IEA Bioenergy

Task 40: Sustainable International Bioenergy trade

Summary, synthesis and conclusions from IEA Bioenergy Task 40 country reports on international bioenergy trade

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1. Introduction and objective

In line with other activities of IEA Bioenergy Task 40, this paper focuses on recent developments in international bioenergy trade. The IEA Bioenergy Task 40 - Sustainable International Bioenergy Trade – Securing Supply and Demand- was established under the International Energy Agency (IEA) Bioenergy Implementing Agreement in December 2003. Essential drivers for bioenergy consumption are security of supply, economics, environmental (GHG mitigation and other) and development at large especially for developing countries. The development of well-functioning international bioenergy markets is expected to be essential for the utilization of bioenergy potentials worldwide. In recent years, the trade flows expanded and the market became more international. Main commodities traded are bio-ethanol, wood pellets, biodiesel and vegetable oils (as feedstock for biodiesel), and forestry and agricultural products.

This trade occurs at significant scales in national, regional and global energy markets, already indicated by Junginger et al. [6]. The future vision of IEA bioenergy Task 40 for global bioenergy trade is that it will develop into a "global commodity market" which will secure supply and demand in a sustainable way. The driving force behind the expansion in bioenergy is the potential it holds in providing an affordable and practical renewable source of energy for climate change mitigation, energy security, and rural development.

As mentioned by Junginger et al. ([6, 24], the development of the international bioenergy market is hampered by the different trade barriers, poor statistical coverage, sustainability issues, indirect trading and the small trade volumes. One of the explicit aims of Task 40 is to investigate developments in international bioenergy trade and exchange national experiences. To this end, the member countries of Task 40 have written individual country reports covering among others biomass production, renewable energy policies, and international bioenergy trade. At the time of writing (end of 2010), Task 40 member countries were Austria, Belgium, Brazil, Denmark, Finland, Germany, Italy, Japan, the Netherlands, Norway, Sweden, the United Kingdom and the United States of America[A]. All country reports are available on the Task 40 website [7] – [18].

This paper is presenting a summary, synthesis and conclusions of these country reports. The main aim is to describe past developments in trade flows and discuss past and current trends and drivers. We do *not* attempt to provide a comprehensive outlook on the future of biomass trade. In section 2, background information on the use of bioenergy in the Task 40 member countries is given. We present the share of bioenergy in the total primary energy supply and total gross electricity generated of each country. In section 3, In section 4, we provide an overview of the bioenergy trade that has been occurring in each member country in the past years, also explaining the policy and market drivers for the import and export flows. Section 5 is an overview of bioenergy and fossil energy prices (in Rotterdam harbour, the Netherlands). Finally, section 6 gives a comparison of the liquid and solid imports in 20054 and 2007, and discusses the trends and main drivers behind the international bioenergy trade flows.

Please not that also in the future, Task 40 will continue to publish country reports, The next major update is scheduled for autumn 2011, and will cover the bioenergy trade situation up until 2010. These new country reports will be published on the Task 40 website.

[A] Canada was a task 40 member until the end of 2009, and has rejoined Task 40 in January 2011. Denmark recently joined Task 40 and did not yet submit a full country report, but a short summary on ongoing developments was included. For Japan, too little data was available to include it in the analysis.

2. Setting the scene: background on bioenergy consumption

2.1 Total Primary Energy Supply

The role of bioenergy (combustible renewable energy sources) in the total primary energy supply (TPES) and its trend in recent years, of task 40 member countries will be discussed in this section. Bioenergy is in all Task 40 countries used as feedstock for electricity generation, heat production or as transportation fuel. The share of bioenergy is mainly depended on economic feasibility and policy incentives. Figure 1 shows the percentages of renewable energy sources and combustible renewables of the Total Primary Energy Supply (TPES) based on International Energy Agency (IEA) statistics. According to these statistics combustible renewable energy sources include: solid biomass, liquid biomass, renewable municipal waste and biogas. The share of renewable energy and combustible renewable energy consumption of the TPES in 2004 (left bar) and 2007 (right bar) is illustrated by Figure 1.

From figure 1, it is clear that both the total renewable and biomass contribution to the total primary energy supply varies strongly between countries: the total contributions from renewables varies from less than 5% Belgium, the United Kingdom and the Netherlands, to more than 40% in Norway and Brazil. Brazil also has the largest contribution of biomass, with Finland and Sweden following. Apart from Canada, Italy and Norway, combustible renewable energy sources are the largest contributors to renewable energy supply. Canada and Norway have a large share of hydropower, in Italy geothermal energy is the largest renewable energy source.

Between 2004 and 2007, the percentage renewable energy increased for all countries illustrated in figure 1. In addition, the share of biomass and biofuels increased for those countries except Canada. The large contribution of combustible renewable consumption in Austria is due to a combination of policy support for renewable liquid transportation fuels and combustion of solid biomass for electricity and heat production. Brazil (bio-ethanol consumption in transport sector), Finland and Sweden (both due to wood fuels and residues of the wood industry) have a high bioenergy share in total energy supply.

2.2 Total gross electricity generated

The contribution of renewable energy sources and combustible renewables to total gross electricity production (TGEG) is also determined for 2004 and 2007, and shown in figure 2. The TGEG (all sources) of the countries in figure 2 is shown in Appendix 1, table A.1. If available, hydropower is a dominant source, especially for countries with large renewable electricity generation. Finland is an exception due to the large wood processing industry, which allows wood residues to be used as feedstock for power generation.

Compared to 2004, the percentage renewable electricity production increased rather little or remained at the same level in 2007 in most countries. However, the consumption of combustible renewables did increase in most countries. Only in Canada, Norway and the USA, less bioenergy was used for electricity production in 2007 compared to 2004. Again, the share of biomass to the total TGEG varies strongly, from less than 0.3% in Norway to over 10% in Finland.

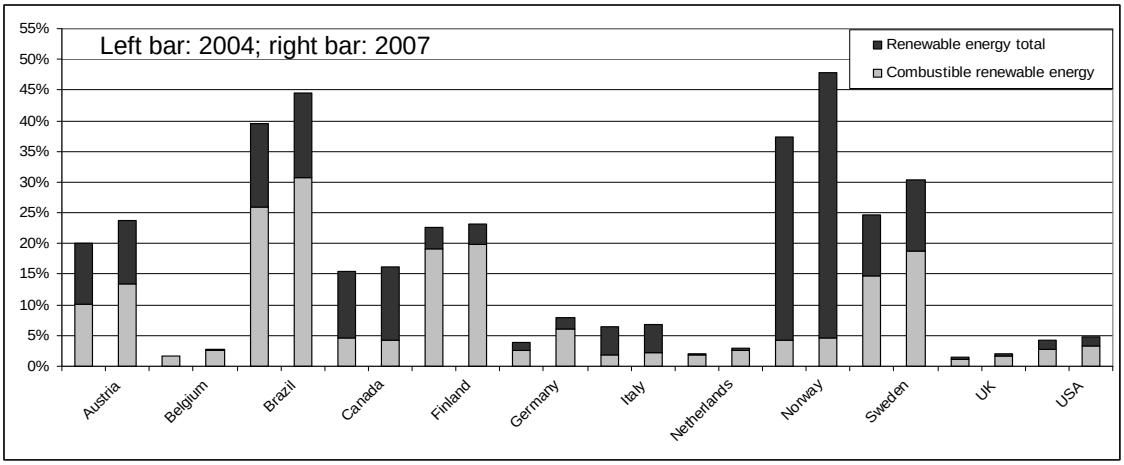

Figure 1 Overview of total renewable and biomass contribution to the total primary energy supply in 2004 (left bar) and 2007 (right bar). Source: IEA [1] [2] [3] See table A.1 for total primary energy supply of different countries.

