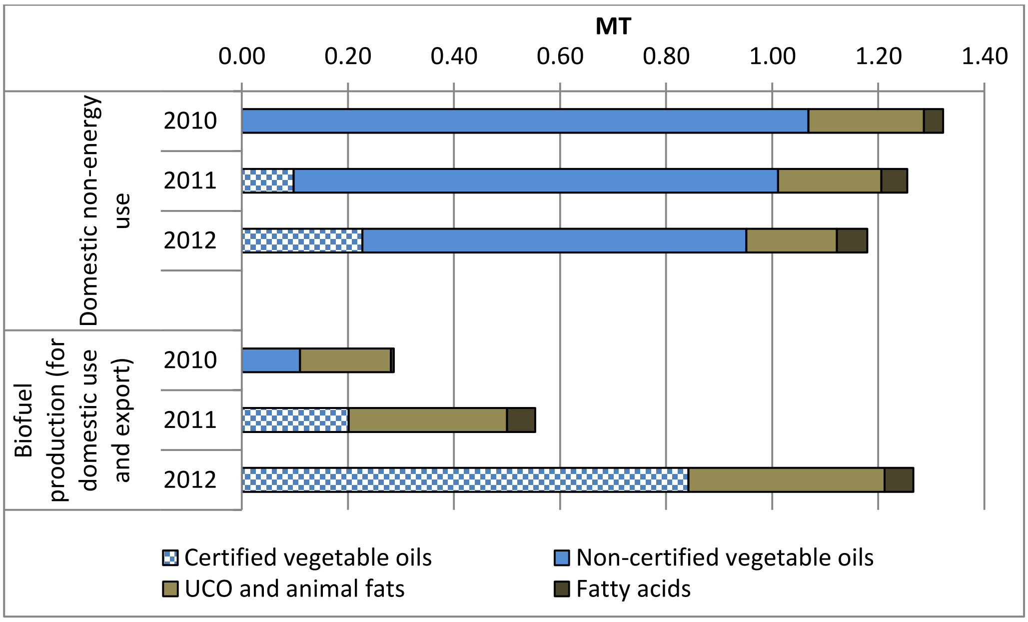


Figure ES-4 Use of certified and non-certified vegetable oils, UCO and animal fats, and fatty acids in the Netherlands
* Assuming all biofuels produced since 2011 were certified

Carbohydrates

Figure ES-5 shows the mass flow of carbohydrates in the Netherlands in 2012. 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). 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. However, it is not publicly known that how much they produce, where they source the raw materials and where they sell the bioethanol to.

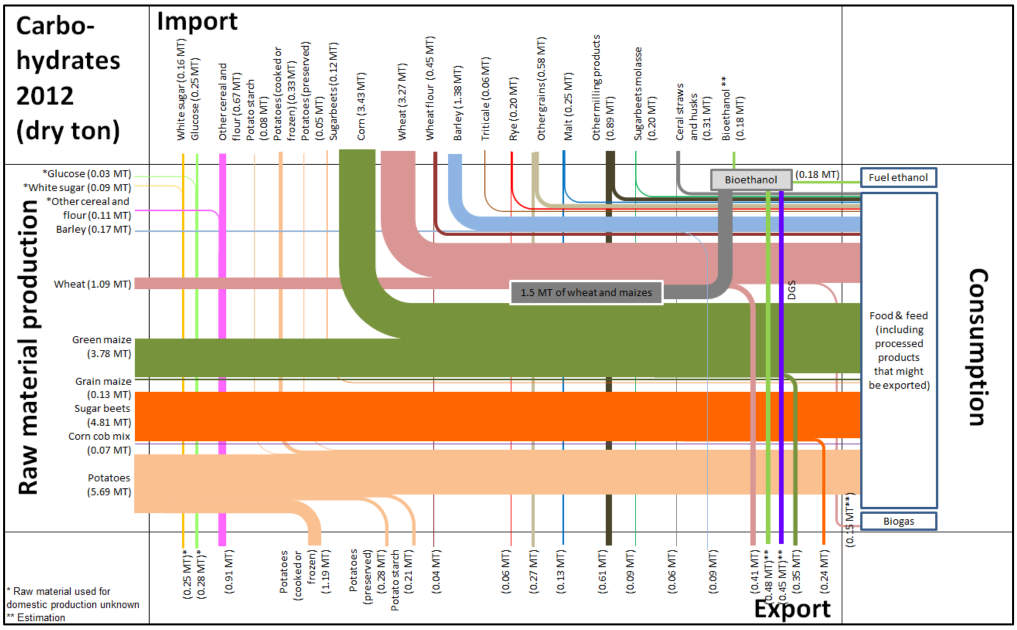
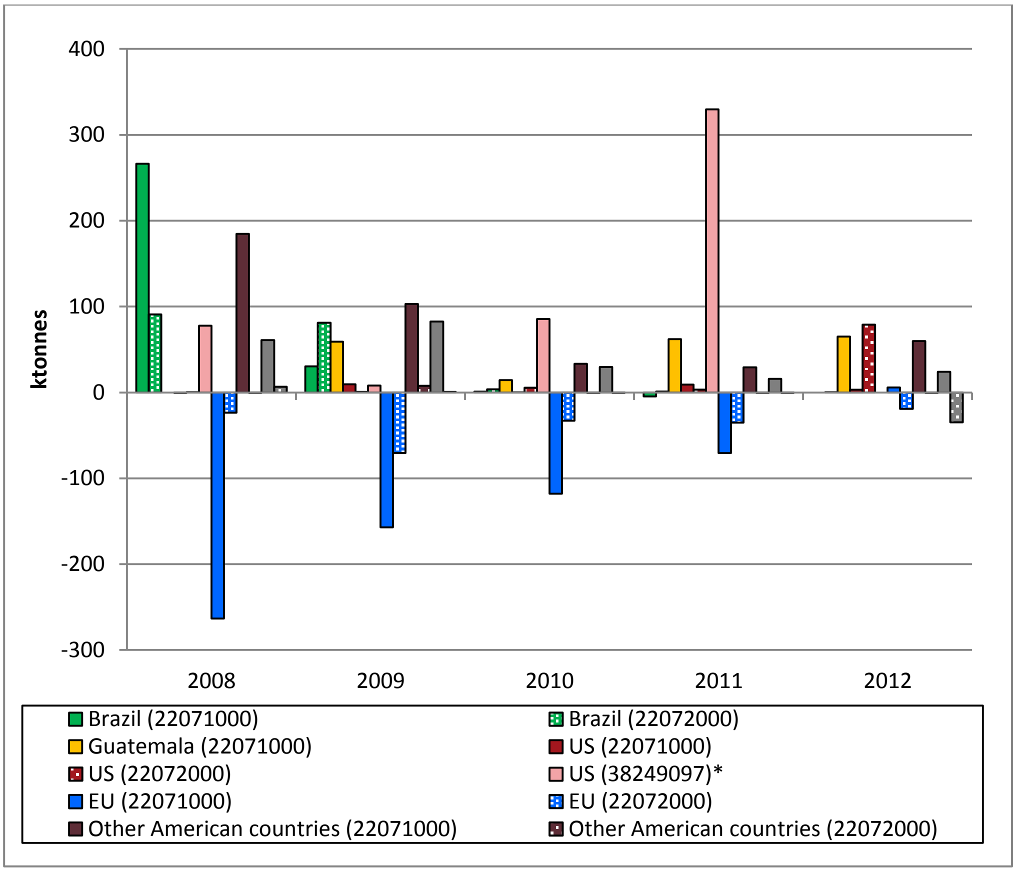


Figure ES-5 Mass balance for carbohydrates flows in the Netherlands in 2012 (dry content)

Figure ES-6 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 (See Section 7.2 for more details). In 2012, these bioethanol blends was reclassified to the higher tariff rate, and trade of ethanol from US to Europe will probably decline significantly. However, it is not sure in the long term how will this impact imports from the US, due to the fact that the EU domestic production is insufficient even with the anticipated capacity expansion in 2013 and 2014. As shown in the figure, US ethanol has returned to the Dutch market under CN 22072000 in 2012. The regulated demand in the EU is expected to raise domestic ethanol prices and will attract bioethanol from the market in Brazil, the United States or other countries (Flach et al., 2012).

In regards of the certification of bioethanol, ISCC is the most popular scheme, but the use of RED Cert also grew in 2012.



ES-6 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

Global biomass trade

Figures ES-7 shows the comparison of the EU imports versus global imports of the selected commodities in 2012. This graph is only meant for indication because each products may have different composition (e.g. soybean and palm oil are different in composition). The EU has been a significant importer of most of these products, and also the largest importer of wood pellets, biodiesel and ethanol. Figure ES-8 depicts the trend of EU imports in comparison with global trade volumes of wood pellets, biodiesel and ethanol from 2008 to 2012. Out of the 11 selected products, wood pellets, biodiesel and ethanol have shown significant changes compared to the others. The import of wood pellet has grown steadily, but both biodiesel and ethanol have shown different trends.

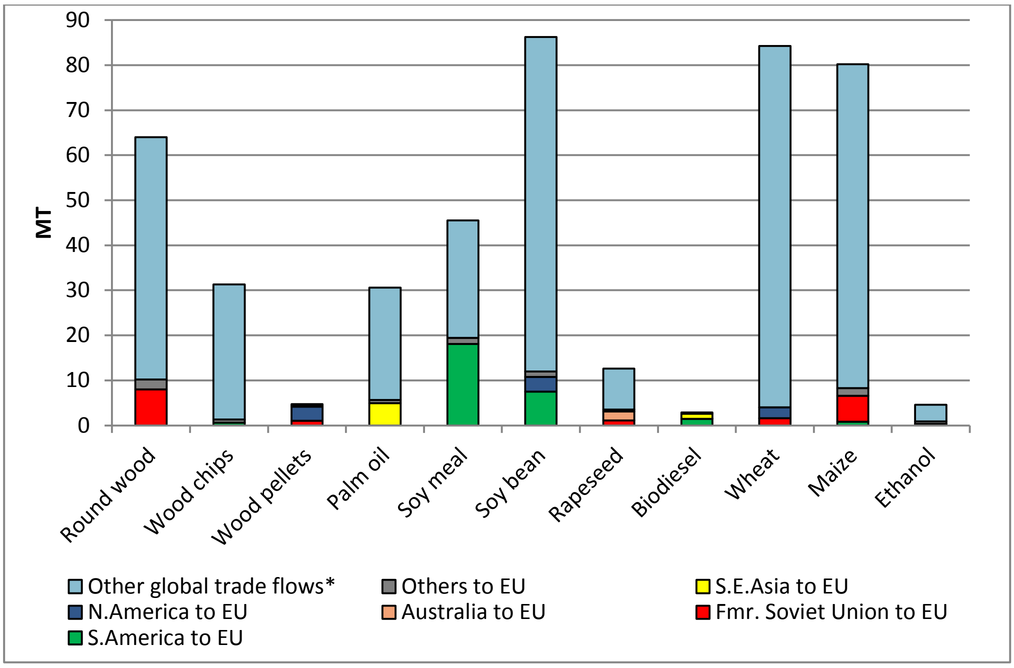
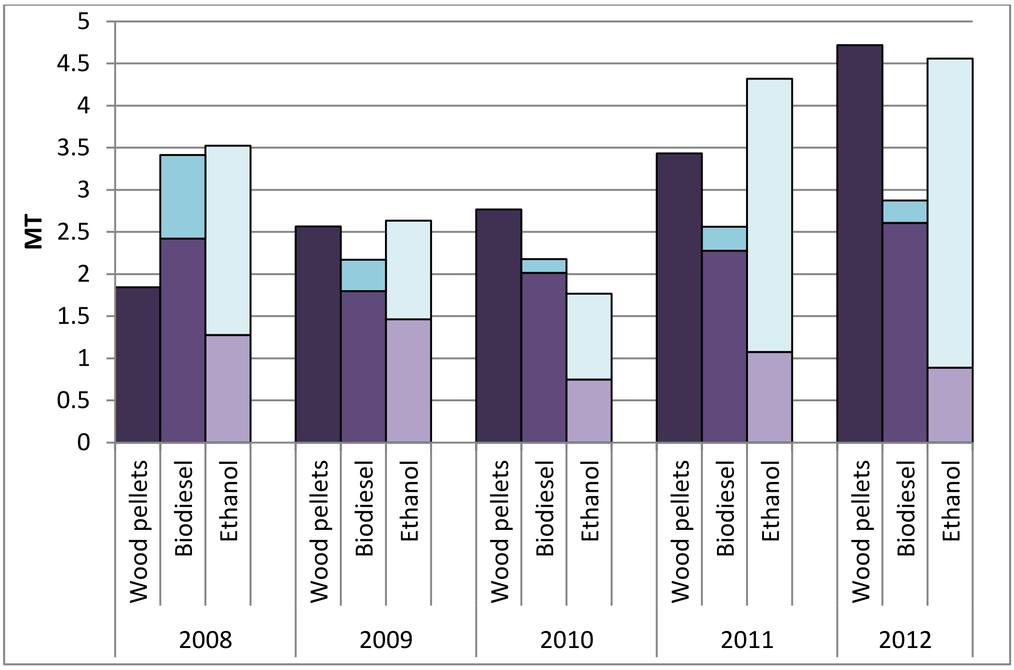


Figure ES-7 EU imports in comparison with global trade volumes for the year 2012. Source: Own calculation based on Figure 6-3 – 6-12.
* Only estimation due to complexity of indirect trade
** This figure includes the EU import under 382490 from US which is suspected to be ethanol



Note: Purple series at the bottom represent "EU imports", light blue series at the top represent "other imports".
Figure ES-8 EU imports in comparison with global trade of wood pellets, biodiesel and ethanol from 2008 to 2012.
Source: Own calculation based on Figure 6-3 – 6-12.
* Only estimation due to complexity of indirect trade
** This figure includes the EU import under 382490 from US which is suspected to be ethanol

Links to DBI/DBM projects

The 26 projects of DBI/DBM target on 18 crops and biomass, i.e. palm oil, soy, jatropha, sweet sorghum, sugarcane (and panela), algae, cassava, candlenut, castor, coffee, reed, bamboo, oilseeds in general, rice husk, straw, switchgrass and waste. Among the these crops, palm oil and soy are the most traded commodities in the world, whereas other biomass either has relatively small trade volumes or is not practically traded (e.g. jatropha). The most popular location is Indonesia, which is also the largest palm oil producer in the world. There are 7 projects on palm oil, 5 in Indonesia, 1 in Columbia and 1 in Sierra Leone. Linking to the trade flows, more than 30 MT of palm oil was traded in 2012 (the EU imports amounted to about 6 MT). Indonesia is the biggest supplier. Certified palm oil started to enter the Dutch market in 2011, and the volume increases from 0.67 MT in 2011 to 0.95 MT in 2012 (assuming all palm oil used for biodiesel production is certified)(See Figure 4-6). Sugarcane which is closely related to ethanol production is one of the targeted crops, and is included in 2 DBM projects. The EU do not import sugar cane in large quantity, but sugar cane ethanol is one of the important types of biofuels imported. However, the export of sugarcane ethanol to the EU has dropped significantly in the past few years due to several reasons like shortage in Brazil and market incentives in the US. Another commodities traded in large volume, soybean, is also included in 2 of the DBI projects. Instead of soybean, the EU is rather a big importer of soymeal. Similar to palm oil, the Dutch market has also started to import certified soybean since 2011. The share of certified soybean is expected to continue to grow.

The EU Import policies

Trade blocks like the EU have been using import tariffs as common practice to shield domestic agricultural and biofuel markets from foreign competition. For liquid biofuels, policy incentives such as tax exemptions and subsidies are granted to support domestic production, as well as import tariffs to limit imports, often geared towards the promotion of domestic agricultural and interests.

Biodiesel: In 2009, to stop the "splash-and-dash" practiced by the US biodiesel traders, the EU has imposed the import levies against the US biodiesel. The "splash-and-dash" effect happened when American producers import pure biodiesel made somewhere else, blend with 1% of petro-diesel to the fuel ("splash"), collect the tax credit ($1 per gallon). After getting the credit, the tanker could continue to Europe ("dash") and receive European fuel tax credits. Again in May 2013, the EU has decided to impose tariffs on biodiesel from Argentina and Indonesia, which are basically made of soy and palm oil respectively. These exporters are punished for allegedly selling biodiesel in the EU below production cost, i.e. dumping. This is because differential export taxes exist in Argentina and Indonesia, favoring the production and export of the finished product biodiesel rather than soybean and palm oil. It is expected that the import taxes will bring these trade flows to a halt, similar to import of US biodiesel due to the five-year anti-dumping duties on biodiesel from the US implemented in 2009. Both Argentinian and Indonesian biodiesel accounted for about 20 percent each in the EU biodiesel market in 2012.

Bioethanol: The EU maintains a higher tariff for undenatured ethanol than for denatured ethanol (€ 0.192 and € 0.102 per litre respectively). The tariffs do not distinguish between the different uses of ethanol (beverage, fuel, industrial). Many Member States (excl. the Netherlands) only permit blending with undenatured ethanol to protect domestic market by the higher tariff rate (Flach, 2013). Since 2009, there was a steep increase of US ethanol entering the EU. 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) subject to a lower tariff, which is 6.5% of the custom value (or around € 0.035/l) (Junginger et al., 2013). At the EU side (most likely on shore) petrol is added to the ethanol (the percentage of petrol varies between 10 and 15) (Vierhout, 2012). This has given big impact to the domestic ethanol producers. To avoid this, the EU reclassified ethanol blends > 70% as CN 22072000 since 2012 (EC, 2013b). The EC has reportedly communicated that with the new regulation, in practice all blends will fall under the high tariff rate of denatured ethanol (i.e. € 0.102/l). Also, the EU in February 2013 announced that it would impose a $ 0.0803/l tariff on US ethanol imports for five years after November 2011 (Junginger et al., 2013).

Agriculture products: In addition to intervention mechanism, the grains market in EU is also controlled through a system of import duties and quotas. The European Economic Community (EEC) has sought to foster domestic production and exportation, and to discourage importation. The EU developed a system where duties were set on the basis of separate reference prices for six grain types, including different types of wheat, maize, rye and sorghum. Also, the EU introduced a system of quotas for imported grains. The duty for imports outside the quota are subjected to a much higher duty. From January 2012, the quota for medium and low quality wheat is lowered taking into account of market loss arising from accession of Bulgaria and Romania to the EU in 2007. Another example is that the EC has suspended the import duties on certain grains for the first half of 2013 to ease the pressure on the EU market, especially for animal feed. On the other hand, trade in whole oilseeds, particularly soybeans, is relatively unrestricted by tariffs and other border measures, but oilseed meals, and particularly vegetable oils, typically have higher tariffs. At the moment, the EU tariffs on oilseeds and on oilseed meals are zero, whereas duties on vegetable oils (except olive oil) range from 0 to 12.8% (EC, 2013). Together with other trade policies, these tariffs intend to shift trades toward whole oilseeds and away from higher value-added oilseed meals and vegetable oils. However, for oilseed meals, the EU sets the tariff to zero and imports large volume of meals due to high demand for feed.

Woody biomass: The situation is a bit different for wood, where the exporters play the crucial role with their trade policies in this arena. The reason could be the high demand and low supply in wood resources in the EU. For example, the export tariff rate in Russia has shown a significant impact on the EU import of Russian wood. Since 2007, the imports of Russian wood has dropped significantly after Russia implemented export duties to boost domestic wood processing industry. However, Russia is still the largest supplier of imported wood. Although the amount of imports is expected to grow in 2012 after Russia has decided to open up a low export duty quota for spruce and pine and allocate a relatively large share of it to the EU, however the EU imports from Russia do not increase much yet in 2012 (UN Comtrade, 2013). To the authors' knowledge, there are no measures on solid biofuels like wood pellets on both import and export sides.

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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 - 2012, Utrecht University has carried out 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 to gain insight into the market mechanism and trade dynamics (Goh and Junginger, 2013). This project has a wider scope (covering both energy 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. A workshop was also organised on 25 Oct 2012 to discuss the preliminary results to the experts for confirmation and comments. Likewise in 2013, a workshop will be organized on 22 December to discuss the latest updated report.

1.2 Aims and scope

This report is largely based on Goh and Junginger (2013), with the latest updates and additional work. The aims of this study are fourfold:

1. **Update of the previous report**: This update focuses on analyzing the trends for 2010-2012, and possibly for 2008-2012 based on data availability. It pays particular attention to describe the market trends, and underlying reasons and drivers. Additional data sources will be explored, for example Port of Rotterdam.

2. **Overview of global biomass trade flows**: This report also screens large biomass importers, examines and analyses their trade flows. It also assesses the trends of these trade flows for 2008-2012.

3. Assessment of the 40 DBI and DBM projects by relating them to the current global biomass flows

4. A brief description of import policies (tariff) currently applied by the European Union

2 Methodology

2.1 Scope of study

In view of the large diversity in biomass, 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 other biomass categories with large volumes in the Dutch economy, e.g. flowers, vegetables, fruits, meats, and processed food are not included in the case study. Nevertheless, waste streams from these biomass might be significant as bioenergy carriers. Data of these organic biomass in municipal waste streams usually can be derived at highly aggregated level. However, the framework can also be expanded to the other biomass categories based on the three aforementioned criteria. For example, agriculture residues could be very relevant to countries with large agriculture industry, such as Malaysia and Indonesia.

2.2 Building mass flow diagrams

The framework consists of three dimensions: (i) cross-border input and output (import and export), (ii) domestic input and output (production and consumption), and (iii) share of sustainable certified biomass. The results are presented in the form of mass flow diagrams. The mass flow diagrams was built in three steps:

Step 1: Creating biomass chains and sustainability certification schemes inventory

First, an inventory of biomass supply chains was created. This inventory should cover as detail as possible inputs of raw materials to secondary, tertiary and end users and finally releases of materials to environment. Sustainability certification schemes applied on these chains were also identified based on literature reviews.

Step 2: Setting system boundaries

Due to the relatively broad aims, this monitoring framework is unlikely to cover the whole life cycle, but largely depends on data availability and feasibility. It should be noted that the boundaries may change with time as the industry is developing rapidly. The system boundaries for the three selected categories were set at different degrees. For woody biomass, the flows of materials can be identified more clearly due to consistent chemical composition in the stream (little or without chemical processing), and therefore near to full life cycle of the biomass can be illustrated (from raw wood to combustion). For oils and fats, the end-uses were identified as for human consumption, animal consumption, for technical purpose and for energy use. For carbohydrates, the biomass was assumed to be mostly consumed as food and feed, and therefore no further categorization was made.

Step 3: Quantitative analysis

In the final step, all flows were quantified as detailed as possible. An overview of data sources are presented in Section 2.3. First, each mass flow was examined quantitatively in both dimensions (i) and (ii). The flows of the three selected categories are presented in three different mass flow diagrams. The diagrams consist of two pairs of axis, where the top and bottom axis indicate import and export, and the left and right axis indicate domestic input and output of the chain. All streams were drawn in the ratio to their actual volume (moisture content should be specified depending on the type of biomass). For countries with huge transshipment volume due to their trading hub nature, such as the Netherlands, net trade balances (i.e. net import and export excluding transshipment) can be used to improve the visualization of mass flows. Finally, dimension (iii) was also assessed quantitatively as detailed as possible.

2.3 Collection and selection of data

Data quality is the main factor that determines the reliability of the analysis and therefore needs to be defined explicitly. As no single data source cover all required information, various data sources were identified and evaluated. When there are more than one source available, data will be selected based on the following order:

(i) *Own data collection directly from the market actors*: In some extreme cases, when reliable data of certain important biomass streams is not available anywhere, data can only be collected directly from industry in the form of surveys and interviews. Direct information collected from the industry is regarded as the most reliable first-hand source of information. However, many companies tend to withhold trade information to protect their business interest. Own data collection is considered the most time-consuming and difficult way, and it is only carried out when the particular flow is of very high importance (i.e. have high potential to substitute fossil fuels and/or materials) and the other data sources are not available.

(ii) *Monitoring bodies and general statistics portals*: The core data contributors are usually monitoring bodies and general statistics portals. A monitoring body can be a governmental department or agency, an industrial association, or a non-profit institution that monitors the products' mass flows within the country or region. Some countries may have official general statistics systems that gather data from these monitoring bodies and/or directly from the industry. However, in this methodological framework, trade statistics that collected at customs is separated as another category. The difference between these two sources can be viewed from two aspects: coverage and nature. Trade statistics portals capture trade flows at trading hubs, such as seaports, mainly at international level. Meanwhile monitoring bodies and general statistics portals may cover the flow of raw materials in secondary processing, post-processing and post-consumption (i.e. waste and residues) within a country or region. In terms of data nature, trade statistics is normally actual physical data (often the monetary values of physical goods) gathered directly from trading hubs, while monitoring bodies and general statistics portals may have various reporting systems that collects data for administrative purposes which does not necessary equal to the actual flows at a particular time due to various administrative reasons. A noticeable example is the consumption data of liquid biofuels that reported in EU to fulfill mandates. This kind of "administrative data" has a policy dimension in the context of carbon mitigation policies, and therefore has a priority in data selection when there are discrepancies between data sources. An inadequacy of this data source is that a monitoring body usually has a very specific scope and interest on certain biomass or specific products, and seldom covers cross-sectoral flows.

(iii) *Trade statistics portals*: Trade statistics portals covers a large range of products categorized using Combined Nomenclature (CN) codes. Table A1 in Appendix listed CN codes for woody biomass, oils and fats, and carbohydrates. A number of studies on bioenergy trade flows have been conducted mainly using trade statistics. 2, 5-8 This type of effort is often fraught with difficulties in differentiating the actual flows given that a number of different trade codes may be applied on similar products based on small differences in product nature, but they do not differentiate the end-uses of the materials explicitly. For example, ethanol can be imported under several different CN codes in different forms and blending level, but it is not known how much has actually used for energy purpose. Nevertheless, the CN system has been continuously improved, for example a new code is introduced for energy pellets in recent years. Furthermore, trade statistics portals do not distinguish sustainable certified materials from general products. Another weakness is that there are significant discrepancies between bilateral trade statistics reported by exporting and importing countries due to differences in timing, level of details and classification. 5,9 In this work, data reported by the case study country was given priority, to ensure a consistent set of data is used when trade flows are linked to biomass flows within the country.

(iv) *Mass balance deductions*: This category is placed at higher order than (v) when the base data comes from (i), (ii) and (iii). Volume of certain streams such as by-products, waste and recycling streams can be deducted through mass balance calculations. Indicators from scientific literature can be used to complete the calculations. An example is the use of ratio method in derivation of glycerol flows, using the ratio of glycerol to monoalkyl esters proposed by scientific literature.

(v) *Fragmented data, assumptions, and data aggregation*: Data may also be found scattered in many public available sources, such as press releases, news, reports by companies or other organizations, and scientific literature. These pieces of information mostly come in fragments, lack of comprehensive descriptions and definitions. To complete the picture, assumptions can be made based on information fragments, related facts, extra- or interpolation, and other appropriate ways. For example, the sustainable share of certain biomass streams in the Dutch market might be assumed equal to that of in the European market, as the country possess the largest trading hub in Europe with very active and complex intra-European trade, making identifying the final destination of sustainable products extremely difficult. The drawback of this data source is that it often lacks of scientific justification and consistency, and therefore it is ranked lower. Ultimately, if there are still some missing details in the mass flow diagram, streams or part of the chain that data is not available at high level of details can be merged to increase the efficiency of the study. For example, paper and cardboard were not separated into individual streams but considered as one general product group, as the specific type and volume of paper and cardboard recycled or combusted is unknown. Besides that, for streams with less distinction and small volumes, such as different forms of wheat powder can also be grouped together to improve the visualization. However, the conditions might change from one case study to another, depending on specific objectives.

The list above shows that there are many discrete analyses and data available, but mostly in different forms, and not every single biomass flows are monitored. The main idea of this framework is to overcome these challenges by matching all data together, supplementing each other to illustrate the big picture of biomass flows. When there are more than one set of data available, only data with the highest rank will be used. Harmonization of data should be performed to ensure a consistent set of metrics when data comes in different units, such as volume, mass, energy, and monetary values. Appendix III shows the conversion factors for biomass, as well as moisture contents. All units should be harmonized to a consistent unit, e.g. MT (MT) in this study to give meaningful comparisons.

2.4 Methodological challenges and conclusions

Five major challenges were identified through this work:

A. Data definitions: administrative data versus actual physical data

Data collected for administrative purpose does not necessary equal to the actual physical flows due to various administrative reasons:

- using definitions different from the CN codes,
- using different definitions between organizations,
- using different definitions as the administrative rules change over time,
- delayed or early reporting,
- considerations of indirect trade flows (administratively reporting the origins of goods as either where the goods are produced, or where the goods are imported from through re-export/transshipment),
- other internal or external considerations

These phenomena are rather prominent for biofuels, reflected in the discrepancies found between data reported by different monitoring bodies. 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. For comparison, CBS reported biodiesel consumption at 0.11 MT and 0.20 MT (in 2010 and 2011 respectively), whereas the monitoring body NEa reported 0.10 MT and 0.29 MT (in 2010 and 2011 respectively). Sustainability of biomass and bioenergy is important in the context of carbon mitigation policies. This phenomenon causes potential barriers to assessment of GHG emission reduction at sectoral or national level especially when it involves large trade volumes consist of both sustainable certified and non-certified biomass. The risk of confusion seems very high due to data inconsistency between countries and sectors when different reporting systems are employed.

