photo by Clive Camm, Vancouver, 2010

Impact of promotion mechanisms for advanced and low-iLUC biofuels on markets

Used cooking oil and animal fats for biodiesel

IEA Bioenergy

Task 40: Sustainable International Bioenergy Trade

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** minor revision on 12 Nov 2014, pg. 43, in green font colour*

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List of Acronyms

ABP	Animal by-products
AF	Animal fat
BTL	Biomass-to-liquid
CIC	biofuel immission certificate, “Certificati di Immissione in Consumo” (Italy)
DfT	Department for Transport (UK)
DME	di-methyl ether
EC	European Commission
EU	European Union
FAME	Fatty Acid Methyl Ester
FOB	freight on board
Gcal	Giga-calories
GHG	greenhouse gas
GJ	Giga Joule
HVO	hydrotreated vegetable oil
IEA	International Energy Agency
iLUC	indirect land use change
ISCC	International Sustainability and Carbon Certification
kTOE	kilo tonne oil equivalent
kton	1000 metric tonnes
OS	obligated subject (for biofuel obligation system in Italy)
PVO	pure vegetable oil
RED	Renewable Energy Directive (2009/EC/28)
RFS	Renewable Fuels Standard (US)
RTFC	Renewable Transport Fuel Certificate (UK)
RTFO	Renewable Transport Fuel Obligation (UK)
TME	Tallow Methyl Ester
TSE	transmissible spongiform encephalopathy
UCO	Used Cooking Oil
UCOME	Used Cooking Oil Methyl Ester
US	United States

1. Introduction

1.1. Background

With current discussions on indirect effects of biofuels (the 'indirect land use change or iLUC debate'), and the aim to broaden feedstocks to non-food biomass, policies are trying to put focus on biofuels from waste, residues and lignocellulose materials, so called 'advanced' biofuels with low iLUC impact. Next to the general biofuel incentives, these biofuels are getting extra support through specific promotion mechanisms. Examples are the double-counting mechanism for advanced biofuels in the EU, and the specific targets for advanced biofuels in the US.

While technologically challenging lignocellulosic ('2nd generation') biofuels are developing slower than expected, markets so far seem to have focused on cheaper options, using waste and residues or cheap feedstocks in more conventional biofuel technologies to take advantage of these extra incentives. Typical examples are used cooking oil or animal fats which are used for biodiesel production in the EU, or sugarcane ethanol to fulfil advanced biofuels targets in the US.

However well these policy measures intended to be, some of these may create unintended effects. These promotion mechanisms induce market movements and also trading of specific biomass and biofuel types. Other applications relying on these (residue) materials - traditionally very cheap feedstocks - may be impacted by this, both in terms of available volumes, and in terms of feedstock prices.

1.2. Scope of the study

In this study, some typical cases are presented where promotion mechanisms for advanced biofuels have had an impact on markets and trade, or may be anticipated to impact markets and trade in the future.

The study focuses on some concrete cases. The selected cases are:

1. **Used cooking oils and animal fats for biodiesel**: impact of the double-counting mechanism for advanced biofuels in the European Renewable Energy Directive on market prices and trade flows, analysed for the Netherlands and Italy.

2. **Sugarcane ethanol**: impact of the subtargets for specific advanced biofuels in the US Renewable Fuels Standard (RFS2), where sugarcane ethanol is classified as 'advanced biofuel'. This has had a clear impact on prices and trade patterns between Brazil and the US.

The other two are more prospective cases, where we can learn from a stimulated demand for straw or woody biomass in the past (for stationary bioenergy). With the introduction of advanced biofuel technologies (based on lignocellulosic feedstocks), these feedstocks may experience an additional demand for biofuels production (also stimulated by specific promotion mechanisms such as double counting):

3. **Crop residues (straw) for bioenergy**: straw may play an important role for advanced biofuels in the future. In countries such as Germany, Denmark or Poland, this is an emerging feedstock for energy and biofuels. There are already some experiences we can take into account from the promotion of straw for stationary energy, e.g. in Denmark.

4. **International trade of US wood pellets for bioenergy in the EU**: Renewable Energy promotion in certain EU Member States is causing considerable trade flows from the US to the EU. There is clear that there are interactions with existing wood markets and forestry practises. In the future there may be additional effects when demand for cellulose-based biofuels enters these markets.

For each case, the specific relevant promotion mechanisms in place, volume and price evolutions of the specific feedstocks, emerging trade patterns and impact on other applications/markets are discussed. Impacts can be increased competition or additional pressure to ecosystems; however, it may also induce new possibilities and synergies for certain markets. Potential future impacts are also anticipated, e.g. on straw or woody biomass when advanced biofuel technologies get more mature.

This report contains the first case study on used cooking oils and animal fats which are qualified as advanced biofuels in European countries. The study has focused on the Netherlands and Italy.

2. Double counting advanced biofuels in the EU

2.1 Renewable Energy Directive

According to the Renewable Energy Directive[1] (RED) the share of renewable energy in the transport sector must rise to a minimum of 10% in every European Member State in 2020. While electric vehicles can contribute to this target, the main share is expected to be covered by biofuels.
The Directive aims to promote only biofuels which fulfil certain sustainability criteria, i.e. they need to generate substantial greenhouse gas (GHG) savings if compared to fossil fuels' emissions, and they should not cause negative impacts on land use in terms of biodiversity and carbon stock.

The use of **waste, residues, non-food cellulosic material and lignocellulosic material** for the production of biofuels is supported as a favourable alternative to traditional agricultural commodities-based feedstocks. In order to stimulate the use of such feedstocks, the RED foresees that biofuels from these feedstock types can be counted double towards the renewable energy in transport target (RED, Art.21). In practice countries can fulfil their target with half the amount of biofuels, and when applied to fuel distributors, they can be allowed to blend only half of the biofuel into fossil fuel in order to reach their blending obligations if the respective biofuel was produced from waste, residues or lignocellulose. This incentive is widely known as ***double counting***.

On 17 October 2012, the EC published a proposal to adapt the Renewable Energy Directive and the Fuel Quality Directive to limit global land conversion for biofuel production, and raise the climate benefits of biofuels used in the EU (the 'iLUC' proposal)[2]. The proposal would cap the contribution of food crop based biofuels towards the 10% renewable energy in transport target to 5%, increase the greenhouse gas performance thresholds for new

[1] Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

[2] Proposal for a Directive amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EC and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources [COM(2012) 595]

installations, and include additional benefits for advanced (low-iLUC) biofuels. Biofuels from specific feedstocks could even be quadruple counted. The proposal is still highly debated, several amendments can be expected. The exact cap on food-crop based biofuels is a point of debate, as well as the potential application of iLUC factors, and which feedstocks could be entitled to have multiple counting. The quadruple counting mechanism will probably be abolished; double counting will stay, but following a positive list of feedstocks.

2.2 Implementation of double counting biofuels in the EU

The Renewable Energy Directive allows double counting in biofuels support mechanisms, but there is no uniform measure provided by the European Commission to implement the double counting mechanism on Member State level. Member States have implemented different measures in the market and applied different definitions to determine which feedstocks are eligible for double counting.

Table 1 is a small selection of non-uniform implementation taken from (ePURE, 2013) (*however the measures may have changed after the time of writing*).

Table 1. Implementation of double counting waste derived biofuels[3]

	DK	FR	DE	HU	IT	NL	ES	UK
UCO		x	x	x	x	x	x	x
Animal fat cat. I	x	x		x	x	x	?	x
Animal fat cat. II	x			x		x		?
Animal fat cat. IIII				x				
Molasses residues		?	x	?	?	?	?	

'x' means eligible for double counting, '?' means unknown, blank means not eligible

The main support policies implemented in EU Member States are[4]:

- ***Substitution obligations***, requiring fuel distributors to put a certain amount of biofuels (% share of transport fuel) to the market.
    - Art.21 biofuels can be counted double towards this target (not always implemented by Member States)
    - Different Member States have coupled this with certificates to demonstrate compliance. These certificates can be tradable, i.e. the obligated party pays another party for certificates showing he has put a certain volume of biofuels on the market.
    - In practice there should be a penalty for non-compliance.
- ***Tax reduction*** for biofuels compared to fossil fuels
    - Some countries still apply tax reduction for biofuels. In some cases there is a differentiated tax for Art.21 biofuels.

The main biofuels applied under the double-counting mechanism are:

- biodiesel (methyl ester) from used cooking oils and animal fats,
- HVO (hydrotreated vegetable oil) from used cooking oils and animal fats,
- biomethane from digestion of organic waste, manure or sludge

[3] ePURE (2013). Double counting, half measures: Study on the effectiveness of double counting as a support for advanced biofuels. Commissioned by ePURE and carried out by Meo Carbon Solutions, March 2013.

[4] B. Kampman et al. (2013). Bringing biofuels on the market - Options to increase EU biofuels volumes beyond the current blending limits. Study commissioned by the European Commission, DG Energy. CE Delft, July 2013.

Some advanced technologies are emerging; most of them are still in demonstration or pre-commercial production; so far their contribution to the transport biofuel targets is marginal:

- bio-ethanol from lignocellulose material, such as straw or woody biomass (in demo, IT)
- bio-methanol from crude glycerine (NL)
- bio-DME from black liquor (SE)
- Fischer-Tropsch diesel (BTL) from gasified woody biomass

Table 2 shows an overview of European countries which have significant volumes of double counting biofuels in their transport fuel consumption. The other EU member states have no or very limited amounts of double counting biofuels.

Table 2. Overview of double counting biofuels in EU Member States[5,6]

kTOE	**2009**	**2010**	**2011**	**2012**	**total biofuels* (in 2012)**	**Principle biofuels for double counting**	**Situation in relation to trade**
United Kingdom	165	298	565	441	888	Mostly UCO & animal fat (AF) biodiesel	Large import dependency
Germany	17	0	45	392	3018	Mostly UCO & AF biodiesel, some bio-methane	Moved from exporter of UCO & AF, to importer of biofuels of these feedstocks
Italy	38	38	64	340	1362	Mostly UCO & AF biodiesel	Large import dependency
Netherlands **	77	85	166 (102)	194 (131)	319 (384)	Mostly UCO & AF biodiesel and HVO; fractions of bio-methanol (from glycerine) and bio-methane	Large importer of UCO & AF; exporter of biodiesel of these feedstocks
Sweden	37	55	95	183	587	Important share of bio-methane (78 kTOE); HVO (from UCO & AF) share is growing; some DME and cellulosic ethanol	Bio-methane is domestic; HVO mostly imported
France	0	63	362	125	2717	Mostly UCO & AF biodiesel	Since 2013 the double counting share is limited to 125 kTOE, leading to UCO exports
Finland			52	105	255	Mostly HVO from UCO & AF	Importer of UCO & AF, exporter of HVO
Spain	131	154	95	n.a.	1927	Mostly UCO & AF biodiesel; marginal fraction of cellulosic ethanol	From 2011 Spain limited the amount of UCO/AF biofuel for double counting. Reduced domestic market led to exports.
Ireland	16	25	68	56	83	Mostly UCO & AF biodiesel	Increasing imports
Greece	5	12	20	24	125	Mostly UCO & AF biodiesel	Domestic market
Hungary			18	17	82	Mostly UCO & AF biodiesel	Domestic market
Austria			0	0	519	No domestic	Important production of UCO &

[5] MS (2013). Second progress report on the development of renewable energy, pursuant to Article 22 of Directive 2009/28/EC. Separate report of the 27 EU Member States on the years 2011-2012. Available on http://ec.europa.eu/energy/renewables/reports/2013_en.htm

[6] Eur'ObservER (2013). Biofuels Barometer 2012. July 2013.

						consumption of double counting biofuels	AF biodiesel (80 kTOE/yr); all exported to neighbour countries
TOTAL EU-27	***493***	***734***	***1564***	***1891***	***14422***		

** physical volumes, without double counting applied*

*** Numbers in bracket represents numbers taken from Dutch Emission Authority (NEa)[7]. NEa does not report real physical volumes, but the volumes that are claimed in a certain year to fulfil the obligation. There are several reasons for a difference between real physical volumes and volumes that are claimed; the most important ones are these two:*

(1) For the national renewable energy obligation for transport it is allowed to have more physical deliveries in one year and to compensate less deliveries in a later year. This freedom reduces the costs. NEa includes these administrative transfers in the data for chapter 3 in their report. However, for international energy statistics and the related RED reporting such administrative transfers do not exist;

(2) Biogas that is claimed for fulfilling the renewable energy obligation for transport (about 3% of total physical biofuel delivery in 2012) is usually not based on a physical delivery of biogas to transport but to a combination of a physical delivery of natural gas to transport and a certificate that proves that somewhere in the national natural gas grid a company injected upgraded biogas into the grid. This is a legal procedure to fulfil the obligation for renewable energy for transport. However, for international energy statistics and the related RED reporting such administrative transfers do not exist.

Overall more than 90% of double counting biofuels in the EU are based on used cooking oils and animal fats.

When looking at the reported volumes of double counting biofuels in the EU Member States, the Member States can be divided in three groups:

- 9 countries with substantial markets, also relying on trade (in terms of feedstock and/or biofuel),
- 6 countries with a (small) domestic market,
- 13 countries where no double counting biofuels have been reported.

Countries like the UK, the Netherlands, Finland and Ireland put a clear focus on double counting biofuels, filling more than half of their biofuels target with these types of biofuels, thereby clearly relying on EU and international markets for acquiring the necessary feedstock.

It would be out of scope of this study to make a complete analysis of feedstocks used for double counting in the whole EU. In this study we have analysed the markets for used cooking oils and animal fats in **the Netherlands** and in **Italy**, and we will refer to a study done by Ecofys in 2013 for the **UK** Market[8].

1.3. Definitions

[7] NEa Report: Naleving jaarverplichting 2012 hernieuwbare energie vervoer en verplichting brandstoffen luchtverontreiniging. Available at: http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2013/09/06/naleving-jaarverplichting-2012-hernieuwbare-energie-vervoer-en-verplichting-brandstoffen-luchtverontreiniging.html

[8] Ecofys (2013) G. Toop et al. Trends in the UCO market. Study commissioned by the UK Department for Transport. November 2013

Used Cooking Oils (UCO) are oils and fats that have been used for cooking or frying in the food processing industry, restaurants, snack shops and households. UCO can be collected and recycled to be used for other purposes. UCO can originate from both vegetable and animal fats and oils.

Animal Fats are fats from slaughtered animals that are rendered into a variety of products. Animal fats can be general fats and tissues, or be rendered from internal organs, bones, heads, and to a small extent from hides or skins. Animal fats are part of the wider group of animal by-products (ABPs).

Animal by-products are products of animal origin mostly not intended for human consumption, such as heads, skins, horns, blood and bones. However, a small percentage of the highest quality animal fats and some bones if processed into gelatine are used for human consumption. Animal by-products can be classified by degree of quality, from high to low:

- Animal fats intended for human consumption.
- Category 3 materials are low risk materials. It includes parts of animals that have been passed fit for human consumption in a slaughterhouse but are not intended for consumption, either because they are not parts of animals that we normally eat (hides, hair, feathers, bones etc.) or for commercial reasons. Category 3 material also includes former foodstuffs (waste from food factories and retail premises such as butchers and supermarkets). Catering waste, including domestic kitchen waste is category 3 material.
- Category 2: animal fats that can be used for soil enhancement and for technical purposes, such as oleochemical products and special chemicals, as well as cosmetics. Examples of this category fats include manure and digestive tract content, (parts of) animals that have died from other causes than by being slaughtered for human consumption, including animals killed to eradicate an epizootic disease;
- Category 1 material is the highest risk, and consists principally of material that is considered a TSE risk, such as Specified Risk Material (those parts of an animal considered most likely to harbour a disease such as BSE, e.g. bovine brain & spinal cord). These materials must be disposed of by incineration or processing (pressure rendering) followed by incineration. They are not allowed to enter the human or animal food chains.

The three categories of ABPs were introduced by EU Regulation 1774/2002 (EC, 2002) that lays down health rules on animal by-products not intended for human consumption and were confirmed by the EU Regulation 1069/2009. If products of different categories are mixed, the entire mix is classified according to the lowest category in the mix.

Before animal slaughtering, a veterinary inspection takes place. If no signs of diseases are found, the animal fats will be further processed with a large portion of animal fats being classified as category 3 fats. After the veterinary inspection, some animal body parts (head, skin, hair, blood, placenta and manure) are removed from the carcass, leaving only: meat, fats, tissues, internal organs, horns/feet and bones. Except for the meat, the remaining parts are then rendered into various products including tallow and protein meal.

3. Promotion mechanisms for advanced biofuels in the Netherlands, UK and Italy

3.1 Double counting mechanism in the Netherlands

The double counting mechanism was implemented in the Netherlands already in 2009. It is described in paragraph 6 of the Ministerial Order for Renewable Energy in Transport (the new order of 2011 replaced the order of 2009). Only raw materials that cannot be used for products of a higher value than for generating electricity or heat, composting or using the lignocellulosic part as animal fodder, are eligible for double counting. Should a particular raw material have an alternative application, then a market analysis must be used to prove that there is an excess of this material available, before it may become eligible for double counting.[9] These biofuels are counted double for the annual obligation of renewable transport fuels. For example, a company only needs to sell 2.5% double-counted biofuels to fulfil the standard its target commitment of 5%.