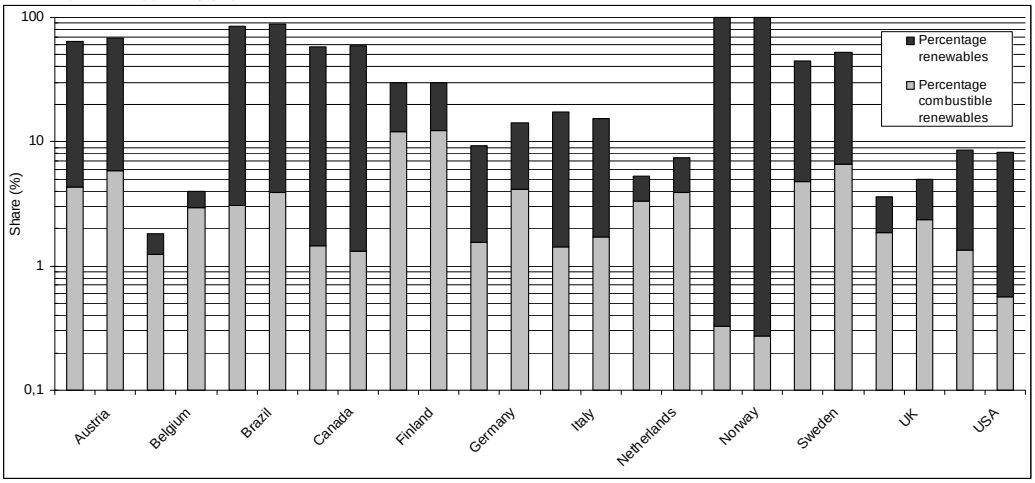

Figure 2 Overview of total renewable and biomass share in the total gross electricity generation (TGEG), defined as gross production – amount of electricity produced in pumped storage plants. Renewables (and biomass) do not include industrial waste, non-renewable municipal solid waste and pumped storage production. [1] [2] [3]. Please note the logarithmic scale on the Y-axis.

3. Overview of ongoing solid and liquid bioenergy trade

The international trade in biomass feedstocks (e.g. wood chips, vegetable oils and agricultural residues) and especially of processed bioenergy carriers (e.g. ethanol, biodiesel, wood pellets) as an energy carrier has grown strongly over the past decade. While practically no liquid biofuels or wood pellets were traded in 2000, world net trade of liquid biofuels amounted to 120-130 PJ in 2009, compared to about 75 PJ on wood pellets. Trade flows have been highlighted in the past years in a number of studies carried out by Task 40 (see e.g. [6, 24, 25]). The text in sections 2.1 and 2.2 below has been taken from the bioenergy chapter 2.4 of the forthcoming IPCC special report on renewable energy sources (SRREN) [26]. In section 2.3, we briefly highlight the importance of indirect trade.

3.1 Overview of liquid biomass production, consumption and trade

Global fuel ethanol production grew from around 375 PJ in 2000 to over 1,600 PJ in 2009 [28]. The two leading ethanol producers and consumers were the United States and Brazil, accounting for about 85% of the world production. In the EU, total consumption for transportation in 2009 was 3.6 million tonnes, the largest users being France, Germany, Sweden and Spain (EurObserv'ER, 2010). Data related to fuel bioethanol trade are imprecise on account of the various potential end-uses of ethanol (i.e. fuel, industrial, and beverage use) and also because of the lack of proper codes for biofuels in global trade statistics. As an estimate, a net amount of 40-51 PJ of fuel ethanol was traded in 2009 [28].

World biodiesel production started below 20 PJ in 2000 and reached around 565 PJ in 2009 [28]. The EU produced about two-thirds of this (334 PJ), with Germany, France, Spain and Italy being the top EU producers (EurObserv'ER, 2010). EU27 biodiesel production rates levelled off towards 2008. The inner-European biodiesel market has become more competitive and its current overcapacity has already led to the closure of (smaller, less vertically integrated, less efficient, remote, etc.) biodiesel plants in Germany, Austria, and the UK. Other main biodiesel producers include the United States, Argentina, and Brazil. Biodiesel consumption in the EU amounted to about 403 PJ (8.5 million tonnes) (EurObserv'ER, 2010), with Germany and France consuming almost half of this amount. Net international biodiesel trade was below 1 PJ before 2005, but grew very fast from this small base to more than 80 PJ in 2009 [28].

3.2 Overview of wood pellet production, consumption and trade

Production, consumption and trade of wood pellets have grown strongly within the last decade, and are comparable to ethanol and biodiesel in terms of global trade volumes. As a rough estimate, in 2009, more than 13 million tonnes of wood pellets were produced, of which the large majority in 30 European countries, the USA and Canada. Consumption was high in many EU countries and the US. The largest EU consumers were Sweden (1.8 million tonnes), Denmark, the Netherlands, Belgium, Germany and Italy (all roughly one million tonnes). Main wood pellet trade routes are leading from Canada and the US to Europe (especially Sweden, the Netherlands and Belgium) and to the US. In 2009, also other minor trade flows were reported, e.g. from Australia, Argentina and South Africa towards the EU, however, these quantities remained negligible. Canadian producers also started to export small quantities to Japan. Total imports of wood pellets by European countries in 2009 were estimated to be about 3.9 million tonnes, of which about half of it can be assumed to be intra-EU trade [29].

3.3. Estimates of indirect bioenergy trade

In sections 3.1 and 3.2, we discussed direct bioenergy trade, i.e. biomass products are traded with the direct aim to utilise it as an energy source in the country of destination. However, significant amounts of products containing organic carbon are also traded for other primary purposes (e.g. roundwood for construction, wood chips for pulp and paper, fruit and vegetables for human consumption), but parts of these streams are used for bioenergy fuel

after all: examples can be black liquor or sawdust, or packaging material and organic waste in MSW, which can all be used to produce heat and electricity.

Even though wood consumption tends to be mainly local, about 129 million cubic meters of roundwood and wood chips were traded internationally in 2006 [24] (see figure 3) - equivalent to about 630 PJ of indirect trade. Thus, indirect trade amounted to twice the size of direct trade, which was estimated to be 300 PJ in 2006 (based on ethanol, wood pellets, palm oil, fuelwood, char coal and biodiesel trade).

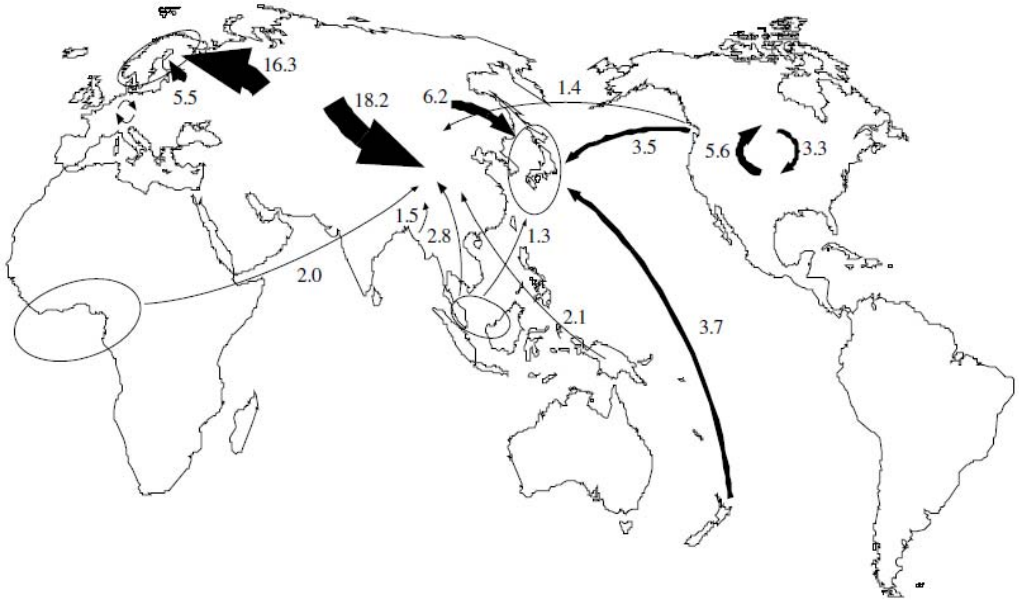

Figure 3 Overview of global round wood trade in 2006 (in Mm3 without bark) [24].

As can be seen, Scandinavia and Japan are large importers of wood chips and round wood. In the Task 40 country reports, indirect trade is explicitly addressed for Norway, Sweden and Finland:

- In Norway, indirect import of solid biomass for energy was estimated to amount to about 4-6 PJ between 2002-2007 (on a total of 5-7 PJ imported solid biomass for energy) [15].
- In Sweden, volumes are more substantial: in 2006, about 26 PJ of wood was traded directly for energy purposes, compared to about 59 PJ indirect secondary fuels like bark, saw dust, black liquor, etc. from the portion that is used in industrial processes [16].
- Finally, Finland showed by similar amounts of indirect solid biomass trade. In 2007, it imported a total of 62 PJ woody biomass for energy, of which 55 PJ was indirect within the forest industry's raw wood imports. The indirect import of wood fuels peaked in 2006 (61 PJ) but are expected to decline due to the increasing Russian export duty on round wood [11].
- Indirect trade was not quantified for Japan, but given their imports of especially wood chips (an estimated 15 million oven dry tonnes in 2008), it is probably substantial.