B. Lack of coherent cross-sectoral reporting system

Each reporting system usually has a very specific scope and interest on certain biomass or specific products, and seldom covers cross-sectoral flows. Taking liquid biofuels as an example, although the origin of biofuel was reported, it is not known explicitly whether the biofuel was produced domestically using imported feedstock, or imported directly from the feedstock producing country, or imported from a third country. The timing of production and consumption, and their relationship with the feedstock flows remain unclear. This has resulted in the unknown composition of biodiesel flow in Figure 4-1 to 4-3 where grey colour was used, because it cannot be matched with data from the oils and fats sector. On top of that, it also causes difficulty to deduct the sustainable share of biomass flows across sectors. Although in the Netherlands some monitoring bodies that cover conventional use of biomass such as MVO (oils and fats) and Probos (woody biomass) have started to include energy use of biomass in their reports, again this is fraught with the same problems in point (A). Overall, the data consistency of biomass flows still needs improvement, and this requires more alignment between monitoring bodies from different sectors.

C. Reliability of bilateral trade statistics

Significant discrepancies between bilateral trade statistics of biomass reported by exporting and importing countries were noticed, especially for intra-EU trade statistics on the EUROSTAT portal. To ensure a more consistent set of data is used, data reported by the case study country was given priority to match with other data collected in the country, but this will lead to different results between country analyses. Vice versa, reconciliation of the bilateral trade statistics may cause inconsistency with other data reported in the country. Besides that, in this study, international trade statistics also shows significant discrepancies with other data sources: For the case of the Netherlands, discrepancies were found in the case of wood pellets when comparing Eurostat with own data collection (directly from the industry), showing differences in net trade balance up to 55 ktonnes per country for the year 2011. The reasons of these discrepancies are multi-fold, but similar to those listed in point (A). The situation is even more complicated in the Netherlands considering the large volume of transshipment and re-export. Various efforts have been made to understand and reconcile the discrepancies in general trade statistics. For bioenergy, a few studies have pointed out that the current CN codes do not differentiate the end-use purposes of the materials between energy use and raw material use. Moreover, more than one product might be included under one CN code. A prominent example is ethanol which is used as transportation fuel and for raw material purposes in the chemical industry. Ethanol is categorized under several different CN codes based on its forms and blending level but not the end uses.

D. Lack of transparency in biomass supply chain

One of the biggest barrier to overcome is the transparency of biomass flows. Currently, the degree of transparency of supply chain is considered low, not only for bioenergy, but also conventional biomass chains, with only few companies willing to publicly identify their biomass suppliers. Most of the companies' reports are incomplete, for example revealing only the percentage of sustainable certified vegetable oil consumed by a company in its annual sustainability report, but without giving any concrete information in volumes, origins, destinations and timing. Companies tend to withhold information (particularly trade information) to protect their business interest. This is further exacerbated when it comes to the question of sustainability of biomass, which is regarded as a very sensitive issue to private companies. Nevertheless, in the Netherlands, the reporting of liquid biofuels consumption is getting more transparent, as more details were revealed in 2012 compared 2011. However, the actual situation of liquid biofuels production in the country remains unclear. There is no public available knowledge on actual sources of feedstock (for bioethanol production) and supply destinations (for both bioethanol and biodiesel production), resulting in a few speculative streams in Figure 4-1, 4-2, 4-3, 5-2 and 5-3 (illustrated in grey). On the other hand, the solid biofuels users will also have to report annually to the government the amount of biomass they use and how sustainability is demonstrated via certification or verification systems. However, the level of details of this reporting system will only be revealed when the report is published.

E. Disparity in sustainability requirements

At present, numerous sustainability certification schemes are being developed or implemented by a variety of private and public organisations with different interests, purposes and target groups. While there are many years of experience for certification of woody biomass with sustainable forestry management schemes, it is worthwhile to point out that in 2011, the sustainability certification of solid biofuels, liquid biofuels and vegetable oils for human consumption has significantly increased. However, the systems in this wide range of schemes, developed largely without coordination among the organisations involved, are incompatible in many aspects, especially the measurement of GHG emission reduction. For example, industrial schemes for wood pellets do take GHG emission measurement along the supply chain into account, but sustainable forest management schemes do not. Similarly, certification of vegetable oils used for biofuels production does employ the RED criteria but certification of vegetable oils used in food sectors does not. There are also differences between schemes applied in different countries. These disparity in sustainability requirements make the comparison between supply chains, sectors and countries become difficult.

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, 3-2 and 3-3 illustrates the flows of woody biomass in the Netherlands in 2010, 2011 and 2012. 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). The country was the second largest EU consumer of tropical wood in 2011. The majority of the tropical sawn wood timber imported originates from Malaysia, Brazil, Indonesia and Cameroon.

There was also a large import of paper and cardboard into the Dutch market, but the volume has been declining since 2010. The recycled percentage has increased from 61% in 2010 to 74% in 2012. However, there was still a large portion of paper and cardboard could not be separated and ended up in waste incineration. Note that about 50% of paper and cardboard was imported products which may also be produced from recycled materials.

A large amount of wood pellets was consumed by the utilities, but the consumption has shown a decreasing trend, from 1.59 MT (1.44 dry MT) in 2010 to 1.05 MT (0.95 dry MT) in 2012. About 90% of the wood pellets were imported. A considerable amount of woody biomass and paper and cardboard were also incinerated to generate electricity and heat. See more details about energy use of woody biomass in Section 3.3.

Table 3-1 shows the data sources for this category. See Section 2.3 for the description of data sources (i) – (v).

Table 3-1 Data sources for "Woody biomass"

Woody biomass	i	ii	iii	iv	v
For the year 2010-2011, data for "Consumed by the utilities (co-firing)" was collected from the utilities directly through surveys, together with the share of certified woody biomass in this stream, and was cross-checked with literature (e.g. Essent, 2011). For 2012, data of woody biomass co-firing was collected by Agentschap NL (2013). This data was then compared with CBS (2013b) to deduce the amount of non-woody biomass (assuming NCV at 15 MJ/kg) co-fired in power plants. Also as a comparison, data was also available on trade statistics with CN code CN 44013020 but without the share of sustainable certified biomass. However, the intra-EU trade data is highly inconsistent from this source, and therefore was not used.	x				x
For 2010-2011, data for "Combustion in BECs and other small installations" was collected from CBS (2013) and personal communication with Reinoud Segers, Statistical Researcher at CBS. Biomass Energy Centres (BECs) are stand-alone biomass combustion plants. For 2012 data was taken from Agetnschap NL (2013).		x			
Data for "Heat boilers for companies" was taken from CBS		x			x

(2013b), assuming 60% of the biomass used by these heat boilers comes from fresh waste wood, as 60% of the boilers were used in wood processing companies. The rest largely comes from agriculture sector, and therefore is not shown here (personal communication with Reinoud Segers, Statistical Researcher at CBS).					
Data for "Waste Incineration" was calculated based on direct information from Agentschap NL (2011) with a rough estimation of biogenic components in municipal and household waste streams made in 1995. However, the quantity of recycled paper and cardboard was also provided by Probos (2011; 2012; 2013), which was used to complete the recycling loop. Therefore, for paper and cardboard, the incinerated amount was calculated by calculating mass balance based on Probos figures, assuming no storage of paper and cardboard (consumption = production + import).		x		x	x
Data for "Wood stoves for households" was taken from CBS (2013), assuming 1/6 of wood used was "Waste wood", and the rest were round fuel woods that might originated from forest residues, gardens residues, old fruit trees, public trees from parks and streets (personal communication with Reinoud Segers, Statistical Researcher at CBS). The moisture content was assumed to be 30%.		x			x
The input streams to "Waste wood (A, B, C wood)" from "Wood products" was derived through mass balance by assuming no export of waste wood. It does not include residues from forests, gardens and parks. Export of "Waste wood (A, B, C wood)" was not shown as data was not available. As a reference, waste wood export in 2007 was 1.16 MT (about 0.76 MT for energy purpose) (Goh et al., 2012).				x	x
Data for "Furniture" was taken from CBS (2013) using selected CN Codes 94036090; 94036010; 94035000; 94016100 ; 94039030; 94016900; 94019080; 94034090. Assuming moisture content at 15%.			x		
Data for the other streams was taken from Probos (2011; 2012; 2013). Assuming density of wood = 0.7 tonnes/m^3. It should be noted that Probos's data also relies on CBS trade statistics. Data for the share of certified woody biomass for non-energy use was also taken from Oldenburger et al. (2013). Figures for 2010 and 2012 were estimated using interpolation of data points, based on figures for 2008 and 2011.		x	x	x	x
Due to absence of data, both consumption and export streams of paper and cardboard were assumed to have a same percentage of recycled products.					x

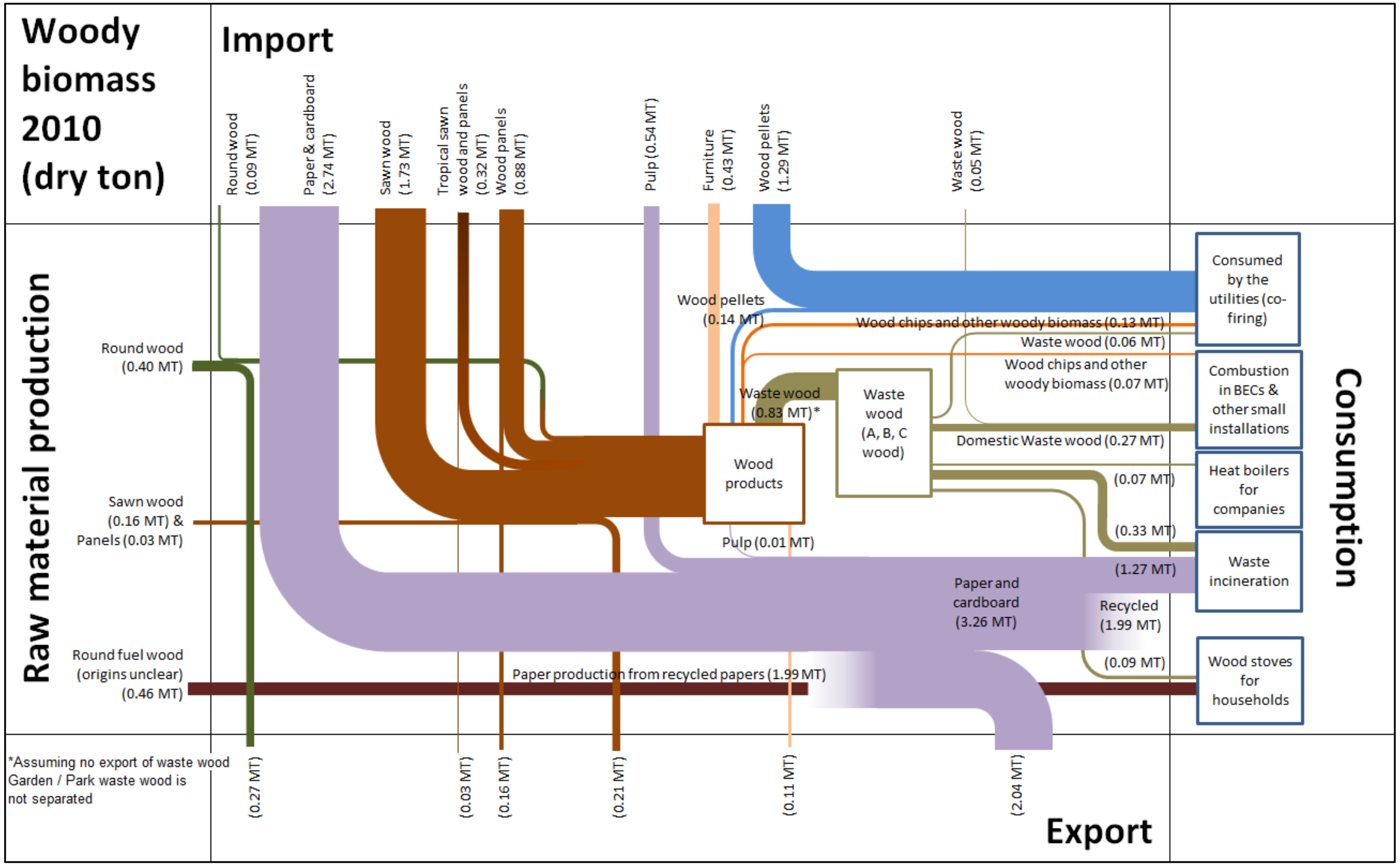


Figure 3-1 Mass balance for woody biomass flows in the Netherlands in 2010 (dry content)

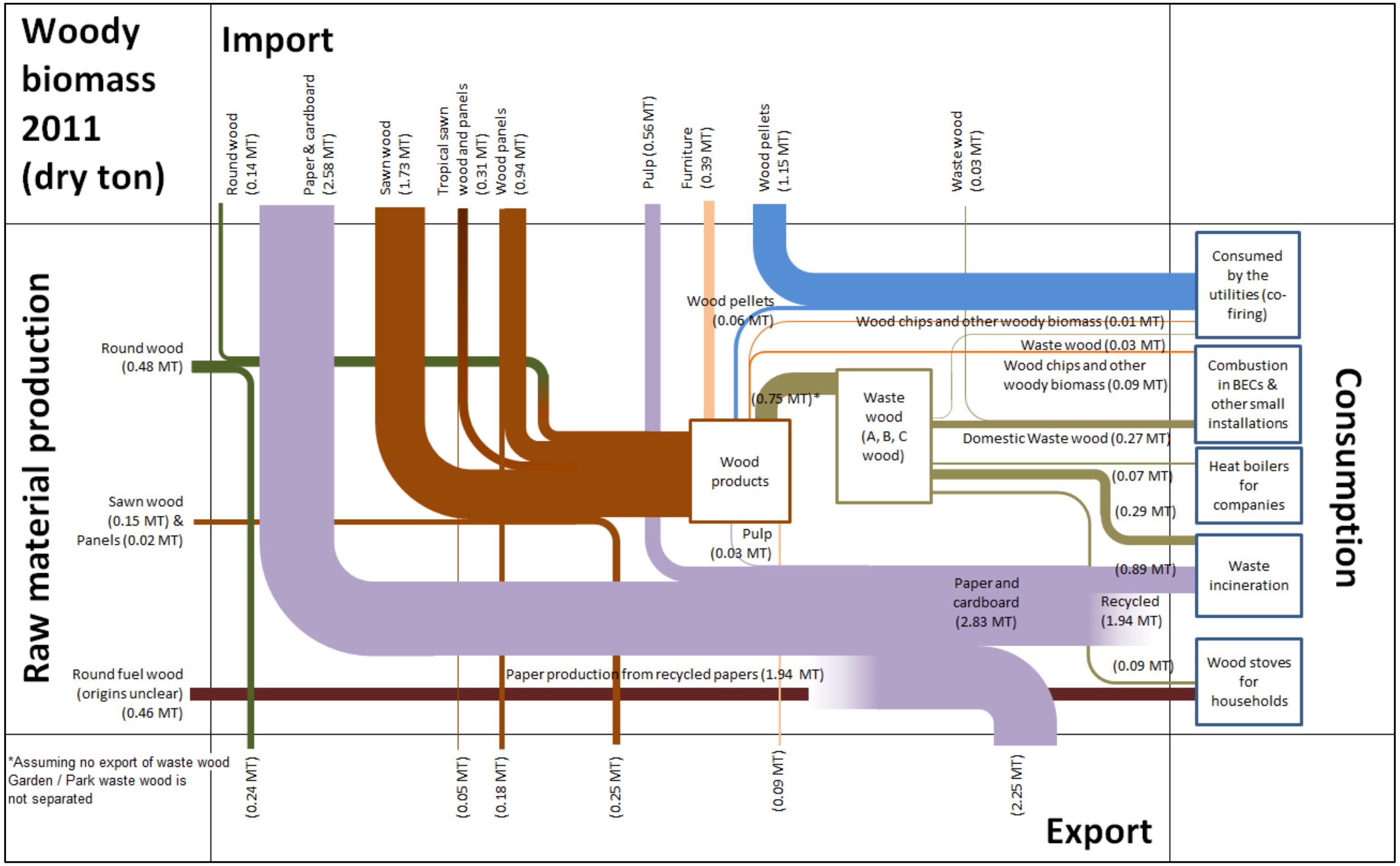


Figure 3-2 Mass balance for woody biomass flows in the Netherlands in 2011 (dry content)

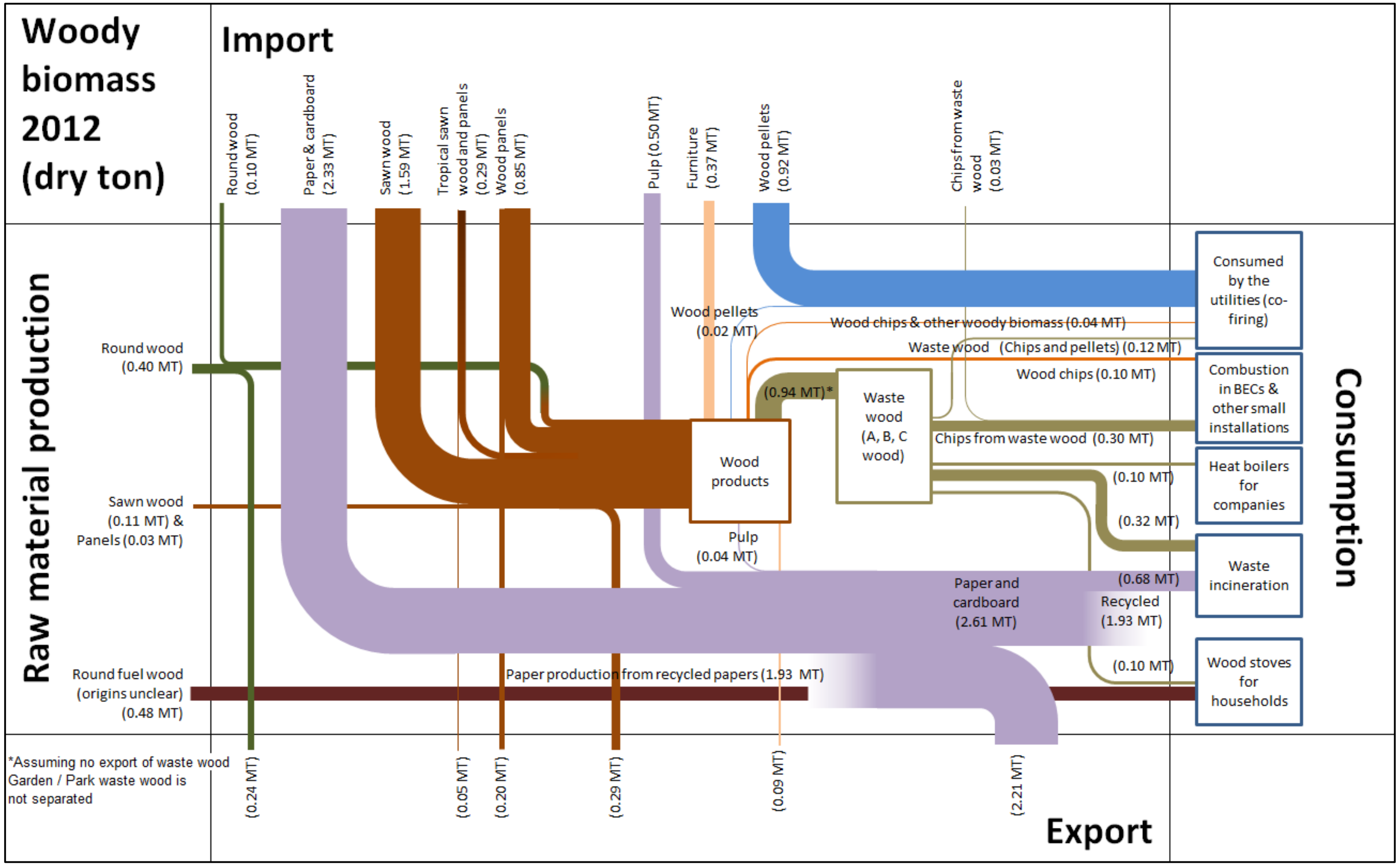


Figure 3-3 Mass balance for woody biomass flows in the Netherlands in 2012 (dry content)

3.2 Sustainability of woody biomass

Table 3-2 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 market share of certified wood products (sawn wood and panels) for non-energy use has increased from 33.5% in 2008 to 65.7% in 2011 (23.7% FSC certified and 42% PEFC certified) (Oldenburger et al., 2013). In 2011, sawn softwood recorded the highest certified percentage: 86% of the market volume (46% in 2008), as most of this sawn softwood came from countries where 60 - 97% of the forest area was certified. About 57% of the certified sawn timber and 73% of the certified wood based panels was consumed by the construction sector and civil engineering. On the other hand, the share of certified paper and paperboard in the Dutch market has increased to 32.8% in 2011. Most of the paper and cardboard consumed in the Netherlands was separated for recycling purposes. However, there was still a large portion of woody biomass and paper and cardboard could not be separated and end up in waste incineration.

Energy use: The recent focus in this category is the energy use of woody biomass by utilities, particularly wood pellets. Figure 3-4 shows the origins and the share of sustainable certified biomass used by utilities. Data of certified wood pellets were collected directly from the industry for 2011 (by UU) and 2012 (by AgNL). Most of the certified wood pellets came from Canada, U.S., Baltic States, Russia and Southern Europe. In 2011, Essent has consumed 0.62 MT GGL certified wood pellets alone in the Amer power plant (Essent, 2012). The amount of certified pellets has dropped significantly in 2012, in line with the overall decline in pellets consumption by the utilities, especially for the case of Canadian pellets.

Table 3-2 Market share of sustainability certification schemes for woody biomass in the Netherlands in 2011

Type of biomass	Sustainability schemes	Market share (% of certified biomass per particular products group in the market)
Woody biomass: Sawn timber and wood based panels (Oldenburger et al., 2013)	*FSC* *PEFC*	23.7% 42.0%
Woody biomass: Paper and cardboard (Olderburger et al., 2013)	*FSC* *PEFC*	23.9% 8.9%
Woody biomass: Wood pellets used by utilities (Self collection; Agentschap NL, 2013)	*Green Gold Label* *Laborelec Label*	51.8% (50.1% in 2012) 33.5% (27.2% in 2012)

A few industrial sustainability schemes are currently available for solid biomass, particularly for wood pellets, but many of them serve primarily for companies which developed them, such as Green Gold Label and Laborelec Label. New systems such as NTA 8080 and ISCC PLUS were not yet being widely applied. The EC is currently in the process of finalizing a set of sustainability criteria for solid biofuels at the EU level, and it is likely that it will be comparable to the existing EU-RED criteria for biofuels and liquid biomass. Meanwhile, the industrial pellet buyers (mainly utilities) are also working together to develop a harmonized sustainability system for wood pellets, namely IWPB. It is expected that the harmonized system will comply with the upcoming criteria by the EC.

Figure 3-5 shows the share of sustainable certified woody biomass in the Dutch market. “Use of waste and recycled streams” include all waste wood, waste incinerations and recycled paper and cardboard. “Origins unclear” indicates round fuel wood used in household wood stoves. “Certified-” and “non-certified woody biomass entering the Dutch market” include all woody biomass excluding the aforementioned two categories. A significant change across 2010-2012 would be the increase of certified woody biomass for energy purpose.

3.3 Energy use of woody biomass

As shown in Figure 3-4, the utilities has decreased significantly their consumption of wood pellets in 2012, amounted to 1.05 MT (0.95 dry MT) compared with 1.59 MT (1.44 dry MT) in 2010 and 1.35 MT (1.22 dry MT) in 2011. This is probably caused by the end of most of the MEP grants in the period 2012-2014. Nevertheless, wood pellet is still the largest group of solid biofuels consumed by the utilities in the Netherlands. Canada was the largest supplier in 2010, but was overtaken by US in 2011, and the gap become even larger in 2012. The import from Southern Europe has doubled in 2011 compared to 2010, but dropped again in 2012.

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 are sourced domestically.

During the last few years, wood-burning stoves in private households are used more and more as a sustainable heat source (see Figure 3-1,2,3). Expectations are that wood consumption in private wood-burning stoves will remain stable in the coming years. 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).

In the Netherlands, relatively large amount of total woody biomass, paper and cardboard ended up in waste incineration (see Figure 3-1,2,3). About half of the biomass (by mass basis) incinerated are non-woody organic compounds, followed by paper and cardboard, woody and other biomass. However, data presented is rough estimation and these biomass may still contain significant amount of non-biomass portion which is difficult to differentiate. New waste incineration plants were commissioned in Delfzijl in 2010 and in Harlingen in 2011, which are connected to industry use. Installations in Hengelo, Dordrecht and Roosendaal were also expanded in 2010 and 2011. At present, there is still unused incinerator capacity, which induced import of household waste from Germany, the United Kingdom and Italy (CBS, 2012b).

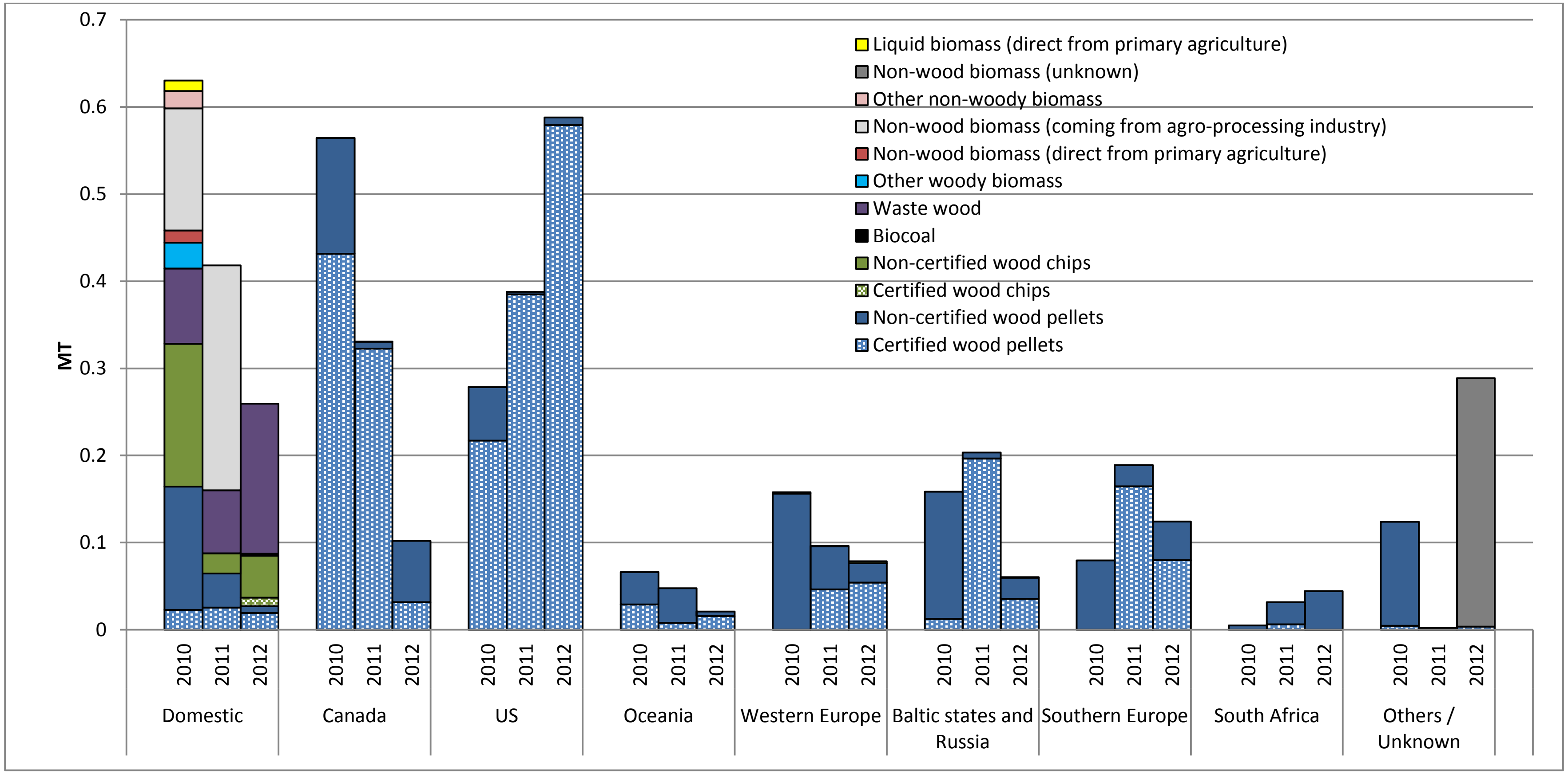


Figure 3-4 Biomass co-fired by the Dutch utilities in 2010 -2012 (Source: Surveys with the utilities; Essent, 2011; Agentschap NL, 2013; CBS, 2013)

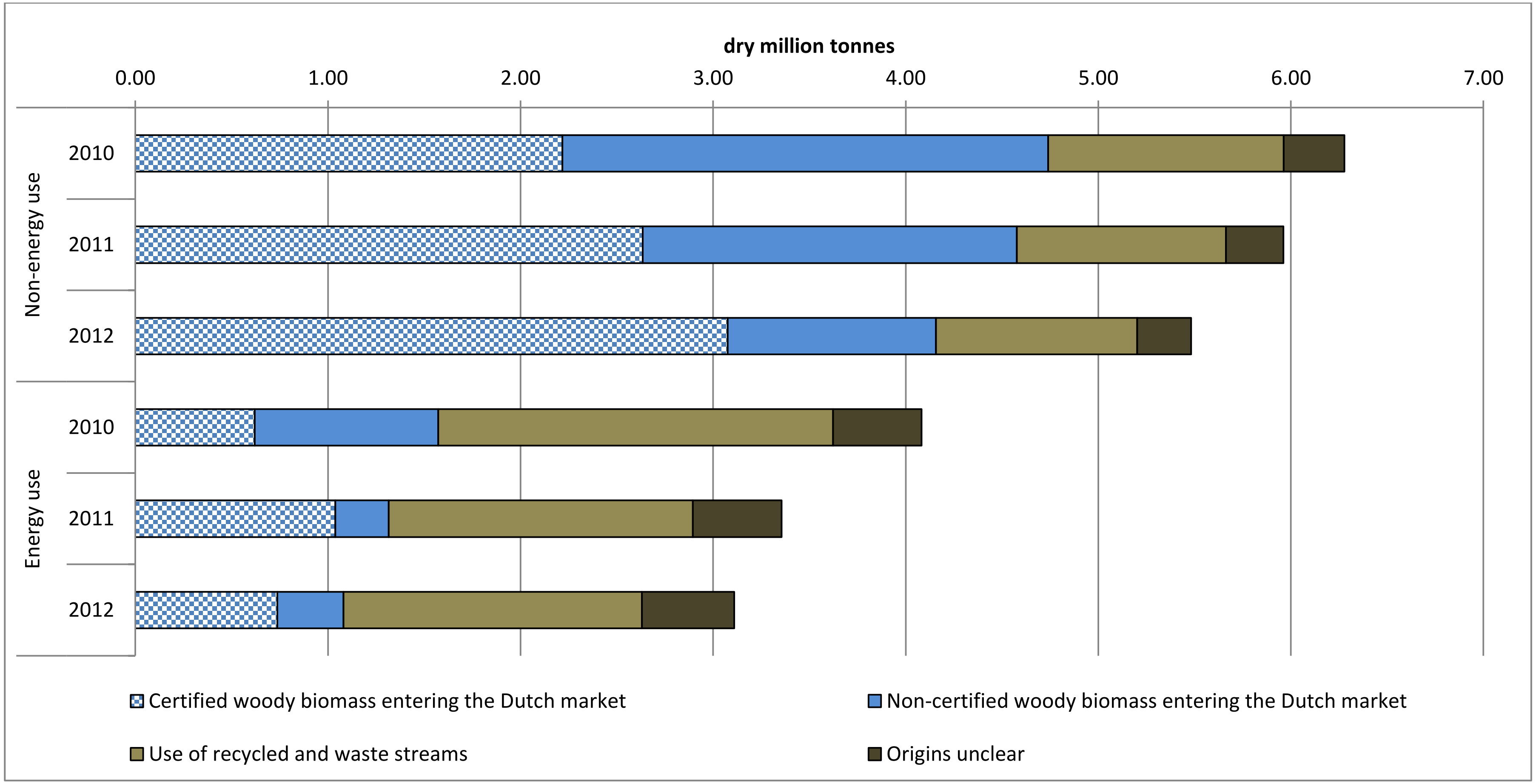


Figure 3-5 Use of certified and non-certified woody biomass in the Netherlands.