To prove that the biofuels are eligible for double counting, companies must include the information accompanied by a verification statement issued by inspection bodies in the annual reports to the Dutch Emission Authority (NEa). The verification protocol for the double counting of biofuels should be used by the inspection bodies. This protocol includes basic rules, procedures and guidelines for the verification of biofuels counted double. The process consists of two phases: (i) gather information from the producer/suppliers, visit the production site, and draw up a verification plan (ii) actual audit and random checks with reports. More information is available on the RVO website.[10]

Bio-tickets

If the obliged parties have a surplus in blending (exceeds mandatory level), they can 'administratively' allocate this surplus to the coming year or trade this surplus with other obliged parties so that they can use for meeting their blending requirement. This surplus is traded in the form of 'bio-tickets'. In fact, bio-tickets need to be submitted to the authorities by fuel distributors to demonstrate compliance to the renewable transport fuel obligation. However, the amount of transactions is not publicly available. The trade of bio-tickets can be done with (i) direct contact with owners of bio-tickets, (ii) through industry associations such as VNPI or NOVE, (iii) through a broker like STX Services. For double counted biofuels, the factor for double counting has to be indicated on the bio-ticket. It is not allowed to split it into two single tickets. [11]

The NEa may impose a penalty order if a registered party fails to comply with these regulations, as well as administrative fine in the event of contravention. Also, the NEa may increase a registered party's annual obligation for a given calendar year by the amount by which that party fell short of its obligation to place biofuel on the Dutch market in the preceding year. [10] However it is not publicly known about the value of fine.

Note that the values in Figure 1 do not correspond to the price paid to the biofuel producer, but the value after delivery, including margins of trader / shipper, (possibly) intermediate

[9] Ministerial Order for Renewable Energy in Transport (2011) Section 6 and Annex IV. Available at: https://www.emissieautoriteit.nl/mediatheek/biobrandstoffen/wet-en-regelgeving/BJZ2011044006%20-%20Regulations%20on%20Renewable%20Energy%20in%20Transport%20-%20stcrt-2011-8235_EN.pdf

[10] RVO (2014) Double counting biofuels. Available at: http://english.rvo.nl/subsidies-programmes/gave/dutch-biofuels-policy/double-counting-biofuels

[11] NEa (2014) Dutch Emission Authority. Available at: https://www.emissieautoriteit.nl/

and filling station. The sharp fall in 2010 is due to the retrospective effect in late 2009 on double counted biofuel (i.e. when the regulations on double counting came into force). As a result, prices fell sharply in 2010. In 2011, 2012 and 2013, the mandatory blending percentage went up. As a result, the parties had less surplus and therefore less tickets to sell.

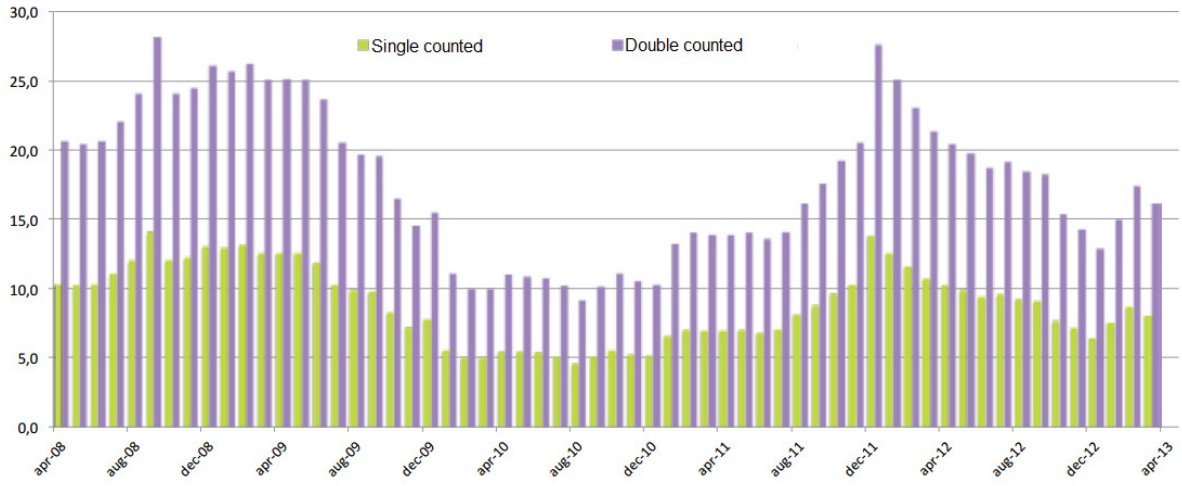


Figure 1. Price development of bio-tickets of liquid biofuels (in euros per bio-ticket)
Source: Groengas.nl[12]
** STX Services publishes a weekly overview of the used biodiesel and ethanol ticket prices.*

3.2 Promotion mechanisms for advanced biofuels in Italy

Since 2007 Italy promotes biofuels by means of a quota obligaton system[13]. According to this system, the obligated subjects (OSs), namely the parties who release for consumption gasoline and diesel to be used for motor transport, have to mix them with a well-established amount of sustainable biofuels.

The obligation, until 2013, was calculated on the basis of the calorific value of the fossil fuels released in the previous year, while from 2014 is based on the fossil fuels released in the current year. The biofuel's quota to be mixed increased over time; for 2014 the level is 4.5%. All kinds of biofuels can be applied to the mechanism.

OSs can also fulfil the obligation buying the so-called biofuel immission certificates ("*Certificati di Immissione in Consumo*" - **CICs**), issued by GSE[14] to the operators that actually release biofuels on the market. A CIC proves the release of 10 Gcal (~1toe) of biofuels. The price of a CIC in 2013 was about 400/450 €. Failure to fulfil the obligation by the OSs implies the payment of a penalty of a value between 600 and 900 €/CIC depending on the extent of the failure.

[12] Groengas.nl (2013). Biotickets voor groen gas en bio-LNG.
[13] Relevant Italian Laws: Law 21 February 2014, n.9; Decree 11 December 2013; Law 7 Agoust 2012, n. 134;
Legislative Decree 3 March 2011, n. 28; Decree 29 April 2008, n. 110; Decree 23 April 2008, n. 100; Law of 24 December 2007, n. 244
[14] GSE: Gestore dei Servizi Energetici S.p.A. is the state-owned company that promotes and supports renewable energy sources in Italy.

CICs banding

As mentioned above, a CIC generally proves the release of 10 Gcal of biofuels; anyway, there are two exceptions to this rule:

"8 Gcal" Bonus: Biofuels produced in the European Union from European food crops are awarded with one CIC every 8 Gcal. The same incentive is recognized if the OS releases any biofuel in mixtures in which the share of biofuels is equal or higher than 25% by volume. From July 2014, the "8 Gcal bonus" is no longer valid.

Double counting Bonus: In Italy the law establishes that the calorific value of the biofuels produced from wastes, residues, non-food cellulosic material, and lignocellulosic material[15] is worth double for the purposes of the calculation of the obligation. In this case, 10 Gcal of biofuels guarantees two CICs (**double counting**). The law n. 134/2012 states some limitations to the double counting biofuels. In particular, from November 2012:

- all wastes and residues must come from EU countries as well as the production of biofuels (constraint on the **"European origin"**);
- biofuel from waste and residues could cover only 20% of the obligation
- residues allowed for the double counting are:
    - glycerol waters;
    - fatty acids from the oil refining;
    - saponified fatty acids from neutralization of the acid part residual oil;
    - residues from the distillation of crude fatty acids and glycerol waters;
    - lubricating oils, vegetable oil derived from fatty acids;
    - marc and wine lees;
    - **animal fats of category 1**[16]

The constraint on the "European origin" and the 20% limit are no longer applied from the beginning of 2014. These limitations do not apply to biofuels produced from raw materials not suitable for food production, lignocellulosic material and algae.

In the case of double counting, the Italian legislation prescribes that, even using voluntary schemes, certificates of sustainability must contain the same information provided by the Italian National Certification System (including the country of origin of the raw material and the country of biodiesel production), in order to monitor the whole biofuel production chain. Therefore, if a voluntary system does not provide enough information, in order to access to double counting, the certification shall integrate information on the raw material producers, through the national system or other voluntary systems.

3.3 Promotion mechanisms for advanced biofuels in the UK

The Renewable Transport Fuel Obligation (RTFO) in the UK supports the government's policy on reducing greenhouse gas emissions from vehicles by encouraging 'sustainable' biofuels. Under the RTFO suppliers of transport and non-road mobile machinery fuel in the UK must be able to show that a percentage of the fuel they supply comes from renewable and sustainable sources. Fuel suppliers who supply at least 450,000 litres of fuel a year are affected. This includes suppliers of biofuels as well as suppliers of fossil fuel.

[15] Biofuel from wastes, residues, non-food cellulosic material, and ligno-cellulosic material according to Article 21(2) of RED

[16] From 2014, also animal fats of category 2 can obtain the double counting bonus.

Next to the obligation system, there were also duty differentials. In April 2010 the 20 pence per litre fuel duty differential for biofuels in the UK was stopped. However the duty differential remained in place for a further two years for biodiesel derived from Used Cooking Oil (UCO). Since April 2012 (start of Year 5 of the RTFO), the duty differential has been removed. Since December 2011 UCO-derived biodiesel has been eligible to receive two Renewable Transport Fuel Certificates (RTFCs) for each litre supplied (between December 2011 and March 2012, both support mechanisms for UCO biodiesel were in place) (Ecofys 2013).

4. Volumes of used cooking oils and fats for biodiesel

4.1 Volumes of used cooking oils and animal fats for biodiesel in the Netherlands

The total volume of biodiesels consumed in the Netherlands in 2010-2012 amounted 0.10 million tonnes, 0.29 million tonnes and 0.26 million tonnes respectively in the three consecutive years.[17,18]
The nominal share of biodiesel in total Dutch diesel consumption was 4.86% in 2012 – a considerable part through double counting. The Dutch biodiesel market is still heavily relying 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. In other words, the physical amount of biodiesel blended is less than 3.9% in 2012 (if 40% comes from double-counted biofuel, only 20% are physically blended).

In addition to UCO and AF, other advanced biofuel pathways have not entered the transport fuel stream in the Netherlands in considerable quantities, except methanol produced from crude glycerine (about 4% of the total compliance) (NEa, 2014).

Figure 2 shows the trade balance of oils and fats mixtures, which is assumed to represent the trade flows of UCO. The trade flows of "other animal fats" are also included as a comparison. Germany has been the largest trade partner of the Netherlands in terms of UCO volume. However, in terms of net import, Belgium, UK and the US are among the biggest suppliers. Interestingly, the import of oils and fats mixture from North America as well as Asia has grown remarkably from 2010. In 2009, the volume of these trade flows was negligible.

In the biofuel sector, a large share of biodiesel consumption comes from double counting, particularly domestic UCO and tallow from Germany. As shown in Figure 3, in 2012, a significant amount of biodiesel made of UCO was also imported 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 Dutch UCO & AF market is closely linked to the German market. The prices in both markets determine the supply and flow of UCO & AF. The demand in Germany has grown

[17] Goh CS, Junginger M, Faaij APC (2014) Monitoring sustainable biomass flows in a bio-based economy: General methodology development. Biofuels, Bioproducts, and Biorefining. 8(1): p83–102.
[18] Goh CS, Junginger M (2013) Sustainable biomass and bioenergy in the Netherlands: Report 2013. http://english.rvo.nl/sites/default/files/2013/12/Sustainable%20biomass%20and%20bioenergy%20in%20the%20Netherlands%20-%20Report%202013.pdf

substantially in the past few years.[19] Figure 4 and Figure 5 show the flows of UCO & AF among other oils and fats streams in the Netherlands in 2010 and 2012. Compared to 2010, a relatively large amount of UCO & AF has been processed to biofuels, however only a small percentage was being consumed domestically. This shows that the Netherlands has become a net exporter for both single- and double-counted biodiesel.

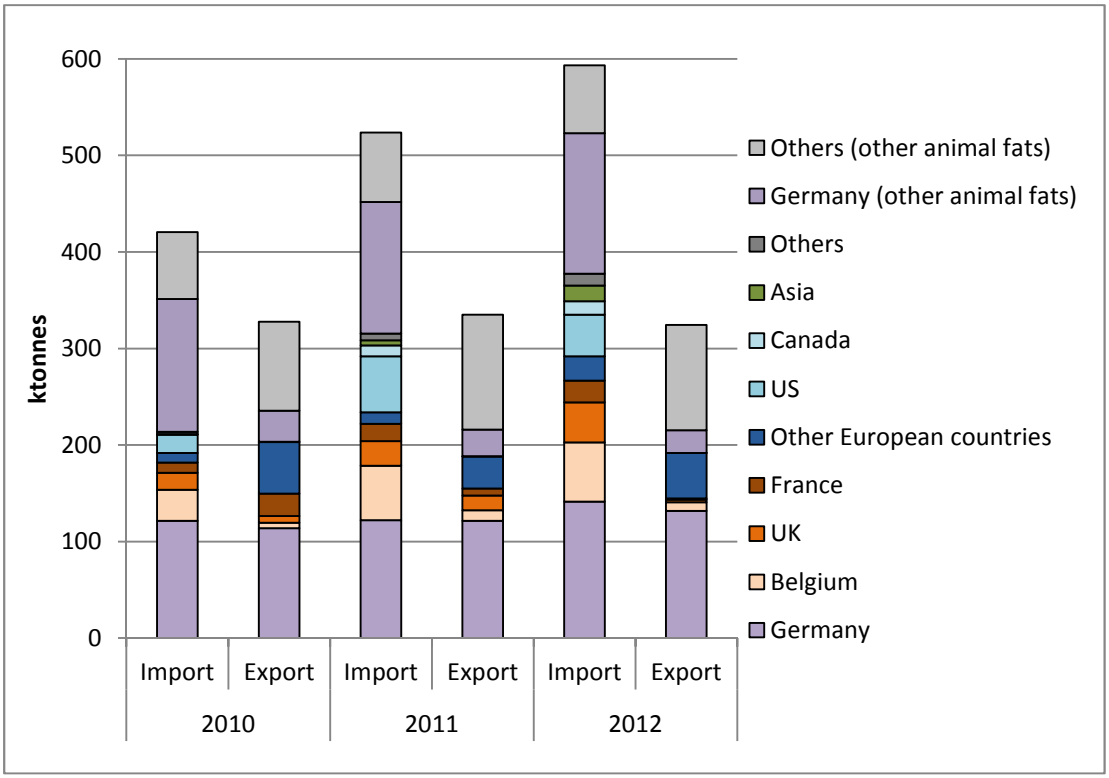


Figure 2. Trade balance of oils and fats mixtures* and other animal fats for the Netherlands [20]

** category "vetmengsels, dierlijk, dierlijk / plantaardig"*

Interview with a Dutch oils and fats expert (hereafter "Expert II"): (see Attachment 3 for the interview script). The amount of UCO/AF collected in the Netherlands is estimated to be 60 ktons per year. This amount fluctuates and is not stable the whole year. There are approximately 50 to 75 companies that collect UCO. Only a few of these companies also process the UCO and make it ready for further use. Only two recycling companies in The Netherlands produce biodiesel (Note: there is also companies that only collect and trade UCO/AF).

Interview with a Dutch UCO & AF collector (hereafter "Expert I"): Upon request, the name of the collector remains anonymous (see Attachment 1 for the interview script). The company collects UCO and AF mainly from the Netherlands and its neighbouring countries like Belgium, Germany and Luxembourg. They also import from other European countries, e.g. Finland and Spain. The collected volume is approximately 3 ktons per month (about 36 ktons

[19] Biofuelsdigest (2013) German biodiesel producer benefiting from RED's double-counting. August 14, 2013. Available at: http://www.biofuelsdigest.com/bdigest/2013/08/14/german-biodiesel-producer-benefiting-from-reds-double-counting/

[20] MVO (2013) Statistics Year Book 2012 (only in Dutch). Available at: http://77.245.87.41/Kernactiviteiten/MarktonderzoekenStatistiek/StatistischJaarboek/tabid/380/language/en-US/Default.aspx

annually), remaining stable in the past few years. The peak is usually in January, when a huge amount of UCO & AF are collected from 'Oliebol' sellers. Oliebol is a type of Dutch snack that is mainly consumed during the time of Christmas and New Year. During the winter when the average temperature is around 10°C the collected fats are solid and thus not that easy to collect. The collected UCO & AF are sold directly to Dutch and foreign based technical companies. There is no mediator in between. These companies process the materials to bio-fuels and also animal feed.