4. Bioenergy trade flows and main drivers in Task 40 member countries

In this section, for each Task 40 member countries, the main developments regarding international bioenergy trade are provided. Where available, the domestic technical production potential of biomass resources is given, and compared to the actual consumption. This is then put side by side with the amounts of international traded bioenergy commodities. Also, the evolution of bioenergy trade from 2004 to 2007 is briefly discussed, and the main drivers behind the import and export flows are highlighted.

4.1 Austria

Bioenergy potential studies in Austria show that mainly the potential of forestry and the wood processing industry is utilized; within the agricultural sector, the potential is largely underexploited. The waste sector is relatively small compared to the other categories. According to Haas et al. [5] the annual biomass potential in Austria can grow up to 265 PJ in 2010. In comparison, a substantial part of this potential is already used: in 2007, the domestic consumption of combustible renewable energy was 185 PJ.

Out of these 185 PJ, a little less than 20% was ***imported***, In comparison to traded amounts of wood and wood products for traditional purposes (construction, pulp and paper etc.), these amounts are however still relatively small [7]. The large utilization of the biomass potential is mainly due to the fact that the Austrian forest and wood industry is well developed. Due to the large role of the Austrian wood processing industry (saw industry, paper and pulp industry, fibre board industry), Austria is a major importer of round wood and wood chips and exporter of wood products. Thus, the high relevance of the Austrian wood processing industry for the Austrian economy is a major driver of "indirect" imports: The saw industry imports round wood and exports timber. Saw residues from these imported round wood streams are used in the paper and pulp industry, the fibre board industry and the energy sector. Although the forestry sector is well developed in Austria, the current utilization has not reached the theoretical maximum sustainable potential. One of the main reasons is the structure of ownership: A large share of the forestry is structured in small scale units. These small scale owners do not show a significant economic interest in making use of their forest. Although there are tendencies to improve this situation, there is still only very moderate progress in this field. On the other hand, large scale forestry enterprises and the federal forestry harvest almost all (and partly even more than) the sustainable potential. Thus, the structure of forestry ownership in Austria is an important driver for biomass imports. The increase of biomass CHP in Austria, driven by the attractive feed-in-tariffs between 2005 and 2007, also led to a strong additional demand for wood chips. This demand is partly covered by increased harvesting in Austrian forestry, and partly covered by increased imports, although they are partly shifted to the increased wood chips imports of the Austrian paper and pulp industry.

In Austria fuel wood is used for covering about 20% of the heating demand. Therefore up to now fuel wood is the most important bioenergy product in Austria. There is also some (and partly unofficial) import of wood log (fuel wood) from neighboring central and eastern European countries (Czech Republic, Slovakia, Hungary, Slovenia) to Austria. The driver for these imports are (1) the high tradition of wood log heating systems in rural regions of Austria and (2) the price difference of wood log from Austrian forestry compared to Eastern European countries (which again is mainly driven by different wage levels).

Austria also ***exported*** about 18 PJ of biomass, ***mainly wood pellets***. Austrian producers of pellets were benefiting strongly of the demand from other neighbouring countries in the past and in 2007 about half of the production volume has been exported (mainly to Italy). This development was due to several drivers: (1) The Austrian saw industry produced a lot of (cheap) saw residues for pellet production. The saw industry had a great interest to find other demand segments for this product than the paper and pulp and fibre board industry. (2) The starting pellet market in Austria led to a strong increase of pellet production capacities. The pellet market in Austria was growing, but the pellet production capacities

were growing even faster. (3) There was a strong demand for pellets from Italy (for small scale users), and partly also from other countries for co-firing purposes (e.g. Belgium). This demand was partly driven by higher mineral oil taxes in Italy (leading to a higher residential fuel price level).

Compared to 2004, the ***import of liquid biofuels*** increased strongly to fulfil domestic demand, which increased due to tax exemption of blended transportation fuels. Especially the import of vegetable oils for the production of biodiesel has increased strongly in recent years. Besides rapeseed oil that is extracted in oil mills in Austria imports of rapeseed oil from other countries are very important for the Austrian biodiesel industry. Up to the year 2005, Austria has been a net exporter of rapeseed oil. With the implementation of the Biofuel Directive in Austria this has changed completely. Thus, the major driver for the import of plant oil are biofuel obligations combined with a lack of domestic plant oil production (lack of suitable arable land combined with lower production costs in Eastern Europe). Another important aspect in this context is the substitution for resources used for bioenergy: Although soybean and palm oil are not used for the production of biodiesel in Austria, there has been a strong increase in the imports of these vegetable oils. It is assumed that more and more rapeseed oil was needed by the biodiesel industry and is therefore missing in the production of margarine and other cooking fats. As a trade-off there has been an increase in the imports of soybean- and palm oil in the same time.

4.2 Belgium

Belgium is a small country with high population density and relatively high energy requirements (international harbors & industry), and rather limited domestic biomass potential. Due to geographical location and land occupation, the Belgian domestic biomass potential is estimated to be between 28 and 31 PJ annually. To fulfill domestic needs for bio-energy – in 2007 about 71 PJ, mostly in the form of electricity and biofuels – there is a clear ***need for imports***. Data of bioenergy trade in the Belgium country report is separately reported for the Flanders and Wallonia region with each having a different approach. The main drivers for the increase in both solid and liquid biomass are policies to reach a certain share of 'green' power in the electricity sector, and a certain share of biofuels in the transport sector:

(1) Green power: the Belgian electricity sector has to produce an increasing amount of green electricity to meet the quota set by the regional governments (Flanders, Wallonia), to be proven through (tradable) green power certificates. If they do not meet these quota they have to pay a penalty. Especially solid biomass (wood pellets) is used by the main electricity producer Electrabel (part of Gaz de France – Suez) both through co-firing in existing coal power facilities, and in coal installations converted to biomass. There are two reasons for import of wood pellets: (a) the high amounts needed by Electrabel are not available on the domestic market, (b) legislation (especially in Flanders) regulates that domestic woody biomass (including residues) is preferentially used in the wood processing industry. This creates an uncertainty in domestic supply and a preference for ***wood pellet imports***. Mind that the biomass supply chain needs to be audited; energy use in pretreatment and transport is subtracted from the green power certificates. Furthermore, imports occur also indirectly as part of other biomass imports (e.g. import of round wood for pulp & paper production, the residues from this biomass are used for energy).

(2) Liquid Biofuels: Belgium launched a quota system in 2006 for biodiesel and bio-ethanol. 4 biodiesel facilities and 3 bio-ethanol facilities, all based in Belgium, received part of the quota. Only this quota can be put on the Belgian market with fuel tax reduction. From mid 2009 an obligation system of 4%vol biofuel blending was implemented for the fuel distribution sector (next to the quota system). So the demand is created by policy. While production capacity is largely sufficient for the domestic market, there is very limited feedstock available on the domestic market, specifically for biodiesel (oil seeds). So most of the ***feedstock for biodiesel needs to be imported***. For bio-ethanol, there is also a

substantial import demand. Most feedstock is imported from the European market, but no official data available. Some of the produced biofuels are exported to neighbor countries.

4.3 Brazil

Brazil is worldwide the second largest producer of bioethanol, has the lowest production costs, and has the potential for enlarging the production significantly. The set of factor are obvious drivers for ***large-scale ethanol production for exporting***, and there are efforts aiming on make this a reality in short to mid-term. For some years Brazil has exported fuel ethanol in reasonable volumes. The volumes exported grew continuously since 1999 and the peak was reached in 2008, when slightly more than 5 billion litres were exported, mainly to US, directly or through Caribbean and Central American countries. However, the exports were drastically reduced in the two following years, to 3.3 billion litres in 2009 and to less than 2 billion litres in 2010 (estimated amount).

The main reasons for the reduction in 2009 are briefly presented in the following text. First, the production in the US grew significantly from 2008 to 2009. Second, the over-evaluation of the Brazilian currency reduced the competitiveness of its production. Third, from 2008 to 2009 the ethanol production in Brazil was affected by adverse climate conditions. In 2010 the inadequate environment for trading ethanol with the US was kept. Even worse, the US became a net exporter of fuel ethanol and a reasonable share was traded with Europe, taking advantage of the tax credit (the Volumetric Ethanol Excise Tax Credit – VEETC) that companies receive for blending up to 90% ethanol to petrol even if the fuel is shipped overseas. Consequently, the exports of ethanol from Brazil to Europe were also impacted, and reduced from about 1.4 BL in 2008 to 380 ML in 2010. Traditionally, the main European markets for Brazilian ethanol were the Netherlands and Sweden, but straight flows to Sweden started to fall in 2005 and in case of the Netherlands a deep reduction occurred in 2009 and 2010.

