

## INTERNATIONAL BIOENERGY TRADE: EXAMPLES, TRENDS AND BARRIERS OBSERVED BY IEA BIOENERGY TASK 40

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**ABSTRACT:** The aim of this paper is to present a synthesis of the main developments and drivers of international bioenergy trade in IEA bioenergy task 40 member countries. The use of biomass for energy varies in these countries between a few percent of the national energy supply up to significant shares (e.g. 15-25% in Finland, Sweden and Brazil). In many European countries such as Belgium, Finland, the Netherlands, Sweden and the UK and, imported biomass forms already a significant part of the total biomass use (between 21-43%). International bioenergy trade is growing rapidly, far beyond what was deemed possible only a few years ago. For example, wood pellets are currently exported by Canada, Finland and (to a small extent) Brazil and Norway, and imported by Sweden, Belgium, the Netherlands, and the UK. In the Netherlands and Belgium, pellet imports nowadays contribute to a major share to total renewable electricity production. Major drivers for international demand are the large resource potentials and relatively low production costs in e.g. Canada, and high demand for biomass due to various policy incentives in importing countries. However, developing the required logistic infrastructure both in exporting and importing countries is required to access larger physical biomass volumes and to reach other (i.e. smaller) end-consumers. Trade in bio-ethanol is another example of a rapidly growing international market. With the EU-wide target of 5.75% biofuels for transportation in 2010 (and the recently announced target of 10% in 2020), exports from Brazil and other countries to Europe are likely to rise as well.

**Keywords:** Biomass trade, barriers to bioenergy, biomass resources

### 1 BACKGROUND, RELEVANCE AND OBJECTIVE

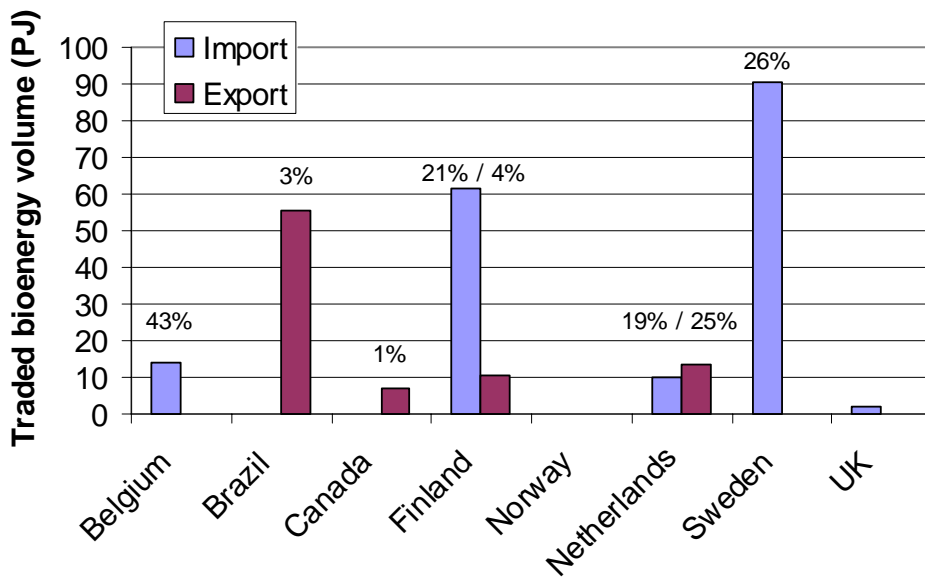
IEA Bioenergy Task 40 was established under the International Energy Agency (IEA) Bioenergy Implementing Agreement in December 2003 with the aim of focusing on international bioenergy trade and its wider implications. One of the explicit aims of Task 40 is to investigate developments in international bioenergy trade and exchange national experiences. To this end, the member countries of Task 40 have written individual country reports covering (a.o.) biomass production, policies to stimulate biomass, international bioenergy trade and opportunities and barriers for further trade. At the time of writing (end 2006), Task 40 had ten member countries: Belgium, Brazil, Canada, Finland, Germany, Italy, the Netherlands, Norway, Sweden and the United Kingdom. With the exception of Germany and Italy, their country reports are available on the Task 40 website [WWW.BIOENERGYTRADE.ORG](http://WWW.BIOENERGYTRADE.ORG).