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.

Figure 4-1, 4-2 and 4-3 show the mass balance for oils and fats flows in the Netherlands in 2010-2012. Different from woody biomass, the top and bottom axis indicate net import and net export instead of actual volume, to avoid the diagram become overcrowded with the large volume of vegetable oils transshipment. As shown in the figures, soy bean has the largest mass flow in this group. Strictly speaking, soy is not primarily an oil crop but used mainly as a protein source. Therefore, a relatively small portion of oil is produced while most of the mass remained as meal after processing, mainly used as animal feeds. Palm oil (including palm kernel oil) has been the largest oil source followed by rapeseed oil, soy oil and sunflower oil. Figure 4-4 summarizes the consumption trends of oils and fats for different purposes. The total consumption shows a steady increase until 2011, and an extraordinary surge in 2012. From 2011 to 2012, the Dutch (net) import has shown a remarkable increase from 0.72 MT to 1.63 MT, owing to the substantial growth of palm-based biofuel production (see Figure 4-6). In 2012, about 0.78 MT of palm oil was processed for energy purpose (mainly to HVO), which is almost 10 times of the processed volume in 2011 (MVO, 2013; Bergmans, 2013). The volume of crude palm oil converted to HVO by Neste Oil increased significantly in 2012 (globally from about 0.4 MT in 2011 to 1.4 MT) as a result of the company’s increased refining capacity to a total of 2.1 MT, of which the Rotterdam plant accounted for 0.8 MT (Neste Oil, 2013). However, as NEa (2013) reported that there is only marginal consumption of palm-based HVO in the country in 2012, most of these palm-based HVO is assumed to be exported. On the other hand, there is also a substantial increase in animal fats import for energy purpose since 2011 (see Section 4.3 for more details on biofuels consumption in the Netherlands). The trends are relatively stable for human consumption, animal consumption and technical purpose.

Figure 4-5 presents the trade flow of monoalkylesters, oil seeds and oils & fats by country or region. In 2012, the import bounced back to the same level as in 2009. 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). 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). Trade of biodiesel is further discussed in Section 4.3. On the other hand, no significant changes for net import of oil seeds, except for the trade with the EU. The EU has been a net importer of oil seeds from the Netherlands except for the year 2011. The net export of oil seeds to the EU has increased impressively in 2012 to about 1 MT. For oils and fats, as mentioned earlier, a massive increase in palm oil import is observed, and they are mostly from Indonesia and Malaysia.

Table 4-1 shows the data sources for this chapter by types of sources. See Section 2.3 for the description of data sources (i) – (v).

Table 4-1 Data sources for "Oils and fats"

Data sources	i	ii	iii	iv	v
Data for most of the oils and fats mass flows was taken from MVO (2013) unless otherwise stated. This includes production data of the companies which are connected to MVO.		x			
The EU standard moisture content is 14% for soya beans (EUROSTAT, 2013). Nevertheless, according to a report by U.S. Soybean Export Council (Guinn, 2013), dependent upon end use and ambient storage condition, there is a range of recommended moisture contents considered safe for storage (11- 13%). The EU standard moisture content will be 9% for rapeseeds, sunflower seeds, linseeds and cottonseeds (EUROSTAT, 2013). For soy meals, moisture content is assumed at 12% (Guinn, 2013).			x		
Data for monoalkylesters, oil seeds, oils and fats trade flows by countries was taken from CBS (2013) with CN code listed in Appendix II. These data are collected by close cooperation between MVO and CBS. Monoalkylesters was assumed to be equivalent to biodiesel. However, CN 271020 is not included because the content of biodiesel is low (<30%) and unknown. Trade flows of meals of soybean and other oilseeds are taken from CBS according to Table A1.		x	x		x
Data for production of biodiesel (oils and fats used for energy purpose) was collected from MVO (2013) and CBS (2013). MVO data was selected due to the level of details (types of feedstock) and also data consistency across the mass flows of whole category. MVO reported 0.29, 0.55 and 1.27 MT of oils and fats consumption for biodiesel production, while CBS (2013b) reported 0.38, 0.49, and 1.18 MT of biodiesel production volume, respectively for the three consecutive years.		x	x		
Data for consumption of biodiesel was taken from NEa (2011, 2012), by assuming the heating value of FAME at 37 MJ/kg and HVO at 44 MJ/kg. There were discrepancies between CBS (2013) and NEa data for biodiesel: CBS reported physical consumption, whereas NEa published administrative data. Physical data was different from administrative data, because (i) companies were allowed to administratively carry over their physical efforts to later years; (ii) it was still unclear whether book and claim is used for the NEa reports after creating low blends - this implies that companies may create a low blend, administratively allocate this low blend to the Dutch market, whereas physically (part of) this low blend is exported. As a comparison, for the three consecutive years, CBS (2013b) reported consumption of 0.11, 0.20 and 0.23 MT, respectively, whereas NEa reported 0.10, 0.29 and 0.26 MT, respectively.		x			
The flows of biodiesel do not tally by combining trade data of monoalkylesters and biodiesel from CBS, production and consumption from MVO and NEa. A net difference of 1.28 MT (export) was obtained through simple mass balance calculation. This flow was categorized as "Other biofuels					x

export", which may include different blends and also hydro-treated vegetable oils (HVO). Data for the trade of HVO is not known, therefore it is calculated based on mass balance. The CN number (customs tariff number) of NExBTL renewable diesel is 27101941. It has been granted in summer 2009 and is valid for the next 6 years. Diesel fuel has the same CN code 27101941 (Taric code 2710194120). It is not possible to measure the amount of bio-content through trade statistics with 8-digits trade code.					
Data for glycerol was taken from CBS (2013) with CN code CN 15200000, 38249055, and 29054500. Also assuming 1 kg of glycerol is produced as by-products of 10 kg of biodiesel production (own estimation).			x		x
Data for sustainable vegetable oils for food sector was taken from Taskforce Duurzame Palmolie (2013) and RTRS for soy bean (RTRS, 2011; IDH, 2013). An assumption was made that all vegetable oils used for biodiesel production in the Netherlands are 100% sustainable certified (to comply with the RED criteria set by the EC). Data for certified vegetable oils used for biodiesel production in 2010 is not available. Since there was no mandatory requirement, it is assumed all vegetable oils used for energy purpose was not certified in 2010.		x			x
Trade statistics of monoalkylesters, oil seeds and oils and fats trade flows (net by regions) for the Netherlands from 2008 – 2011 was collected from CBS (2013)			x		

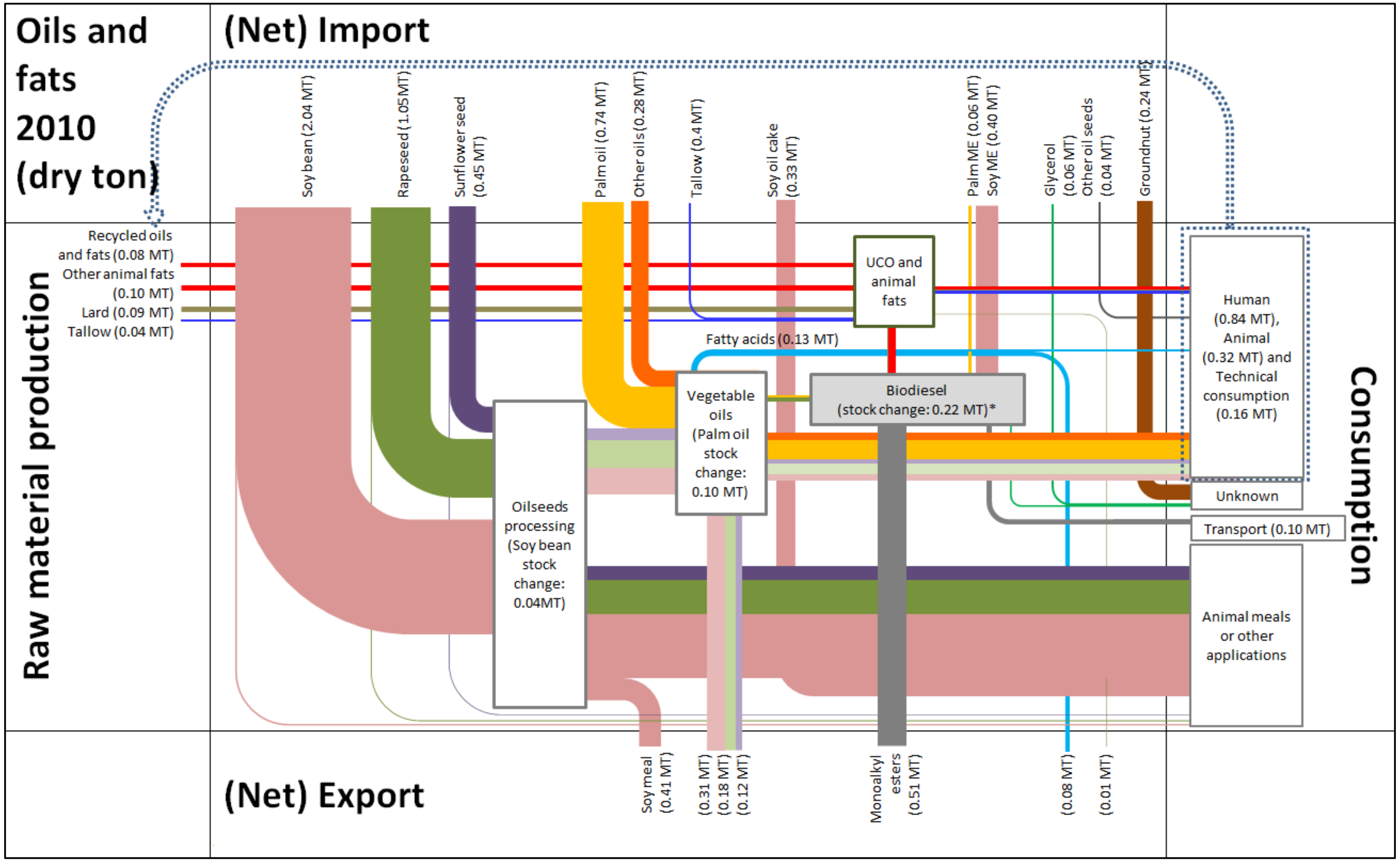


Figure 4-1 Mass balance for oils and fats flows in the Netherlands in 2010 (dry content)

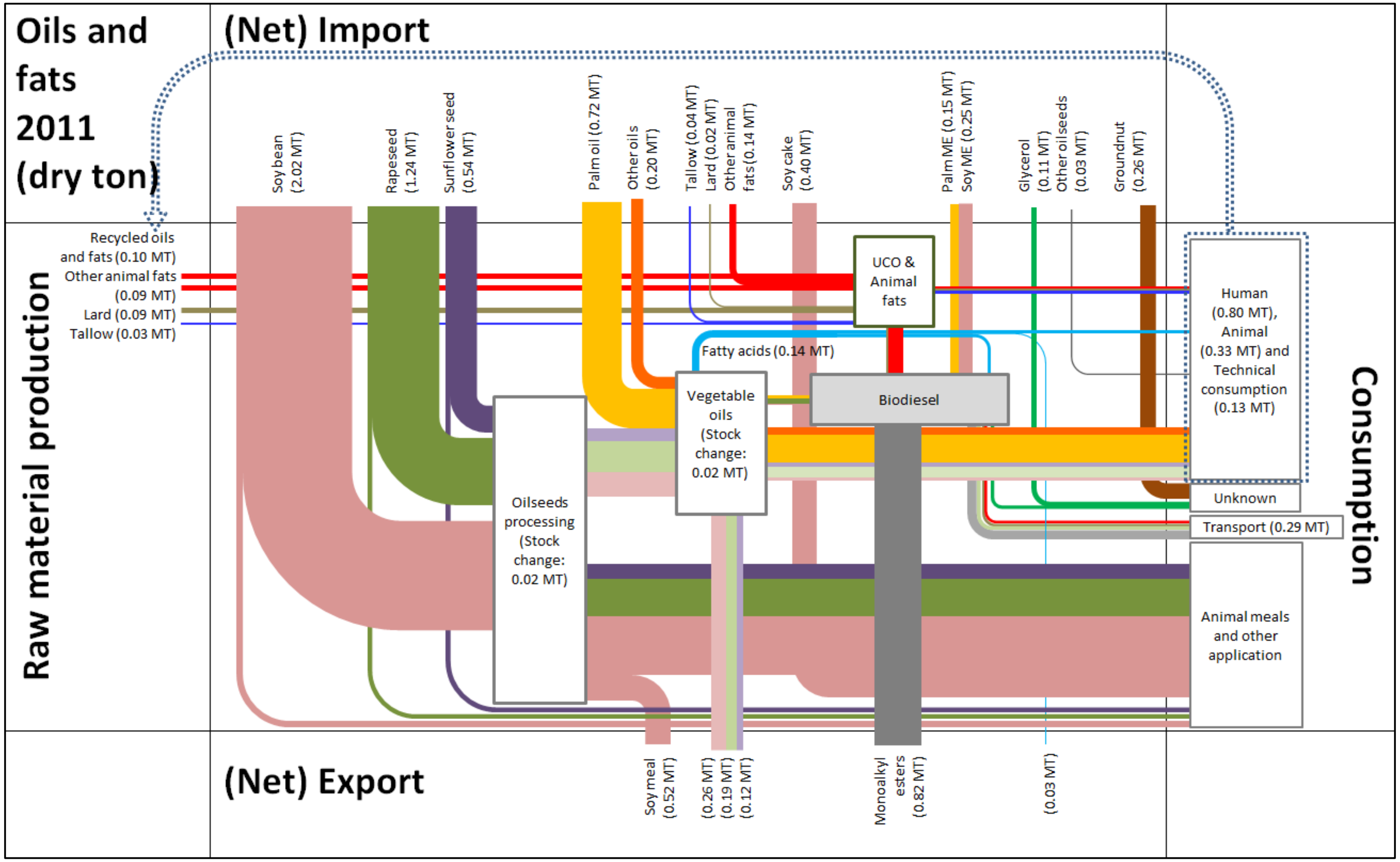


Figure 4-2 Mass balance for oils and fats flows in the Netherlands in 2011 (dry content)

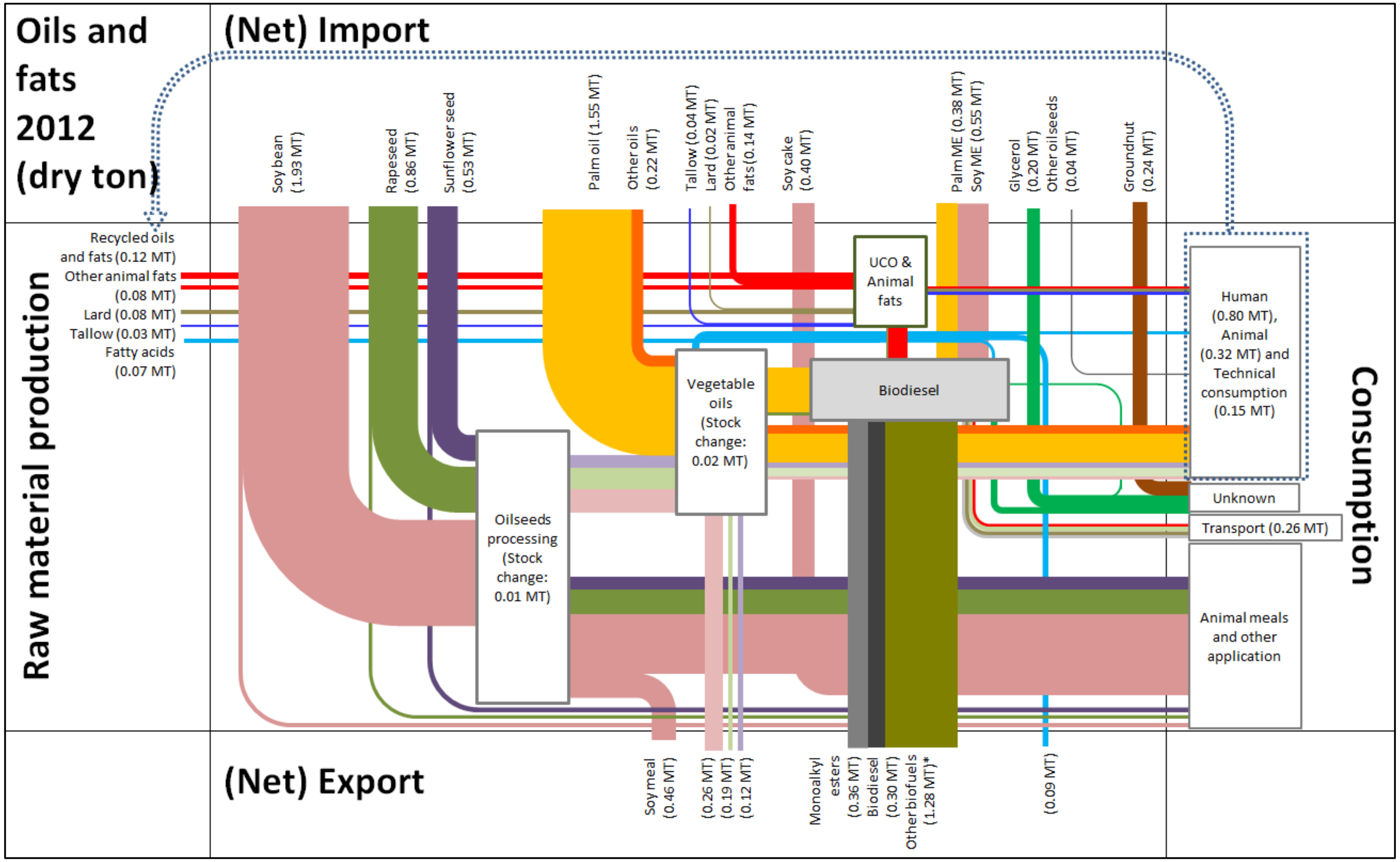


Figure 4-3 Mass balance for oils and fats flows in the Netherlands in 2012 (dry content)

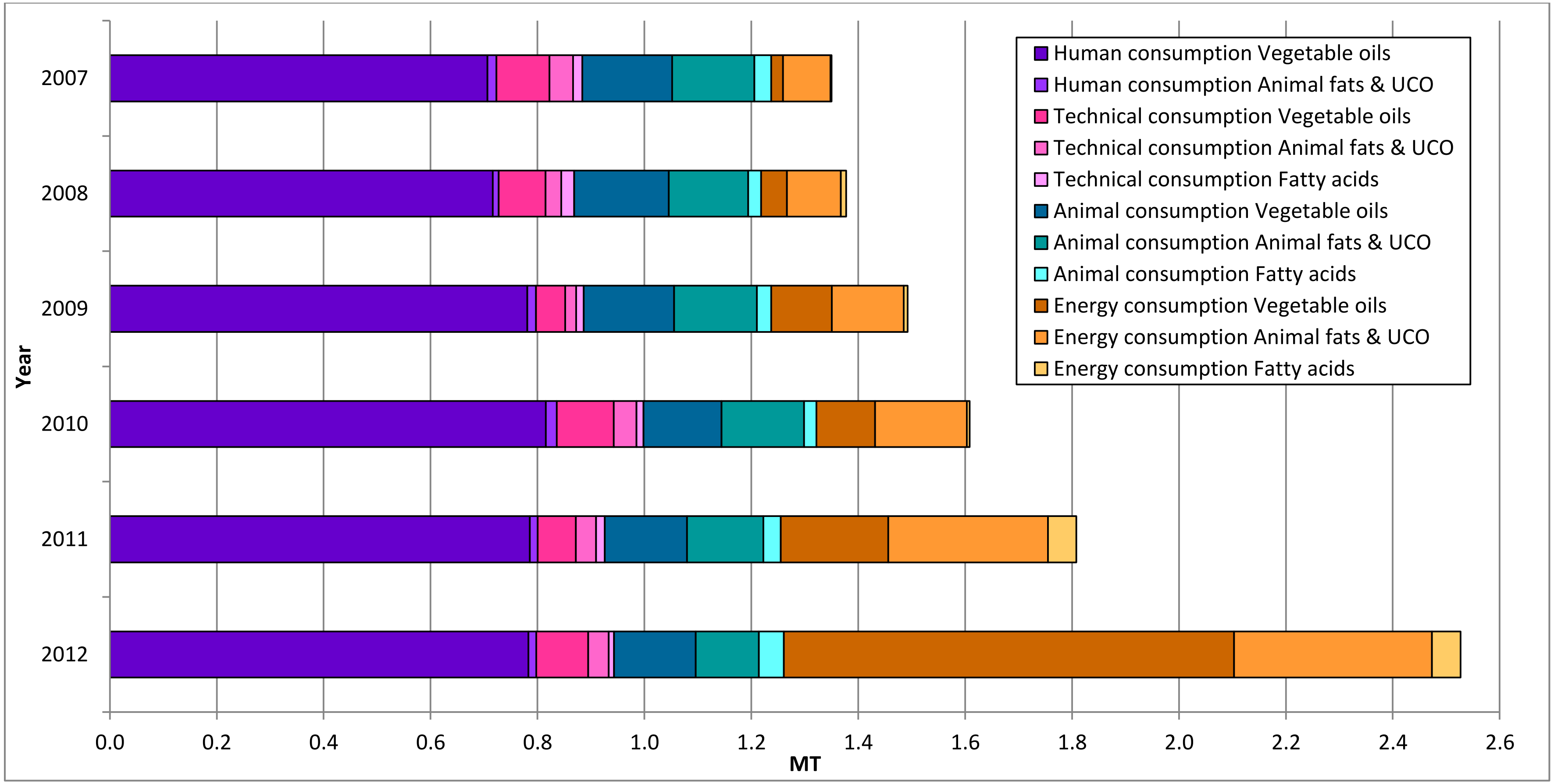


Figure 4-4 Consumptions of oils and fats for different purposes (Source: MVO, 2013)

Note 1: Animal fats include UCO

Note 2: Energy consumption includes biodiesel produced for both domestic use and export

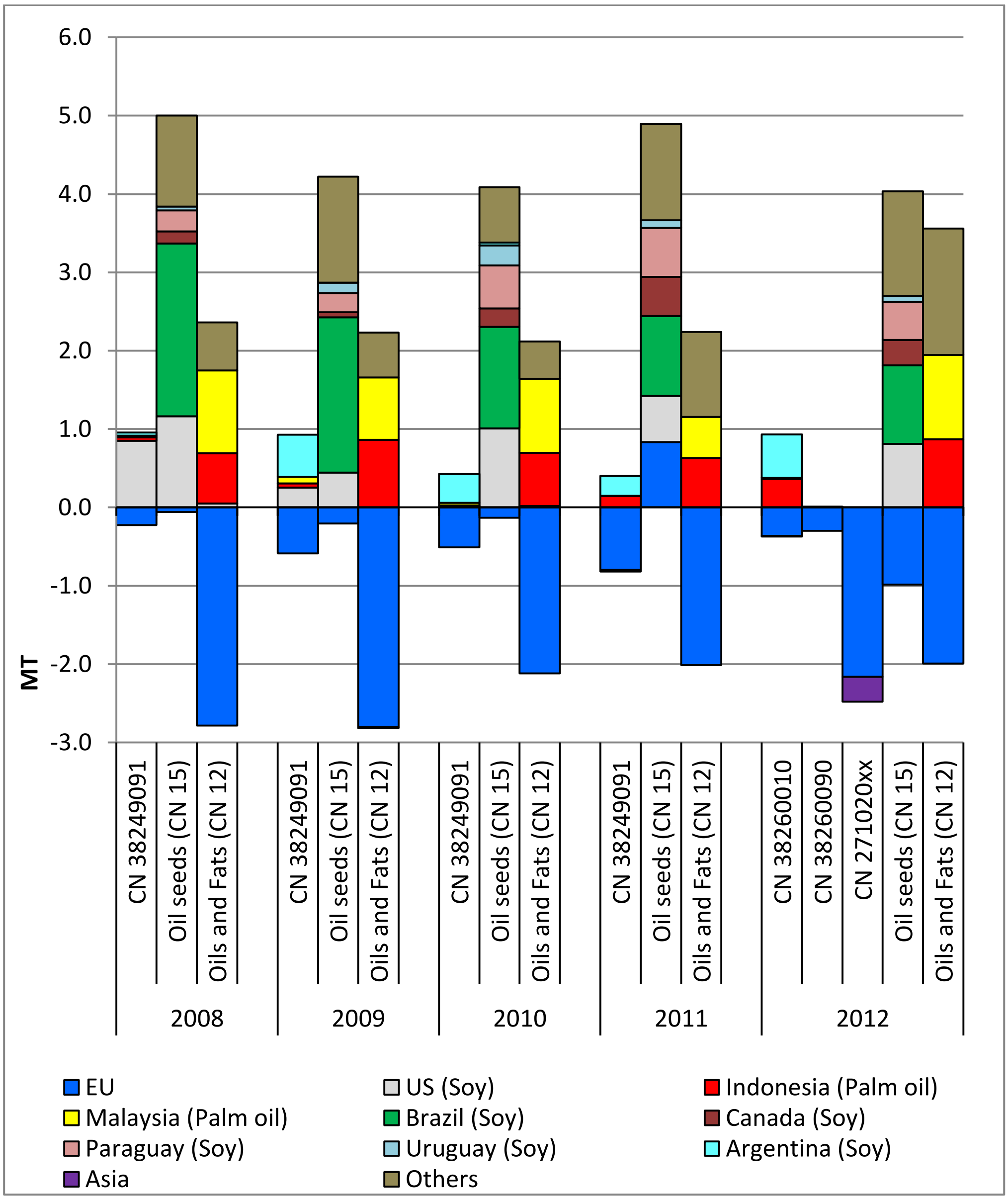


Figure 4-5 Monoalkylesters, oil seeds and oils & fats trade flows (net by regions) for the Netherlands from 2008 – 2011 (MT) (Source: CBS, 2012a)

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

4.2 Sustainability of vegetable oils

Figure 4-6 shows the share of certified vegetable oils in the Netherlands in 2011. Figure 4-7 shows the use of certified and non-certified vegetable oils, UCO and animal fats, and fatty acids in the Netherlands. 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. It should be noted that this figure takes the assumption that all vegetable oils used for biofuel production in the Netherlands are 100% sustainable certified. Data for certified vegetable oils used for biodiesel production in 2010 is not available. Since there was no mandatory requirement, it is assumed all vegetable oils used for energy purpose in 2010 were not 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).