In the most favourable years the Brazilian exports of fuel ethanol represented no more than 15% of its production that means that the domestic market is by far the most important. Brazilian producers and the government blame against the tax duties imposed by the US and the EU, but no specific action has been taken in this regard. In fact, only Brazil has been deeply affected by such policies. Investments have been made aiming specifically on exports, but there are no perspectives of large growth of the exports in the next 5 years.

Regarding biodiesel and pellets, there is no precise information about traded amounts. It can be assumed that ***exports of biodiesel are null***, as the domestic market has risen and the prices paid for the producers have been high.

In case of wood pellets, there is no data available in the official accountability regarding trade. There are dispersed information that ***wood pellets have been exported***, but in small quantities. There are some companies interested on getting information about the European market, and the conditions for entering in this market. In theory the potential of pellets production for exporting would be good in Brazil, but it is still far from being deployed.

4.4 Canada

The potential in Canada is largely based on woody biomass: road side and urban (waste) wood residues, and mill residues such sawdust and bark. Total estimated potential is roughly 740 PJ, which also includes ethanol and biodiesel production and agricultural residues. Dedicated energy crops are not included. Canada is primarily a ***biomass exporter***, ***including wood pellets, pyrolysis oil, and a small amount of ethanol***. In 20 years Canada has grown into a world power in pellet exports, with production capacity of 2 million tonnes. In 2007, about 1.49 million tonnes of wood pellets were exported, mainly to Western Europe and the United States.The drivers were large and growing markets in Europe, initially Sweden, then the Netherlands and Belgium and increasingly the UK. The underlying drivers are renewable energy incentives in EU countries. However, Canadian producers are paid in

Euros and they get far less now than in 2008-09 due to the plummeting value of the Euro against the Canadian dollar. Feedstock cost is a key factor in trade. Many plants must use a greater proportion of expensive harvest residues rather than lower-cost mill residues owing to the current lack of the latter. The domestic market for pellets is only about 100,000 tonnes. This market is expected to grow, but slowly since there are few policy instruments promoting pellet usage. Ontario Power Generation plans to use 2 million tonnes of pellets annually by 2015, but a lot of this supply will come from Northern Ontario, which is too far from ocean ports to be considered for exports. ***Bio-ethanol is traded with the US***, but only small intercompany trades where the north-south cross border transportation distance is shorter than shipping east-west. The driver is monetary, to save transportation costs. Canada is the world's largest producer of pyrolysis oil. All of the production from the 100-tpd Ensyn plant is sold into the US. Ensyn built six plants in Wisconsin, where pyrolysis oil is used in the food and chemical industry and for building heat. When the Renfrew plant was built in Canada, the easiest market was for these markets in Wisconsin. The primary driver is familiarity with the product, and market-driven savings in the US compared with fuel oil. Recently Ensyn announced plans to build the largest pyrolysis plant in the world in High Level Alberta, however all production will be used to make power for the grid in Canada. So far the major driver "against" trade is lack of familiarity with the product. It is twice as energy dense as wood pellets, and it would be an excellent tradable product**.**

4.5 Denmark

Denmark is a large ***importer of wood pellets:*** in 2009, domestic production was 2.4 PJ and imports amounted to 17.1 PJ. Imports for consumption in Power Plants, CHP plants and District Heating Plants are largely policy driven as they are needed to meet national emission reduction targets as domestic sources for raw material is insufficient. Import for consumption in private households (8.3 PJ) is market driven.

Also the ***import of wood chips and firewood*** is market driven: domestic production was 9.8 PJ in 2009, compared to imports of 4.2 PJ. Import mainly from the Baltic area is cheaper than an (also increasing) domestic production of wood chips from Danish forests. Domestic production of firewood for private households amounted to 23.1 PJ in 2009, compared to imports of 2.0 PJ. The import is oven dried firewood from Poland and the Baltic area and 6 meter stems which are processed to firewood in Denmark. The import is based on price competition with Danish products.

In 2009, Denmark also **exported biodiesel based on rape seed**. This trade flow is policy driven: Domestic production was 3.3 PJ and export was 3.1 PJ. Favourable policies in Germany stimulated the export, and a weak domestic market makes almost no domestic consumption.

4.6 Finland

The Finnish domestic biomass production potential is 201-355 PJ, including forest chips, firewood, wood pellets, biogas and agricultural residues. The current total bioenergy consumption as reported in the Finnish report (395 PJ) exceeds this potential. Finland has been a significant ***net importer of solid biomass fuels***. In 2007, the total international trading of solid and liquid biomass fuels was approximately 77 PJ of which import was 62 PJ. Most of the import is indirect and takes place within the forest industry's raw wood imports. In 2007, as much as 21% of wood energy was based on foreign-origin wood. Wood pellets and tall oil form the majority of export streams of biomass fuels. Main driver for raw wood import has been the availability and price competitiveness of imported raw wood. Majority of imported raw wood in Finland has been originated from Russia. There has not been proper demand for round wood in North Western Russia, which has made the import to Finland feasible.

Wood pellets and tall oil form the majority of export streams of biomass fuels. In the main destination countries for pellets (Sweden and Denmark), the considerably higher

taxation of fossil fuels in energy production and the subsidies for electricity from biomass have made the export of pellets economical.

Since 2007, the import ***of palm oil and export of bio-diesel*** have emerged in Finland, as a large (340 000 t/yr) hydro-treaded biodiesel (NExBTL) production plant come into operation. Majority of the biodiesel production has been exported abroad as market driven (higher paying capacity abroad than in Finland). Price competitiveness has been a reason for the use of palm oil instead of local vegetable oils.

4.7 Germany

The potential of bioenergy in 2010 in Germany was estimated to be approximately 560 PJ, although a sharp increase until 2030 is foreseen. Biogas and energy crops are expected to play an important role in future bioenergy production. The consumption of solid biomass in Germany increased between 2004 and 2007 substantially, roughly 20%. For wood pellets, even a threefold increase in consumption between 2004 – 2007 was observed. For sawdust and used wood the consumption approximately doubled in 2007 compared to 2004. The German country report mainly specifies the trade of solid biomass. International bioenergy trade in Germany consists mainly of wood pellets and wood waste; half of the domestic production of ***wood pellets is exported*** [12], mainly for industrial purposes (i.e. electricity production), as there is no market for large-scale cofiring in Germany. At the same time Germany ***also imports wood pellets*** for heating purposes (small-scale applications) and waste wood for electricity generation. Imports also occur indirectly (wood processing industry) this applies especially to wood chips.

Important drivers for solid and liquid bioenergy imports in Germany are policies that aim to combat climate change and increase the energy security. Main policy instruments to be named that promote bioenergy usage in Germany and thus bioenergy imports are the renewable energies act (EEG), the renewable energies heat act (EEWärmeG), market incentive programme (MAP) and tax incentives for biofuels. These measures particularly stimulated the ***imports of liquid biomass***, i.e. palm oil for electricity generation but also biodiesel as fuel. The imported biomass is often cheaper than the locally produced one or an alternative, i.e. palm oil vs. locally produced rapeseed oil. Also, there is a lack of availability of a commodity (palm oil) which requires imports. On the export side, exports of wood pellets are rather market driven in Germany.

4.8 Italy

The Italian bioenergy industry is currently largely interested in trade of biomass and biofuels for utilization in its various branches (biopower, biomass heating and biofuels for transports). The National Renewable Energy Action Plan attributes an important role to bioenergy and although the current regulatory framework for the production of electricity supports the utilization of biomass supplied from local productions (from a distance of less than 70 km radius from the plant), it is likely that trade will have an increasingly growing role to meet the Italian renewable energy target of 17% share in 2020. Most of the Italian bioenergy sectors are interested by trade flows in form of imports, whereas export flows of biomass and biofuels represent only a small share of the overall trade balance. The drivers behind bioenergy trade are several and vary depending on the sector.

Biomass power:
In 2009, 53 biomass plants generated a biomass demand of around 3-4 million tons, a share in the range of some hundreds of thousand tons derived from ***imports of wood chips and other products (PKS, olive cake etc.)***. The drivers behind this trade are economic (cost competitiveness of imported biomass) but also related to logistic and “organizational” factors. For some large plants, mainly located in southern Italy, trade represents a mean to integrate the discontinuous and fragmented supply of biomass from local producers and dealers.

Biomass heating:
The largest European pellet market for heating stoves is the national market for pellets in Italy with an annual demand of 850,000 tons. The market of pellet stoves grew significantly in the past years and in 2009 (+15%), driving the expansion of the pellet demand that is higher than the current domestic production, therefore generating an ***import flow of wood pellet*** of around 250.000 tons from other EU countries (Germany, Austria, Portugal, Baltic States). The main drivers behind the expansion of the stove market are essentially two: (1) A policy/regulatory driver: the availability of a tax exemption for private homeowners investing in energy efficiency measures (55% of costs are deductible from taxes); and (2) An economic driver: pellet heating is sensibly cheaper than heating with fossil fuels such as LPG or heating oils in areas not served by the natural gas grid. Prices of wood pellets are fluctuation by demand; peak prices in late winter and lower during spring and summer. These fluctuations in demand and prices caused market instability in recent years [13].