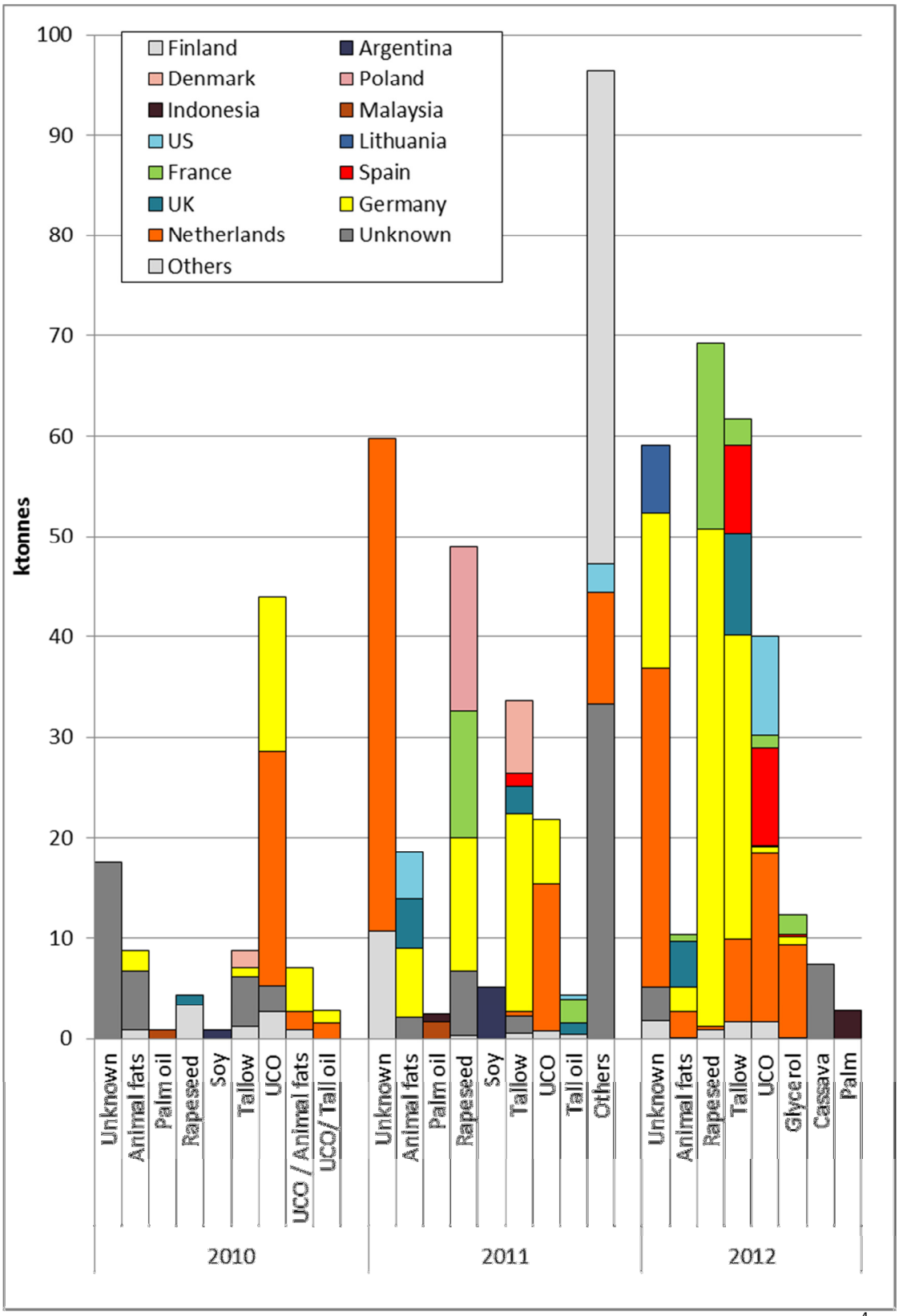


Figure 3. Biodiesel consumed in the Netherlands in 2010 - 2012 by feedstock and country [4]
Note: Tiny streams are omitted. 'Others' implies the feedstock is known to NEa but reported at aggregated level.

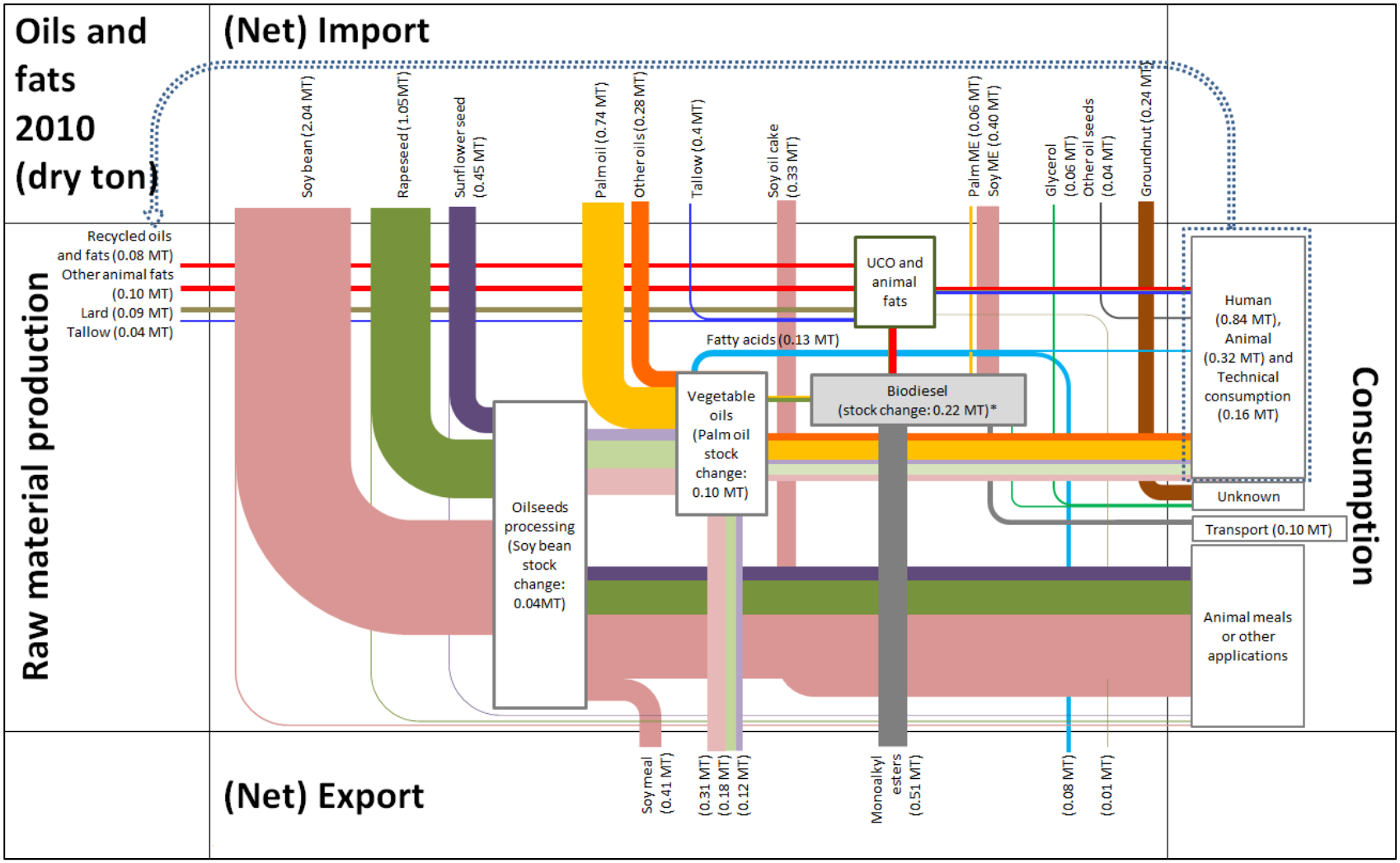


Figure 4. Mass balance for oils and fats flows in the Netherlands in 2010 (dry content)
Source: Goh et al, 2013

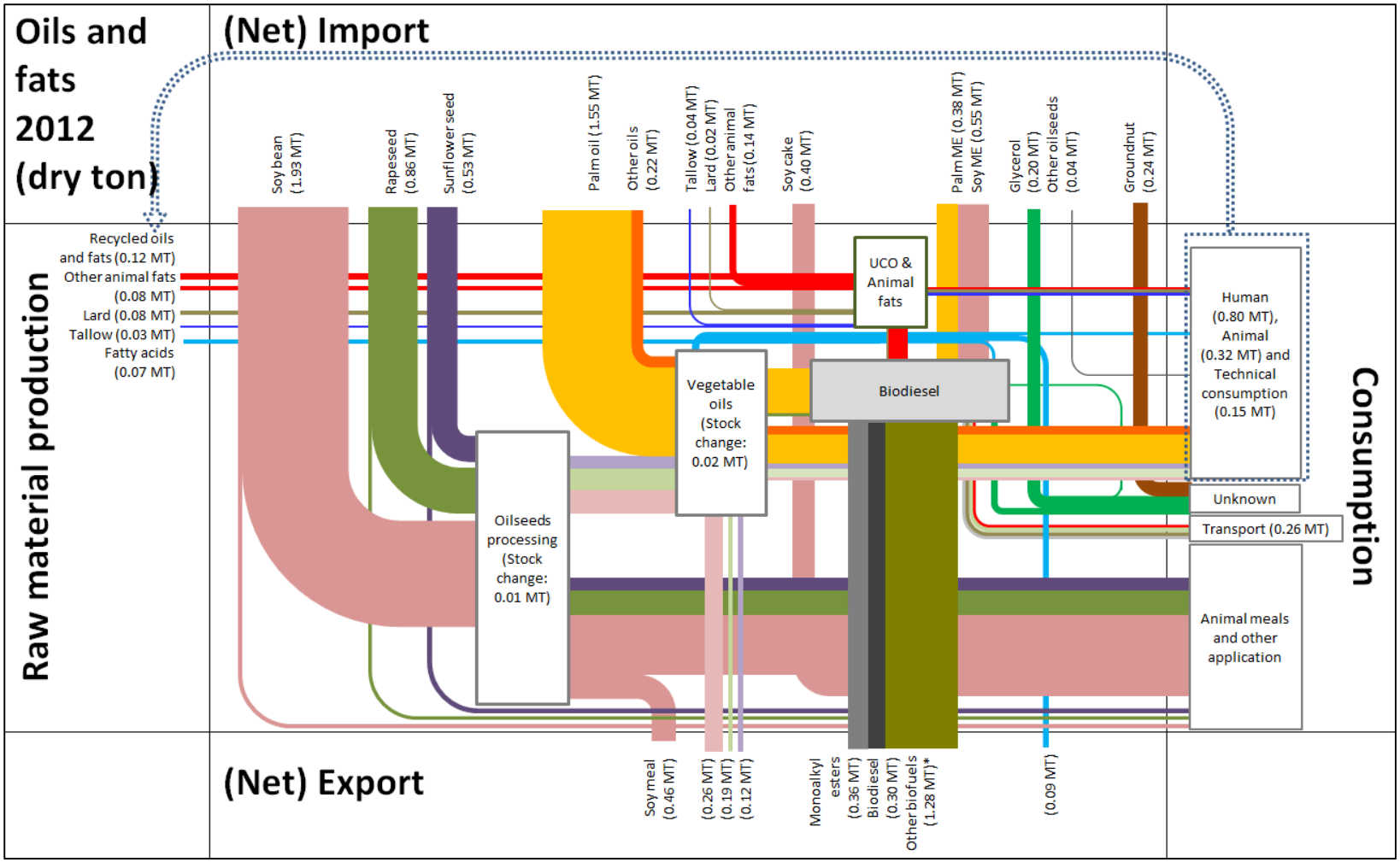


Figure 5. Mass balance for oils and fats flows in the Netherlands in 2012 (dry content)
Source: Goh et al, 2013

4.2 Volumes of used cooking oils and animal fats for biodiesel in Italy

From 2012, GSE is entitled to issue the CICs and to collect information from the obligated subjects, through self-declarations, about biofuels released in Italy. Data included into the self-declarations derive from the sustainability certificates. GSE stores the collected data in a database that was used to carry out the following analyses (GSE, 2014).

The year 2012 was the first with the new system of self-declarations and sustainability certification into force. Since it was a start-up period, the certification schemes provided less detailed information about the chain of custody of the biofuels than in the following year (i.e.: "European Union" or "Not European Union" as country of origin, or "Unknown" for feedstock if no banding was required).

Until November 2012, raw materials used to produce double counting biofuels could be defined in the sustainability certificates generally as "wastes" or "by-products". Therefore, in for 2012 definition in Table 3, the self-declaration contained the following feedstock definitions are used: "unknown undefined wastes", "undefined unknown by-products" and "undefined food crops".

Starting from 2013, after the end of the start-up phase, operators have only the possibility to define the origin of the raw materials from EU Countries as from "European Union" in general.

4.2.1 Biofuel quantities

The total quantity of biofuels released in Italy passed from 1583 ktonnes in 2012 to 1433 ktonnes in 2013. Meanwhile, the double counting biodiesel quantity dropped from 380 ktonnes to 129 ktonnes in one year. This is attributable to the special limitations to double counting biofuels into force throughout 2013 in Italy and to the accurate controls on the correctness of the information gathered.

The following figures show the quantities of biofuel released in Italy, considering biofuel typology and CIC banding. Tables are available in Annex B.

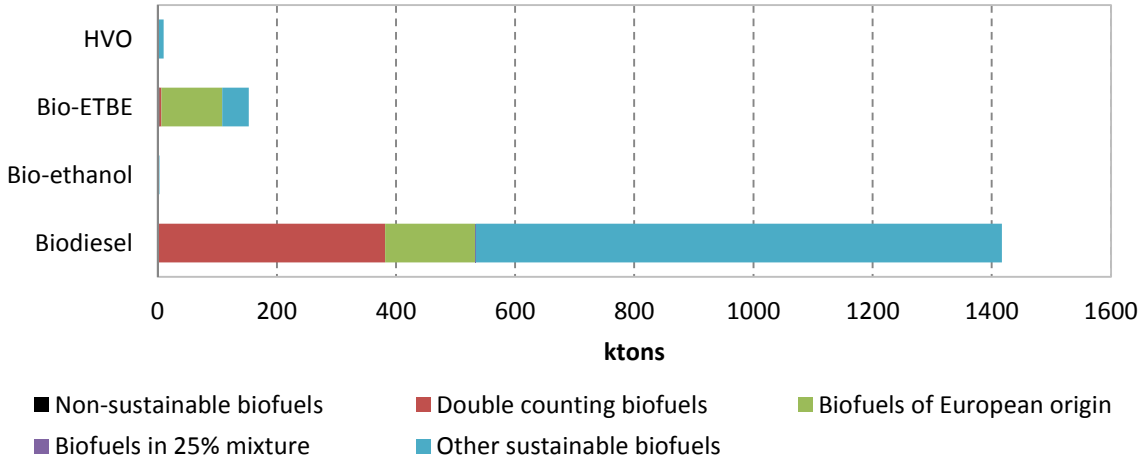


Figure 6. Distribution of biofuels in Italy in 2012
Source: GSE (2014)

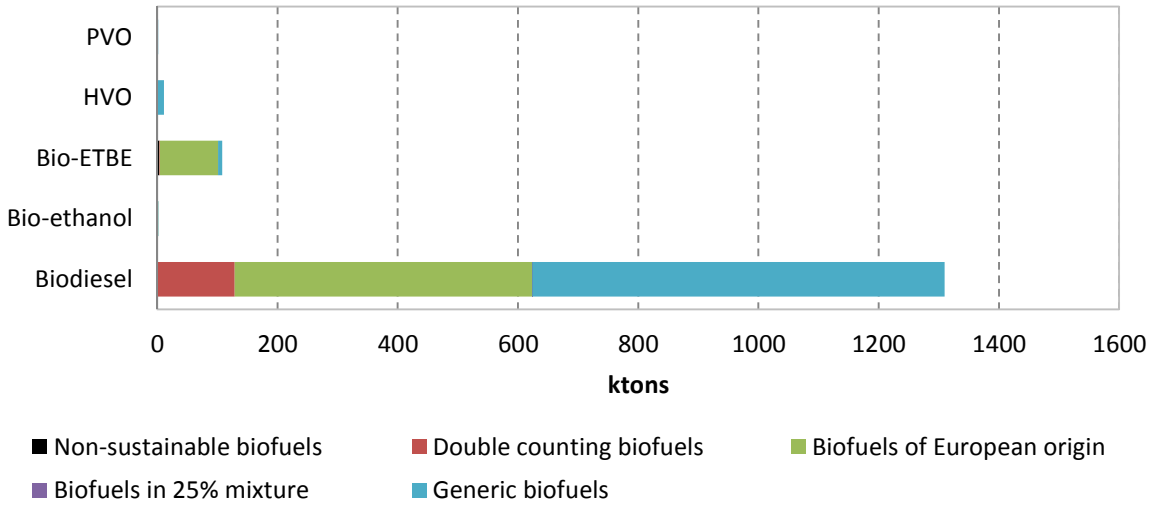


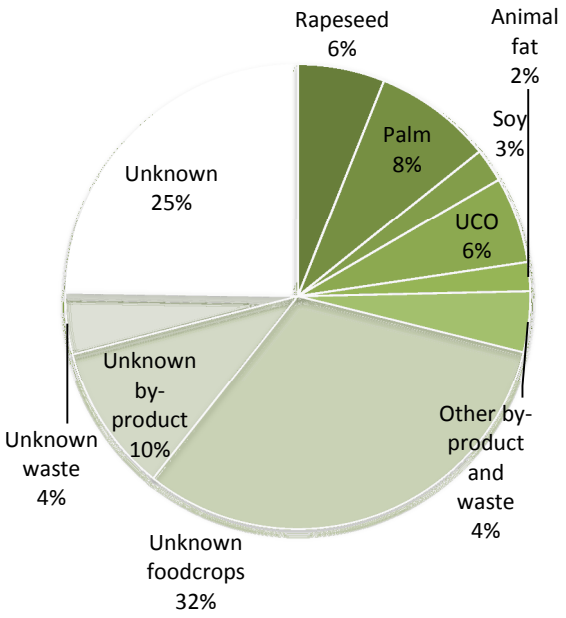
Figure 7. Distribution of biofuels in Italy in 2013
Source: GSE (2014)

4.2.2 Role of used cooking oils and animal fats in biodiesel

The following tables shows the feedstocks for biodiesel consumed in Italy in 2012 and 2013.