The aim of this paper is to present a synthesis of the country reports. As the member countries of Task 40 are rather heterogeneous, we provide an overview of the energy characteristics and the contributions and overall trade volumes of biomass to the total energy mix.. In addition, we summarize a number of trends, drivers and barriers for international bioenergy trade. The synthesis thus includes key lessons drawn from the first operating period of IEA Bioenergy Task 40 (2004-2006) on the development of international bioenergy trade, which we believe to be relevant for the industry, policy makers and scientists alike.

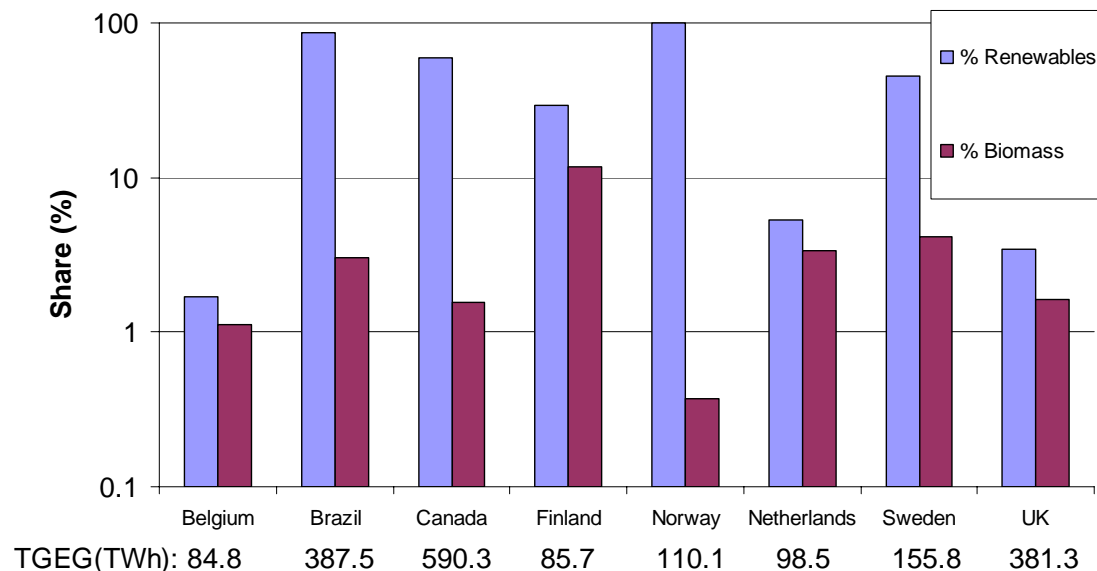
### 2 OVERVIEW OF THE BIOENERGY MARKTES AND TRADE IN TASK 40 MEMBER COUNTRIES

To put the current international bioenergy trade into perspective, we present in brief the main characteristics of the Task 40 member countries. Figure 1 shows the contribution of all renewable energy sources in general and bioenergy is shown as share of the total primary energy supply (TPES) in 2004. This graph illustrates the different situation in the different member countries. For example, the Scandinavian countries, Brazil and Canada have a high share of overall renewable energy contributions (between 15-45% to the TPES). The specific contribution of bioenergy to the TPES is particularly high in Brazil (26%, mainly due to the use of bio-ethanol as transportation fuel) and Finland (19%) and Sweden (16%), mainly due to the use of various wood fuels in the forest industries. On the other hand, in Belgium, the Netherlands and the UK the contributions of renewable energy RE are less than 2% of the total TPES. However, biomass supplies 85-95% of all renewable energy in these countries.