Power generation with bioliquids:
The production of bioelectricity is relying more and more on small scale applications (< 1 MW_e) due to the availability of a feed in tariff. One of the few efficient and relatively cheap applications for producing bioelectricity in this power range is the use of stationary engines running with pure vegetable oil, whose number has been growing significantly since 2008. In addition, some large energy companies are demanding growing volumes of bioliquids to use in large power plants in substitution of traditional fossil fuels. The supply of bioliquids is largely met by ***imports of vegetable oil*** (palm oil, canola oil), estimated around 1 million tons in 2009, mainly driven by economic factors, while the domestic production is growing but still delayed by the excessive fragmentation of economic operators and agricultural producers.

Biodiesel and Bioethanol:
In 2009, roughly one third of the domestic consumption (1.17 mil. tons) of biodiesel derived from ***direct biodiesel imports*** (from U.S., Argentina Germany etc.). In addition to this, ***also a large share of the feedstock*** used by Italian biodiesel producers (15 plants) is estimated to be derived from imports. However, a ***minor flow of exports*** was observed. Drivers behind these net imports are similar to those of bioliquids (fragmentation of feedstock production). In addition, an uncertain and unstable regulatory framework with regard to the mechanism of blending mandates and the setting of volume quotas subject to tax exemptions has prevented the stabilization of the market, forcing operators to rely on imports rather than long term planning of domestic production. As far as bioethanol is concerned, the domestic production (only 105.000 tons) is entirely converted into ETBE to be used as fuel additive. As for biodiesel, the uncertainties in the regulatory framework have negatively affected the development of this sector, in that constituting a driver for imports of feedstock and of ETBE itself**.**

4.9 The Netherlands

A thorough analysis of the Dutch technical biomass potential was carried out by Koppejan 2009 [4] and showed a domestic production of 489 PJ, of which 124 PJ is available for bioenergy production. In comparison, currently, about 85 PJ bioenergy is domestically consumed, but this also includes large amounts of imported biomass.

The Netherlands ***import an increasing amount of wood pellets*** for cofiring in power plants. Import volumes have more or less increased steadily from less than 100 ktonnes in 2003 to more than (an estimated) 1 million tonnes in 2010. Domestic production of wood pellet varies between 100-120 ktonnes per year, so to meet the demand, Wood pellets have been imported from Canada (e.g. British Columbia), the Baltics, Germany, Portugal, and since 2008 increasingly also from the south-east of the USA. The consumption of biomass for co-firing amounted to 15,7 PJ in 2007, of which 11,9 PJ were imported (i.e. 75%). The largest Dutch user is utility Essent, but also other utilities like E.On and Electrabel use wood pellets in their Dutch coal power plants. To a certain extent, the Netherlands also act as a hub, and there are minor amounts of pellet re-exports to other European countries. The main driver for

the wood pellet imports is the so-called MEP feed-in tariff scheme, which provides a feed-in premium for electricity from woody biomass of 6.1 €ct/kWh. However, most of these MEP contracts and in 2012-2013, and it remains unclear how large-scale co-firing may be supported if the years after. Without this policy support, wood pellet imports may drastically decline, as wood pellets cannot compete with coal solely based on the value of carbon credits attributed to the use of biomass.

Furthermore, up until 2007, significant amounts of ***solid wood waste streams were exported up to 2007***. The export of used wood however decreased since then because of the development of new bioenergy installations in the Netherlands (especially stand-alone wood incineration), increasing domestic demand.

The Netherlands are a major hub for liquid biomass, and ***import and re-export huge amounts of vegetable oils, biodiesel and ethanol***. Due to the large harbour (Rotterdam) large amounts of biofuels or biofuel feedstocks are traded, partially for own consumption, but largely also fro re-export to e.g. Germany or other countries [14]. Especially during 2006-2008, the import of heavily subsidized biodiesel from the US has been on the one hand a strong driver for increasing trade, but on the other hand has proven detrimental for the production of biodiesel in the Netherlands. While the European Commission introduced provisional anti-dumping and countervailing measures against imported US biodiesel in March 2009 (and on July 7th 2009 extended these measures for 5 years), Dutch traders reported that this led in practice to biodiesel being exported from the US to Canada, and from there to Europe, thereby circumventing these measures. With regard to the use of vegetable oils for electricity production, the Netherlands imported substantial quantities of palm oil for co-firing up until 2006. In August 2006, the Dutch government abruptly cancelled the feed-in tariff for electricity from liquid biomass, effectively terminating the use of palm oil for electricity production from 2007 onwards.

4.10 Norway

For Norway, the potential is estimated to be 140 PJ, of which around 30% is currently utilised. The Norwegian authors also specify the economic potential of biomass; below 5€/GJ as much as 38 PJ is available from different sources. However, in spite of these excess biomass resources, especially from the forests, ***Norway is a net importer of biomass, mainly in the form of indirect trade through the forest industries***. The net wood import in the forest industries is 20-30% of the wood consumption of which a significant share ends up as process heat. A relatively large forest industry combined with stable/non-increasing harvest are the main explanations for this situation.

High labour costs imply a net import of firewood. The consumption of firewood is estimated to be 1.235 million ton in 2007 of which 7% was imported (Statistics Norway 2010). The import of firewood more than doubled from 1999 to 2009 and.

The blend of biofuels in transport fuel is about 2.5% and is planned to be increased to 5% in 2011 will imply a ***net increase of liquid biofuel imports*** to Norway as the domestic production of liquid biofuel is very limited.

For other biofuels, the extensive production of bioenergy production in Sweden affects the biomass trade in Norway. A significant share of the harvest of ***biowood*** and utilisation of ***harvest residues*** that are starting up in Norway is ***exported to Sweden***. The export of waste from Norway increased by nearly 70% from 2008 to 770 000 ton in 2009. About 7% of the waste is exported. The waste import was 303 000 ton in 2009. Most of the waste export goes to energy production in Sweden. Restrictions on waste disposals combined with lower delivery fees for waste in Sweden are the main reasons for increased export. The wood pellet production at Biowood Norway with a capacity of 450 000 ton which is starting up in 2010 is mainly going to be exported.

Implementation of the government target from 2007 of 14 TWh additional bioenergy by 2020 – close to a doubling of the current production is likely to imply an increase in the net import of biomass to Norway as mobilization of domestic resources seems be challenging within this time horizon.

4.11 Sweden

The Swedish bio-energy sector operates within the Free Market concept. However, that market is influenced by the fact that it exists under the "umbrella of Carbon Dioxide Taxes" and is restricted by general laws and regulations, mainly EU and other international directives and agreements. Few specific national schemes are at hand; an exemption is the Green Certificate scheme for power generation.

Therefore, drivers, both for export and import, vary "from day to day" with market conditions. Small scale trade takes place in other patterns than large scale trade. Generally the small scale trade is carried out by SME firms, and large scale import by utilities and industries; large scale export are planned to be carried out by a few large forest and fuel producing companies. Drivers for export are higher profitability to export than to use domestically, and the widening surplus of biomass, due to increase in forest growth and stagnating demand from traditional user, e.g. pulp & paper and saw mills. Surplus areas for biomass are found in the Central South and in the North; the major deficit area is the Stockholm and Lake Mälaren region. To a great extent, international trade is found to be more efficient to take care of those imbalances, compared to internal national trade.

A ***large portion of the import consists of very cheap biomass, e.g. industrial waste, recovered wood and demolition wood***. Due to the installed efficient flue gas cleaning technology, these fuels can be combusted fulfilling the EU standards for emissions. In recent years an increased capacity for such boilers has been installed, and considerably more capacity is in the pipeline. For now, these boilers can thus be seen as a technological driver for bioenergy imports. It remains to be seen if those fuel streams can increase to fill the demand or if the fuels will be utilized at the sources.

What is said above relates mainly to solid biomass fuels. Drivers for liquid biofuels are presently unclear, apart from what is required in the RED. It is generally assumed, that the present drivers will be sufficient to make the Swedish energy system reach (and exceed) the target of the EU RED.

4.12 United Kingdom

In the United Kingdom (UK) in 2007, 144 PJ bioenergy was consumed, compared to an estimated potential (in 2020) of about 690 PJ. Main contributions are from lignocellulosic energy crops and landfill gas. There is some disagreement as to the actual domestic potential of bioenergy, but it is generally accepted that demand will outstrip supply and thus imports are an inevitable reality. In fact most of the current consumption is already imported. The two most important markets are electricity and heat and liquid biofuels (biodiesel and ethanol). For these markets, ***mainly vegetable oils, wood waste, wood chips and saw dust are imported*** [17].