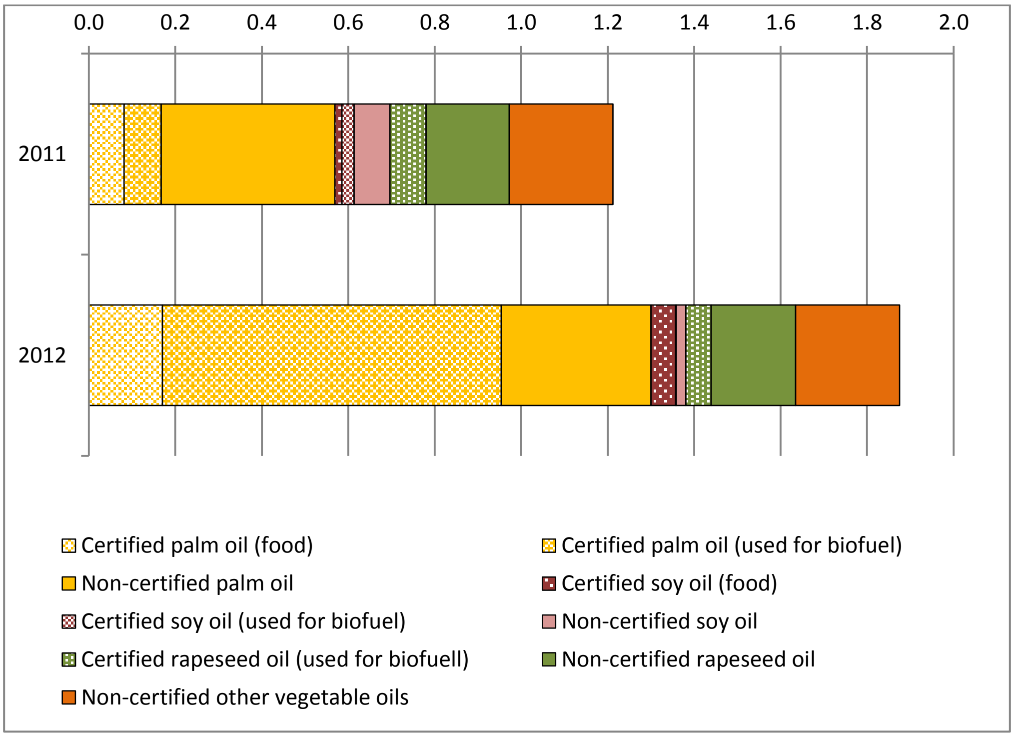


Figure 4-6 Share of certified vegetable oils processed in the Netherlands in 2011 and 2012

Table 4-2 shows the market share of sustainability of various oils and fats products. The amount of palm oil used for energy production has increased substantially in 2012. Assuming all of these are certified, the share of certified vegetable oils becomes more than half in 2012. For biodiesel consumption in the country, ISCC certified biodiesels remain as the largest group. The share of 2BSvs and NTA 8080 also shows significant growths.

Table 4-2 Market share of sustainability certification schemes for oils and fats in the Netherlands in 2011 and 2012

Type of biomass	Sustainability schemes	Market share (% of certified biomass per particular products group in the market)	
		2011	2012
Oils and fats: Total vegetable oils (Taskforce Duurzame Palmolie, 2013; RTRS, 2011)*	*RSPO (Palm oil)*	6.7%	9.1%
	Biofuels (Palm oil)	7.1%	41.8%
	RTRS (Soy oil)	1.4%	3.1%
	Biofuels (Soy oil)	2.3%	0.0%
	Biofuels (Rapeseed)	6.9%	3.1%
Biodiesel (on weight basis) (NEa, 2011; 2012; 2013)	*ISCC*	48.4%	55.0%
	2BSvs	4.9%	15.0%
	RTRS	1.8%	0.0%
	NTA 8080	0.0%	10.5%
	Biograce	0.0%	2.8%
	Others	9.6%	16.7%

* Including vegetable oils used for biofuels production, assuming all of these vegetable oils are certified with biofuels schemes, but it is not known which schemes are used.

Palm oil

Palm oil is an important ingredient in food industry and a potential raw material for biofuel. For food industry, food producers, processors and other market actors in the Netherlands has set a target to completely switch to RSPO certified palm oil in 2015. The Dutch Task Force Sustainable Palm Oil is committed to promoting the cultivation and the use of sustainably produced palm oil. This task force consists of various market actors representing the Netherlands-based links in the palm oil chain, i.e. the palm oil refiners, processors, and retailers along the chain. RSPO certified palm oil has increased from 4.8 MT in 2011 to 6.7 MT in 2012. Total consumption of palm oil in the EU is about 5.7 MT, of which 43% is from Indonesia and 35% is from Malaysia (UN Comtrade, 2013). 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 21% (about 0.08 MT) to 41% (about 0.17 MT) of total palm oil consumed for food purpose. Up to 2012, 99 Dutch companies have joined the RSPO, 70 companies have joined "Palm Green Supply Chain" and 38 companies have become "supply chain certified". The dairy and milk substitute is leading with 76% of their total palm oil consumption certified. Friesland Campina and Unilever are among the forerunners in switching to sustainable certified palm oil. Albert Heijn and Verkade have announced that they will only use sustainable palm oil in their products; and many other food companies have also committed themselves to start buying sustainable palm oil. 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 MT from 2010 to 2012. 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 2012, approaching 9.8% of total Dutch soy imports or equaling to 294 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.

Rapeseed

Started in 2008, Cargill and Unilever worked in partnership to verify German oilseed rape production against the Unilever sustainable agriculture code which aims to improve their practices beyond those required by mandated European good agricultural practice. Cargill has supplied the first-ever sustainable verified rapeseed oil to Unilever with an initial consignment covering five percent of Unilever's rapeseed oil needs (Cargill, 2012). However, it is unclear how much of this has entered the Dutch market. Other than that, there is currently no specific certification for rapeseed, but mainly ISCC is used for the purpose of biofuel production.

Biodiesel

Figure 4-8 shows the application of sustainability schemes on biodiesel consumed in the Netherlands. ISCC is the most popular scheme with its dominance in most categories, but the application of NTA 8080 and 2BSvs is also growing remarkably. A large portion of the biofuels falls under double counting. There is a significant increase in the certification of double-counted FAME in 2012 compared to 2011, mainly certified with ISCC.

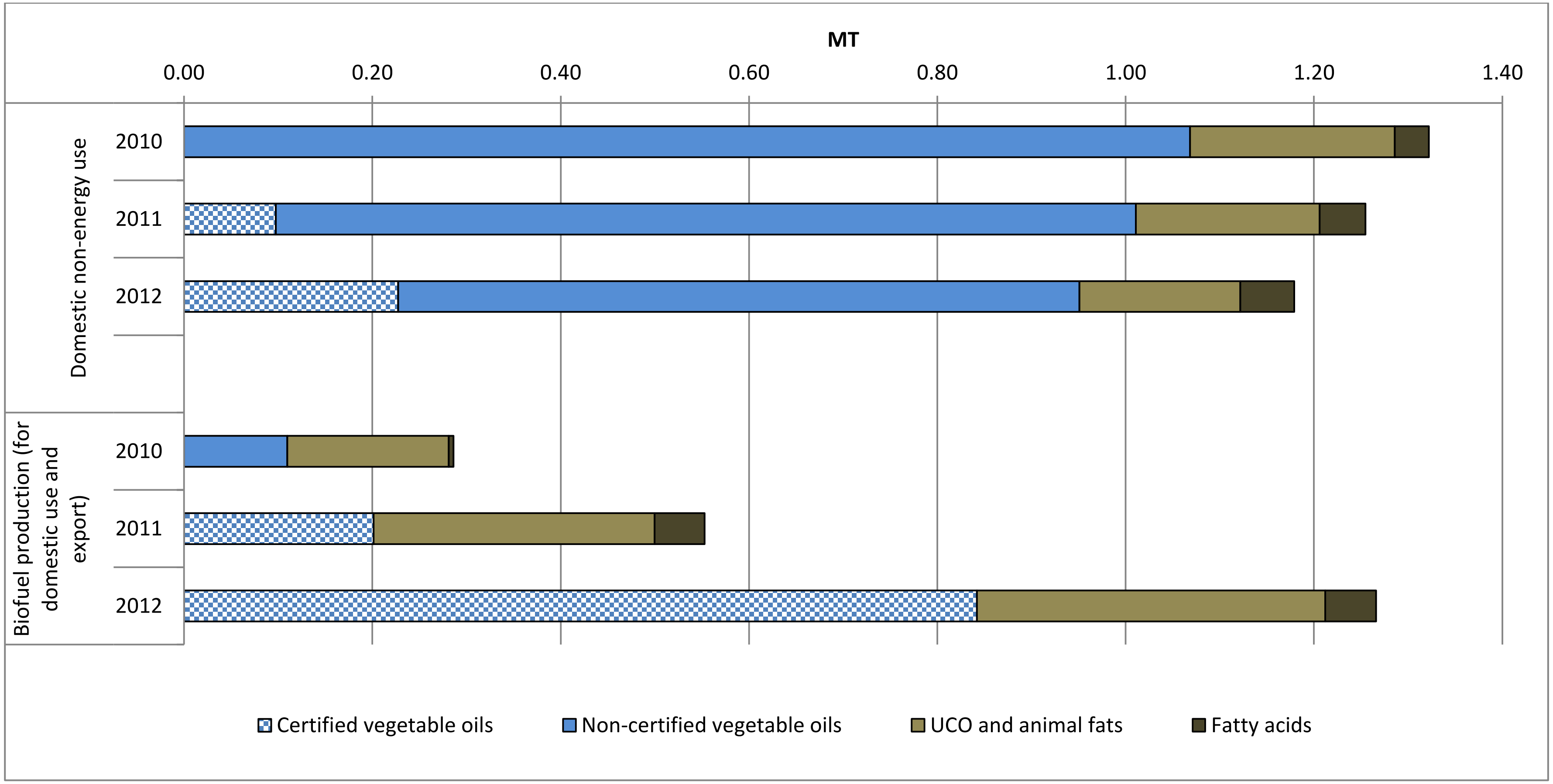


Figure 4-7 Use of certified and non-certified vegetable oils, UCO and animal fats, and fatty acids in the Netherlands

* Assuming all biofuels produced since 2011 were certified

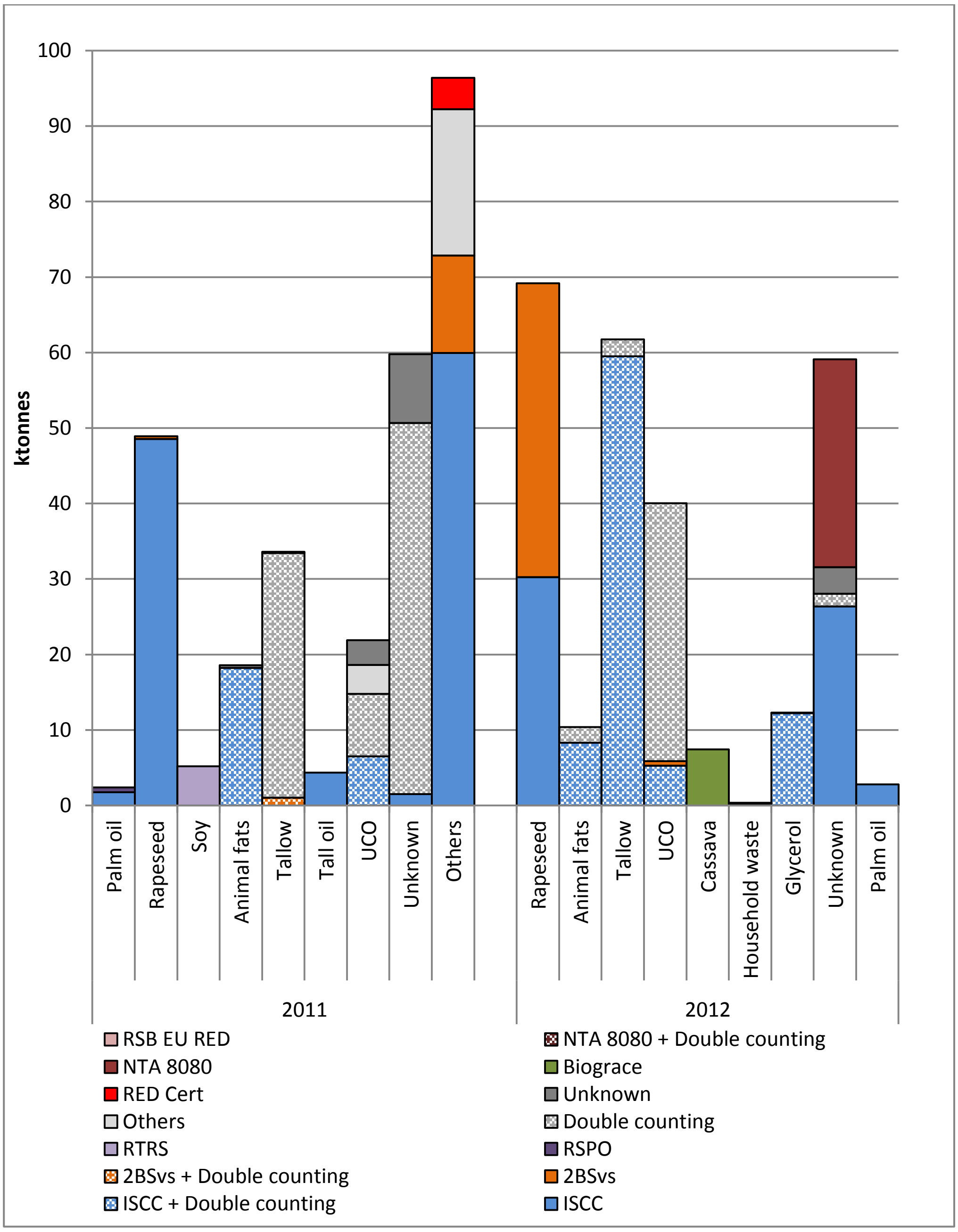


Figure 4-8 Biodiesel consumed in the Netherlands in 2011-2012 by schemes (Source: NEa 2012, 2013)

4.3 Energy use of oils and fats

Figure 4-9 shows the quantity of biodiesels consumed in the Netherlands in 2010-2012. The total volume amounted to 0.1 MT, 0.29 MT and 0.26 MT respectively in the three consecutive years. Biofuels consumption in the Netherlands is monitored by NEa. The reporting by the industry has shown improvement after the first year of implementation, with more details reported.

The nominal share of biodiesel in total Dutch diesel consumption is 4.86% in 2012, 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 40% of the compliance with the annual requirement of renewable energy in transportation in 2012. 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 consumption come from double counting, particularly biodiesel made of domestic UCO and tallow from Germany. In 2012, the country also consumed significant amount of biodiesel made of UCO from Spain 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 relatively large amount of double counting biodiesel not only in the Netherlands but also in the European market has caused some suspicion. Concerns have recently been raised that the market has been distorted by lack of verification on wastes (compared to crop feedstock) and over incentivisation causes unintended consequences. It could be very difficult to trace the origins of the UCO (Tsay, 2012). This creates a loophole that may lead to the deliberate production of waste and the importing of poorly checked 'waste' from other countries. These flows of feedstock (which may include non-certified vegetable oils) are not traceable, as there are still no mechanisms to trace, verify or distinguish waste-derived biodiesel.

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 (CBS, 2013b). 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. It seems that the Netherlands has a large unused production capacity for biodiesel, but the capacity 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). 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. As NEa (2013) reported that there is no consumption of palm-based biodiesel in the country in 2012, these HVO is assumed to be exported.

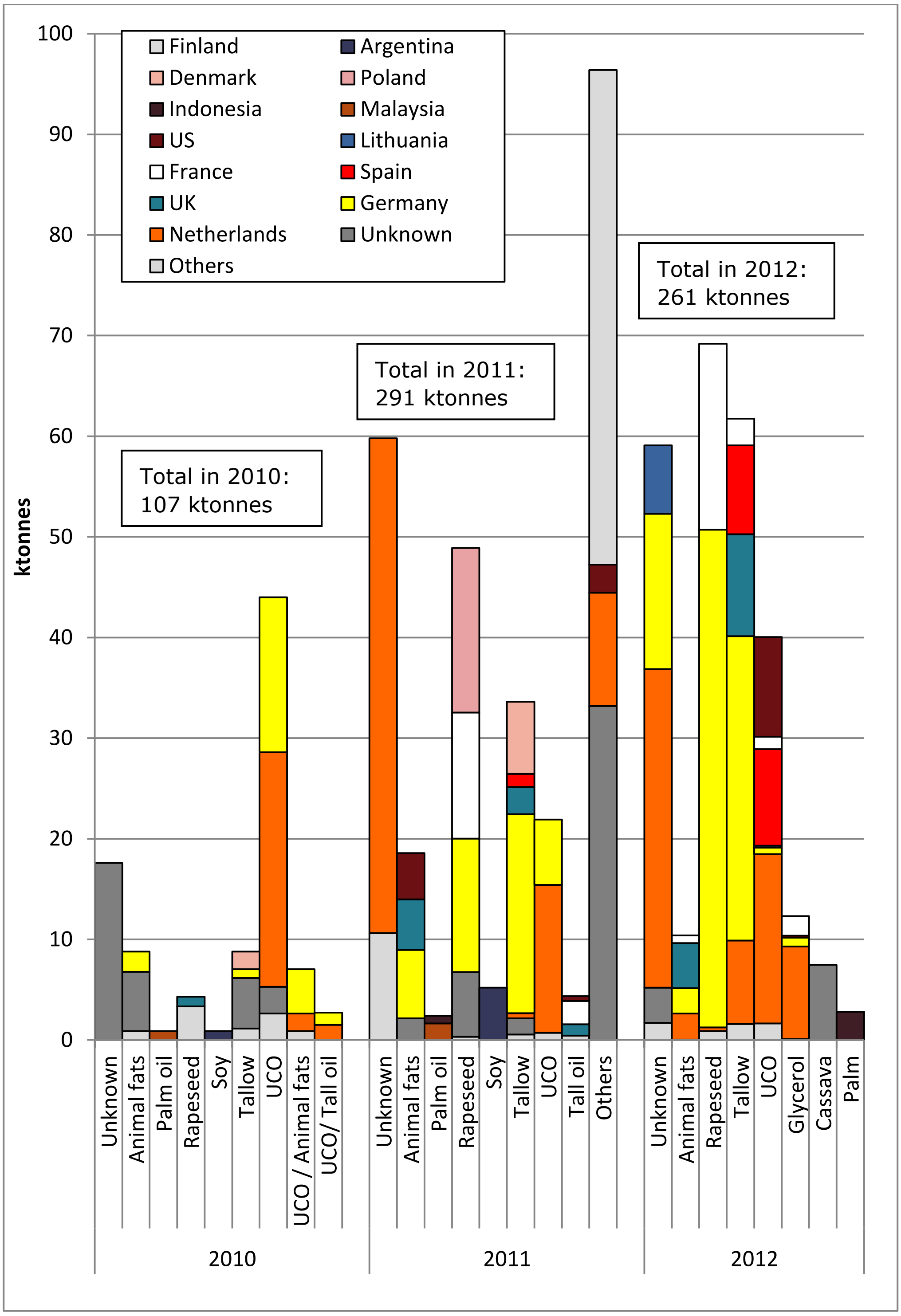


Figure 4-9 Biodiesel consumed in the Netherlands in 2010 and 2011 by feedstock and country (Source: NEa, 2011; 2012; 2013)
Note: Tiny streams are omitted. 'Others' implies the feedstock is known to NEa but reported at aggregated level.

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, 5-2 and 5-3 illustrate the quantified mass flows of carbohydrates in the Netherlands in 2010, 2011 and 2012. Basically the Netherlands was able to self-supply more than half of its total carbohydrates consumption. Other carbohydrates products and sugars (e.g. white sugars) have very little flows. 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 5-2 and 5-3 was only for indication because the actual feedstock and destination are unknown. CBS (2013b) has reported the production of biodiesel in the Netherlands, but the number for bioethanol is not known.

Figure 5-4 depicts the Dutch grains and starchy crops production from 2008 to 2012. 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). Figure 5-5 shows the net trade balances of grains and starch for the Netherlands across the period 2008 to 2012. The Netherlands is an exporter of potatoes. On the other hand, the country imports large quantity of wheat, maize and barley. Most imports come from Europe, but there are also imports of maize from South America. In 2008, the Netherlands imported 0.78 MT and 0.14 MT of maize from Brazil and Argentina, respectively. However, these imports drop dramatically in 2009 to less than 0.2 MT in total. In 2011, imports of maize from outside the EU took recovery and bounced back to about 1.1 MT, contributing to more than quarter of total maize import. In fact, the EU controls the entry of lower priced grains from third countries by means of a system of import duties and quotas (EC, 2013).

Table 5-1 shows the data sources for this chapter. See Section 2.3 for the description of data sources (i) – (v).

Table 5-1 Data sources for “Carbohydrates”

Data sources	i	ii	iii	iv	v
Data for all streams other than bioethanol and biogas was taken from CBS (2013) using CN code listed in Appendix.			x		
Data for biogas was taken from CBS (2011)		x			
Data for all crops produced domestically came with different moisture content (CBS, 2013). Their moisture content was harmonized to 16%.		x			
Moisture content of grains imported is assumed at 14% (US Grain Council, 2013; TIS, 2013; EUROSTAT, 2013), which is the maximum level allowed to be considered “dry for		x	x		

shipment”. Moisture content is usually specified in the contract by the buyer, independent of the grade. Moisture content is important because it affects the amount of dry matter being sold and purchased. In addition, the average moisture level and variability in a shipment of maize affect its quality arriving at destination.					
Data for consumption of bioethanol was taken from NEa (2011; 2012; 2013). Total consumption was found to be almost constant at 0.18-0.19 MT. As a comparison, CBS (2013b) reported 0.21, 0.23 and 0.19 MT for three consecutive years.		x			
Connection between bioethanol and grains was only a rough estimation. It is not publicly known that how much they produce, where they source the raw materials and where they sell the bioethanol to. NEa reported that 0.19 MT of bio-ethanol was consumed in 2012 and almost all of them was made from materials from foreign countries, but it was unclear where was these bioethanol produced. As a comparison, Flach (2013) reported that the total ethanol production in Benelux is estimated at 0.68 MT in 2011, and forecasted at 0.87 MT in 2012.					x
Connection between secondary products (sugars, flour, glucose) and raw material was unable to establish due to data limitation.					x
Trade statistics of ethanol for 2008 – 2011 were collected from CBS (2013).			x		

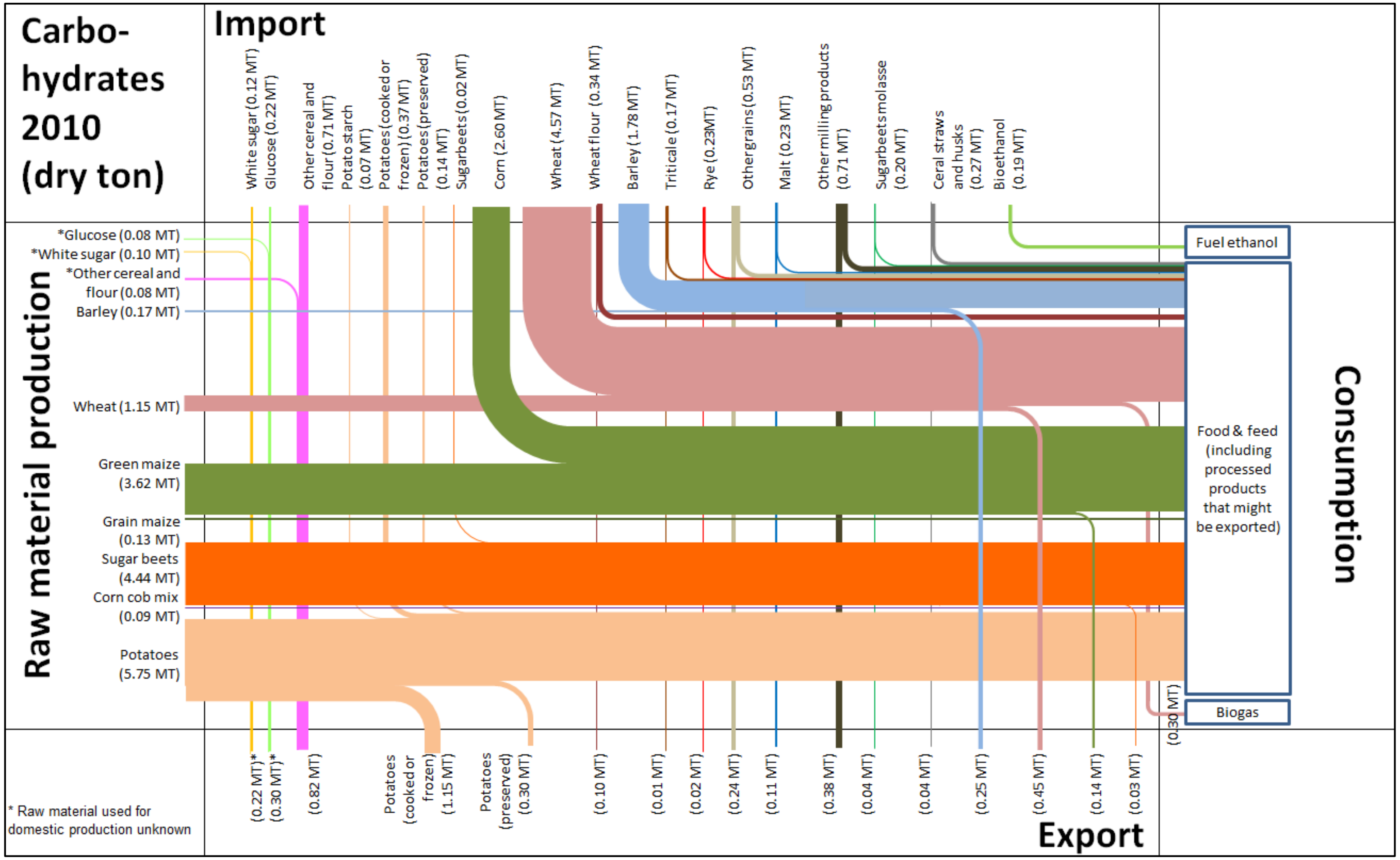


Figure 5-1 Mass balance for carbohydrates flows in the Netherlands in 2010 (dry content)