Table 3. Feedstocks for biodiesel in Italy in 2012
Source: GSE (2014)

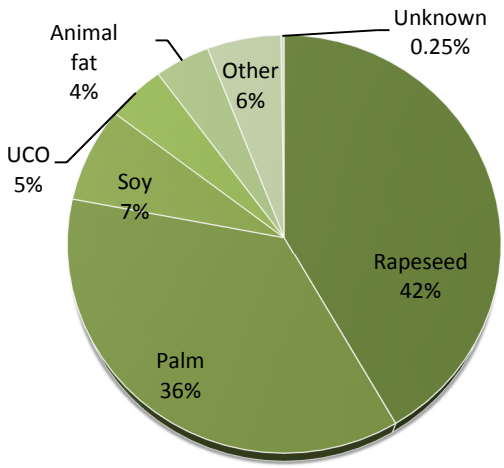
Feedstock	kton	ktoe
Rapeseed	86	76
Palm	117	103
Soy	33	29
UCO	86	76
Animal fat	28	25
Other by-product and waste	60	53
Undefined food crops	451	398
Undefined by-product	146	129
Undefined waste	60	53
Unknown	351	310
Total	**1417**	**1252**



Due to the large amount of raw materials defined as “unknown” in 2012, it is not possible to know exactly the trend of UCO and animal fat biodiesel in that year. Data show that the use of UCO biodiesel decreased in 2013, following the trend of the double counting biodiesel in general. Possibly this was a consequence of the introduction of the constraint on the “European origin”, into force throughout 2013 and partly also in 2012. It is expected that volumes of UCO biodiesel will increase again in 2014.

Table 4. Feedstocks for biodiesel in Italy in 2013
Source: GSE (2014)

Feedstock	kton	ktoe
Rapeseed	546	480
Palm	476	418
Soy	97	85
UCO	59	52
Animal fat	56	49
Other	74	65
Unknown	3	3
Total	**1.310**	**1.153**



4.2.3 Emerging trade patterns and sourcing regions

The GSE database on biofuels released in Italy allows to know the origin of the raw materials and the countries where the biodiesel production facilities are located. In this overview we will focus on biodiesel.

In 2012, 1417 ktons of biodiesel were released in Italy; in 2013, this amounted 1310 ktons. Figure 8 and Figure 9 show the countries of origin of the feedstock and of the biodiesel's production sites in 2012 and 2013.

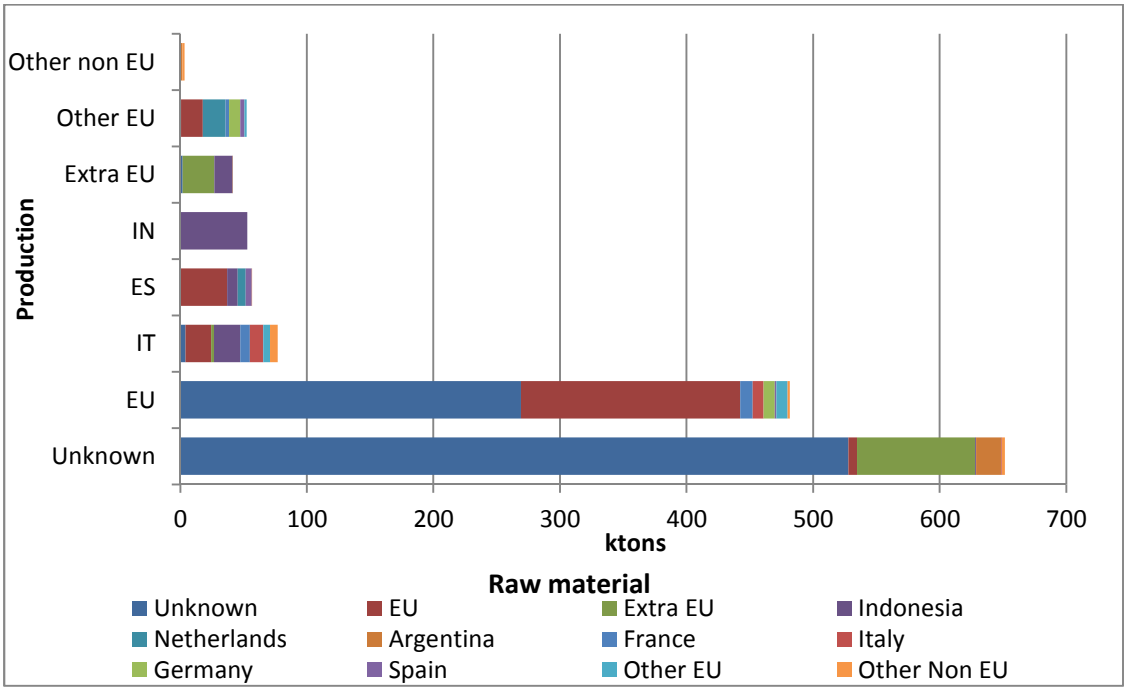


Figure 8. Origin of the raw materials and of the production of biodiesel for Italy in 2012
Source: GSE (2014)

As mentioned above, in 2012, due to the start-up period of the sustainability certification scheme there was a lack of information (possibility to report 'unknown'), which did not allow to monitor the market of biodiesel properly.

2013 data are clearer than the 2012 data, with less volumes of biofuels classified as 'unknown'. In 2013, Indonesian palm oil represented a significant share of the raw materials used to produce biodiesel sold in the Italian market, followed by German rapeseed oil.

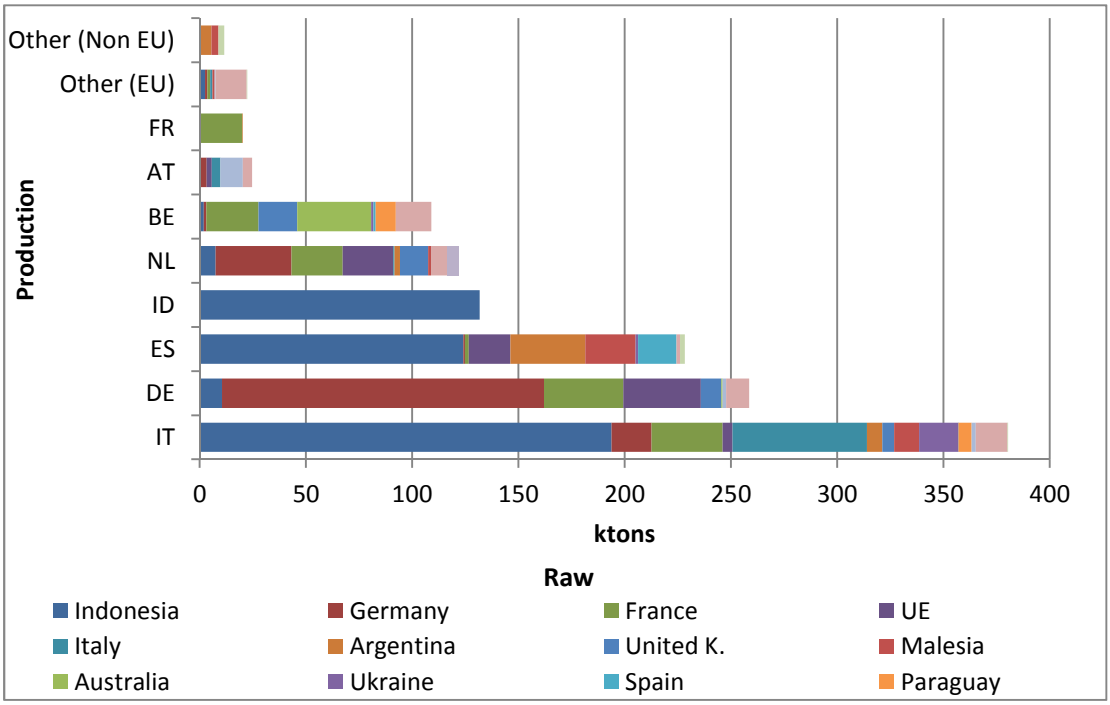


Figure 9: Origin of the raw materials and of the production of biodiesel for Italy in 2013
Source: GSE (2014)

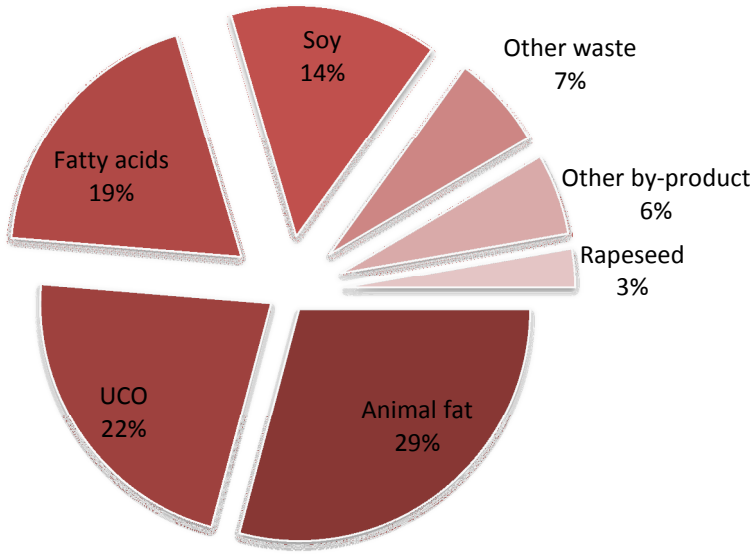


Figure 10. Raw materials of Italian (feedstock ánd production) biodiesel in 2013
Source: GSE (2014)

Italian biodiesel (considering both feedstock and production) represented in 2013 only 4.8% of the total biodiesel released, with a production of 63 ktons. Figure 10 shows how these are distributed: animal fats and UCOs were the most used raw materials in the national biodiesel

production, reaching more than half of the total production. In general, only 17% of the biodiesel produced in Italy came from dedicate crops.

4.2.4 Biodiesel from UCO

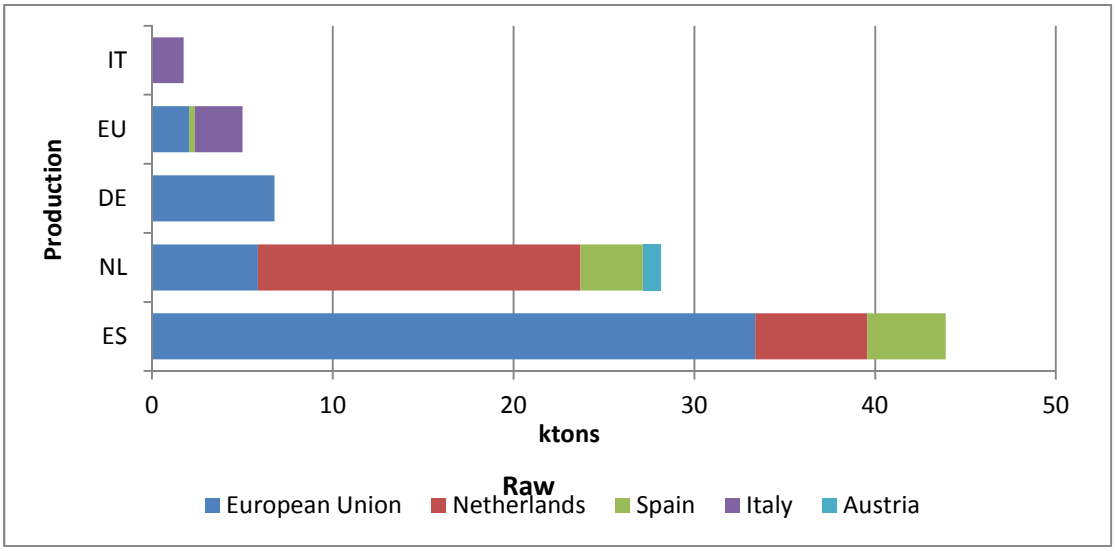


Figure 11. Origin of the raw materials and of the production of biodiesel from UCO for Italy in 2012
Source: GSE (2014)

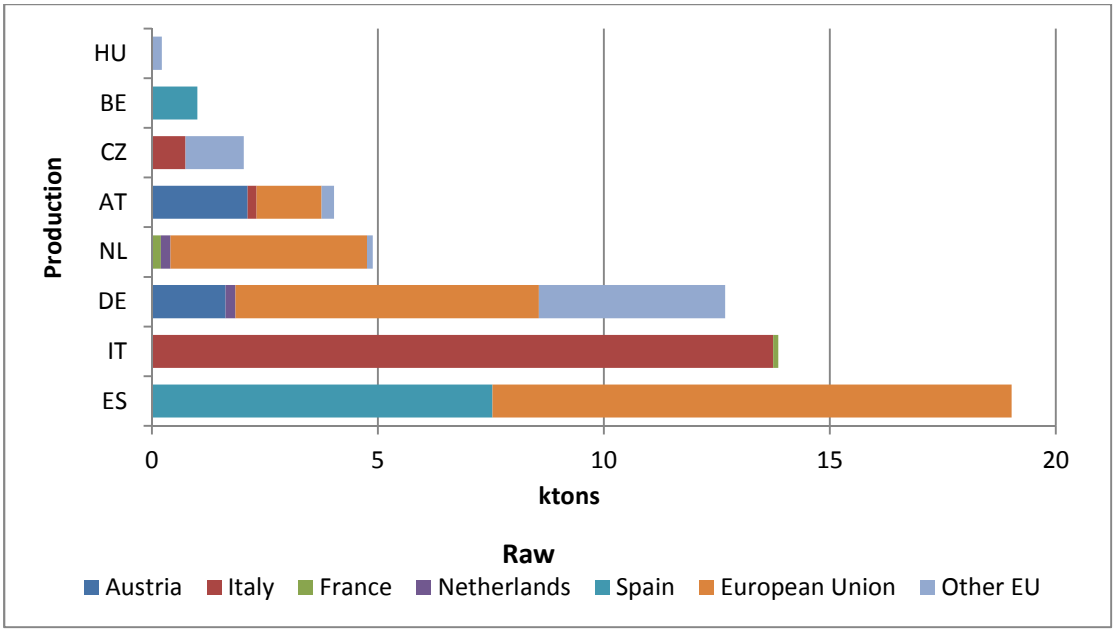


Figure 12. Origin of the raw materials and of the production of biodiesel from UCO for Italy in 2013
Source: GSE (2014)

UCO biodiesel produced in Spain was the most sold in Italy in 2013. Unfortunately, the country of origin of a large part of the feedstock used in Spain is uncertain because it was defined generally as "European Union" (see

Table 8 in Annex B). This generic origin concerns over 41% of the total UCO biodiesel.

Biodiesel from Italian UCOs grew from about 2 ktons to almost 14 ktons in one year, becoming the second most common feedstock (as seen on Figure 12) used in Italy to produce biodiesel. An effect of the constraint on the "European origin" for the double counting is that no UCO biodiesel is declared as coming from outside the EU.

Table 8 in Annex B shows that the UCO biodiesel market involves a large part of European countries (at least 13 countries).

4.2.5 Biodiesel from Animal fats

The verified Italian production of AF biodiesel has grown from 3 to 26 ktons in a year: the national and EU policies created a new interesting market for animal fats of category 1: in fact, about 18 ktons of biodiesel has been produced from this kind of waste in Italy.

Figure 14 shows a very bustling market, involving over 15 countries in the EU: for example, Italian animal fats are sold in Austria for the production of biodiesel that is imported in Italy and vice versa.

The generic origin "European Union" is less relevant than in the UCO sector, covering only 7% of total AF biodiesel.