In the case of liquid biofuels, it is important to recall that the RTFO was the world's first attempt to regulate the sustainability of biofuels and thus it has been emulated in other countries, particularly in Europe. Much of the feedstock for biofuels, 3.33% of all road transport, supplied to the UK market (2009/10) comes from developing countries; the potential UK market for biofuels is estimated at £130M. About 11% of the feedstock used was from domestic sources, of which 93% met qualifying sustainability standards criteria.

This sector is largely policy-driven. Currently the government is reviewing the Renewable Energy Strategy and the Biomass Strategy of 2007 whose outcome is expected by early Spring 2011. Until such review is completed, it is difficult to provide more specific details

except to say that no fundamental changes are expected. The government continues, in the main, to consider biomass energy as an important energy source for the UK.

The Office for Renewable Energy Deployment (ORED) (www.decc.gov.uk/en/) coordinates all aspects of renewable energy in the UK. UK provides three key financial incentives to renewables: Renewables Obligation, Feed in Tariff, and Renewable Transport Obligation. Two other initiatives under consideration are a Renewable Heat Incentive and a Green Investment Bank. A Comprehensive review of Feed in Tariffs is currently underway and should provide greater investment certainty. Recently the government has also announced the promotion of anaerobic digestion as a key area for further development.

Important drivers for imports are the fact that domestic resources are not enough to meet demand, are too expensive and have already their own line of supply. Exports are by-products e.g. some companies may export if they get much higher prices or if for some reason they have a surplus. It is important to note that these companies are multinational and in the latter case are merely re-distributing resources

A major factor hampering the trade development is that this market has not developed into a "commodity" and many (all) trade agreements are done on a bilateral basis e.g. between two parties. Also, the secrecy of trade deals makes it difficult to obtain an accurate picture of ongoing trade flows.

4.13 United States of America

In the US, renewable energy production is being driven mostly by US government policy and high energy prices. In his 2007 State of the Union address, President Bush announced a goal to reduce the nation's gasoline consumption by 20% by 2017. With recent high energy prices, passage of the Energy Policy Act of 2005 (P.L. 109-58), and the Energy Independence and Security Act of 2007 (P.L. 110-140), there is ongoing congressional interest in promoting greater use of alternatives to petroleum fuels. Biofuels — transportation fuels produced from plants and other organic materials — are of particular interest. Ethanol and biodiesel, the two most widely used biofuels, receive significant federal support in the form of tax incentives, loan and grant programs, and regulatory programs.1 The 2008 Farm Bill also modified existing incentives — including ethanol tax credits and import duties — and established a new tax credit for cellulosic biofuels. The Farm Bill also authorized new biofuels loan and grant programs, but these will be subject to appropriations, likely starting with the FY2010 budget request.

Imports:
Most US regulations and drivers are designed for minimizing imports and maximizing US resources. Therefore, there are few drivers driving up imports of renewable energy. Yet, for transportation fuels, the market and international trading increased rapidly. In 2007, the US imported 1950 million litres of biodiesel, the net export (gross export minus imports) was 600 million litres [18].

Exports:
The demand for biomass pellets in Europe has been rapidly increasing in recent years. In 2005, the European Union experienced a 16% growth in electricity produced from biomass. This growth is expected to continue and is attracting US industries to expend their production of wood pellets explicitly for export to the EU. The problem with the wood pellet industry is that demand can be very volatile. A warm winter in Europe in 2008 drastically cut their demand for wood pellets which impacted their demand for imports. In the US, the low price of coal and its prominence in power generation (coal accounted for roughly 48% of electricity generated in the US in 2008) present the biggest challenges to growth of the wood pellets market. However, if enacted future federal greenhouse gas regulations could change this. Because wood pellets are considered greenhouse gas neutral, co-firing them with coal reduces CO_2 emissions on a 1-to-1 basis.

5. Prices bioenergy commodities

In important factor in the market development is the price of bioenergy (subsidy included) compared to the costs of fossil fuels including fuel and emission tax. The bioenergy stimulation policy; subsidy or bioenergy consumption target and the fuel and emission tax differ per country. Although policies defines bioenergy markets, the link between bioenergy utilization and bioenergy (residues and waste included) prices is often observed.
This section tries to give insight in the price trends in recent years and a comparison to fossil fuels. The prices presented in this section are all for biomass delivered CIF (cost insurance and freight) to the Rotterdam harbour, which is a good indicator for the North-Western European region.

A comparison of solid fuels is shown in figure 4, wood pellets compared to coal, coal prices are taken from the Dutch statistical office [19]. Pellet prices are bulk prices for large European consumers [20]. As can be seen in figure 4, there is no clear link between the prices of these commodities. Wood pellet prices have fluctuated between 6.5 and 8 €/tonne between 2007 and 2009, while coal prices peaked in mid-2008 at 4,5 €/GJ and since then declined to 2007 levels around 2 €/GJ. When taking into account the price of avoided CO_2 wood pellets were for a short time period (almost) able to compete with coal. Nowadays, this is not possible without policy support.

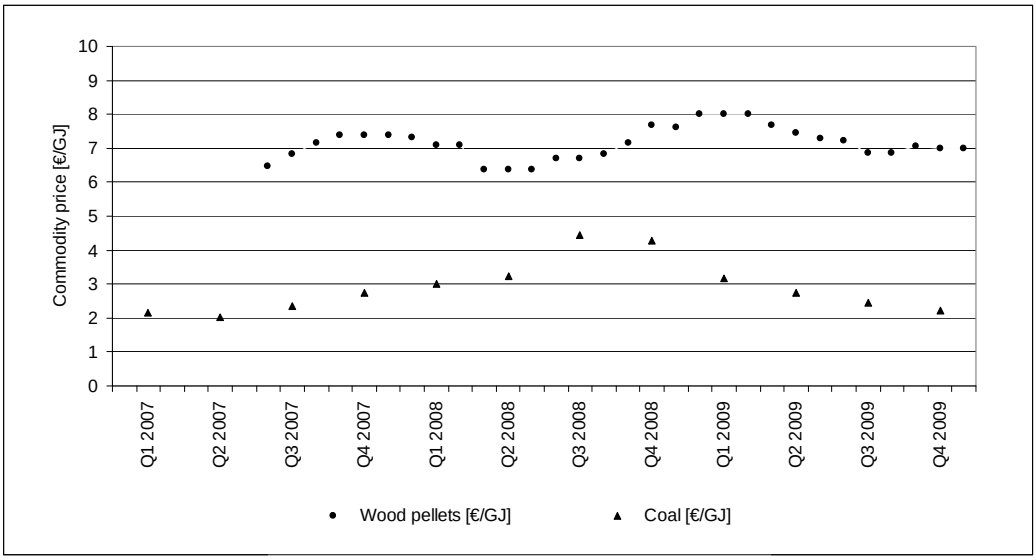

Figure 4 Wood pellet and coal prices 2007-2009

In figure 5, the price of ethanol delivered to Rotterdam is compared to the price of gasoline in the Netherlands [21], excluding VAT taxes and fuel tax, and crude oil [22]. Ethanol prices are based on delivery in Rotterdam [23]. Figure 4 clearly shows a correlation between ethanol prices and crude oil and gasoline prices, although the fossil commodities peaked in mid-2008, and ethanol only peaked at the end of 2008.