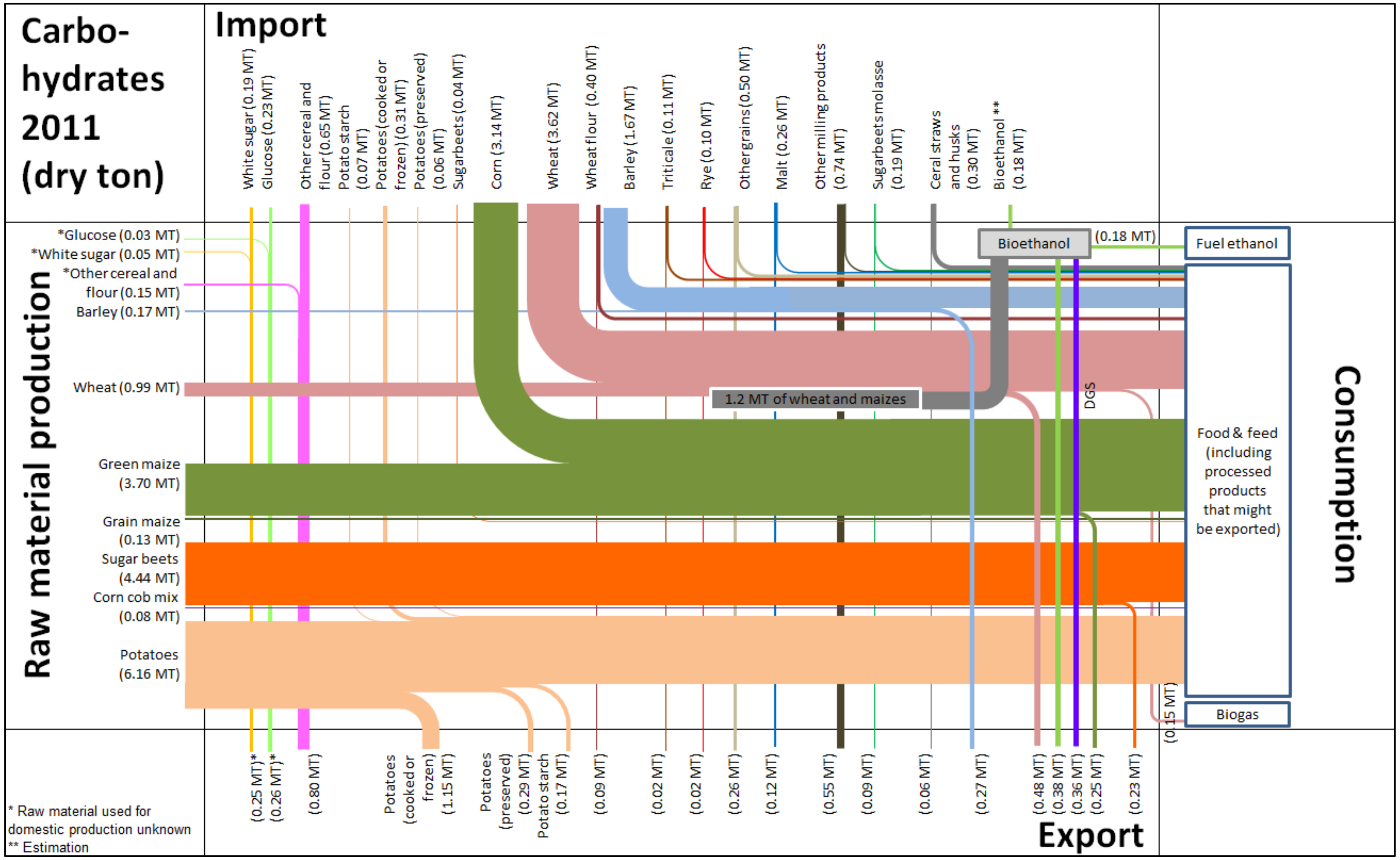


Figure 5-2 Mass balance for carbohydrates flows in the Netherlands in 2011 (dry content)

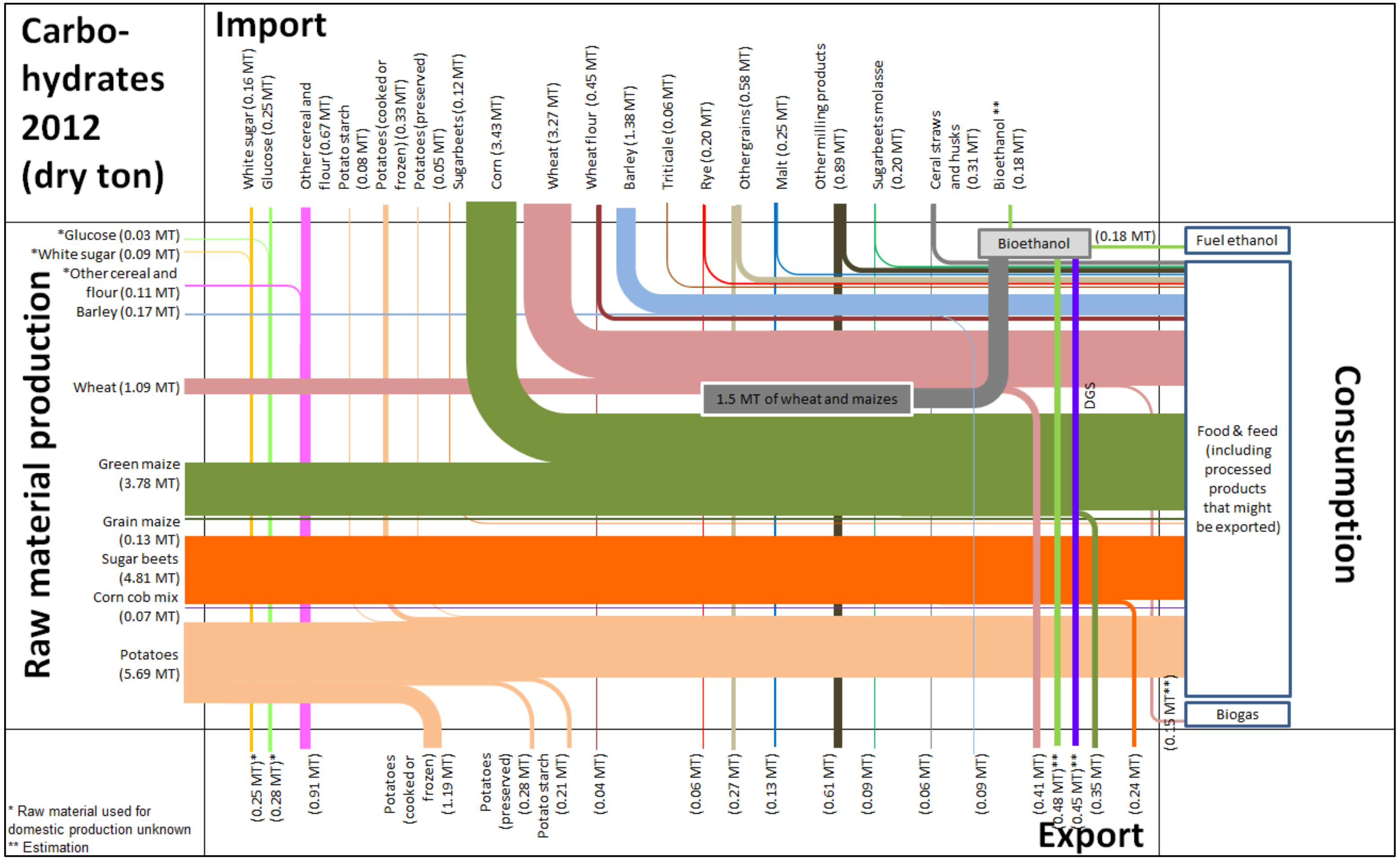


Figure 5-3 Mass balance for carbohydrates flows in the Netherlands in 2012 (dry content)

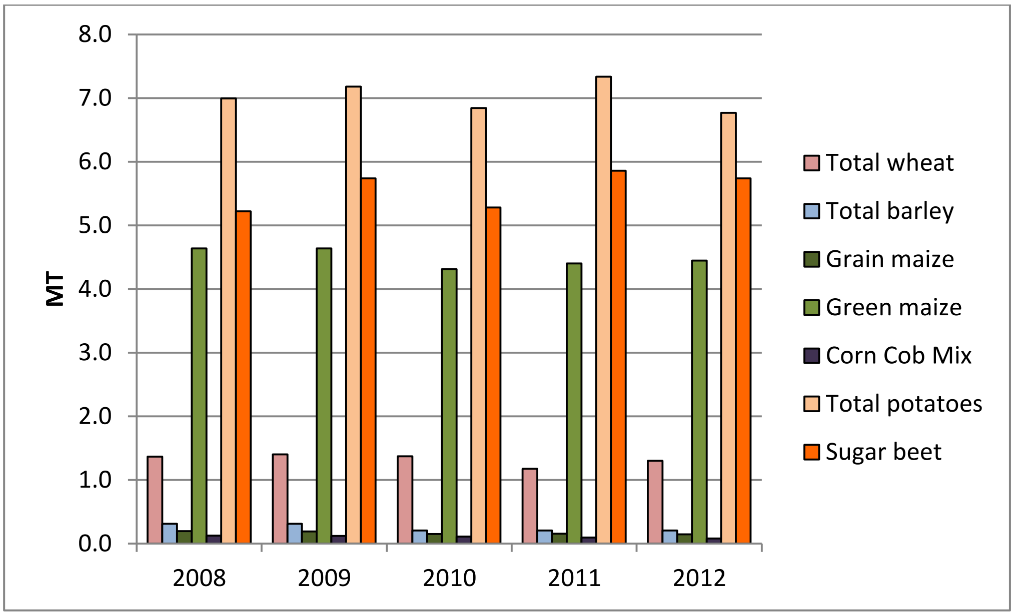


Figure 5-4 Grains and starchy crops production in the Netherlands from 2008 to 2011 (MT). (Source: CBS, 2012a)
* Moisture content was harmonized to 16%

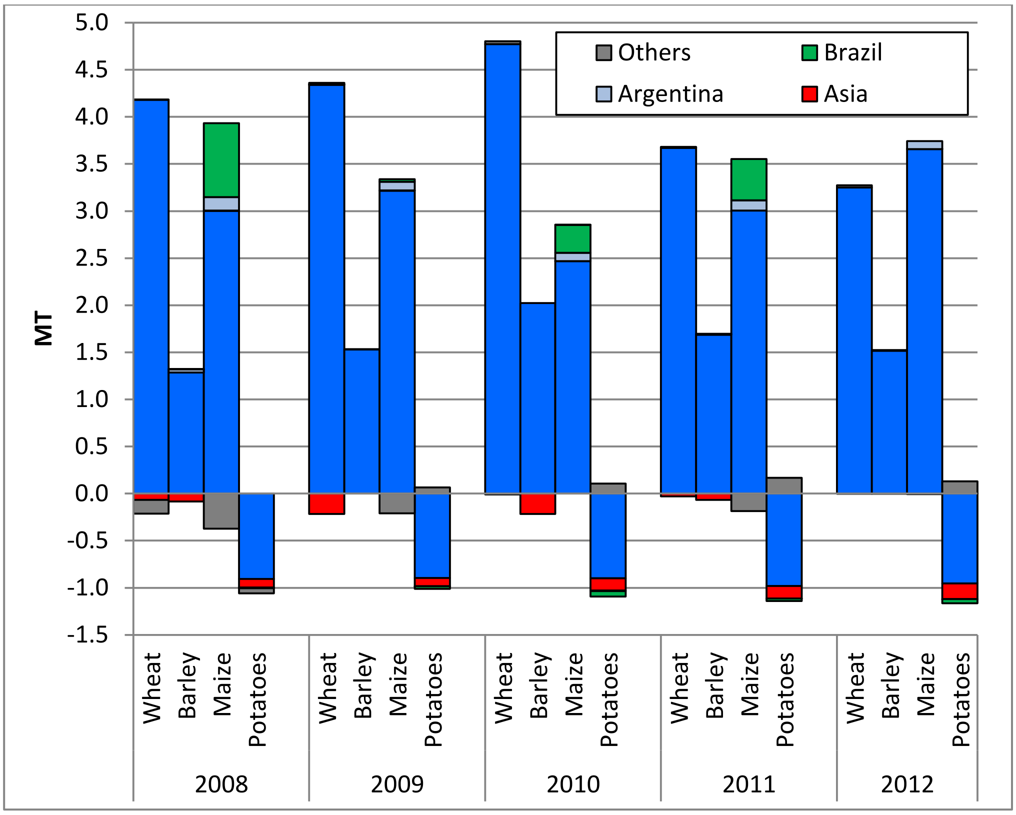


Figure 5-5 Trade flows (net by region / country) of grains and starch for the Netherlands from 2008 to 2011. (Source: CBS, 2013)

a. Wheat: 10019099, 10019900, 10019190
b. Barley: 10030090, 10039000
c. Maize: 10059000
d. Potato: 20041010, 20052080

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. Table 5-2 shows the market share of schemes for bioethanol in the Netherlands. ISCC is the most popular scheme, but the use of RED Cert also grew in 2012. Figure 5-6 shows the application of sustainability schemes on bioethanol consumed in the Netherlands in 2011 and 2012. ISCC is the most popular scheme, but the use of RED Cert also grew in 2012.

Table 5-2 Market share of sustainability certification schemes for bioethanol in the Netherlands in 2011 and 2012

Type of biomass	Sustainability schemes	Market share (% of certified biomass per particular products group in the market)	
		2011	2012
Bioethanol (on weight basis) (NEa, 2011; 2012; 2013)	*ISCC*	84.0%	92.9%
	RBSA	3.9%	0.5%
	RED Cert	0.0%	5.3%
	Others	11.1%	1.3%

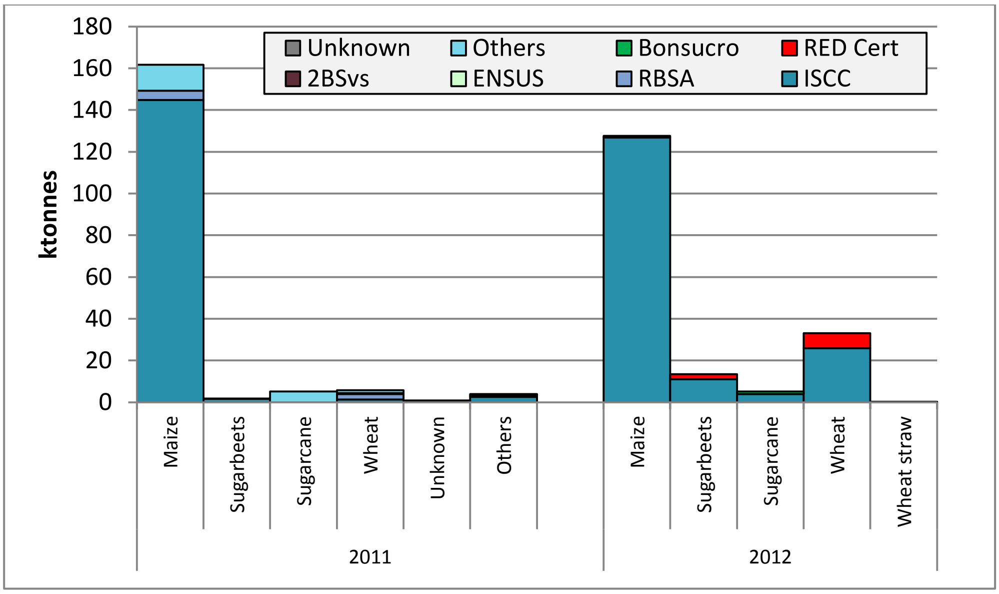


Figure 5-6 Sustainable certified bioethanol consumed in the Netherlands in 2011 and 2012 by schemes (Source: NEa, 2012; 2013)

5.3 Energy use of carbohydrates

Figure 5-7 illustrates the Dutch bioethanol consumption from 2010 to 2012. The total consumption remains between 0.18–0.19 MT. Different from biodiesel, which has a diverse source of feedstock and origins, the majority of the bioethanol consumed in the Netherlands originated from US maize and European wheat. Maize ethanol dominates with 40% of market share in 2010 and even 90% in 2011, but the number dropped to 71% in 2012. This is probably due to the reclassification of US ethanol to higher tariff rate (see the third paragraph). East Europe emerges 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. 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). 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.

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. 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). 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). It is not publicly known that how much they produce, where they source the raw materials and where they sell the bioethanol to.

Figure 5-8 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 (See Section 7.2 for more details). In 2012, these bioethanol blends was reclassified to the higher tariff rate, and trade of ethanol from US to Europe will probably decline significantly. However, it is not sure in the long term how will this impact imports from the US, due to the fact that the EU domestic production is insufficient even with the anticipated capacity expansion in 2013 and 2014. As shown in the figure, US ethanol has returned to the Dutch market under CN 22072000 in 2012. The regulated demand in the EU is expected to raise domestic ethanol prices and will attract bioethanol from the market in Brazil, the United States or other countries (Flach et al., 2012).

Besides bioethanol, it can also be 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 (CBS 2012). 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).

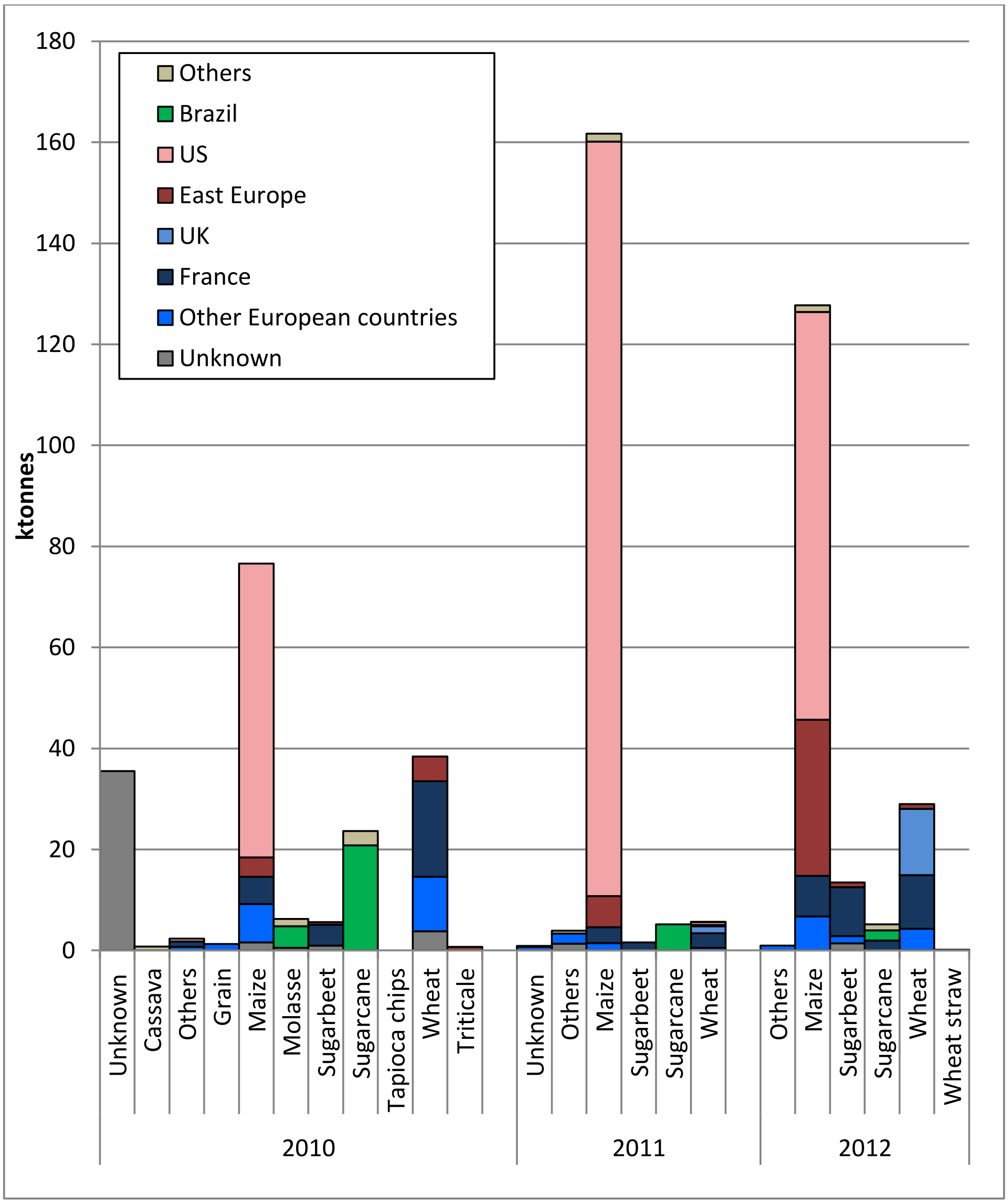


Figure 5-7 Bioethanol consumed in the Netherlands in 2010 -2012 by feedstock (Source: NEa, 2011; 2012; 2013)

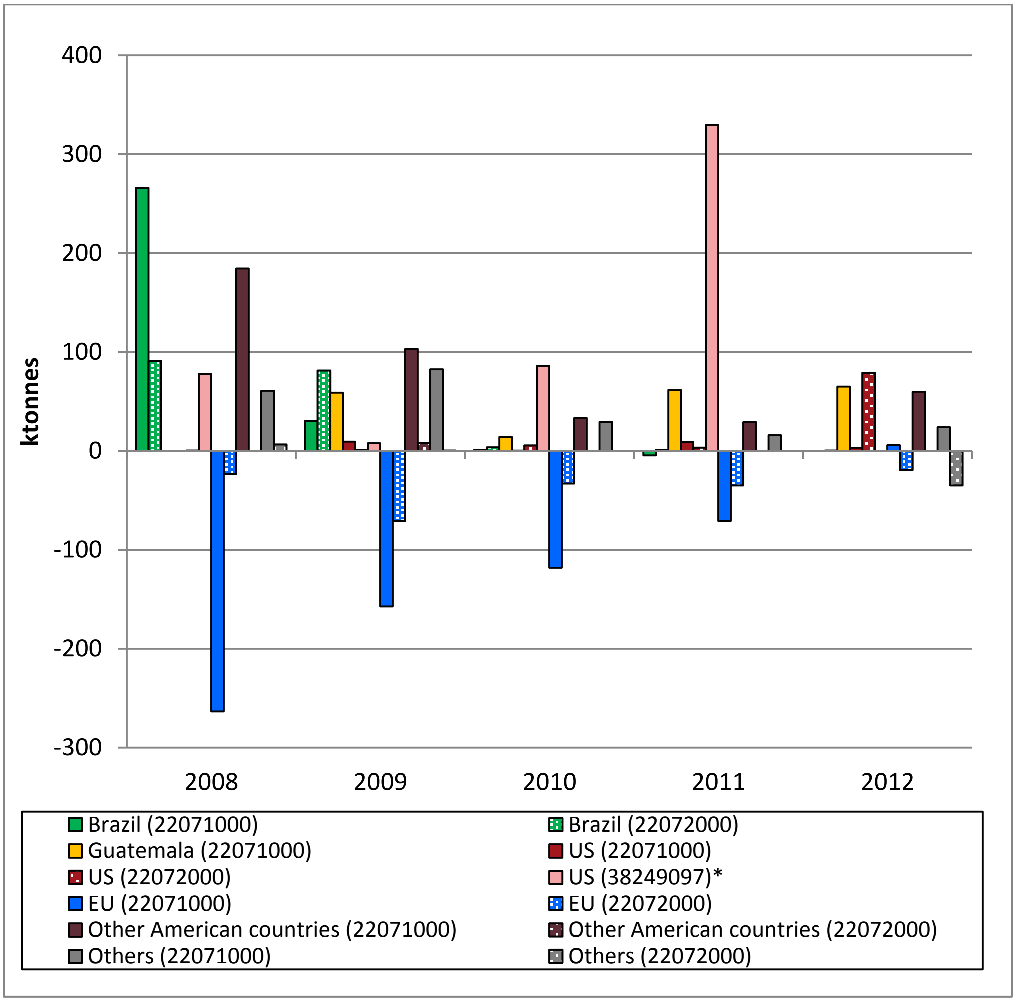


Figure 5-8 Ethanol trade balances (net) of the Netherlands for 2008 – 2012 (ktonnes). (Source: CBS, 2013)
* Note: Fuel ethanol from US was found registered as 38249097 upon arriving in the EU, but the number reported under this code may also contain other chemicals.
d. CN 22071000: Undenatured ethyl alcohol of actual alcoholic strength of >= 80%
e. CN 22072000: Denatured ethyl alcohol and other spirits of any strength
f. CN 38249097: Other chemical compounds

Indirectly, biomass from this category also ended up for energy use via livestock, as they also serve as feed (also applied to soy meals and other oil seed meals in “Oils and fats” category). There are two major portions of energy to be tapped via livestock, i.e. co-digestion of manure and “milk heat”. Co-digestion of manure includes the production of biogas from the fermentation of manure, together with other plant materials. Since 2010, more than 2 MT of wet biomass was fermented annually, and about half of them was manure. The total annual manure production in the Netherlands was about 70 MT. From 2010 to 2012, the manure digesters yielded about 4% of the final Dutch consumption of renewable energy (about 2 PJ of electricity and 1 PJ of heat). On the other hand, “milk heat” is a special form of energy released during the cooling of milk in dairy farms. The heat comes mainly from the cows, contributes about 0.3% of the Dutch consumption of renewable energy (CBS, 2012).

6 Overview of global biomass trade flows

6.1 Introduction

Over the last few years, the global biomass trade have shown a slow growth due to unfavorable global economic context. Many biomass commodities have experienced a slump in trade volume in 2009, which however followed by a rebound in 2010. For agricultural products, weather conditions also had an impact on the trade performance, particularly maize and wheat. The EU has become the top importer of products from developing countries over the years, recording more than 70% of its total annual imports between 2009 – 2011 while still showing a growing trend, compared to 43% share in total agricultural imports of Canada, the US, Australia, New Zealand and Japan (EC, 2012).

This chapter focuses on the market trend from 2008 to 2012 to match with the time frame chosen for the Dutch case study. Seeing the complexity of global biomass trade flows, 11 commodities from three biomass categories are selected for this analysis. They are (i) woody biomass: round wood, wood chips, wood pellets; (ii) oils and fats: palm oil, soybean, rapeseed, biodiesel; (iii) carbohydrates: wheat, corn, ethanol.

Approach:

- Data was collected from existing statistics (i.e. the UN COMTRADE) and studies performed by IEA Bioenergy Task 40. Trend analysis was based on literature review (e.g. the USDA GAIN reports).
- The study mainly focuses on comparison of the EU and the other big importers. Exporting countries are categorized in regions, unless any single exporter from a region is detected with large exporting volume to the importer.
- Production volume (taken from FAOSTAT) is also included for comparison.
- **Intra-EU trade is excluded.**

Figures 6-1 shows the comparison of the EU imports versus global imports of the selected commodities in 2012. This graph is only meant for indication because each products may have different composition (e.g. soybean and palm oil are different in composition). The EU has been a significant importer of most of these products, and also the largest importer of wood pellets, biodiesel and ethanol. Figure 6-2 depicts the trend of EU imports in comparison with global trade volumes of wood pellets, biodiesel and ethanol from 2008 to 2012. Out of the 11 selected products, wood pellets, biodiesel and ethanol have shown significant changes compared to the others. The import of wood pellet has grown steadily, but both biodiesel and ethanol have shown different trends. These will be further discussed in the following sections.

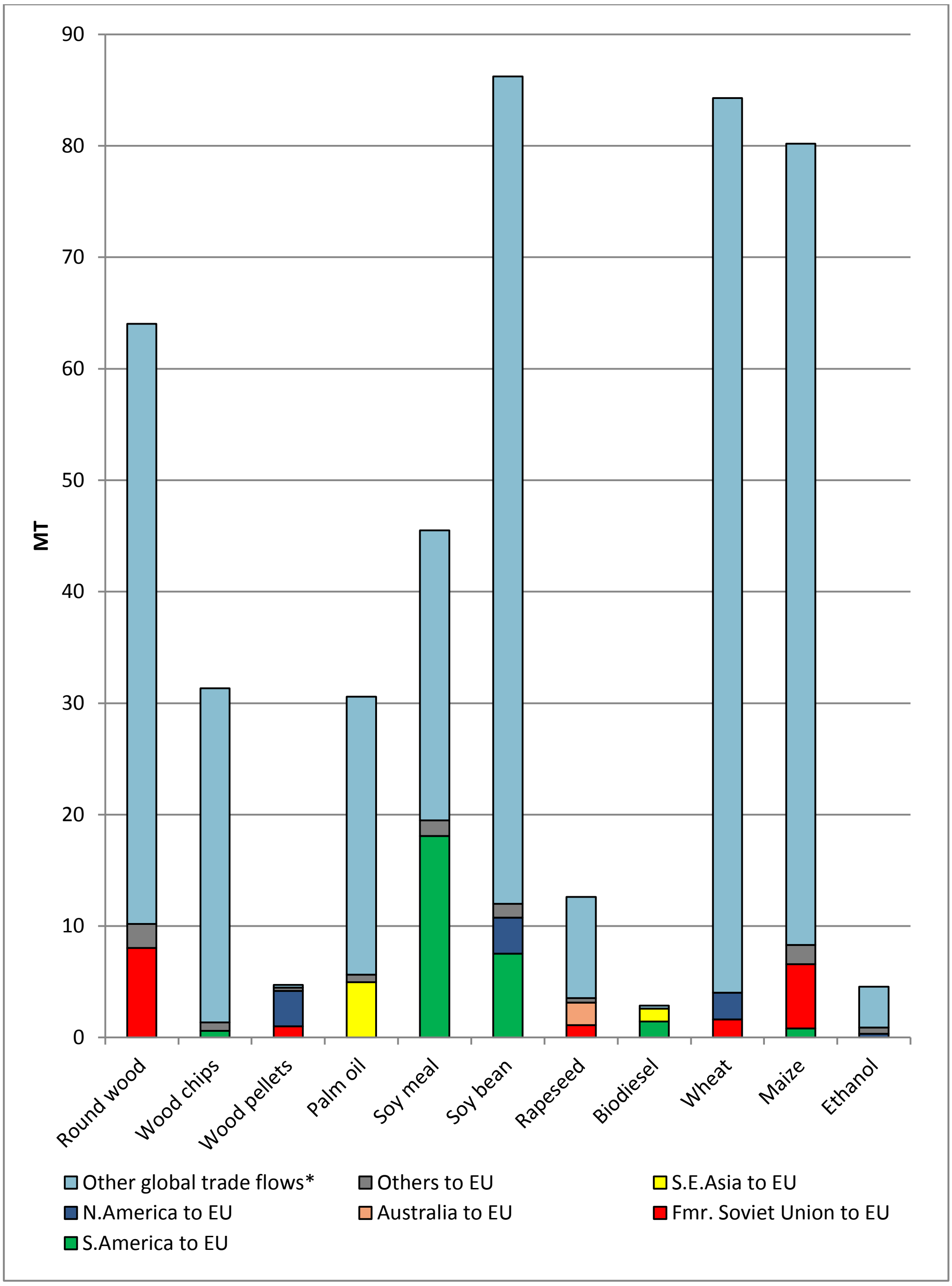
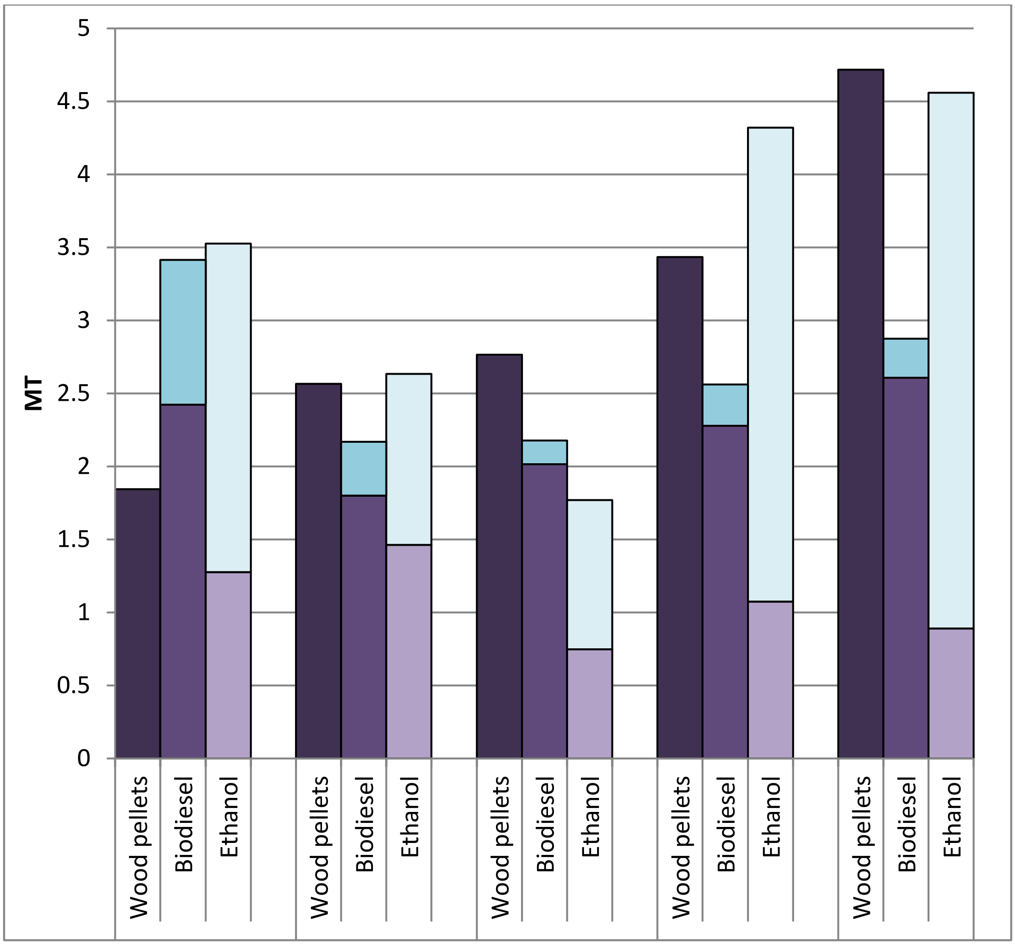


Figure 6-1 EU imports in comparison with global trade volumes for the year 2012
Source: Own calculation based on Figure 6-3 – 6-12.