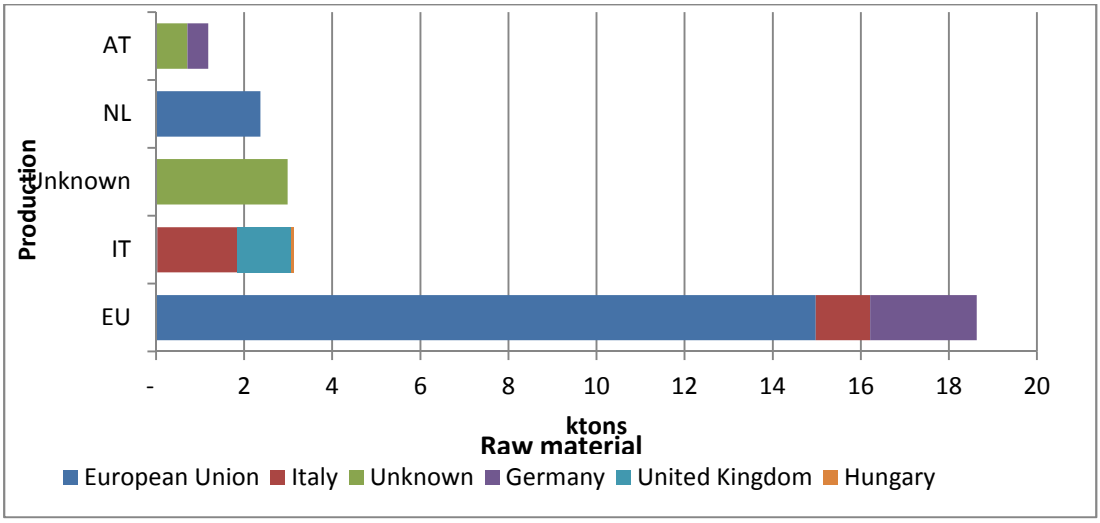


Figure 13. Origin of the raw materials and of the production of biodiesel from AF for Italy in 2012
Source: GSE (2014)

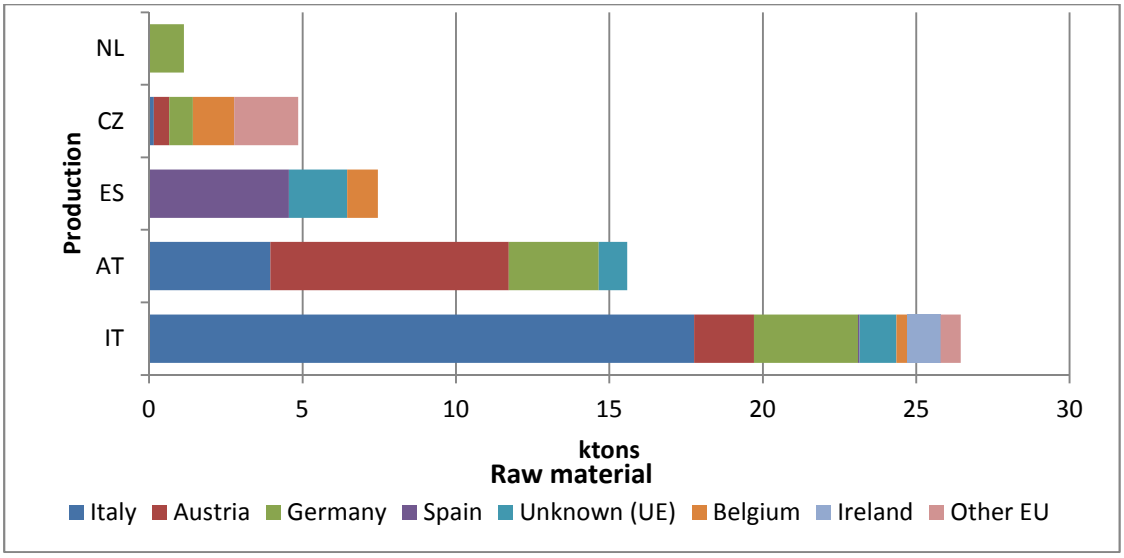


Figure 14. Origin of the raw materials and of the production of biodiesel from AF in Italy in 2013
Source: GSE (2014)
(German production excluded for graphic reasons)

4.3 Volumes of used cooking oils and animal fats for biodiesel in the UK

Figure 15 shows total UCO biodiesel volumes reported since the start of the RTFO in April 2008. The reported 'years' run from 15 April until 14 April the next year.

UCO biodiesel volumes have increased significantly since Years 1 and 2, with particularly high volumes reported in Year 4 (2011-2012). In year 5 and 6, volumes have been reduced to levels somewhat below year 3. For comparison, biodiesel from tallow (animal fat) is reported around 70-80 million litres in total, around half from the UK, the rest from other European countries.

As shown in the Figure, around 30% of the UCO originated from the UK, 30% from other European sources and 40% from outside Europe (most from the USA). The share of non-European sources is clearly growing. In year 6 the UCO originates from over 50 countries worldwide (RTFO, 2014).

The very large volume of UCO reported to be of Dutch origin in Years 3 and 4 has decreased markedly in Year 5 after the volume was questioned by the UK Department for Transport (DfT). The decrease may simply be because the volume of UCO from that source has decreased or it may be indicative of biodiesel being traded through the Netherlands and therefore potentially misreported as being of Dutch origin (i.e. mistakenly reporting the origin of the biodiesel or the place of purchase of the biodiesel, rather than the origin of the UCO feedstock itself). The DfT has worked with other Member States and with EC-recognised voluntary schemes to highlight the need to ensure full traceability and chain of custody checks throughout the UCO supply chain back to the origin of the used oil. (Ecofys, 2013)

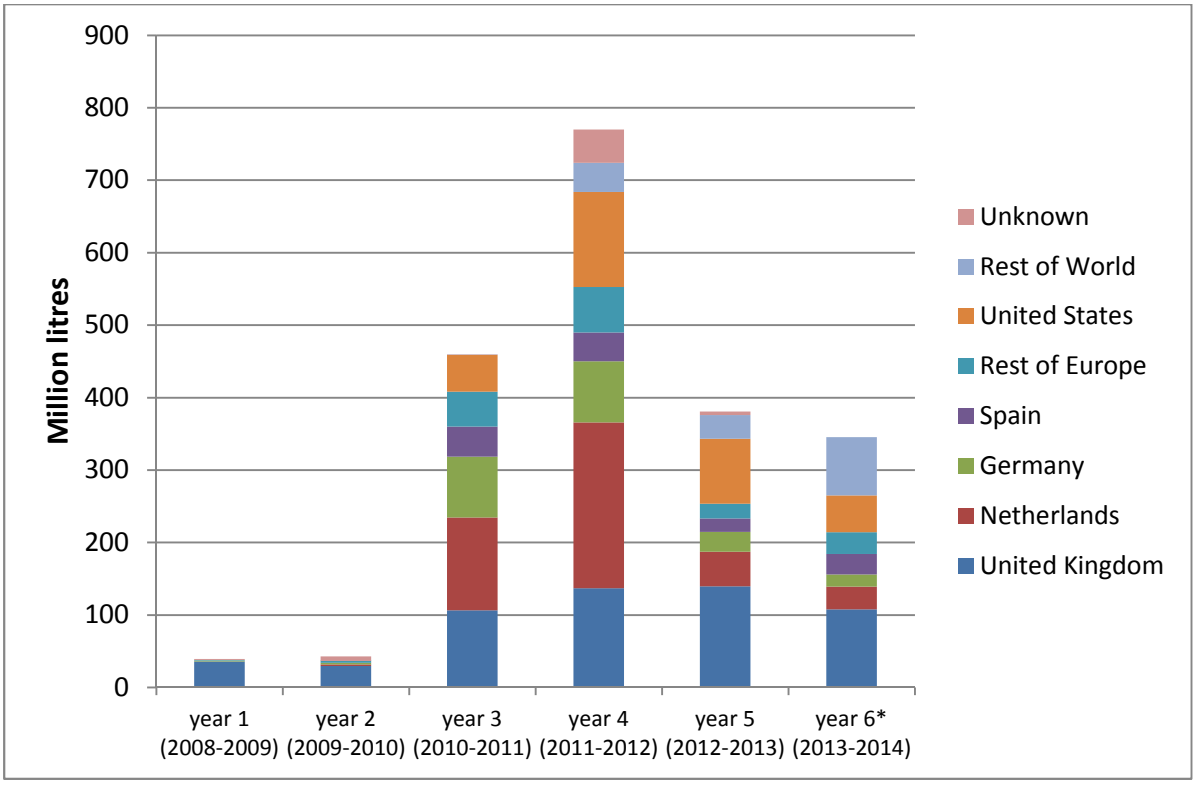


Figure 15. Main countries of origin for UCO reported under the RTFO in million litres.
Source of the data: Ecofys (2013) & DfT RTFO Biofuel Statistics (2014)
(years run from 15 April until 14 April, the next year)
** year 6 data are preliminary*

5. Price evolutions

5.1 Prices in the Netherlands

According to a Dutch UCO & AF collector, the prices of the UCO & AF differ markedly, based upon certification, quality, and volume. Different certifications are applied: ISCC-EU certificates for AF like fish oil & ISCC-DE for UCO. The current prices (in Feb 2014) are: 300 €/ton for non-certificated UCO & AF, 400 €/ton for AF certificated with ISCC-EU, 500 €/ton for UCO certificated with ISCC-DE. The historical prices of 2010-2013 are not published by the company, however, it is said that the trend is quite stable and does not have significant fluctuations for each categories.

On the other hand, Greenea, a broker in Europe specialized in waste-based feedstock and biodiesel, also reported the evolution of UCO, tallow, UCOME and TME prices in the ARA region in April – June 2014 as shown in Figure 16. The prices are relatively higher compared to the aforementioned source. The price of tallow cat 1 is much lower compared to UCO; however, the price gap is small when they are converted to methyl esters.

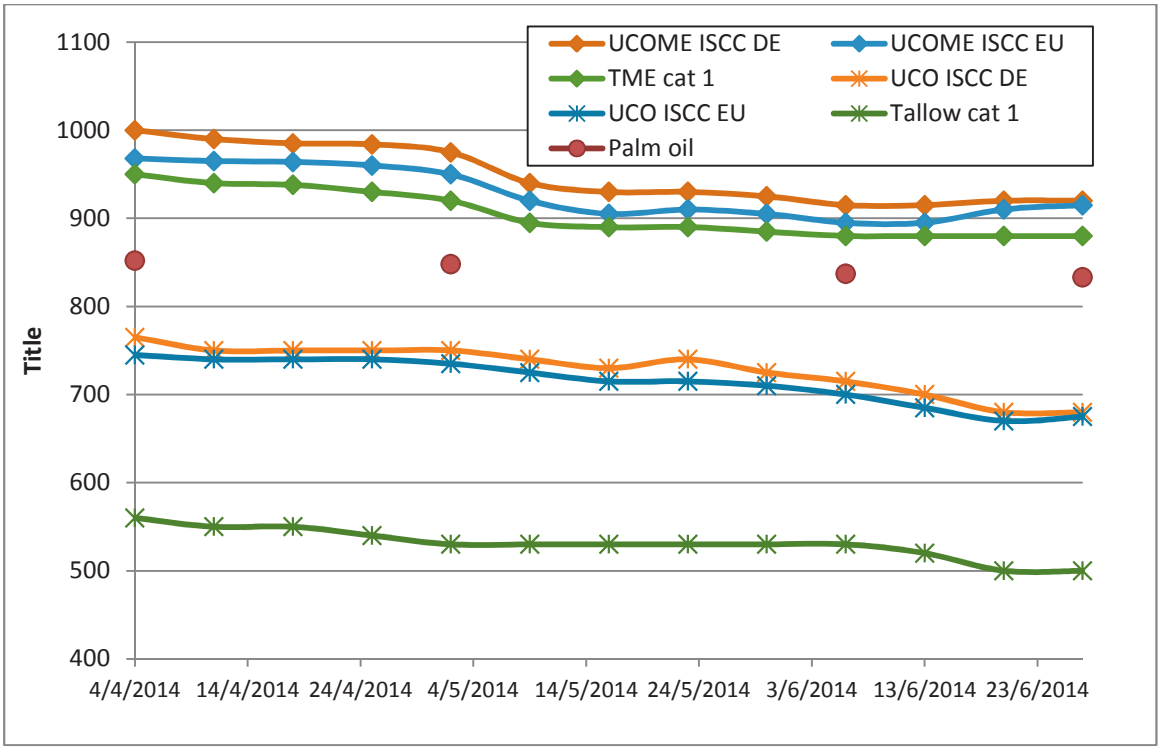


Figure 16. Evolution of UCO, tallow, UCOME and TME prices in April – June 2014
Source: Greenea; Indexmundi (palm oil)

As UCOME prices are declining at the time of writing, the UCO price level has also dropped significantly. Compared to virgin oil prices in Figure 17, the prices of UCO and AF still remain lower.

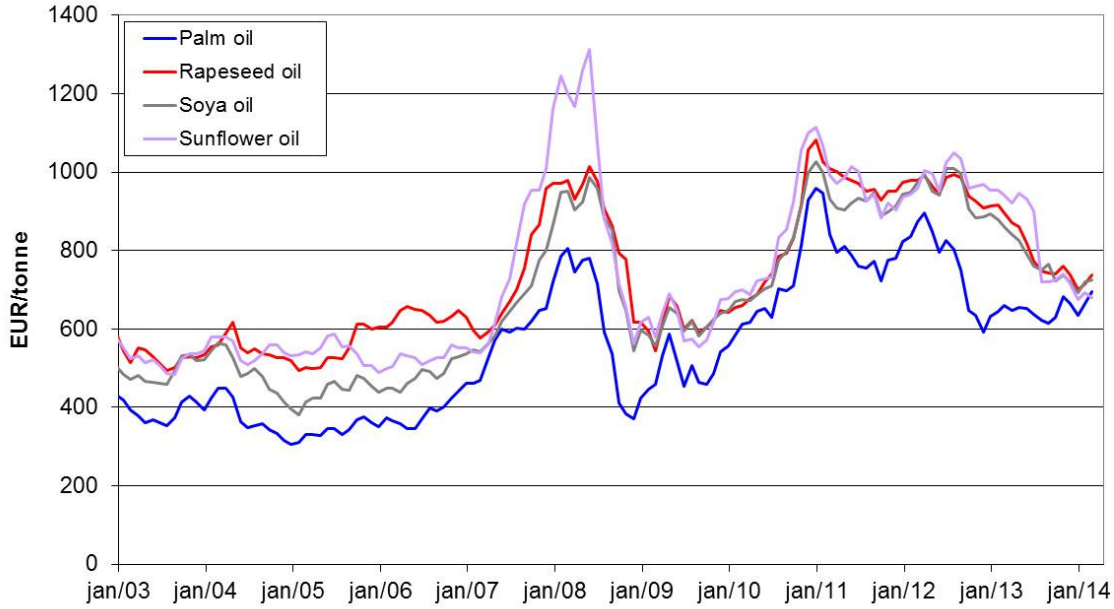


Figure 17. Evolution of vegetable oil prices, delivered in the Netherlands
Source of the data: FAOSTAT (2014)
Prices are CIF NW Europe for palm and sunflower oil; FOB ex-mill in NL for rapeseed and soy oil

5.2 Price evolutions in Italy

5.2.1 Used cooking oils

The price of UCO is influenced by several factors, such as[21]:

- percentage of acidity;
- percentage of MIU (moisture, insoluble impurities and unsaponifiable matters);
- quantity delivered and means of transport of the batches.

Therefore, the prices presented are for UCO with the following properties:

- acidity under 5%;
- MIU under 3%;
- batches of 25/30 tons delivered with dedicated trucks;
- no extraneous elements.

The price of UCO has risen strongly in the last years. In the nineties, when UCOs was considered as a common waste without an economic value, its price was around 100-200 ITL/ton (0.05-0.1 €/ton).

Currently, the price of UCO in Italy is around 400-450 €/ton. Sustainable certified UCO, used for the production of biodiesel or to produce electricity in power plants, has a higher price: it reaches 600-650 €/ton considering the UCO certified through the Italian National Certification scheme, which can be used only in Italy, and 700-750 €/ton for UCO certified through ISCC EU, which can be used in all Europe. According to a stakeholder, **a large part of Italian certified UCO is sold in the European market** (in Austria, Netherlands, Hungary, Bulgaria and Czech Republic)[22].

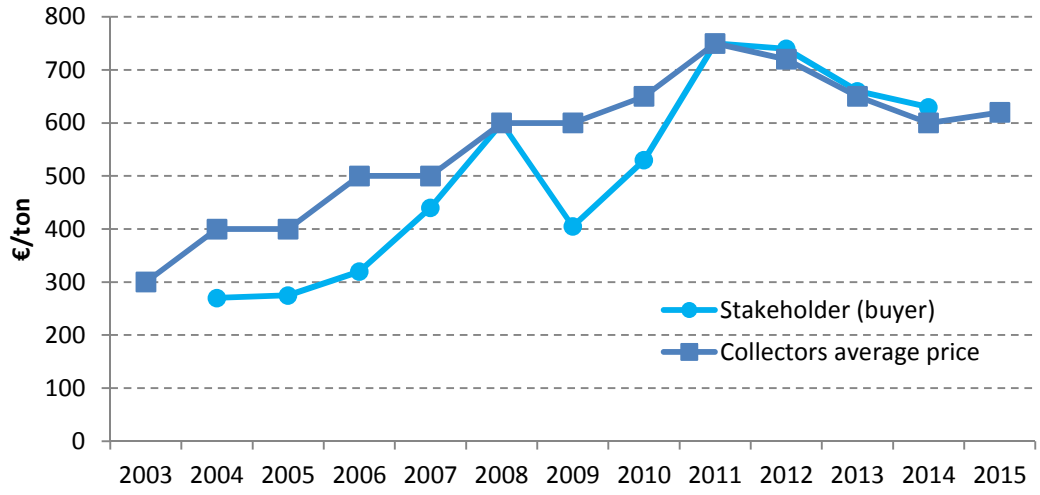


Figure 18. Price of sustainable used cooking oils in Italy [23]

In Figure 18, two different trends of UCOs prices are shown. The blue line indicates the average annual price according to an important biodiesel producer, while the orange line indicates the estimated selling price of regenerated oils according to the collectors. Even if

[21] Interview with UCO biodiesel producer (Rome, 2014). Upon request, the name remains anonymous.
[22] Interview with UCO collector (Rome, 2014). Upon request, the name remains anonymous.
[23] Interview with UCO biodiesel producer (2014) & CONOE (2013): Presentation on Used Cooking Oil market in Italy

the two lines are a bit different, it is clear that from 2004 to 2011 the price of UCO has doubled.

The increase in the UCO price has two main causes:

- UCOs, during the last twenty years, have been used in various sectors (chemical, energy, building, etc.); it has caused an increase in the demand, which widening the UCO market;
- The UCO price is strongly influenced by virgin oil such as rapeseed oil or palm oil[24]. Figure 19 confirms that the prices of used cooking oil have a trend very similar to that of common oils. The difference remains in the order of 200-300 €/tonne. In relative terms UCO prices are getting closer (40% of virgin oil price in 2004; 70% of virgin oil price in 2013). There is no clear sign that the double counting premium – which became operational in 2012 - has noticeably impacted the market prices.