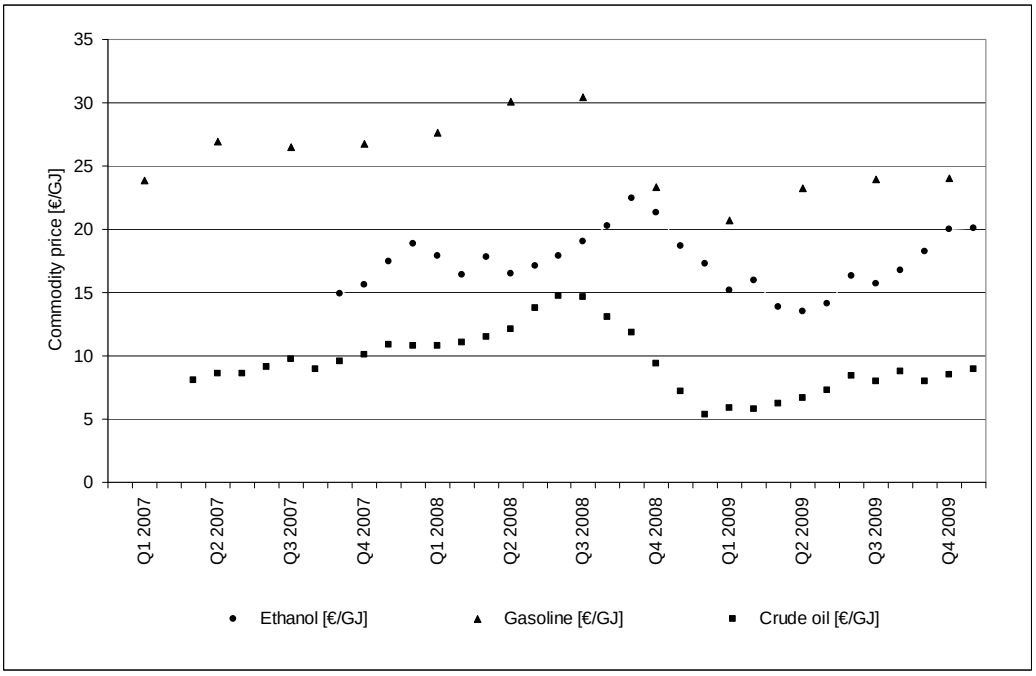

Figure 5 Ethanol, gasoline and crude oil prices, 2007-2009

Similar to the correlation between ethanol and gasoline, figure 6 shows that also Rapeseed Methyl Esters (RME), conventional diesel and rapeseed oil are directly linked. Both RME and rapeseed oil prices [23] are for Rotterdam delivery, diesel prices are Dutch diesel prices excluding VAT taxes and fuel tax [21].

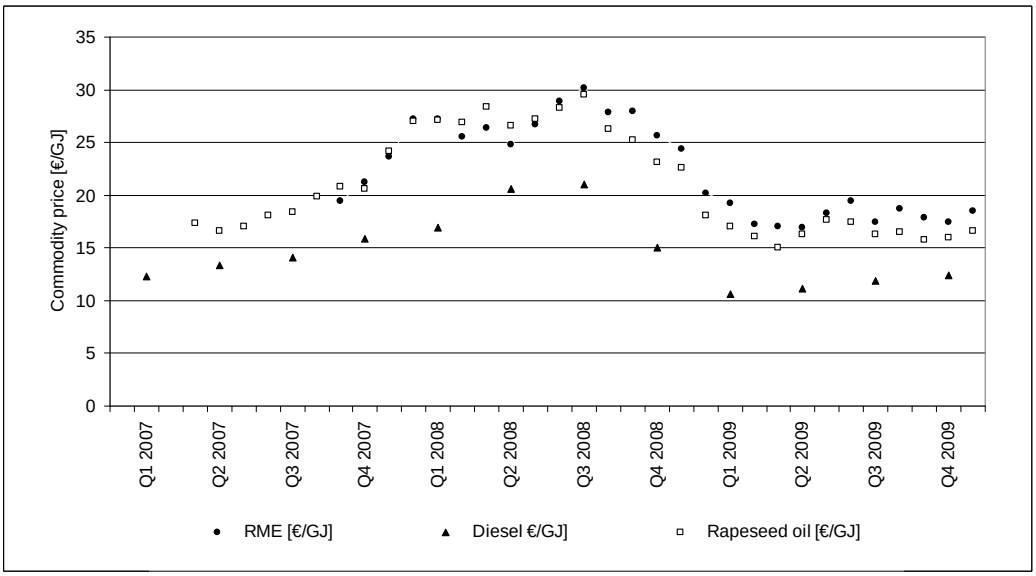

Figure 6 Rapeseed Methyl Esters, Fossil fuel diesel and Rapeseed oil prices, 2007-2009

6. Overview of biomass trade flows, trends and drivers

In Figure 7, a quantitative overview of the solid and liquid bioenergy imports and exports for the Task 40 member countries is given for 2004 and 2007. These numbers should be used with care – in many cases, they are based on estimates and are often incomplete due to lack of reliable statistical data. Especially for exports, the end-use in the importing country is often unknown, e.g. whether traded ethanol is used as a transport fuel or used for other purposes.

The uncertainty of the collected is also evident when we compare the data collected by Task 40 members to statistics of the International Energy Agency. In table 3, trading flows from country reports and IEA statistics are expressed as percentage of domestic consumption. Domestic consumption is taken from the IEA statistics. As can be seen from table 3, these numbers differ, in some cases marginally, in a few cases (Norway, Sweden, UK) substantially. This is due to several factors:

- Trade secrecy: often, trade flows are small, and trade is bilateral. This is especially still the case for solid biomass. In these cases, it is difficult to get accurate information on volumes and origin because of confidentiality reasons.
- Informality of markets: often markets are informal and difficult to monitor. A typical example is the trade in fuel wood. Also wood chip trade is difficult to monitor: the quality of statistics may be so weak that they be misleading.
- Evasion of import duties: to avoid paying import duties, ethanol and biodiesel are sometimes blended with other chemicals, so that they fall under another tariff code, and no duties have to be paid. In such cases, naturally these biofuels are also not properly accounted for in trade statistics.
- Definition of 'domestic' production: Import of feedstocks to produce biofuels 'domestically': especially for biodiesel production, it has become common to import vegetable oils, and produce biodiesel domestically, while this technically is indeed domestic production, a large part of the energy content has been produced abroad. As the vegetable oils are imported, but the end-sue if often not clear at that point, it is difficult to account those flows as bioenergy trade.
- Indirect imports: Similarly, many countries import large quantities of wood in the form of roundwood or wood chips. The residues from this wood (e.g. black liquor or bark) are used for energy purposes, and count as domestic energy, even though the feedstock was produced abroad.
- Fragmented data: in many cases, data on trade flows is incomplete or scattered over different organisations.

Table 3 Import and export of bioenergy expressed as percentage of the domestic combustible renewable consumption [1-3], [7] – [18]

		Austria	Belgium	Brazil	Canada	Finland	Germany	Italy	Netherlands	Norway	Sweden	UK	USA
IEA	Import	14	31	0	2	0	0	22	30	5	0	11	1
	Export	9	3	3	0	1	0	0	3	0	0	3	0
Country reports task 40	Import	18	30	0	1	3	1	10	36	12	11	22	2
	Export	10	1	1	4	4	1	15	10	4	0	3	1

]