* Only estimation due to complexity of indirect trade
** This figure includes the EU import under 382490 from US which is suspected to be ethanol



Note: Purple series at the bottom represent "EU imports", light blue series at the top represent "other imports".

Figure 6-2 EU imports in comparison with global trade of wood pellets, biodiesel and ethanol from 2008 to 2012.
Source: Own calculation based on Figure 6-3 – 6-12.

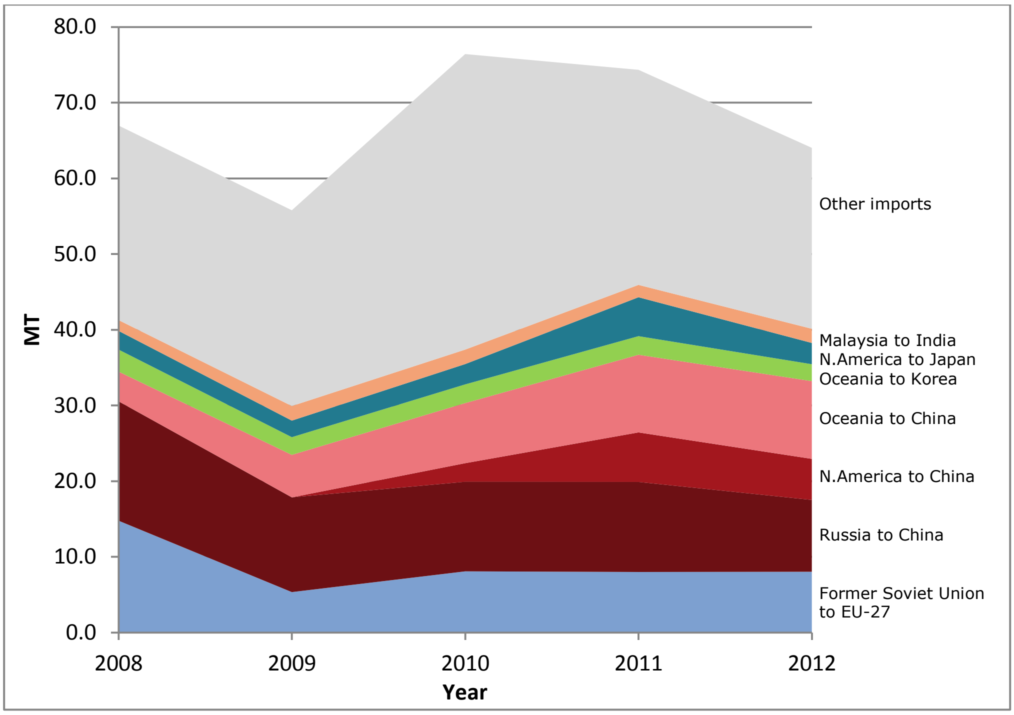
* Only estimation due to complexity of indirect trade
** This figure includes the EU import under 382490 from US which is suspected to be ethanol

6.2 Woody biomass

The production of timber has shown a steady increase after the slump in 2009, reaching 4837 MT in 2012 (FAOSTAT, 2013). Figure 6-3 illustrates the major trade flows of round wood. The total trade volume (imports) fluctuates from 55 MT to 75 MT. China is the largest buyer of round wood (almost 40% of global imports). Since 2010, the export of Russian round wood to China has slightly declined, while South America emerged as a significant supplier to China.

Figure 6-4 shows the major trade flows of wood chips. After the downturn in 2009, the global traded volume of wood chips have shown a steadily increasing trend compared to round wood. The traded volume has increased from about 21 MT in 2009 to just over 31 MT in 2012. China has contributed to this growth, remaining as the second largest chip destination since 2010, due to major investments in pulp capacity and lack of domestic fibre resources. This growth is also partly caused by the expansion of wood processing capacity in Turkey (Wood Business, 2013). Despite still ranked as the largest importer of wood chips, import volumes of Japan has dropped considerably after 2009 and never returned to 17 MT recorded in 2008. Following that, the EU-27, particularly Finland, has been importing large amount of residual chips from Russian sawmills and chips from the Baltic States. Turkey also emerged as a major importer in 2012, mainly relying on chips from the US. The global trade of wood chips is expected to grow continuously with larger demand from countries with limited resources and marginal fiber supplies.

Figure 6-5 depicts the global trade of wood pellets. The EU has been the dominant importer (almost 100%). The trade volume has shown a steep increase in 2012, reaching 4.5 MT in 2012. Canada is the main contributor to this growth, rising from 1.16 MT in 2011 to 1.96 MT in 2012. These pellets mostly come from British Columbia. The imports from US also increase steadily since 2008. This is caused by the recent investment of the European utilities in North America, especially in the “fibre basket”, i.e. the Southeast US. The UK, The Netherlands, Belgium and Denmark are among the biggest importers of wood pellets, in particular industrial pellet for co-firing in power plants. Financial support from governments is the most crucial factor affecting the trade flows.



MT	2008	2009	2010	2011	2012
Malaysia to India	1.43	1.93	1.91	1.63	1.88
N.America to Japan	2.47	2.19	2.68	5.14	2.81
Oceania to Korea	2.91	2.34	2.47	2.46	2.23
Oceania to China	3.93	5.62	7.94	10.26	10.27
N.America to China	0.00	0.00	2.46	6.55	5.43
Russia to China	15.77	12.52	11.83	11.89	9.48
Former Soviet Union to EU-27	14.77	5.34	8.08	8.00	8.03
Other imports	25.70	25.86	39.05	28.41	23.90

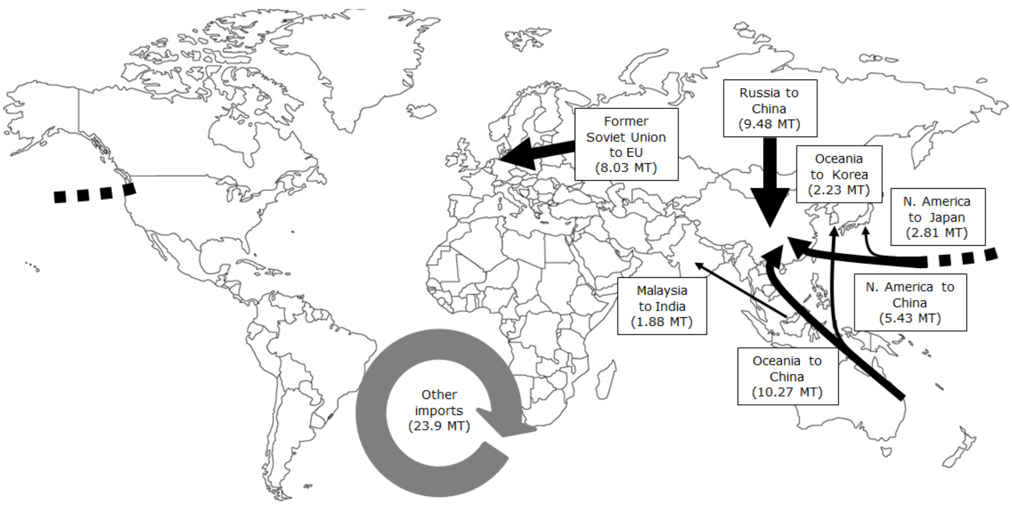
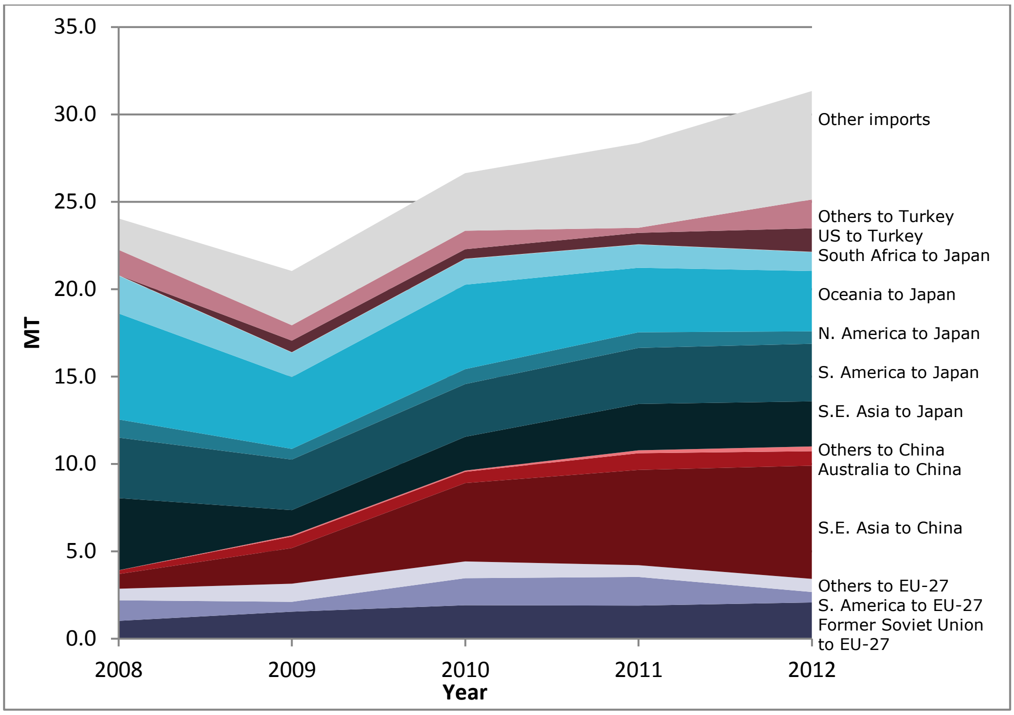


Figure 6-3 Major trade flows of round wood (Source: UN Comtrade, 2013)

- 4403,"Wood in the rough, whether or not stripped of bark or sapwood, or roughly s ...","Wood in the rough, whether or not stripped of bark or sapwood, or roughly squared.",0,4,"44"
- Weight is estimated at 900 kg/m^3 when only data in m^3 is available.



MT	2008	2009	2010	2011	2012
Others to Turkey	1.45	0.88	1.06	0.29	1.65
US to Turkey	0.00	0.66	0.54	0.65	1.34
South Africa to Japan	2.16	1.40	1.47	1.33	1.08
Oceania to Japan	6.07	4.11	4.83	3.69	3.45
N. America to Japan	1.04	0.61	0.85	0.89	0.71
S. America to Japan	3.46	2.89	3.02	3.21	3.29
S.E. Asia to Japan	4.13	1.44	1.93	2.65	2.58
Others to Japan	0.03	0.02	0.02	0.02	0.02
Others to China	0.01	0.07	0.07	0.17	0.28
Australia to China	0.21	0.66	0.65	0.95	0.83
S.E. Asia to China	0.84	2.04	4.48	5.45	6.48
Others to EU-27	0.66	1.04	0.96	0.67	0.75
S. America to EU-27	1.17	0.56	1.55	1.64	0.60
Former Soviet Union to EU-27	1.02	1.55	1.91	1.89	2.07
Other imports	1.79	3.10	3.29	4.84	6.21

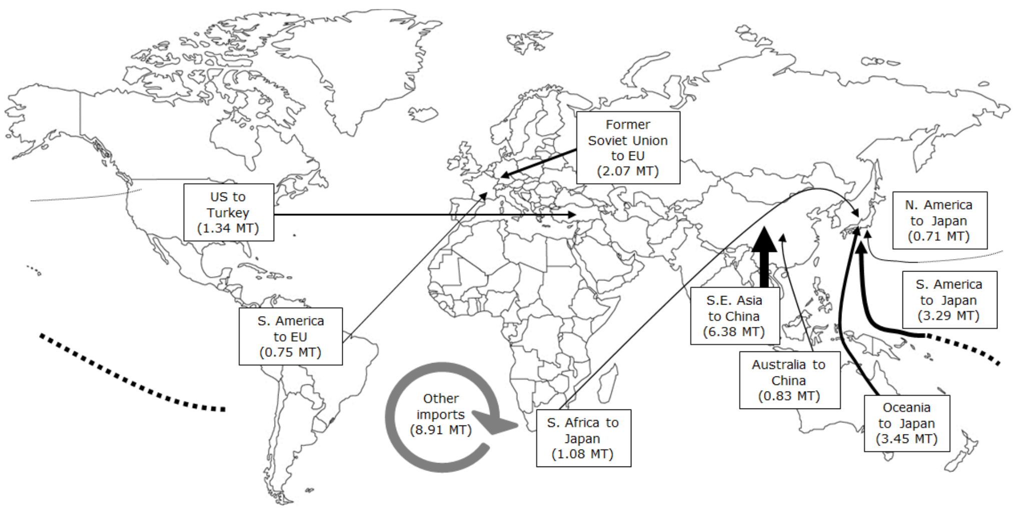
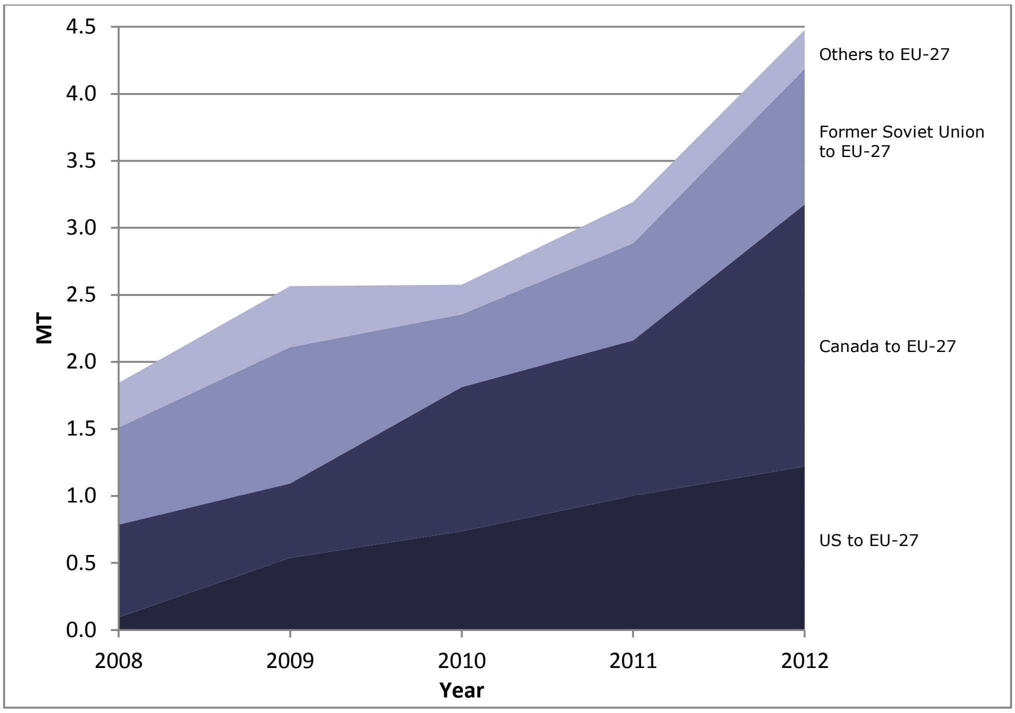


Figure 6-5 Major trade flows of wood chips (Source: UN Comtrade, 2013)

- 440121,"Wood, in chips/particles, coniferous","Wood, in chips/particles, coniferous",1,6,"4401"
- 440122,"Wood, in chips/particles, non-coniferous","Wood, in chips/particles, non-coniferous",1,6,"4401"



MT	2008	2009	2010	2011	2012
Others to EU-27	0.33	0.46	0.22	0.31	0.29
Former Soviet Union to EU-27	0.72	1.02	0.54	0.73	1.01
Canada to EU-27	0.69	0.56	1.08	1.16	1.96
US to EU-27	0.09	0.54	0.74	1.00	1.22
Other imports	0.00	0.00	0.19	0.24	0.24

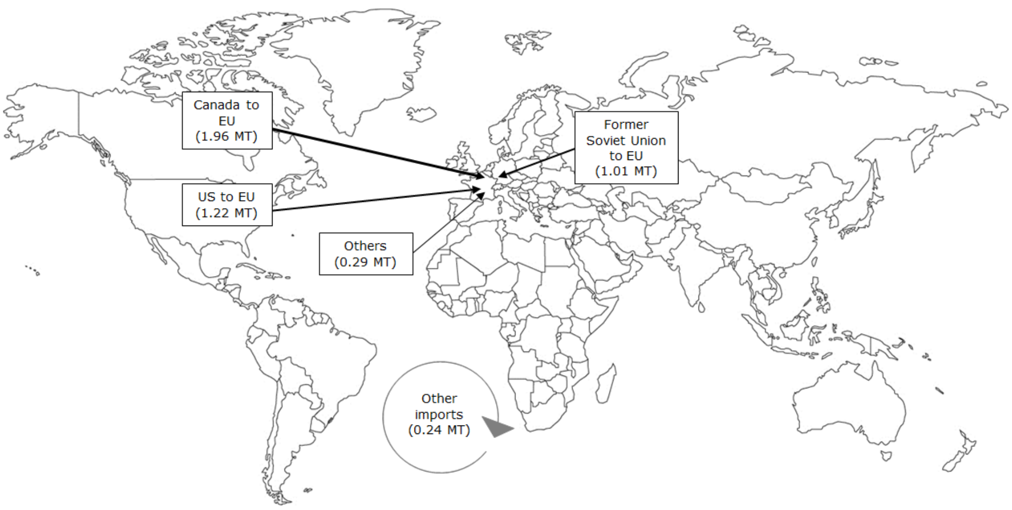


Figure 6-5 Major trade flows of wood pellets
- Source: For 2008 - 2009 data is taken from UN Comtrade under code "440130" . For 2010 - 2012 data is taken from Lamers et al. 2013

6.3 Oils and fats

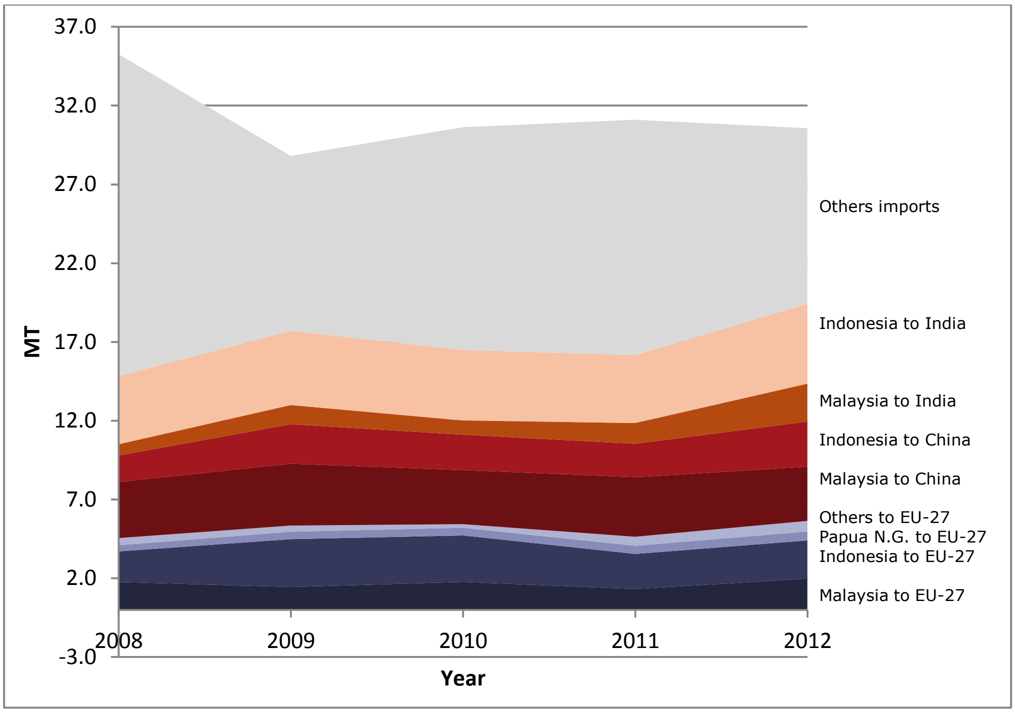
Global trade of oils and fats consists of palm oil, soybean, rapeseed and other oilseeds. This category includes three major types of products, i.e. oilseeds, oils, and meals. The ratio between these three products is determined by divergent demand, limits on domestic processing capacity as well as trade policies. As shown in the Dutch case study, mainly oilseed is imported and crushed locally. As the commodities are closely substitutable and competitive, the trade flows could be diverted depends on seasonal availability, relative prices and other factors. Trade policies such as tariffs and domestic subsidies are normally used to monitor the market and trade (see Chapter 7 for more details).

Figure 6-6 shows the major trade flows of palm oil. The global palm oil production has recorded about 50 MT, showing an increase of almost 20% in 2012 compared to 2008, after a near stagnant trend in 2008-2010 (FAOSTAT, 2013). Malaysia and Indonesia dominates the production, account for 35% and 50% respectively, while the rest is contributed by Papua New Guinea, Brazil, Solomon Islands and Colombia. The total trade volume of palm oil remains steady after 2009. Despite the fall in 2011, the EU imports rose again in 2012. India has also increased its palm oil imports in 2012.

Figure 6-7 depicts the major trade flows of soybean in 2008 – 2012. Despite the low production of maize due to unfavorable weather conditions, soybean exports from North and South America continue to grow steadily. Soy production has expanded rapidly in South America since 1970s, and in recent years has expanded into vast farmland in Brazil attributed to infrastructure improvement. The global production has reached 265 MT in 2010, and slightly dropped to 253 MT in 2012 (FAOSTAT, 2013). Although China is now the fourth largest soybean producer, it is still the largest importer, and the importing volume is still growing spurred by increasing food demand (USDA, 2013). On the other hand, the EU-27 imports large quantity of oil cakes from South America due to its protein deficit. Soy meal is mainly used in livestock production. Argentina is the world largest exporter of soy meal and oil, owing to its highly developed crushing industry and relatively small domestic market (USDA, 2013). Abundant agricultural resources in South America implies possible further expansion of soybean production, but this may be limited by the rising concerns over the sustainability issue, in particular the impacts of (indirect) land use change.

Figure 6-8 presents the major trade flows of rapeseed in 2008-2012. The traded volume seems relatively low compared to palm oil and soybean (excluding intra-EU trade). The production has increased globally up to 20%, from 57 MT in 2008 to about 65 MT in 2012. One of the main factors that stimulates the production in the EU and also Ukraine is the growing demand of biodiesel in the EU.

International biodiesel market has grown remarkably over the past decade. The recent trend is shown in Figure 6-9. The trade volume has reached more than 2 MT in the past few years. The biodiesel market is relatively volatile and highly dependent on policy development. It is also largely influenced by the existing global vegetable oil and oilseed market. Lamers (2012), Goh et al. (2013) and some other reports have studied the global trade in details for 2008 to 2012. In 2013, the EU expanded the 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 (see also section 7.2). 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 the US in January 2013, these biodiesel is expected to flow into the US instead of the EU (ICIS, 2013; Bloomberg, 2013). Despite the EU remains as the biggest producer and consumer, the EC has recently proposed to put a 5% cap to limit the usage of first generation biodiesel (i.e. those made of vegetable oils). If this is realized, the market will receive big impact and the trade flows may change greatly as many production has been targeted for export to the EU. Within the EU, the economic impact could also be significant as the existing EU policy schemes has stimulated investment and a rapid growth and in production capacity in the last few years.