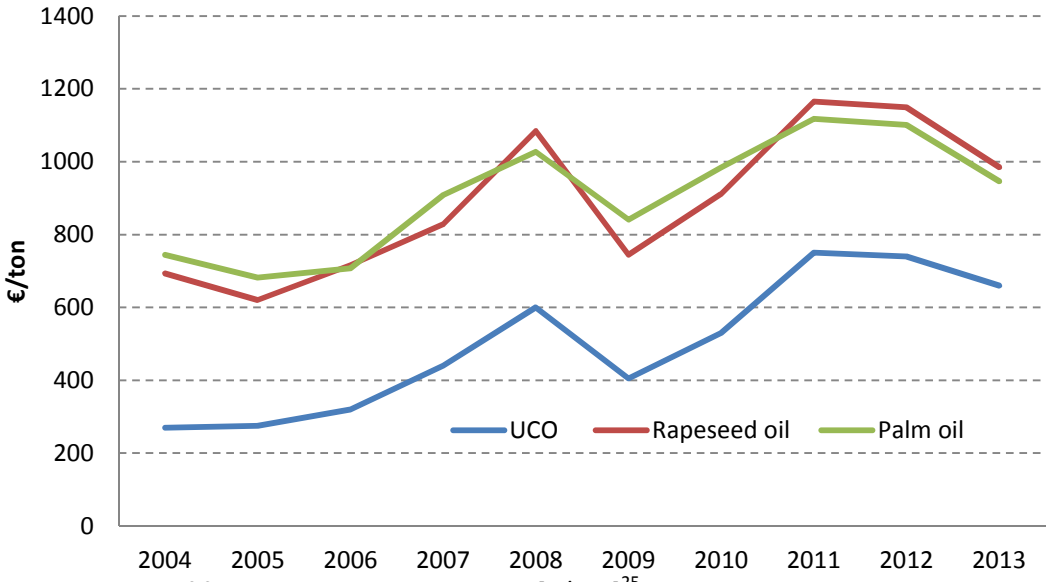


Figure 19. Prices of food commodities and UCO [€/ton][25]

5.2.2 Animal fats

The below graphs show the evolution of animal fats prices from 2008 until 2012.[26]

[24] OILECO (2014): Overview of the UCO market, emerged issues, and possible market outlets to promote.
[25] Source: Interview with UCO biodiesel producer (2014); data on food commodities are from Milan's Chamber of Commerce price database
[26] Assograssi (2014): Animal fat price database

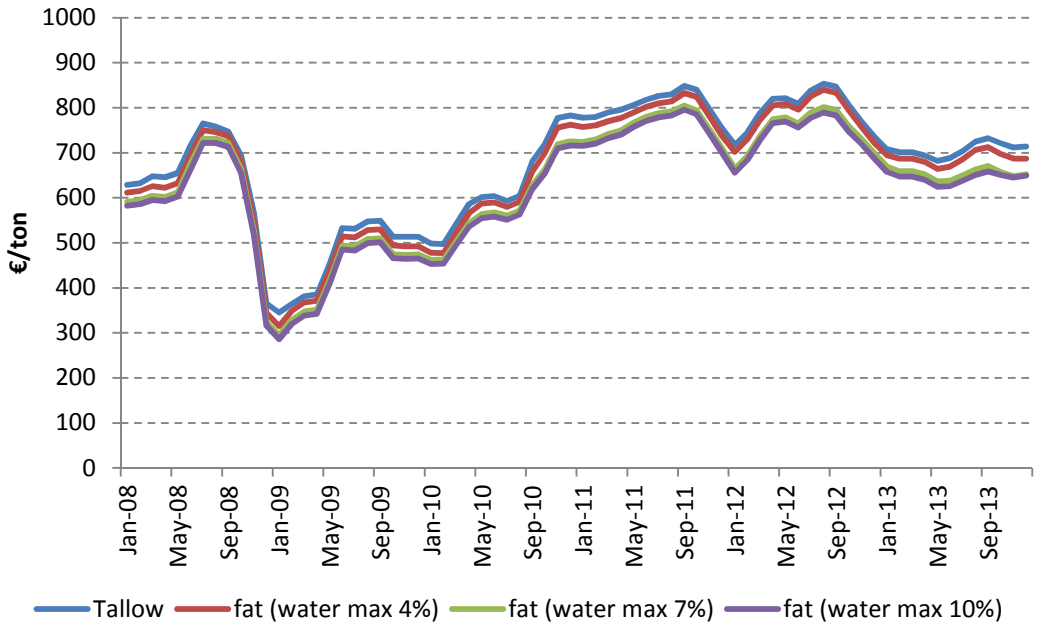


Figure 20. Price of animal fats for livestock use

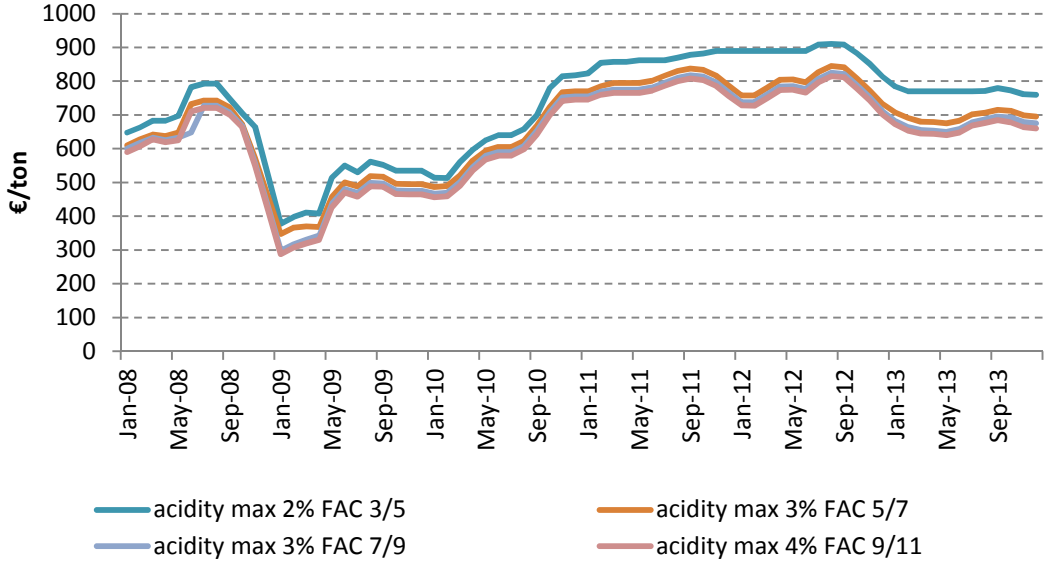


Figure 21. Price of beef tallow for industrial use

** FAC is a colour scale used to determine the purity of the tallow. Lower values indicate purer tallow.*

As Figure shows, the price trend of animal fats follows that of virgin oils. There is no clear sign that the double counting premium – which became operational in 2012 - has noticeably impacted the market prices.

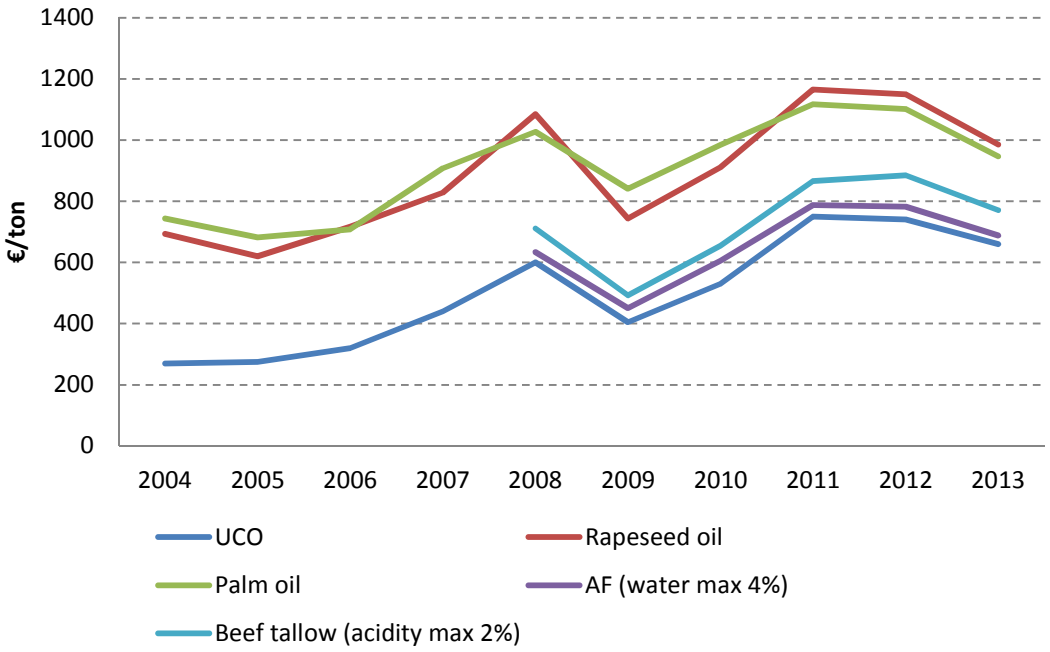


Figure 22. Prices of food commodities, UCO and animal fats [€/ton]

In Figure , however, it is possible to see an increase in the spread between the prices of the "best" beef tallow (acidity under 2%) for industrial use and those of the other beef tallows. According to the biodiesel producers, the double counting bonus, started in 2012, fostered the increase of the prices of the "best" beef tallows.

5.3 Prices in the UK

The UCO market has changed dramatically over the past years, although it is still relatively immature and can be intransparent. The price of UCO naturally increases along the supply chain from the generating source to final UCOME (biodiesel), as the UCO is continuously processed to improve its quality. Some estimations from Ecofys in 2013 on the basis of stakeholder interviews: whereas restaurants sell UCO for a maximum of 300 €/ton, small UCO collectors could charge up to 550 €/ton for filtered UCO. Larger UCO collectors and melting plants sell purified UCO ready for biodiesel production for 800-880 €/ton (Ecofys, 2013).

6. Traditional applications and impact on these markets

6.1 Impact on other markets in the Netherlands

Before the year 2003, **UCO** was mainly used as an animal feed ingredient or in oleochemistry. However, in 2003, the EU Animal Byproduct Regulation banned the use of UCO in animal feed due to health reasons. The first alternative use of UCO after 2003 was electricity production in Scandinavia. The Netherlands was one in the first batch of countries to promote the use of UCO for biodiesel, and was the first to implement the double counting measure in 2009.

It is not known if the use of **AF** for biofuels production has caused any direct impact on traditional applications, i.e. as animal feed ingredient and other technical use.

In terms of volume changes, Figure 22 shows the consumption trend of UCO and AF for different purposes in the Netherlands.

The consumption volume of UCO and AF has decreased significantly for animal consumption in 2011 and 2012, however it seems that fatty acid (by-product from oils and fats processing) has filled in the demand gap. On the other hand, since 2011, the volume of UCO and AF consumed for bioenergy production (in the Netherlands only biofuels) has become larger than the total volume of UCO and AF consumed for other uses.

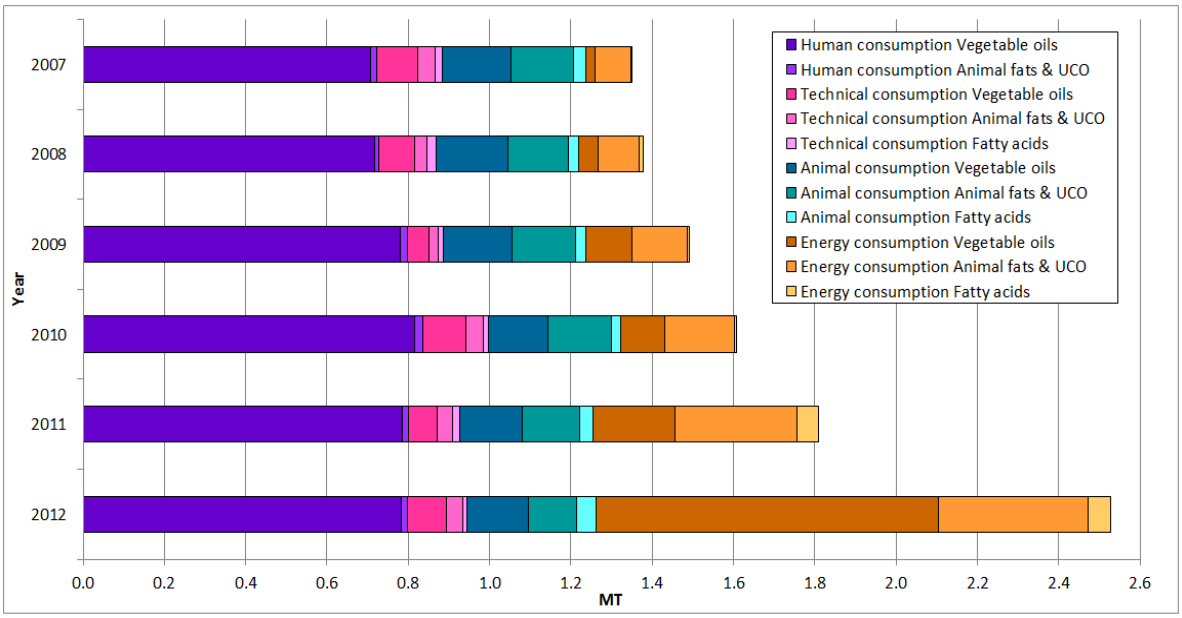


Figure 22: Consumption of oils and fats for different purposes in the Netherlands
Source: MVO (2014)

6.2 Impact on other markets in Italy

6.2.1 Used cooking oils

The consumption of edible oils in Italy is approximately 1,400,000 tonnes per year[27], of which about 20% (280,000 tonnes) becomes used cooking oils: about half of the total quantity is consumed in the household sector and it is difficult to collect after the use; the remaining amount is used in the food industry or in restaurants and it is easier to collect. About 100,000 tons of UCOs are successfully collected in Italy and therefore recycled for other uses.

Traditional uses of UCO in Italy are:

- Production of vegetable lubricants;
- Production of soaps;
- Production of fats for industry;
- Release agents for construction sector;
- Energy production in bioliquids plants;
- Biodiesel production.

[27] CONOE (2013): Presentation on Used Cooking Oil market in Italy & OILECO (2013): Daniele Guidi presentation on OILECO final conference

The most recent estimates[28] indicate that around 5800 tons of UCO are burned in two different bioliquids power plants. All UCO used in power plants came from Italy. By comparison, around 400 ktons of palm oil is burned in Italy in similar power plants.

The "European origin" limit imposed on biodiesel from wastes is responsible for the significant import of UCO biodiesel from EU countries (around 45 ktons), but the permission to not explicitly declare the country of origin lead to a loss of information (42% of UCO are generically from "European Union").

6.2.2 Animal fats

Animal fats have several uses: edible animal fats (as category 3) are largely used in the food industry, such as in the meat manufacturing and for frying, or directly in cooking. Various acids and triglycerides of refined and fractionated fats are used as emulsifiers in the food production.

Animal fats are also broadly used as ingredients in feed for livestock animal and pets, in the petrochemical industry (as lubricants, insulators, emulsifiers, etc…) and also in the manufacturing of health care products like soap, perfumes and cosmetics.
In 2013 around 17,000 tons of animal fats were used in Italy as bioliquids to produce electricity.

The blending obligation (both in Italy and abroad) is the cause of the increase, during the last years, of the demand of all categories of animal fats to produce biofuels.
The below graphs show the total production (in tons) of animal fats (referred to the 85% of the Italian producers) from 2008 till 2013, split between the quantity used for biodiesel production and the volumes used for other purposes (food industry, animal feed, petfood, fertilizers, petrochemicals etc.).

Concerning category 3 fats the quantity used to produce biodiesel doubled in 2010 compared to 2009. It continued to grow in 2011, reaching almost 80,000 tons. In 2012, it decreased to about half its value in the previous year. In 2013 the quantity fell to 28,000 tons.

[28] GSE (2014). Bioliquids database.