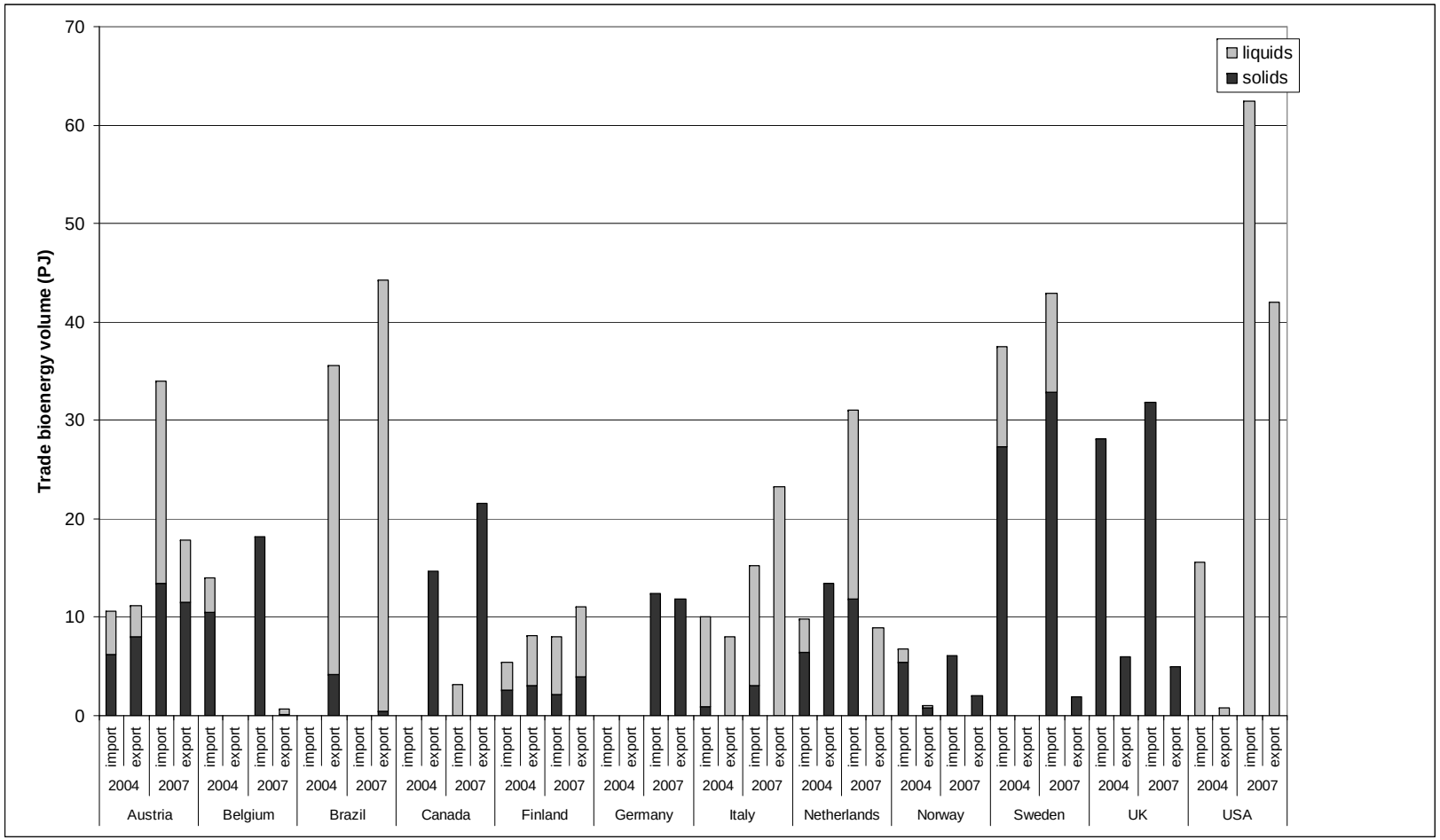

Figure 7 International traded bioenergy flows in Task 40 countries. Numbers should be considered as rough estimates, they do not necessarily include all biomass streams. Based on the available country reports [7] – [18]

6.1 Trends

Notwithstanding the uncertainties discussed above, a number of developments and trends can be derived from the information presented in sections 2-4:

Between 2004 and 2007, the absolute amount and share of bioenergy in the total energy system has increased in all task 40 member countries except for Canada, the US and Norway. In some countries, the increase has been substantial, e.g. doubling in Belgium and Germany.

International bioenergy trade has played an important role in this increase: summed up over all Task 40 countries, the total trade volume of both imports and exports has increased by about a factor of 2 between 2004 and 2007 (see table 4). The increase was mainly due to a strongly rising trade in liquid biofuels (164% increase in total imports, 172% increase in exports), while the trade in solid biomass increased more moderately (51% and 16%).

Table 4. Overview of total imports and exports of liquid and solid biomass in 2004 and 2007 from the Task 40 member countries

Total imports	2004	2007	Increase by
Solids (PJ)	87.4	131.8	51%
Liquids (PJ)	50.5	133.4	164%
Total (PJ)	137.9	265.2	
Total exports	**2004**	**2007**	
Solids (PJ)	50.1	58.4	16%
Liquids (PJ)	48.6	132.2	172%
Total (PJ)	98.7	190.6	

In countries such as Belgium, Denmark and the Netherlands, a substantial part of the electricity produced from biomass is based on imported feedstocks (mainly wood pellets and wood chips). On the other hand, Canada and the USA remain mainly exporters of wood pellets to Europe, with domestic consumption for electricity production being negligible up until 2010. This may however change in the future.

In almost all European countries, the import of liquid biofuels (especially biodiesel) has increased: Austria, Belgium, Germany, Italy and the Netherlands are clear examples. An interesting exception is Denmark, exporting biodiesel produce from rapeseed. The US have become a major importer and (re-)exporter of biodiesel in 2007-2008. The export volumes of biodiesel increased by a factor of 50 between 2004 and 2007. At the same time, ethanol exports from Brazil to the US peaked in 2008, but have decreased since then.

Imports of vegetable oils to produce biodiesel (next to direct imports of biodiesel) have also increased, e.g. to Austria and the Netherlands. In Austria, this has also led to a substitution effect: as more and more rapeseed oil is used for biodiesel production, increasing amounts of soy and palm oil are imported for the production of example margarine.

Prices of liquid biofuels such as bioethanol and biodiesel, and even vegetable oils, show a strong correlation with those of gasoline and diesel. As in many EU countries, the required quota is reached by mandating blending for each seller of transport fuels, there is a direct substitution of gasoline and diesel. This seems to be more important than e.g. the prices of vegetable oil and ethanol. On the other hand, prices of solid biomass used for electricity production do not show this clear correlation, and are likely depending (also) on several other

factors, such as height of feed-in tariffs, prices of CO_2, shipping costs and the costs for the raw material. However, no statistical analysis was performed to confirm these speculations, so they should be handled with care.

6.2 Drivers

Policy drivers:

For the vast majority of trade flows, supportive policies are the main driver. Especially the blending quota for liquid biofuels (5.75% in 2010, to increase to 10% in 2020) has been a major driver behind the imports of liquid biofuels. On top of that, the policy support for producing and blending biodiesel in the US has been a major driver for exports of biodiesel. Much of the large growth shown in figure 7 and table 4 is due to the extremely high growth of international trade in biodiesel, which was basically negligible in 2000, while it nowadays is comparable to the trade flows of ethanol and wood pellets.

Policies have also been an important driver for the trade of solid biomass for power generation in e.g. Belgium, Italy and the Netherlands, and for small-scale heat production in Italy.

Finally, it is of interest to point out that in the US, policies are actually designed to minimize imports, and maximizing US resource use, either for domestic use, or (even though perhaps unintentionally) for export.

Market and other drivers:

Next to policy driven trade, there are also examples of market driven trade: for example, Both Brazil and Canada have become exporters of respectively ethanol and wood pellets because of their ability to produce them at (much) lower costs (including shipping) than many EU countries and the USA. In some cases imports are driven by a high demand, and a simple lack of local resources (e.g. clean, woody biomass in the Netherlands and the UK). In other cases, the domestic resources may be available, but are simply more expensive: for example, fuel wood is imported by Austria from its eastern neighbours and by Norway from Sweden because of the price difference (mainly lower wages in the exporting countries). In Italy, in areas with no natural gas grid, (imported) wood pellets are a cheaper fuel to use than LPG or heating oil.

Only in a few cases, technological development and efficiency improvements drive trade: one example mentioned by Sweden is the growing demand for waste wood as fuel for efficient boilers equipped with advanced flue gas cleaning systems, able to meet the stringent emission demands.

Finally, the presence of a strong forestry industry seems to be also a driver for indirect imports (i.e. imports of raw wood and wood chips, and use of the resulting residues for energy), as is the case for Austria, Finland, Norway and Sweden.

6.3 Other trends and barriers for bioenergy trade

In the Task 40 country reports, also other trends and threats were reported:

Acceptance of bioenergy by consumers and policymakers as sustainable renewable energy sources is a key element in the further utilization of bioenergy potential worldwide. In many countries, large parts of the domestic potentials are not utilized, which can be both an opportunity and threat for international biomass trading.

The recent global financial crisis with its consequences (e.g. currency exchange ratio, less investments in bioenergy or at higher rates) was perceived as a threat for the development of

a stable international bioenergy trading market. Also growing domestic demand can reduce international trade.

Low data availability is a threat for market transparency, a good “biomass production and trade monitoring system” is a possible solution to overcome lack of data or data inconsistency.

Economic attractiveness is often seen as a barrier of bioenergy consumption worldwide. Cost of bioenergy is a combination of, among others, production costs, transportation costs, policy subsidies or taxation and import / export tariffs. Transportation costs largely contribute to overall costs due to the underdevelopment logistical and infrastructural system, both in country of production and consumption. For overseas transport, the cost of shipment is a large fraction of transportation costs. Ship transportation costs skyrocketed in 2007 due to large demand for overseas transport of goods. Due to the economic dip those costs declined heavily after 2008.

The anti dumping measure of the EU for biofuels from the United States also add significantly to the overall cost and are especially by the US as a barrier for further market development. For other countries, import and export tariffs can be an issue. The categorisation is hereby important: ethanol is seen as agricultural product, biodiesel as industrial product. Different taxation schemes apply here.

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Appendix

Table A.1 Total primary energy supply in PJ and Total Gross Electricity Production, in TWh of member countries of the IEA Bioenergy Task 40.

		Austria	Belgium	Brazil	Canada	Finland	Germany	Italy	Netherlands	Norway	Sweden	United Kingdom	United States
TPES [PJ]	2004	1383	2404	8535	11210	1587	14502	7686	3423	1153	2248	9737	96912
	2007	1383	2376	9814	11224	1520	13803	7423	3351	1125	2100	8805	97498
TGEG [TWh]	2004	62	84	387	598	86	610	293	101	110	152	393	4148
	2007	61	88	445	640	81	630	308	103	135	149	392	4323