MT	2008	2009	2010	2011	2012
Indonesia to India	4.32	4.71	4.47	4.31	5.07
Malaysia to India	0.71	1.22	0.90	1.32	2.41
Indonesia to China	1.68	2.51	2.24	2.12	2.87
Malaysia to China	3.56	3.92	3.43	3.78	3.43
Others to EU-27	0.46	0.39	0.23	0.57	0.68
Papua New Guinea to EU-27	0.39	0.47	0.49	0.52	0.57
Indonesia to EU-27	1.94	3.04	2.95	2.22	2.43
Malaysia to EU-27	1.76	1.45	1.77	1.32	1.97
Other imports	20.43	11.10	14.14	14.94	11.15

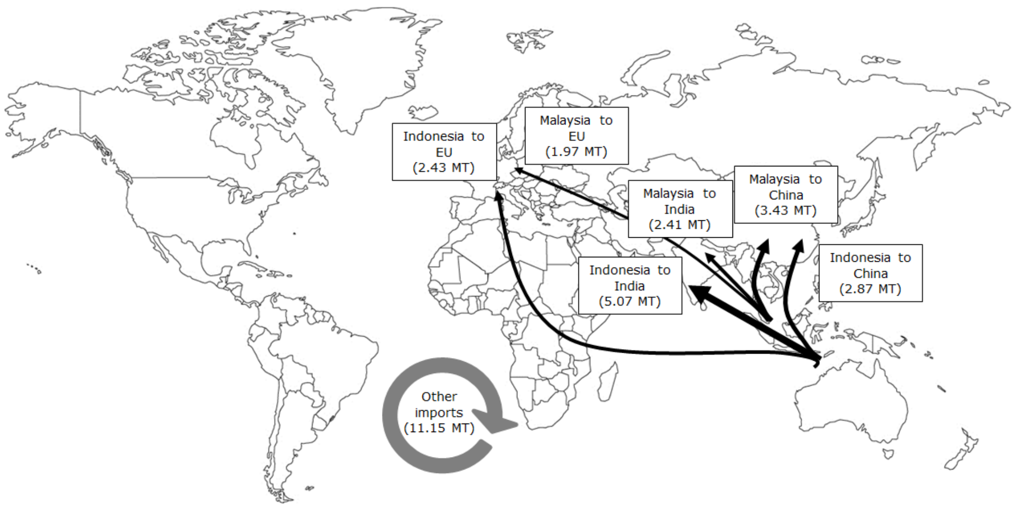
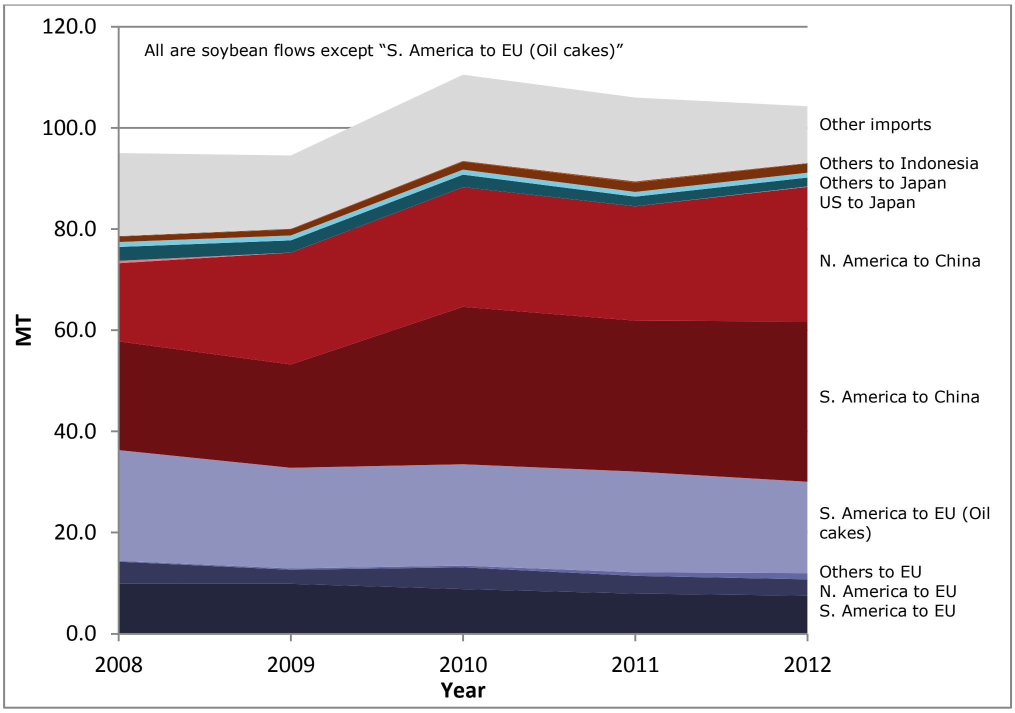


Figure 6-6 Major trade flows of palm oil (Source: UN Comtrade, 2013)

- 151110,"Palm oil, crude","Palm oil, crude",1,6,"1511"
- 151190,"Palm oil, other than crude, & fractions thereof , whether or not ref. but n ...","Palm oil, other than crude, & fractions thereof , whether or not ref. but not chemically modified",1,6,"1511"



MT	2008	2009	2010	2011	2012
U.S. to Indonesia	1.08	1.18	1.58	1.85	1.81
S. America to Indonesia (Oil cakes)	1.47	1.73	2.19	2.62	3.11
U.S. to Japan	2.73	2.41	2.47	1.89	1.76
Others to Japan	0.98	0.98	0.99	0.94	0.96
World to Japan (Oil cakes)	1.68	1.91	2.19	2.20	2.11
N. America to China	15.45	22.12	23.67	22.61	26.60
S. America to China	21.50	20.43	31.13	29.83	31.69
S. America to China (Soy oil)	2.41	2.34	1.06	0.91	1.62
S. America to EU-27 (Oil cakes)	21.89	19.92	20.05	19.93	18.07
Others to EU-27 (Oil cakes)	0.96	0.79	1.53	0.94	1.41
Others to EU-27	0.18	0.25	0.34	0.70	1.22
N. America to EU-27	4.37	2.79	4.30	3.51	3.24
S. America to EU-27	9.88	9.87	8.83	7.94	7.53
Other imports	16.42	14.50	17.03	16.58	11.23

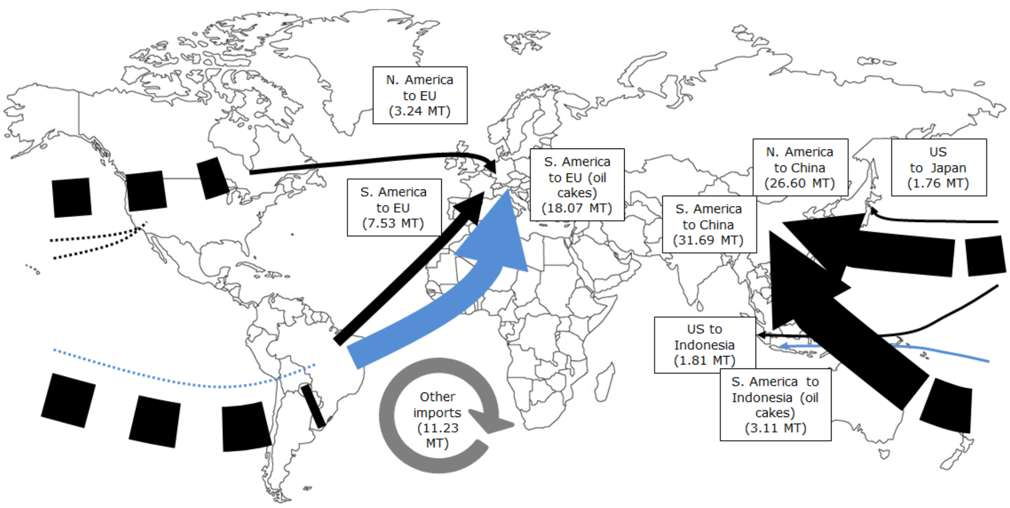
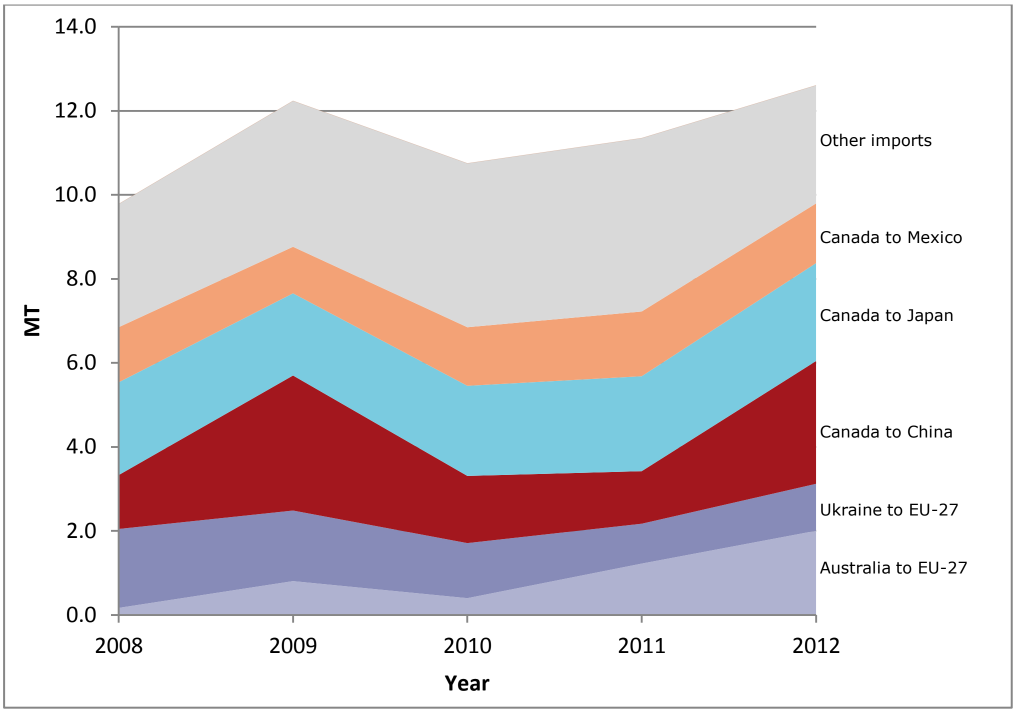


Figure 6-7 Major trade flows of soybean (Source: UN Comtrade, 2013)
- All refer to soy bean unless otherwise specified.
- 120100,"Soya beans, whether or not broken","Soya beans, whether or not broken",1,6,"1201"
- 230400,"Oil-cake & oth. solid residues, whether or not ground/in pellets, from extr ...","Oil-cake & oth. solid residues, whether or not ground/in pellets, from extraction of soyabean oil",1,6,"2304"



	2008	2009	2010	2011	2012
Canada to Mexico	1.31	1.11	1.39	1.54	1.42
Canada to Japan	2.21	1.96	2.15	2.26	2.33
Canada to China	1.28	3.21	1.60	1.25	2.92
Ukraine to EU-27	1.88	1.68	1.31	0.95	1.12
Australia to EU-27	0.17	0.81	0.40	1.22	2.00
Other imports	2.93	3.48	3.90	4.13	2.81

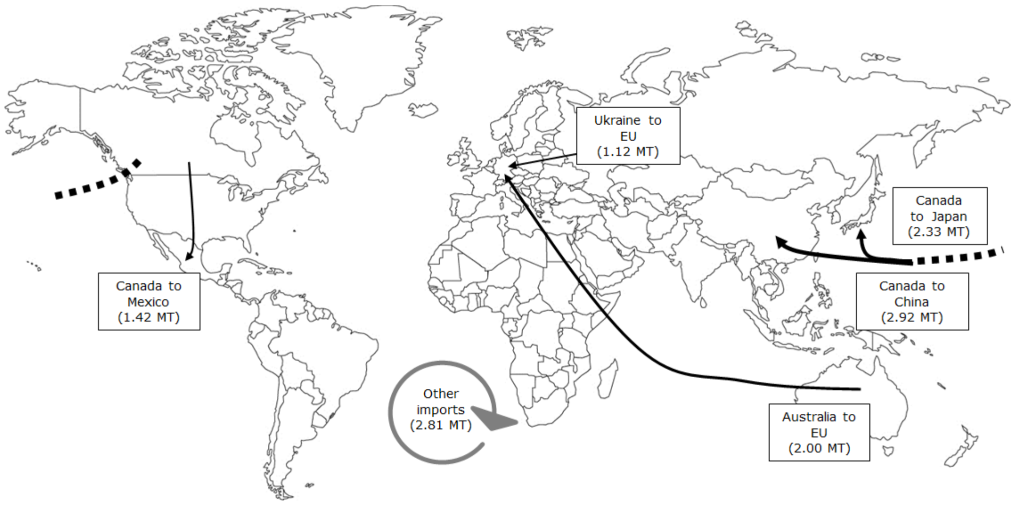
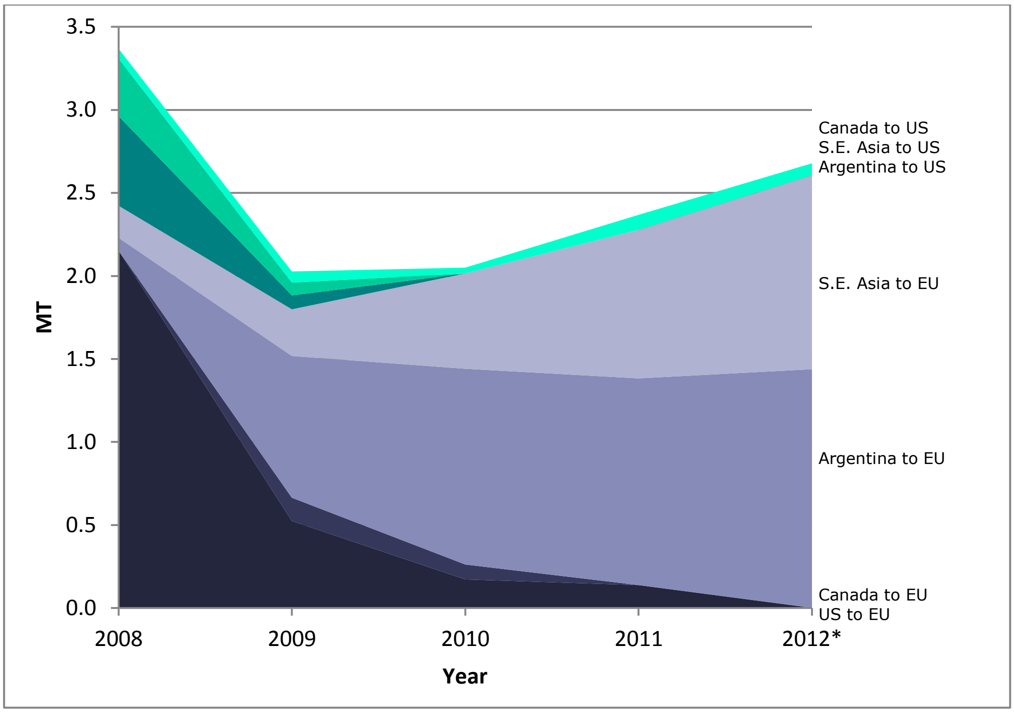


Figure 6-8 Major trade flows of rapeseed (Source: UN Comtrade, 2013)
- 1205,"Rape or colza seeds, whether or not broken.","Rape or colza seeds, whether or not broken.",0,4,"12"



MT	2008	2009	2010	2011	2012
Canada to US	0.06	0.07	0.04	0.09	0.07
SE Asia to US	0.35	0.08	0.00	0.00	0.00
Argentina to US	0.54	0.08	0.00	0.00	0.00
SE Asia to EU-27	0.19	0.28	0.57	0.90	1.17
Argentina to EU-27	0.08	0.85	1.18	1.25	1.44
Canada to EU-27	0.00	0.14	0.09	0.00	0.00
US to EU-27	2.15	0.52	0.17	0.14	0.00
Other imports	0.04	0.14	0.13	0.19	0.20

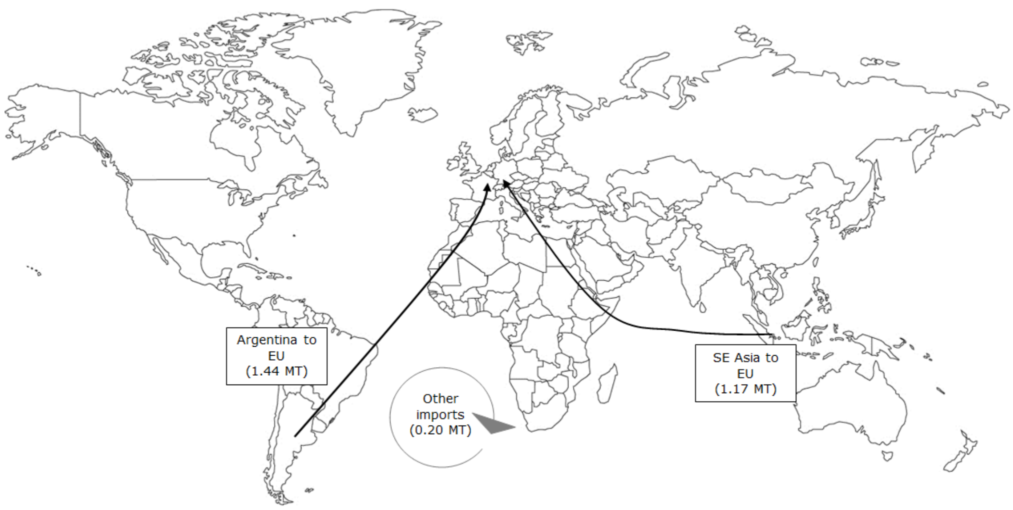


Figure 6-9 Major trade flows of biodiesel

* Source: Lamers (2012) for 2008 – 2011, UN Comtrade (2013) for 2012

6.4 Carbohydrates

Similar to oilseeds, grains products are also often substitutable and competitive. In addition, oilseed meal and other protein sources may also compete with grains products for feed purpose. However, flexibility of markets is also limited by the types of animals fed, local preferences and other factors.

Wheat and maize (corn) are the two of the largest traded grains. Wheat is also a major food staple, mainly used to produce bread, pasta and noodles. Figure 6-10 illustrates the major trade flows of wheat. It shows a rather stable annual production around 680 MT, except in 2010 and 2011 with a fluctuation between 650 – 700 MT. The US is the biggest exporter of wheat, although its production share is only about 10% of global production (USDA, 2013). The other major producers are Former Soviet Union, the EU, Australia, Canada and Argentina. As shown in the graph, the trade volumes are quite evenly distributed among the trade flows, implying the diversity of exporting countries. The production is rather stable because wheat is being planted and harvested at different times across the northern and southern hemisphere. This provides significant stability to the wheat price and global market. It is likely that the wheat production will grow steadily, owing to the increasing food demand caused by rising population.

Maize is another large component of global grain trade, mostly traded for feed, and smaller amounts traded for industrial and food uses. In recent years, the production of maize and other feed grain has been spurred by the demand for biofuels. The total global production has shown an increase of about 7-8% from 2008 to 2012 (FAOSTAT, 2013). Although the US domestic consumption is more than quadruple of the export volume, the US still dominates the world maize trade. The global market is highly related to the weather conditions in the US corn belt. Figure 6-11 shows the major trade flows of maize from 2008 to 2012. Following the rebound in 2010, the total trade volume of maize has gone down in 2012. This is mainly attributed to the drought in the US (EC, 2012). Despite the decrease of US exports to Japan and Korea, the flow to China is growing steadily. Ukraine and South America (mainly Brazil) filled the gap in the world market caused by the adverse weather conditions in the US, taking over US shares in Asian and Middle East markets. Ukraine actually stands out as the one with the highest growth in sales of agricultural products to the EU in 2012 (EC, 2012). Japan remains as the largest importer due to domestic demand of coarse grain as feed with attention to quality (Japan is a very large meat producer). Meanwhile, the second largest importer, South Korea, is regarded as a more price-conscious buyer that switches between wheat and maize, as well as between different producers (USDA, 2013).

Figure 6-12 depicts the trend of major ethanol trade flows in recent years. In 2010, the once biggest supplier, Brazil, has experienced supply shortages as a result of lower sugarcane production, increased demand, and strong competition from the sugar market. Since 2011, there has been cross trade of cane and corn-based ethanol between Brazil and US. In 2012, the net flow changed its direction, i.e. more ethanol is exported from Brazil to the US. Between 2009-2011, there has been a steep increase of US ethanol being imported into the EU, but it dropped again in 2012 (See Chapter 7).

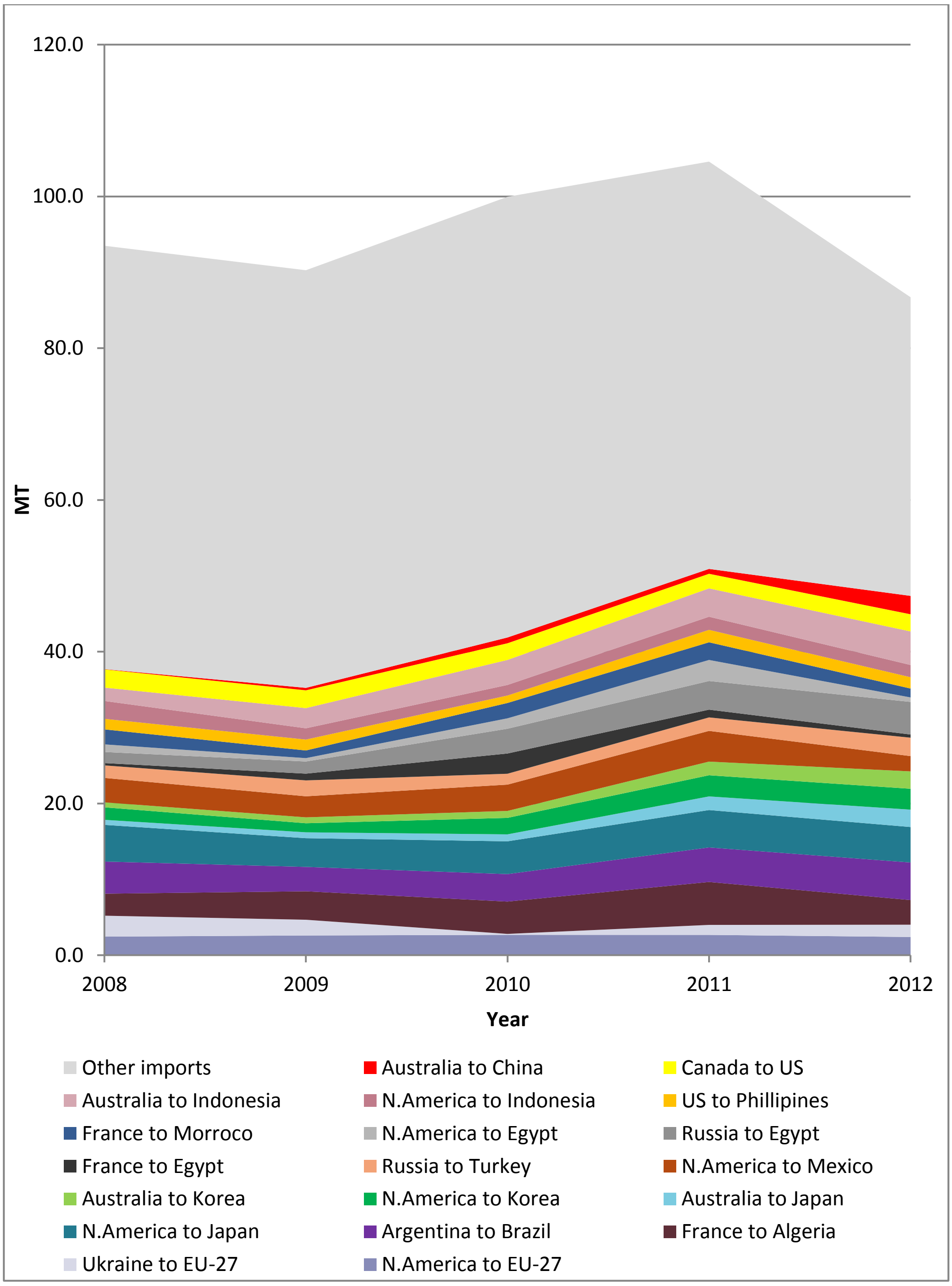
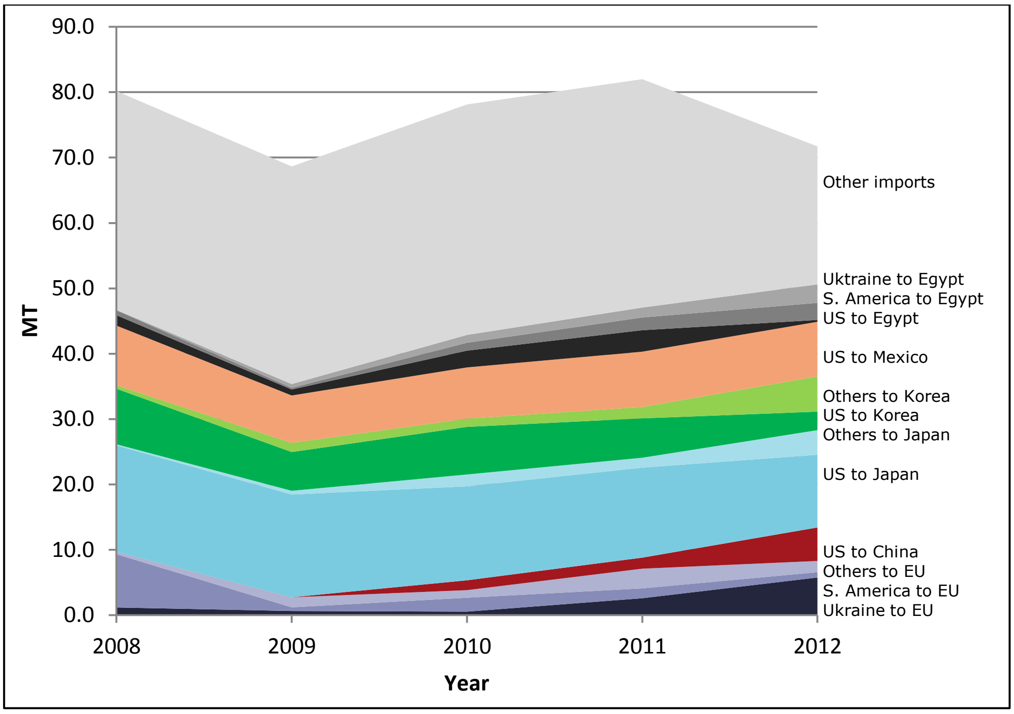


Figure 6-10 Major trade flows of wheat (Source: UN Comtrade, 2013)

- 1001,"Wheat and meslin.","Wheat and meslin.",0,4,"10"



MT	2008	2009	2010	2011	2012
Ukraine to Egypt	0.05	0.58	1.20	1.52	2.83
S. America to Egypt	0.75	0.25	1.21	1.94	2.61
US to Egypt	1.59	0.91	2.56	3.29	0.28
US to Mexico	9.13	7.25	7.84	8.47	8.36
Others to Korea	0.52	1.40	1.26	1.73	5.38
US to Korea	8.50	5.93	7.28	6.02	2.84
Others to Japan	0.18	0.57	1.81	1.52	3.77
US to Japan	16.28	15.72	14.38	13.77	11.13
US to China	0.00	0.01	1.50	1.69	5.11
Others to EU-27	0.36	1.54	1.16	3.02	1.73
S. America to EU-27	8.15	0.55	2.13	1.51	0.81
Ukraine to EU-27	1.18	0.64	0.54	2.59	5.76
Other imports	33.49	33.30	35.26	34.94	21.12

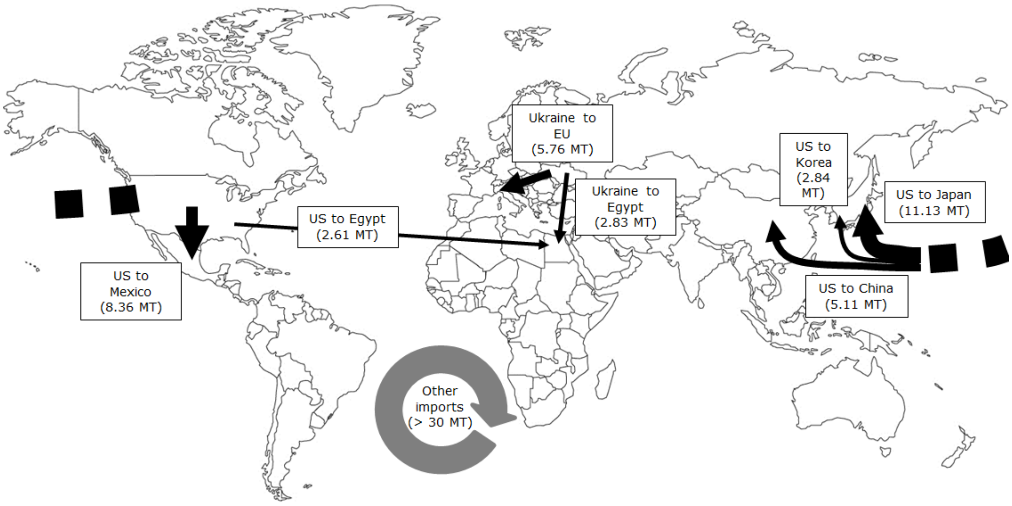
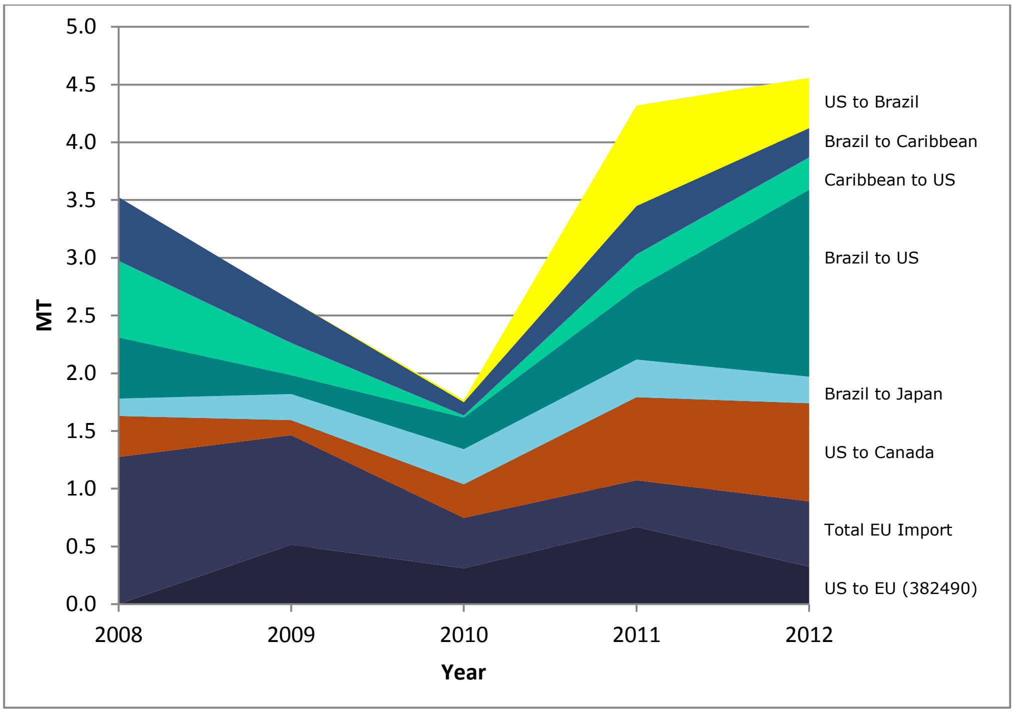


Figure 6-11 Major trade flows of maize (Source: UN Comtrade, 2013)

- 100590,"Maize (corn), other than seed", "Maize (corn), other than seed",1,6,"1005"



MT	2008	2009	2010	2011	2012
US to Brazil	0.00	0.00	0.02	0.87	0.44
Brazil to Caribbean	0.55	0.37	0.11	0.42	0.25
Caribbean to US	0.66	0.28	0.02	0.29	0.28
Brazil to US	0.53	0.16	0.27	0.62	1.62
Brazil to Japan	0.15	0.23	0.30	0.33	0.23
US to Canada	0.36	0.13	0.29	0.72	0.85
Total EU-27 import	1.27	0.95	0.44	0.40	0.57
US to EU-27 (382490)	0.00	0.51	0.31	0.67	0.32

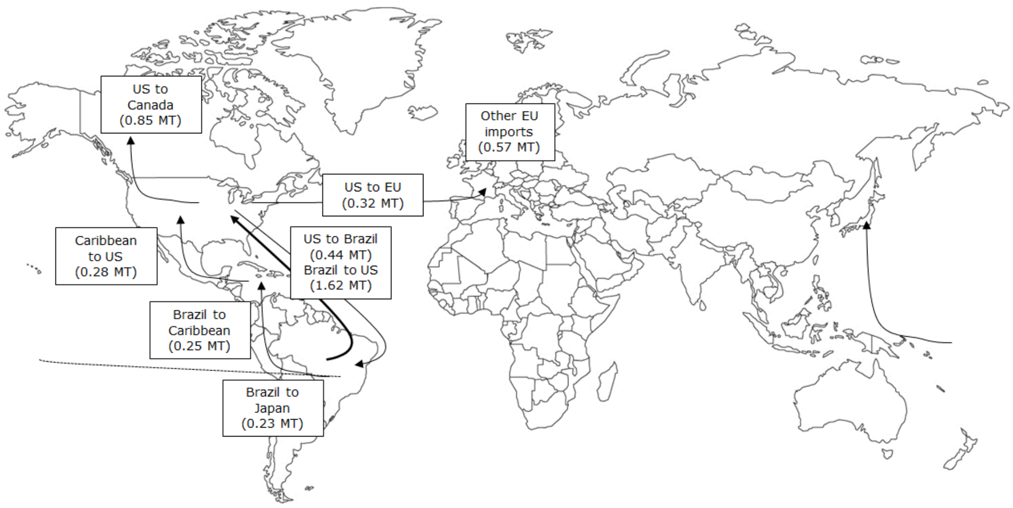


Figure 6-12 Major trade flows of ethanol* (Source: UN Comtrade, 2013)
* This figure includes the EU import under 382490 from US which is suspected to be ethanol
- 2207,"Alcohol of a strength by volume of 80 % vol or higher","Undenatured ethyl alcohol of an alcoholic strength by volume of 80 % vol or higher; ethyl alcohol and other spirits, denatured, of any strength.",0,4,"22"
- 382490,"Other chem. prods. & preps. of the chem./allied industries (incl. those con ...","Other chem. prods. & preps. of the chem./allied industries (incl. those consisting of mixts. of nat. prods.), n.e.s.",1,6,"3824" (This graph only includes 2009 – 2012 for US to EU-27 (382490)

6.5 Links to the DBI/DBM projects by Agency NL

The Sustainable Biomass Import programme (DBI) and the Global Sustainable Biomass programme (DBM) specifically focus on promoting the sustainability of biomass for energy, transport and chemical purposes. DBM aims to promote the sustainability of the biomass chain, with the relevance of the development being an important condition. For DBI, the focus is on the promotion of sustainability of the biomass-import chains for energy and chemistry applications in the Netherlands. For DBM, the sustainability guidelines of the Testing framework for Sustainable Biomass apply. For DBI, projects must furthermore satisfy the criteria of the RED (Renewable Energy Directive).