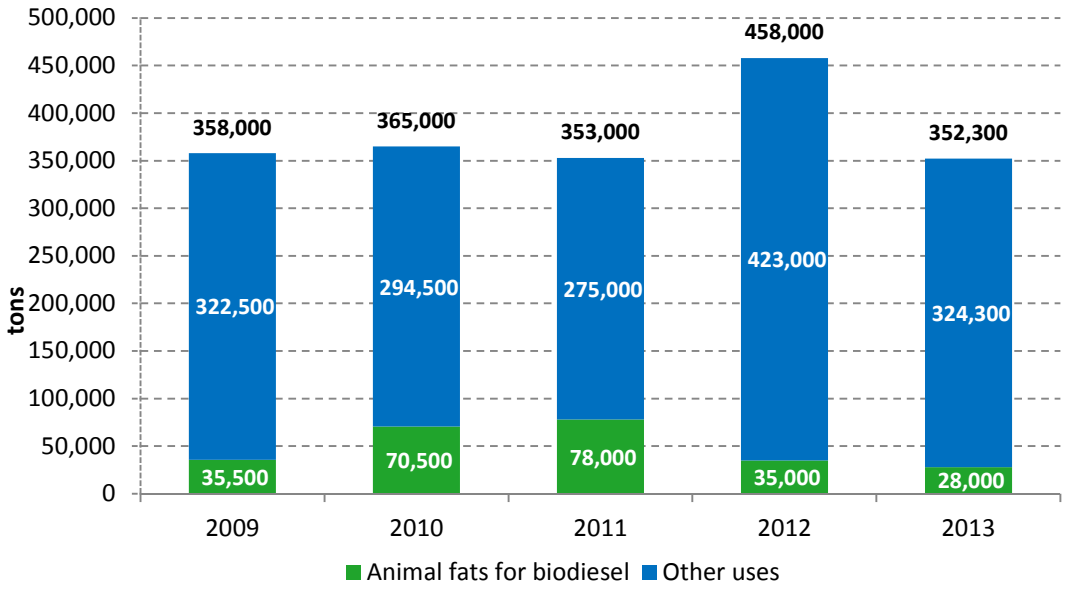


Figure 23. Uses of category 3 fats
Source: Assograssi (2014)

Concerning category 1 and 2 animal fats, their use has increased significantly during the recent years, both for biodiesel production and for other uses. As depicted in Figure 24 the quantity of category 1 & 2 fats used in the biodiesel production has grown from negligible quantities in 2008, 2009 and 2010 to 6.000 tons in 2011 and 7.000 tons in 2012. In 2013, the quantity decreased slightly to 6.500 tons, following the decreasing trend of raw material. The use, from 2011, of animal fats of category 1 & 2 to produce biodiesel could be due, in part, to the introduction of the double counting for these kinds of animal fats.

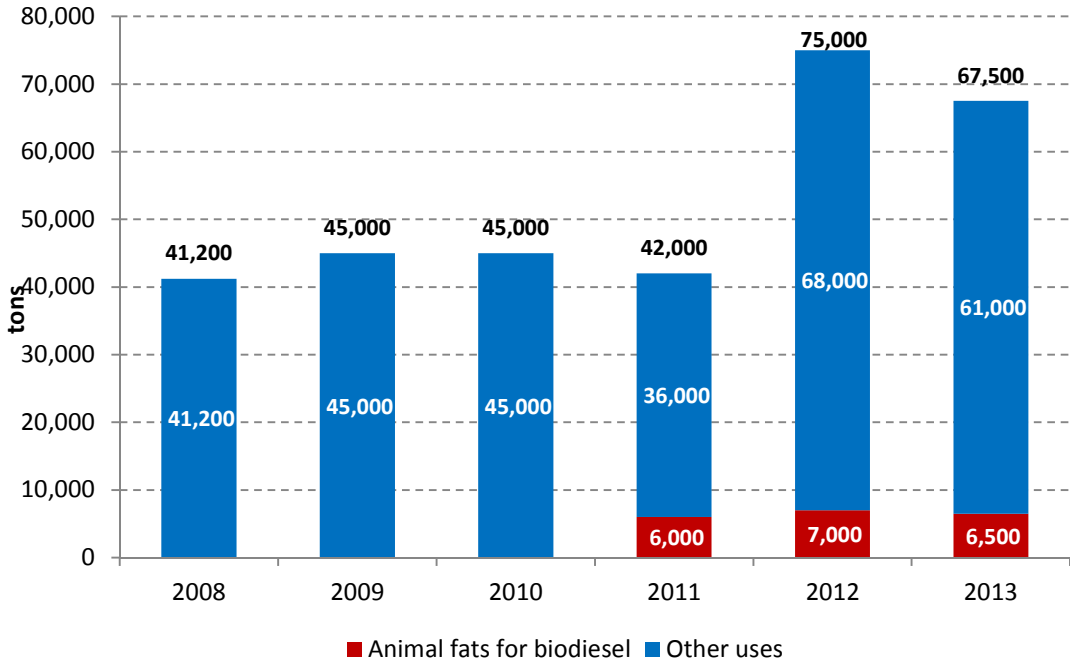


Figure 24. Uses of category 1 & 2 fats
Source: Assograssi (2014)

The graph below depicts the origin and the quantities of animal fats of category 3 used for biodiesel production from 2008 until 2013. The graph shows a growth in the use of lard and "multi species animal fats" (like beef tallow) to produce biodiesel from 2008 until 2011. From 2012, data are available only on multispecies animal fats. Anyway, according to the trading associations in 2012 and 2013 there was a fall in the use of poultry, pig fats and lard to produce biodiesel.

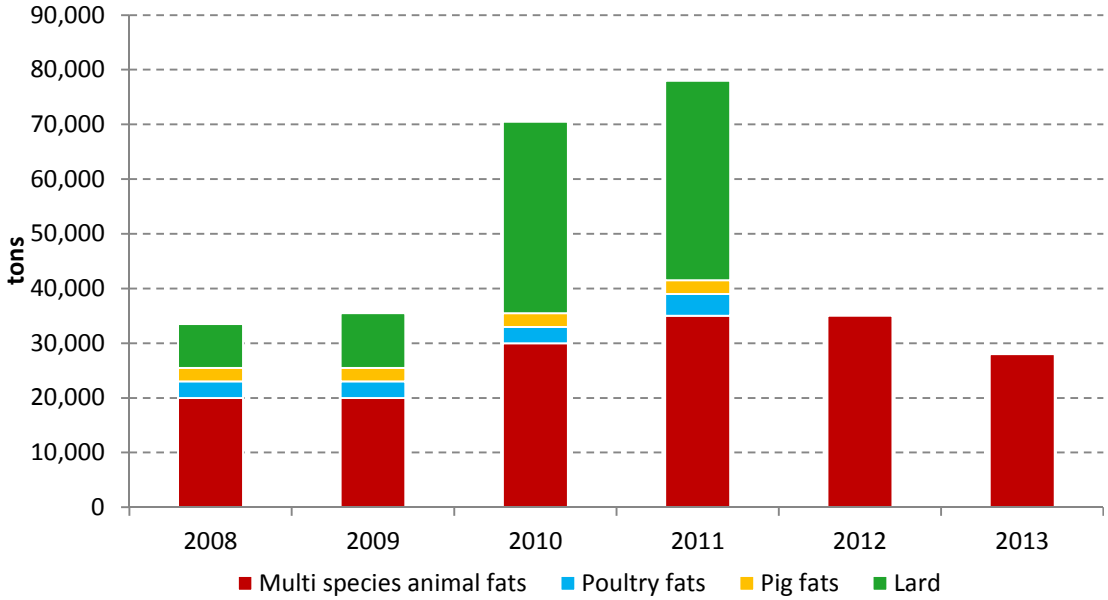


Figure 25. Category 3 animal fats - typologies
Source: Assograssi (2014)

6.3 Alternative uses for UCO in the UK

UCO can be used for energy production (incineration or biodiesel), for oleochemical products or for the production of animal feed. The latter is mostly prohibited in the EU following the implementation of the Animal By-Products Regulation EC 1774/2002 in October 2004, as a reaction to the BSE scare from 1993 to the early 2000s. Certain high quality sources of UCO are still permitted to be used for animal feed (e.g. from food manufacturers where the oil has been in a controlled environment throughout), although the main alternative use in the EU for UCO now is the oleochemical industry.

The oleochemical industry relies on animal fats and UCO for the production of a variety of products ranging from consumer products like shampoo and candles, to plastics and building materials. According to APAG, the European association of the oleochemical industry, the relation between UCO and animal fat used in the industry is 1:9 (i.e. for every 10 tonnes of raw material, 1 tonne is UCO and 9 tonnes is animal fat). The relatively low UCO share is explained by its variable quality, due to the variety of sources from different entities using different vegetable oils.
(Ecofys 2013) estimates that 90% of the UCO in the EU-27 is currently used for biodiesel production and 10% is used by the oleochemical industry.

If UCO is not otherwise collected, the most common outcome is that it is simply put into the local drainage system or sent to landfill, despite these disposal options being prohibited

under UK law. Several stakeholders indicated that most of the additional UCO recovery witnessed over the last few years is from customers (e.g. restaurants, pubs) who used to pour their waste oils into the drains, but are instead choosing to have it collected, in part due to the price they now receive for it from UCO collectors.
(Ecofys, 2013)

6.4 Outside the EU

The situation with regard to UCO uses outside the EU is completely different, as animal feed production from UCO is allowed in for instance the US and China.

In Indonesia, UCO can even be reused as cooking oil for human consumption. The latter is explicitly forbidden in China, but it is reported to happen to a large extent. A black market has emerged and sells simply processed UCO blended with fresh oil back to the restaurants. This so-called '***gutter oil***' is a big threat to the health of Chinese consumers and the Chinese government is establishing official UCO collectors who sell their UCO for biodiesel production (Ecofys, 2013).

7. Critical issues and risks

Biofuels from UCO or animal fats can be double counted towards companies' obligations, so there is a clear incentive to use these instead of virgin oils (targets can be reached with only half the amount of biofuel). Nevertheless available amounts are limited, so there may be different issues arising:

- Lower efforts towards advanced biofuel technologies
- Reduced physical volumes of biofuels on the markets
- Inefficient trade and market distortions due to differences in policies between countries
- Impacts on traditional markets relying on these feedstocks,
- Risk for unlawfully claiming double counting for certain batches of vegetable oil biofuels.

7.1 Lower efforts towards advanced biofuel technologies

While the double counting mechanism was intended to support technology innovation (towards more technologically advanced '2nd generation' biofuels), markets have so far focused on mature technologies like biodiesel from UCO & AF, much less on 'advanced technologies' from lignocellulose. UCO and AF biofuels were already part of the biofuel pool before the double counting mechanisms were introduced – although to a lesser extent. Although greenhouse gas savings of UCO biodiesel are higher than virgin oil biodiesel, applying promoting mechanisms on UCO and AF does only little to contribute to technology innovation and potential remains limited (in the order of 1% of transport fuel consumption).

7.2 Reduced physical volumes of biofuels on the markets

For some countries relying heavily on UCO and AF biofuels, we notice a decrease of the physical amount of biofuels on their markets - although administratively the obligated target is still achieved - because of their shift to double counting biofuels. This also implies that less

fossil fuel is displaced when using the double counted UCO biofuel, contributing less to energy security.

The following figures show the biofuel volumes in Germany and the UK. The decreasing trend of biofuel consumption is clear, while targets have been constant in the period 2010-2012 (6.5% in Germany, 4.5% in UK). Two effects have played: (1) a decreasing trend in transport energy consumption, and (2) a shift to double counting biofuels.

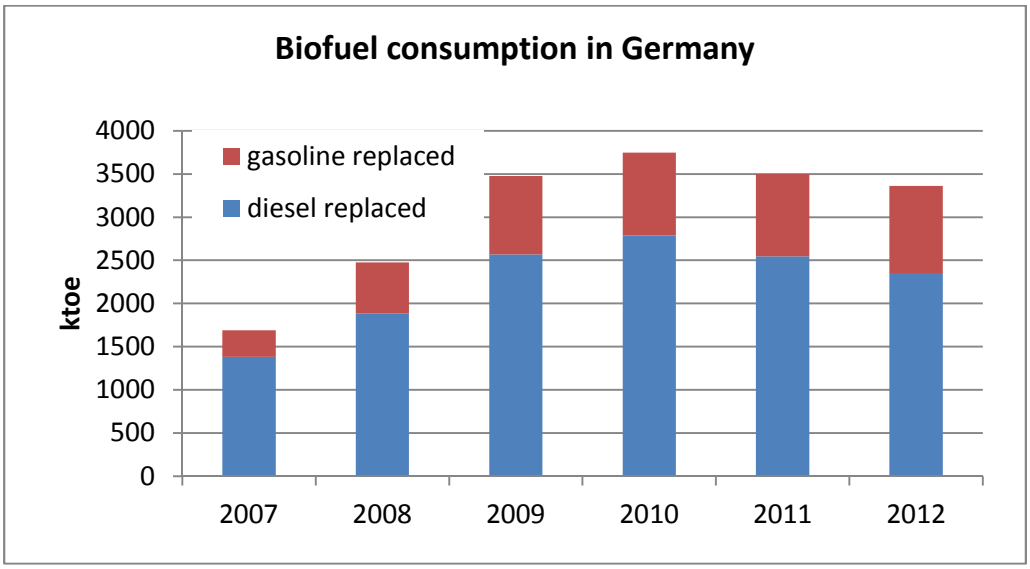


Figure 26. Evolution of biofuel consumption in Germany
Data source: BMF, 2014

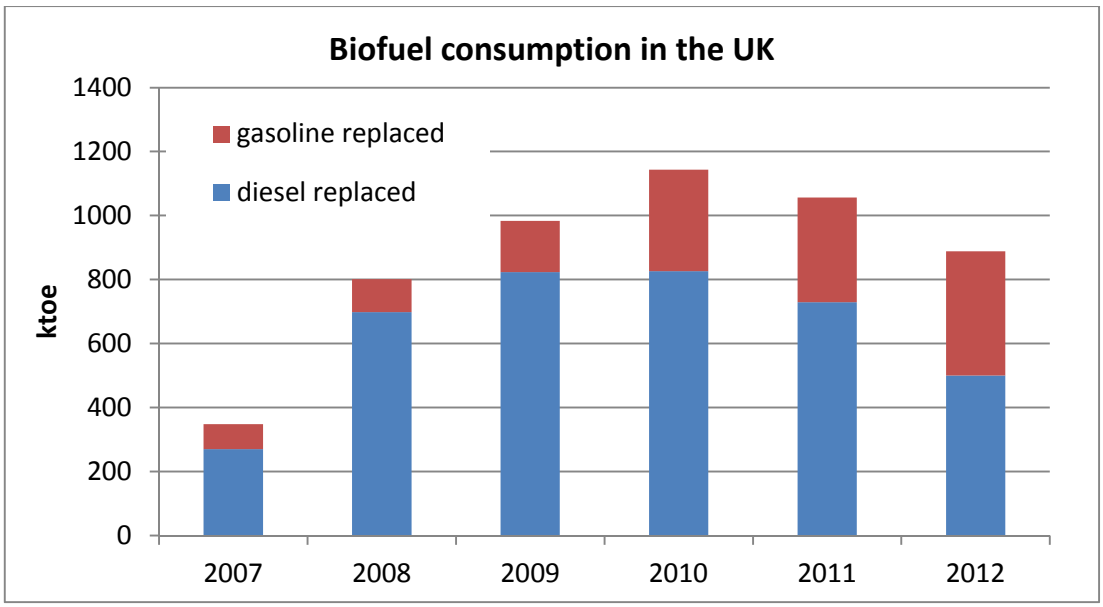


Figure 27. Evolution of biofuel consumption in the UK
Data source: Biofuels Barometer (2013), RTFO

7.3 Inefficient trade and market distortions due to differences in policies between countries

Member States have implemented different promotion mechanisms and incentives. Promotion mechanisms in countries like the UK, the Netherlands, Italy, Finland and Ireland have attracted UCO and AF from other countries (which have less favourable policies). Some are even fulfilling more than half of their renewable fuels target with these types of biofuels. Nevertheless UCO and AF potential is limited (in the range of 1% of transport fuel consumption if based on domestic resources). So these countries clearly rely on EU and international markets for acquiring their feedstock, while other countries (which have less favourable policies) may be deprived from an interesting feedstock option for their own market.

In addition, uncertainties in policies such as the definition of waste, the eligibility of a feedstock type for double counting and mechanisms to verify the sources have caused confusion in the market.

Export regions in America and Asia also implement their own support policies for biodiesel (from UCO), so we should watch out that European incentives are not competing against domestic policies in these regions. This may induce displacement effects and create trade inefficiencies. Moreover, shipping this material to the other side of the world also brings along additional greenhouse gas emissions – it is probably more beneficial to improve domestic waste management and processing of UCO in these regions.

7.4 Impacts on traditional markets?

Before the year 2003 UCO and AF were mainly used as an animal feed ingredient or in oleochemistry. However, in 2003 the EU banned the use of (most) UCO and AF in animal feed due to health reasons.

In terms of volumes large amounts of UCO and AF have become available since 2003. The application of UCO and AF for biofuels indeed provides an interesting outlet for these waste products, of which previously much was disappearing into the local drainage system or sent to landfill. It can stimulate efficient collection practices as waste oils have interesting market values.
It could also provide an alternative for unhealthy practices (extended use in cooking), e.g. the so-called '*gutter oil*' practice in China (to feed processed UCO blended with fresh oil back to restaurants), which is a big threat to the health of Chinese consumers.

In the past 10 years prices for UCO and AF have clearly increased, up to a level slightly below virgin oils. Other applications of UCO and AF – mainly in the oleochemical industry, which uses around 10% of UCO resources – were also impacted by these price increases.

7.5 Risk of fraud and challenges in verification

Double counting has provided incentives for using biofuels derived from certain feedstocks (related to the value of tradable certificates). There is a risk for unlawfully claiming double counting for certain batches of vegetable oil derived biofuels (which are supposingly not eligible for double counting). In the past years we have seen high increases of these types of double counting biofuels, but with difficulty to trace origins of the UCO (especially sourced from outside the country). There were also no uniform mechanisms to distinguish and trace waste-derived biodiesel. When taking away some of the unclarities and implementing stronger tracing and verification procedures, markets seem to decrease (see decrease of

double counting biofuels from 2012 to 2013 in Italy, or the sudden decrease of Dutch UCO from 2011 to 2012 in the UK market).

Another issue being debated in the past years is the risk of deliberate 'production' of UCO. There is a risk of fraud when the economic value of UCO is higher than virgin oils due to double counting measure that provide extra incentives to use UCO for biofuel production. Since it could be very difficult to trace the origins of the UCO (especially sourced from outside the country), there is a risk of deliberate production of waste and imports of poorly checked 'waste'.[29] In Germany, UCO and AF used as biofuel feedstock must be traceable, starting from the origin up to and including the production of the biofuel, and requires ISCC DE certification. In the Netherlands, only the verification (not certification) of double counting following Dutch legislation is required and done at the biofuels producer.

Interview with UCO verifier in the Netherlands: Albert Diedering, a UCO verifier from DEKRA (a certification body for a.o. ISCC and RedCert) (see Attachment 2 for the interview script). *He mentioned that the price differences only became relevant after Germany implemented the double-counting policy in 2012 (which has led to a much larger demand compared to the Dutch market). He pointed out that the risk of fraud is rather small if the UCO and AF are collected from the food retail industry as they are unable to exploit the price difference - the price difference only exists when a large quantity of virgin oils are purchased at a reduced price. In the Netherlands most of the UCO is gathered at rather small (fast food) restaurants, so the risk is low. The risk of fraud mainly takes place at large scale operations. It is therefore important that verifications carried out at such operations will be thorough and strict.*

He also mentioned that prices of UCO are mainly determined by the market. The risk of fraud could be higher if the price difference becomes larger between virgin oil and verified UCO. The price of verified UCO will increase when supply is lower than demand. For large scale gathering operations, verification cost has relatively smaller impact.

The main problem that DEKRA is facing is the reliability of the certified companies, because some parties may be certified but it is questionable if they have followed the rules, and tracing that is difficult. However, until now (the time of interview conducted) DEKRA did not encounter any fraud with regard to this aspect.

Verification bodies in the Netherlands – DEKRA Certification BV, Ernst & Young CertifyPoint BV, Control Union, Quality Inspection Services BV

Another possible side effect suggested by an interviewee is the artificial increase of the UCO volume by shortening the lifespan of frying oil in the kitchen. If this is true, the demand of virgin oil for human consumption will have increased. However this is not the case for the Netherlands. As shown in Figure 22, the consumption of vegetable oils has been rather stable in the past 4 years for human, animal and technical consumption, except a substantial increase for biofuel (mainly HVO) production.

[29] Tsay M (2012) The Impact of Double Counting Legislation on UCOME & TME. 1st Annual Biofuels Conference 2012 - Tackling Fragmentation in the International Biofuels Sector. June 28–29, 2012, Amsterdam, The Netherlands. Available at: http://www.platts.com/IM.Platts.Content/ProductsServices/ConferenceandEvents/2012/pc299/presentations/Maria_Tsay.pdf

8. Conclusions and lessons

Producing biofuels from used cooking oil or animal fats provides an interesting outlet for these products, with high greenhouse gas advantage (in comparison to virgin oil biodiesel), on condition that these feedstocks are really waste. Nevertheless we should take into account that potentials of UCO and AF are limited and to achieve higher fossil fuel replacement, other biofuel types will still be needed.

The double counting mechanism, which was intended to promote advanced biofuels, has merely incentivised the use of UCO and AF biodiesel, a relatively mature and inexpensive biofuel in relation to other biofuels. UCO can be fed into normal biodiesel facilities with existing pre-treatment technology which does not incur significant cost compared to virgin oil. For market parties this was a very cost-effective way to reach their obligations, but it hardly contributed to technological advances. More specific promotion mechanisms will be needed to achieve that.

European Member States have implemented different promotion mechanisms and incentives for biofuels. There are large differences in uptake of double counting biofuels (mainly from UCO and AF) between countries. Countries like the UK, the Netherlands, Finland and Ireland put a clear focus on double counting biofuels, fulfilling more than half of their renewable fuels target with these types of biofuels. Nevertheless, UCO and AF potential is limited (in the range of 1% of transport fuel consumption if based on domestic resources). So these countries clearly rely on EU and international markets for acquiring their feedstock, while other countries (which have less favourable policies) may be deprived from an interesting feedstock option for their own market. Harmonized measures in biofuel policies and consistent definitions across Member States are needed to avoid market distortions and trade inefficiencies.

Countries which are focusing on double counting biofuels tend to have lower physical amount of biofuels on their markets compared to administrative reporting. This also implies that less fossil fuels will be displaced for using more UCO to fulfil the emission target (the physical blending of UCO biodiesel is only half of the volume of typical biodiesel for the assumed same amount of emission saving), and such strategy contributes less to energy security.

Prices for UCO & AF have steadily increased in the past years, from near zero in the 1990s to somewhat below virgin oil prices since 2007-2008, when biodiesel reached significant volumes in the markets. The trend seems to be that they stay somewhat below virgin oil prices, even after introduction of double counting. Before double counting was introduced UCO & AF were already one of the cheaper solutions to produce biodiesel, and demand from the biodiesel side has increased their prices. However, there is no clear indication that the double counting mechanism has created an extra increase of UCO & AF prices, as the prices are still lower than the prices of virgin oils.

It is important to distinguish, trace and verify UCO and AF to reduce the risk of fraud. There have been some inconsistencies in the markets in previous years. A uniform mechanism at EU level is needed for tracing and verification to reduce unclarities. ISCC is frontrunner for double counting verification (mainly focused on the German market). However, the administrative burden for market parties should remain reasonable.

Demand for second generation biofuels made from waste streams may continue to grow in the EU; however, the expansion of the UCO and AF market is questionable. The limitation mainly comes from the supply side. Some growth may be possible in terms of efficient collection of UCO from the household side. Experts believe that the market for UCO will become more stable in the near future, balancing prices and logistics costs of the collection.

Import of UCO from North America and Asia is growing but the potential is unclear, and it seems that the verification of these UCO will be challenging. These regions also implement their own support policies for biodiesel from UCO, so we should watch out that EU incentives are not competing domestic policies in these regions. This may induce displacement effects and create trade inefficiencies.

As mentioned, producing biodiesel from waste oils and fats does provide an interesting alternative for unsustainable disposal (drainage, landfill) and unhealthy practices (extended use in cooking). However, the double counting mechanism led to over-incentivising / overcompensation of the additional costs of UCO and AF biodiesel on the market, which can lead to inefficient trade and market distortions, and can create significant risks for fraud.

Annex A
Summary of interviews on UCO & AF in the Netherlands

1. UCO/AF Collector

Date: 7 January 2014
Name: Anonymous
Company: Dutch based UCO/AF collector
Interviewer: Ravindresingh Parhar

Collecting
This Dutch based Used Cooking Oil (UCO) and Animal Fat (AF) collector is collecting UCO and AF from the Netherlands and its neighbouring countries like Belgium, Germany and Luxembourg. However they have also imports from other parts of Europe for instance Finland and Spain.

The amount of collected UCO/AF is approximately 3 ktons/month and approximately 36 ktons annually. The amount of collected UCO/AF per year is stable. The small differences are in January, when a huge amount of UCO/AF is collected from Oliebol sellers. Oliebol is a Dutch snack that is mainly consumed during the time of Christmas and New Year. During the winter when the average temperature is around 10^0C the collected fats are solid and thus not that easy to collect.

Trade
The collected UCO/AF is traded to Dutch and foreign based technical companies. These technical companies process this UCO/AF to bio-fuels and also animal feed. It is assumed that blending of biofuels will reduce GHG emissions by 35%. There is no mediator in between; the fats are sold directly to these processing companies.

The price of the UCO/AF fluctuates a lot based upon the quality and amount. The company does have an EU certificate and thus it buys/trades only sustainable products that have a certificate. If the fat is an AF, for example fish oil after verification the AF will get an ISCC-EU certificate. For UCO after verification the license will be ISCC-DE. The price can fluctuate due to these verifications and licenses that are provided to the oils/fats. The current prices are:

- € 0.30/kg for non-certificated UCO/AF
- € 0.40/kg for AF certificated with ISCC-EU
- €0.50/kg for UCO certificated with ISCC-DE

The historical prices of 2010-2013 are not published by the company, however it is said that it is quite stable and does not have significant fluctuations. The expectations for the coming years are unpredictable.

Verification
Dekra, a verification agent is having each three months an extensive investigation. The possibility of fraud is thus very low. The challenge for the coming years is to increase profit and extending the company further during the crisis. The intervieweeis glad that the UCO/AF market is awarded a ISCC-system certificate.

2. UCO/AF Verifier

Date: 9 January 2014
Name: Albert Diedering
Company name: Dekra Netherlands
Interviewer: Ravindresingh Parhar

Verification
Dekra Netherlands is an ISCC- and RedCert certificated UCO/AF Verification Company based in Arnhem, the Netherlands. Their main job is to avoid fraud in the UCO/AF trade.

According to the expert there are changes that fraud is being perpetrated in this business as long as the UCO/AF prices are higher than the "virgin oils". However, the price difference only exists when a huge amount of virgin oils are purchased for a reduced price. The UCO/AF that Dekra verified are coming from local fast food restaurants and thus the risk of fraud is minimal, since these parties will not be able to exploit the price differences.

Dekra does visit these fast food restaurants or even UCO/AF collectors to verify the UCO and AF. Since the UCO/AF collectors collect mainly from these fast food restaurants again the risk of fraud is rather small with the argument that buying cheap virgin oil is only feasible if a huge amount is being purchased. Furthermore Dekra did not experience any fraud on the UCO/AF market regarding the trade.

Market
In the Netherlands the double-counting policy has existed before the EU agreement. Price differences became relevant since Germany implemented the double-counting policy. The verification process may have an impact on the UCO/AF prices: the costs of verification will grow and thus UCO/AF will become more expensive, and this will result in a higher risk of fraud. Legal cross border trading within the EU is only possible if the products are certified with an ISCC or RedCert certificate.

The main problem that Dekra is facing is the reliability of the certified companies because some parties may be certified, but it is questionable if they have followed the rules and tracing that is difficult.

3. Oils and fats sector organization (Advisor)

Date: 10 April 2014
Name: Anonymous
Company name: Expert working for the oils and fats sector.
Interviewer: Ravindresingh Parhar

Collecting
In The Netherlands 50 to 75 companies collect UCO. The amount of UCO collected per year is estimated to be 60 ktons per year approximately in the Netherlands. This amount does fluctuate during the year. In January due to the Oliebollen a peak is noticed. There are a few recycling companies in the Netherlands that collect the UCO and make biofuels from it (Rotie vetveredeling makes their own biofuels with Biodiesel Amsterdam and UCO Kampen does this as well).Fuel suppliers like Shell and Texaco only buy the biofuel and don't produce themselves. Fuel suppliers buy the biofuel from biodiesel companies and blend this with their fossil fuels. 5.25% of biofuels should be present in the fuels for 2014 (blending). A few

years ago the market price of cleaned UCO on average was between €500-800 per tonne (0.50-0.80 €/kg).

Verification

The government (Ministry of Infrastructure and Environment) cannot prove frauds in the sector thus the claims are just rumours. It is not cost beneficial for the UCO collectors/producers to use virgin oils as used oils since this will cost the company themselves more money. The national implementation of the legislation on biofuels (RED) requires full tracking and tracing making the possibility for fraud really low. Germany is a frontrunner with legislation requiring full tracking and tracing of biofuels from by-products by (national legislation based on the Renewable energy Directive requiring ISCC DE certification).

Challenges

Challenges on the market are to extend the business. To increase the supply, UCO from households needs to be collected. Currently collection of household UCO is being developed in The Netherlands. This could also be extended to other Member States. The production of animal fats is a completely different sector with its own properties.

Double counting is implemented only in a few EU states. In Germany for example double counting is only on biofuels from UCO and not on biofuels from AF. The German authorities don't allow AF biofuel to be used to fulfil the obligations under the RED. This decision may be influenced by parties that are also involved in using AF as a feedstock.

Market

Before the year 2003 UCO was mainly used as an animal feed ingredient. However in 2003 the EU Animal By-product Regulation banned the use of UCO in animal feed due to health safety reasons. The first alternative use of UCO after 2003 was electricity production in Scandinavia. The European commission is not clear about UCO if it is a waste product or an animal by-product. If it is classified an animal by-product than complex import procedures apply. If classified as waste import procedures are easier.

Future

Neste Oil is a Finnish company that produces 'NExBTL', a biofuel that is fully compatible with mineral diesel. Neste Oil owns plants in Finland, Singapore and Rotterdam. Their process is based on hydrotreatment of vegetable oils or animal fats in order to produce alkanes.
See http://www.nesteoil.com/default.asp?path=1,41,11991,22708,22709,22710
NExBTL can be mixed with mineral diesel in any blend, or can be used as a pure biofuel.

Policy makers should avoid market distortion when developing new policies. Policies should also be based on sound science. If science didn't reach a mature stage more research is needed before drafting new legislative proposals.

From a resource efficiency perspective waste products like UCO should be collected separately to recycle it and use it as a feedstock. Furthermore using biomass will support the transition to a biobased economy .

Annex B
Tables of biofuels and biodiesel in Italy

Overall biofuels

Table 5 ktons of biofuels in Italy in 2012
Source: GSE (2014)

	Gcal/CIC	Biodiesel	Bio-ethanol	Bio-ETBE	Hydro-treated vegetable oil
Non-sustainable biofuels	-	1,36	0,02	3,06	-
Double counting biofuels	5	379,74	-	2,94	-
Biofuels of European origin	8	152,58	-	102,42	-
Biofuels in 25% mixture	8	0,28	-	-	-
Other sustainable biofuels	10	883,10	3,15	44,34	10,01
Total	**-**	**1417,06**	**3,17**	**152,76**	**10,01**

Table 6 ktons of biofuels in Italy in 2013
Source: GSE (2014)

	Gcal /CIC	Biodiesel	Bio-ethanol	Bio-ETBE	Hydro-treated vegetable oil	Pure vegetable oil
Non-sustainable biofuels	-	0,02	0,01	3,04	-	-
Double counting biofuels	5	128,81	0,02	1,09	-	-
Biofuels of European origin	8	494,74	1,37	97,15	-	-
Biofuels in 25% mixture	8	0,32	-	-	-	-
Other sustainable biofuels	10	685,91	0,89	6,57	10,97	1,81
Total	**-**	**1309,80**	**2,27**	**107,85**	**10,97**	**1,81**

Biodiesel from UCO

Table 7. Origin of the raw materials and of the production of biodiesel from UCO for Italy in 2012 (tons)
Source: GSE (2014)

		Origin raw material					
		European Union	**Netherlands**	**Spain**	**Italy**	**Austria**	**Total**
Production sites	ES	33365	6195	4351	0	0	**43910**
	NL	5849	17859	3449	0	956	**28113**
	DE	6783	0	0	0	0	**6783**
	EU	2049	0	317	2648	0	**5014**
	IT	0	0	0	1744	0	**1744**
	Total	**48046**	**24054**	**8117**	**4392**	**956**	**85564**

Table 8. Origin of the raw materials and of the production of biodiesel from UCO for Italy in 2013 (tons)
Source: GSE (2014)

		Origin raw material														
		EU	**IT**	**ES**	**AT**	**DE**	**CZ**	**BE**	**NL**	**SK**	**FR**	**HU**	**PL**	**SI**	**RO**	**TOT**
Production sites	Spain	11488		7757												**19246**
	Italy		13978		1						112					**14091**
	Germany	6715			1625	2560		1136	221	400			27			**12683**
	Netherlands	4349				128			213		197					**4887**
	Austria	1441	194		1774	264								9	2	**3683**
	Czech Rep.		973			242	1324	10	284							**2833**
	Belgium			1002												**1002**
	Hungary											216				**216**
	Total	**23993**	**15145**	**8759**	**3400**	**3194**	**1324**	**1146**	**718**	**400**	**309**	**216**	**27**	**9**	**2**	**58641**

Biodiesel from animal fats

Table 9. Origin of the raw materials and of the production of biodiesel from animal fats for Italy in 2012
Source: GSE (2014)

		Origin of the raw material						
		EU	**Italy**	**Un-known**	**Germany**	**United Kingdom**	**Hungary**	**Total**
Production sites	European Union	14.980	1.234	-	2.416	-	-	**18.630**
	Italy	31	1.811	-	-	1.227	65	**3.133**
	Unknown	-	-	2.988	-	-	-	**2.988**
	Netherlands	2.373	-	-	-	-	-	**2.373**
	Austria	-	-	710	477	-	-	**1.187**
	Total	**17.383**	**3.045**	**3.698**	**2.893**	**1.227**	**65**	**28.311**

Table 10. Origin of the raw materials and of the production of biodiesel from animal fats for Italy in 2013
Source: GSE (2014)

		Origin raw material																
		IT	**AT**	**DE**	**ES**	**EU**	**BE**	**IE**	**NL**	**FR**	**HU**	**UK**	**LT**	**SK**	**CZ**	**SI**	**PL**	**TOT**
Production sites	IT	17763	1946	3390	50	1203	357	1085			362	296						26454
	AT	3956	7761	2938		930												15585
	ES				4556	1899	1000											7455
	CZ	154	506	764			1345		984	490			236	195	114	47	21	4856
	NL			1138														1138
	DE			32														32
	Total	**21873**	**10213**	**8263**	**4606**	**4032**	**2702**	**1085**	**984**	**490**	**362**	**296**	**236**	**195**	**114**	**47**	**21**	**55520**

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