Table 6-1 is the factsheet of the 26 projects of DBI/DBM. These projects target on 18 crops and biomass, i.e. palm oil, soy, jatropha, sweet sorghum, sugarcane (and panela), algae, cassava, candlenut, castor, coffee, reed, bamboo, oilseeds in general, rice husk, straw, switchgrass and waste. Among the these crops, palm oil and soy are the most traded commodities in the world, whereas other biomass either has relatively small trade volumes or is not practically traded (e.g. jatropha). The most popular location is Indonesia, which is also the largest palm oil producer in the world.

There are 7 projects in palm oil, 5 on Indonesia, 1 in Columbia and 1 in Sierra Leone. Four of these projects involve development of sustainable supply chain, while the other three focus on demo facility, feasibility study and research. Linking to the trade flows, among the biomass targeted, palm oil is the most traded commodity, reaching more than 30 MT of global imports in 2012 (the EU imports amounted to about 6 MT). Indonesia is the biggest supplier. The Dutch market has consumed and processed 1.63 MT of palm oil in 2012 compared to 0.72 MT in 2011, which is roughly 5% of total global imports. About 0.78 MT out of 1.63 MT is converted into biofuels (mainly in the form of HVO) in the Netherlands and exported to other European countries. Certified palm oil started to enter the Dutch market in 2011, and the volume increases from 0.67 MT in 2011 to 0.95 MT in 2012 (assuming all palm oil used for biodiesel production is certified) (See Figure 4-6). Sugarcane which is closely related to ethanol production is one of the targeted crops, and is included in 2 DBM projects. The EU do not import sugar cane in large quantity, but sugar cane ethanol is one of the important types of biofuels imported. However, the export of sugarcane ethanol to the EU has dropped significantly in the past few years due to several reasons like shortage in Brazil and market incentives in the US. Another commodities traded in large volume, soybean, is also included in 2 of the DBI projects. Instead of soybean, the EU is rather a big importer of soymeal. Similar to palm oil, the Dutch market has also started to import certified soybean since 2011. The share of certified soybean is expected to continue to grow. The Netherlands is the forerunner in the EU to use certified palm oil and soybean in significant volumes.

In contrast, the other targeted biomass have a much lesser traded volume compared to the aforementioned palm oil and soybean. They are also not common materials used for biofuel production like sugarcane. There are no existing supply chains of some of these biomass, e.g. jatropha, ricee husk, straw and etc. Jatropha is one of the main crops targeted, included in seven out of the 26 projects. This may lead to the establishment of completely new supply chains (e.g. jatropha from East Africa).

Table 6-1 Fact sheet of DBI and DBM projects

Project no.	Country	Crops	Type of project	
DBM01002	Mali	Jatropha	Pilot project	Poverty alleviation
DBM01004	Indonesia	Sweet Sorghum	Demo facility	Research
DBM01005	Mali	Jatropha	Sustainability assessment	
DBM01011	Brazil	Sugercane	Development sustainable supply chain	Capacity building
DBM01012	South Africa	Waste	Research	Capacity building
DBM01013	Mozambique	Jatropha	Development sustainable supply chain	
DBM01014	Indonesia	Palm Oil	Demo facility	Capacity building
DBM01015	Colombia	Palm Oil	Development sustainable supply chain	Capacity building
DBM01017	Zambia	Jatropha	Development sustainable supply chain	Poverty alleviation
DBM01018	Tanzania	Jatropha	Research	Certification
DBM02011	Colombia	Panela	Development sustainable supply chain	
DBM02020	Vietnam	Algae	Research	Capacity building
DBM02021	Indonesia	Palm Oil, Algae, Waste	Development sustainable supply chain	
DBM02024	Panama	Cassava	Development sustainable supply chain	Poverty alleviation
DBM02025	Tanzania	Jatropha	Development sustainable supply chain	Poverty alleviation
DBM02026	Sierra Leone	Palm Oil	Feasibility study	
DBM02031	Indonesia	Candlenut, Castor	Development sustainable supply chain	
DBM02032	Central and South America	Coffee	Development sustainable supply chain	Research
DBM02036	Indonesia	Palm Oil	Development sustainable supply chain	
DBM02037	South Africa	Oil seeds	Development sustainable supply chain	Capacity building
DBM02038	Indonesia	Palm Oil	Research	Capacity building
DBM02039	Indonesia	Palm Oil	Development sustainable supply chain	Capacity building
DBM02045	Mozambique	Supply chain	Development sustainable supply chain	Capacity building
DBM02047	Brazil / Indonesia / Mozambique / South Africa	Sugercane, Palm Oil, Jatropha, Waste	Development sustainable supply chain	
DBM02050	Mexico	Jatropha	Development sustainable supply chain	
DBM02053	Indonesia	Rice husk	Development sustainable supply chain	
DBI1006		Wood	Pilot plant	
DBI1010		Straw, Reed, Switchgrass	Feasibility study	
DBI1013		Wood, Waste	Pilot plant	
DBI2002		Pyrolyse	Research project	
DBI2006		Bamboo		
DBI2007		Jatropha	Feasibility study	
DBI2009		Soy		
DBI2011		Soy, Sugarcane		

Summaries of all projects (which will be expanded with final reports in the coming months) are available at: http://www.agentschapnl.nl/biomass (click 'Projects')
Or direct link: http://english.agentschapnl.nl/topics/sustainable-entrepreneurship/sustainable-biomass/programmes/sustainable-biomass-projects

7 Brief overview of the EU import policies

7.1 Introduction

The most important and well-known trade barrier are import tariffs. Trade blocks like the EU have been using import tariffs as common practice to shield domestic agricultural and biofuel markets from foreign competition. The EU also has preferential trade agreements and generalized system of preferences (GSP) that grant preferential market access to certain countries.

7.2 Biofuel

For liquid biofuels, policy incentives such as tax exemptions and subsidies are granted to support domestic production, as well as import tariffs to limit imports, often geared towards the promotion of domestic agricultural and interests. This objective usually has higher priority over the promotion of biofuels with economic, energetic or environmental advantages. Below are examples:

Biodiesel: Anti-dumping measures

In 2009, to stop the “splash-and-dash” practiced by the US biodiesel traders, the EU has imposed the import levies against the US biodiesel. The “splash-and-dash” effect happened when American producers import pure biodiesel made somewhere else, blend with 1% of petro-diesel to the fuel (“splash”), collect the tax credit ($1 per gallon). After getting the credit, the tanker could continue to Europe (“dash”) and receive European fuel tax credits.

Again in May 2013, the EU has decided to impose tariffs on biodiesel from Argentina and Indonesia, which are basically made of soy and palm oil respectively. These exporters are punished for allegedly selling biodiesel in the EU below production cost, i.e. dumping. This is because differential export taxes exist in Argentina and Indonesia, favoring the production and export of the finished product biodiesel rather than soybean and palm oil. The levies is targeting as high as € 104.92 a metric ton, will last for six months and may be prolonged for five years (Bloomberg, 2013). It is difficult to quantify in how far these preferential export tariffs have *de facto* spurred production and export of biodiesel in both countries – however, the fact is that both countries continue to export biodiesel, while e.g. Malaysian biodiesel exports were very low in 2012 (Junginger et al., 2013). It is expected that the import taxes will bring these trade flows to a halt, similar to import of US biodiesel due to the five-year anti-dumping duties on biodiesel from the US implemented in 2009. Both Argentinian and Indonesian biodiesel accounted for about 20 percent each in the EU biodiesel market in 2012.

Domestic producers hope to reduce the pressure on the market after most of the highly competitive biodiesel is now prevented to enter the EU. Argentina has announced that will file an objection to the World Trade Organization (WTO), calling the tariffs an act of protectionism that lacks technical justification (Reuters, 2013). On the other hand, the EU also suspects possible trade-distorting aid for Argentinian and Indonesian exporters, and was threatening to impose separate anti-subsidy duties, but in August 2013 the EC decided not to adopt this (EBB, 2013).

The impact of this trade policy may lead to the flow of Indonesian and Argentinian biodiesel to the US. In January 2013, the US Congress has reinstated the tax credit of $1.00/gal for biodiesel. However, the export of palm methyl ester (PME) to the US is less likely since PME is regarded as less valuable compared with other biodiesel grades such as soy methyl ester (SME). Also, the Malaysian PME exports to the EU may also increase to fill the void left behind by Indonesia to a certain extent, but this has been constrained by high cost of feedstock (ICIS, 2013).

Bioethanol: Harmonizing the classification of ethanol/petrol blends

The EU maintains a higher tariff for undenatured ethanol than for denatured ethanol (€ 0.192 and € 0.102 per litre respectively). The tariffs do not distinguish between the different uses of ethanol (beverage, fuel, industrial). Many Member States (excl. the Netherlands) only permit blending with undenatured ethanol to protect domestic market by the higher tariff rate (Flach, 2013).

Since 2009, there was a steep increase of US ethanol entering the EU. 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) subject to a lower tariff, which is 6.5% of the custom value (or around € 0.035/l) (Junginger et al., 2013). At the EU side (most likely on shore) petrol is added to the ethanol (the percentage of petrol varies between 10 and 15) (Vierhout, 2012). This has given big impact to the domestic ethanol producers. To avoid this, the EU reclassified ethanol blends > 70% as CN 22072000 since 2012 (EC, 2013b). The EC has reportedly communicated that with the new regulation, in practice all blends will fall under the high tariff rate of denatured ethanol (i.e. € 0.102/l). The EU's decision contrasts with the abolishment of the ($ 0.142/l) import duty on ethanol charged by the US until the end of December 2010 (Kfouri, 2011). Also, the EU in February 2013 announced that it would impose a $ 0.0803/l tariff on US ethanol imports for five years after November 2011 complaint that US ethanol importers were selling the fuel below cost – or "dumping" – a practice that EU ethanol producers say caused ethanol prices in Europe to fall (Junginger et al., 2013).

Nevertheless, under the Everything But Arms Initiative, the Cotonou Agreement, the Euro-Med Agreements and the GSP Plus, many ethanol exporters, such as Guatemala, South Africa and Zimbabwe, has duty-free access opportunity for biofuel export to the EU. However, these imports are minor. Another significant producer, Pakistan, was removed from the GSP by the EU due to domestic producers' pressure. The relatively higher import duty favors the export of raw molasses over the value added products (Gustafsson, 2009).

7.3 Agriculture products

In addition to intervention mechanism, the grains market in EU is also controlled through a system of import duties and quotas. The European Economic Community (EEC) has sought to foster domestic production and exportation, and to discourage importation, mainly by means of price mechanisms (Nidera, 2013):

1. domestic price levels are kept relatively high.
2. prices of imported grain are kept at levels approximating those of domestic grain, by imposition of a special assessment, termed levy, bringing the lower world market price up to the domestic EEC price level,

3. exports from EEC are fostered through payment to the EEC exporter of restitution.

The EU developed a system where duties were set on the basis of separate reference prices for six grain types, including different types of wheat, maize, rye and sorghum. Also, the EU introduced a system of quotas for imported grains. The duty for imports outside the quota are subjected to a much higher duty. These measures are used from time to time to monitor the market. From January 2012, the quota for medium and low quality wheat is lowered taking into account of market loss arising from accession of Bulgaria and Romania to the EU in 2007. Another example is that the EC has suspended the import duties on certain grains for the first half of 2013 to ease the pressure on the EU market, especially for animal feed. More details about the tariff system is published by the EC (2013).

Compared with trade in other agricultural commodities, trade in whole oilseeds, particularly soybeans, is relatively unrestricted by tariffs and other border measures, but oilseed meals, and particularly vegetable oils, typically have higher tariffs. Agricultural tariff schedules for WTO member countries report the current maximum permissible duties. At the moment, the EU tariffs on oilseeds and on oilseed meals are zero, whereas duties on vegetable oils (except olive oil) range from 0 to 12.8% (EC, 2013). Together with other trade policies, these tariffs intend to shift trades toward whole oilseeds and away from higher value-added oilseed meals and vegetable oils. However, for oilseed meals, the EU sets the tariff to zero and imports large volume of meals due to high demand for feed. This has also given impacts on grains traded as feed.

7.4 Woody biomass

The situation is a bit different for wood, where the exporters play the crucial role with their trade policies in this arena. The reason could be the high demand and low supply in wood resources in the EU. For example, the export tariff rate in Russia has shown a significant impact on the EU import of Russian wood. Since 2007, the imports of Russian wood has dropped significantly after Russia implemented export duties to boost domestic wood processing industry. However, Russia is still the largest supplier of imported wood. Although the amount of imports is expected to grow in 2012 after Russia has decided to open up a low export duty quota for spruce and pine and allocate a relatively large share of it to the EU, however the EU imports from Russia do not increase much yet in 2012 (UN Comtrade, 2013). Finland, which traditionally has accounted for 50% or more of these imports, is likely to be the key beneficiary.

However to the authors’ knowledge, there are no measures on solid biofuels like wood pellets on both import and export sides.

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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	-	-
ii	Monitoring bodies and general statistics portals	Probos	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 Agentschap NL; 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 CN 15200000	Animal or vegetable fats and oils and their cleavage products; prepared animal fats; animal or vegetable waxes Glycerol, crude; glycerol waters and glycerol lyes
CN 29054500	Glycerol
CN 38249055 CN 38249091 CN 38260010 (since 2012) CN 38260090 CN 271020xx	Mixtures of mono-, di- and tri-, fatty acid esters of glycerol (emulsifiers for fats) Monoalkyl esters of fatty acids, with an ester content of 96.5%vol or more esters (FAMAE) Biodiesel and mixtures thereof, not containing or containing less than 70 % by weight of petroleum oils or oils obtained from bituminous minerals. 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 CN 12129300 CN 1213xxxx	Sugar beets Sugar cane 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 CN 200520xx	Potatoes prepared or preserved otherwise than by vinegar or acetic acid, frozen, other than products of heading 2006: Potatoes prepared or preserved otherwise than by vinegar or acetic acid, not frozen, other than products of heading 2006
CN 22071000 CN 22072000 CN 38249097	Undenatured ethyl alcohol of an alcoholic strength by volume of 80%vol or higher Ethyl alcohol and other spirits, denatured, of any strength Other chemical compounds

Appendix III Conversion factor for biomass

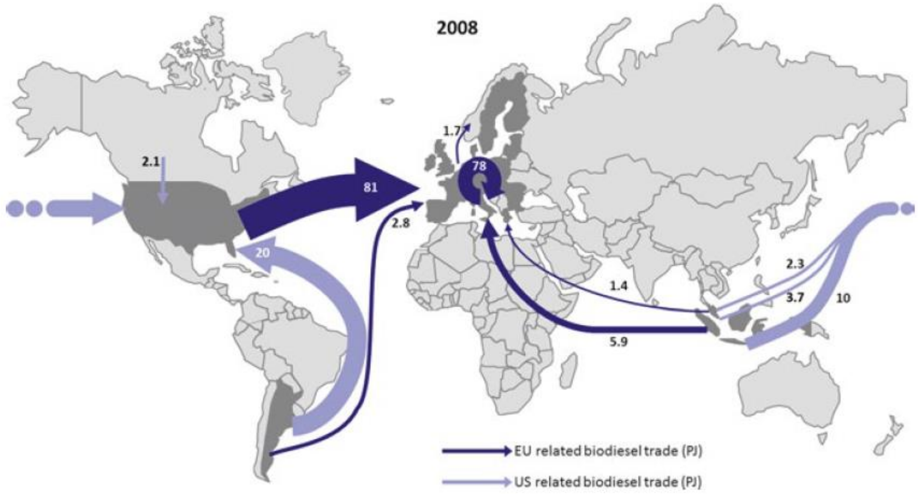
	Value	Unit
Woody biomass		
Density (Own estimation)	0.7	kg/m^3
Lower heating value [a]		
- Wood pellet	17	MJ/kg
- Wood chips	12	
- Waste wood and other woods	12	
Economic value [b,c]	Change with time	$/kg
Moisture content [d]		
- Air dry lumber (roundwood, sawn wood, wood panels)	12 – 15 (Assumed 15%)	%
- 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.	%

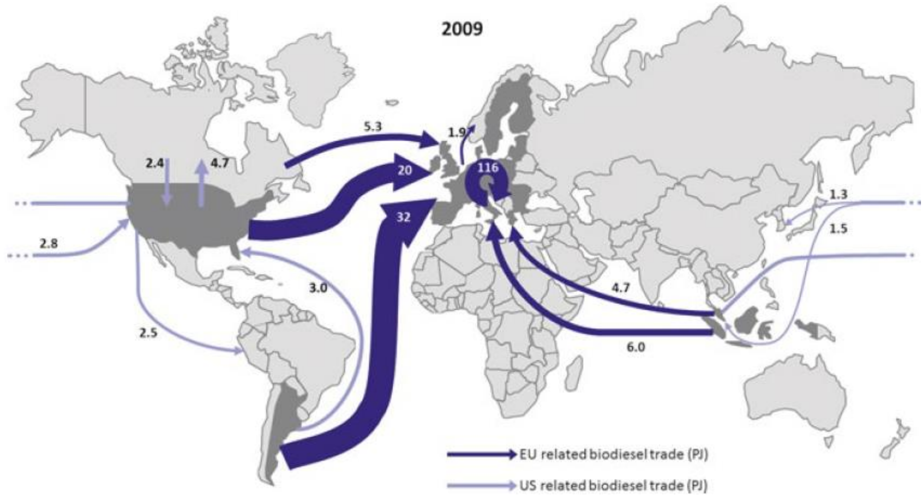
a) Segers R, Personal communication with Reinoud Segers (Statistical Researcher at CBS).
b) Argus Biomass Markets (2013). http://www.argusmedia.com/Bioenergy/Argus-Biomass-Markets [accessed 5 July 2013]
c) Index Mundi. Available at: http://www.indexmundi.com/
d) TIS (2013). Available at: http://www.tis-gdv.de/tis_e/ware/inhaltx.htm [accessed 13 November 2013]
e) Samuelsson R, Larsson SH, Thyrel, M, Lestander TA (2012) Moisture content and storage time influence the binding mechanisms in biofuel wood pellets. Applied Energy 99:109–115.
f) Watson WF, Stevenson R (2007). The Effect of Seasonal Variation in Wood Moisture Content on Chip Size and Kraft Pulping. Available at: http://www.tappi.org/Downloads/Conference-Papers/2007/07EPE/07EPE06.aspx [accessed 13 November 2013]
g) Hoefnagels R, Searcy E, Kara C, Cornelissen T, Junginger M; Jacobson J, Faaij A (2013) Lignocellulosic feedstock supply systems with intermodal and overseas transportation. Submitted to BioFPR.
h) EBTP (2011). EBTP Biofuels Fact Sheets 2011. Available at: ttp://www.biofuelstp.eu/fact_sheets.html [accessed 5 July 2013]
i) Platts (2013) BIOFUELSCAN. Available at: http://marketing2012.platts.com/content/BFGL2012-Biofuels-Free-Trial?mvr=ppc&gclid=CL67z6vf1rQCFcNV3godsG0AZQ [accessed 5 July 2013]

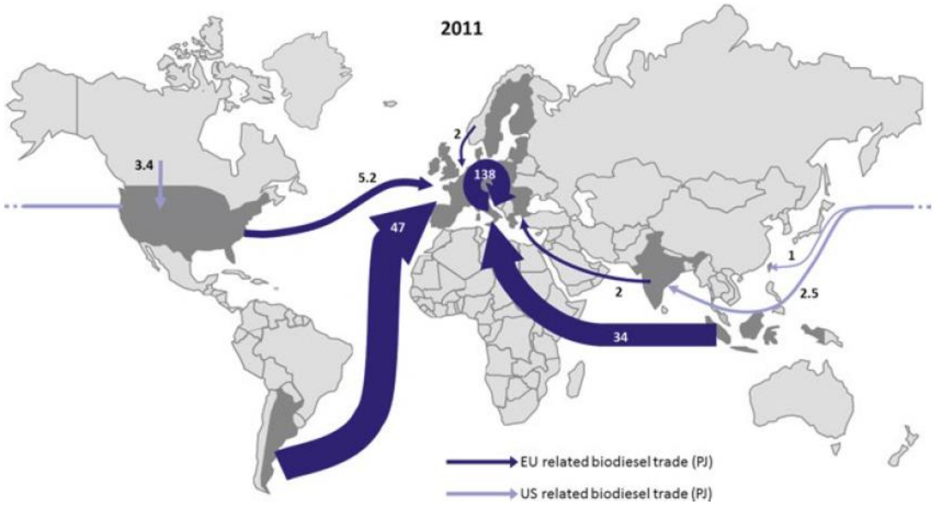
* UCO and animal fats are assumed to be pretreated before they were fed into biofuel production

Appendix IV Global trade flows of biofuels 2008 - 2011

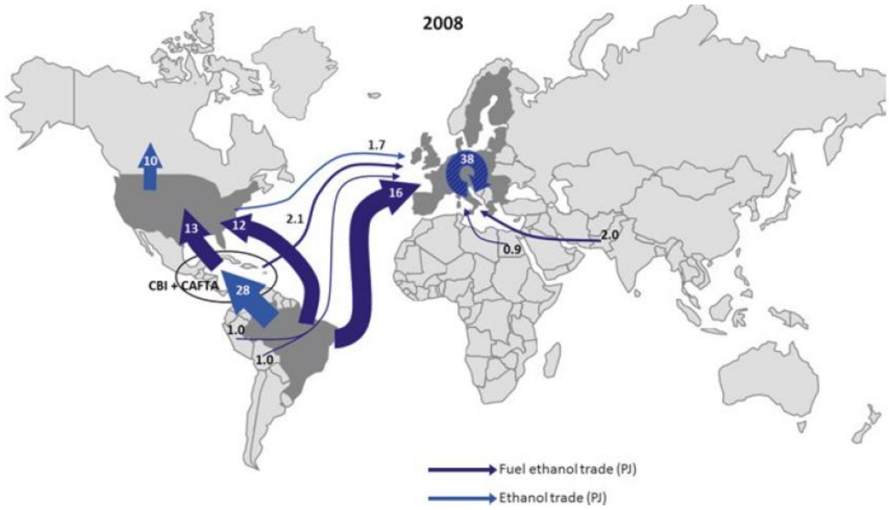
Biodiesel *(Adapted from Lamers, 2013)*

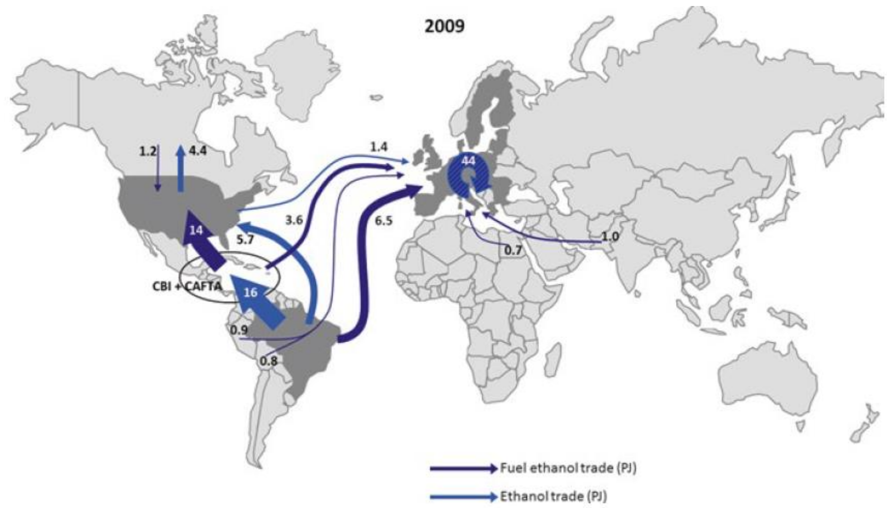


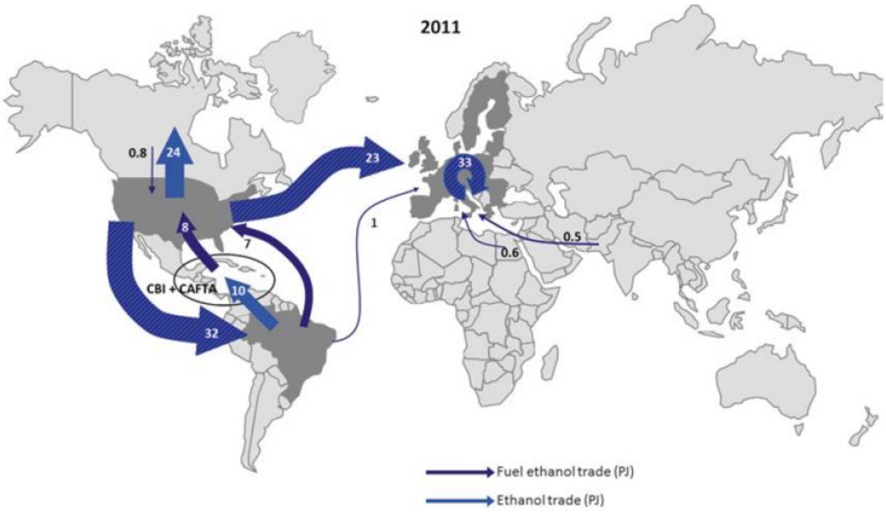




Fuel Ethanol *(Adapted from Lamers, 2013)*







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