These differences are caused by many different characteristics of these countries: Brazil and Canada are relatively sparsely populated countries with large hydropower and biomass potentials. The Scandinavian countries are similarly characterized by large areas of (boreal) forests, and large forestry industries. Norway has a special position, being blessed with both large fossil fuel reserves and large hydropower potentials. On the other hand, the UK, Belgium and the Netherlands are densely populated countries, with only limited to marginal hydropower and biomass potentials, though some fossil fuel reserves (e.g. gas and oil in the Netherlands and the UK).



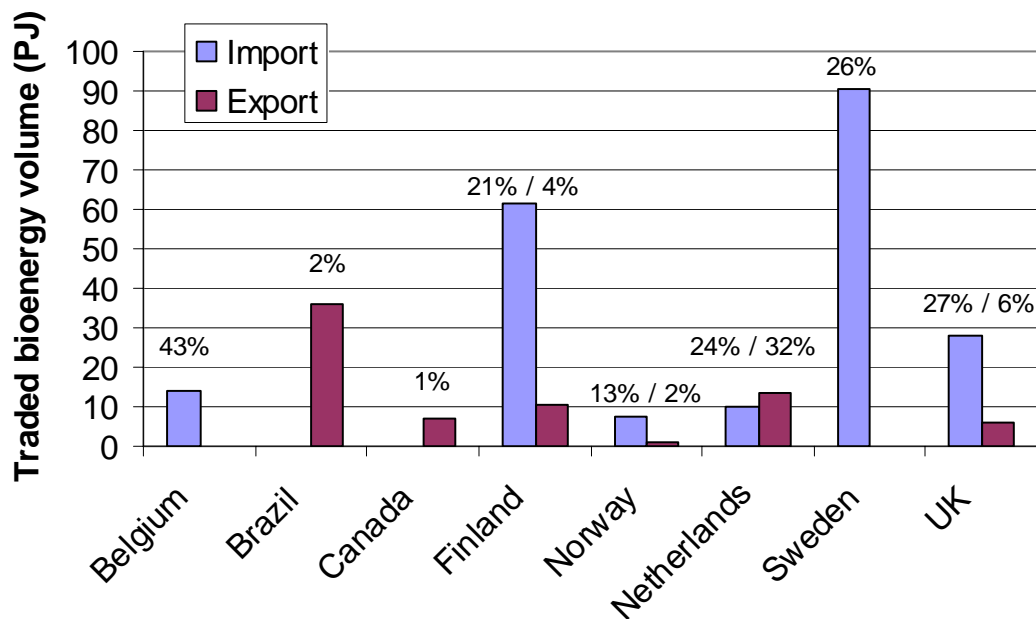
**Figure 1** Overview of bioenergy imports and exports in the T40 member countries in 2004 (with the exception of Belgium: 2005). Source: Task 40 country reports. The numbers above the percentages indicate the size of the traded volumes as share of the domestic primary biomass supply in 2003. These numbers should be considered (rough) estimates, possibly not including all biomass streams



**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. The numbers below the bars give the TGEG per country in TWh. Source: IEA (2006). In order to facilitate visual comparison, the y-axis is on a logarithmic scale.

The contribution of renewable energy (and specifically biomass) to the total gross electricity supply is even more diverse as shown in Figure 2. Perhaps the most extreme case is Norway, with almost 100% of total electricity production from hydro and only 0.4% from biomass. Similar patterns of high shares of hydro power and smaller shares of electricity from biomass are found in Canada (2%) and Sweden (9%). In the other member countries, biomass contributes a significant share to the total renewable electricity production, ranging from 40-65%. Against this background we now take a closer look

at the traded biomass volumes in the Task 40 member countries. In Figure 3, we provide an overview of the imported and exported biomass volumes, and compare them to the national primary domestic supply of biomass for energy utilisation in task 40 member countries. Quantifying the trade volumes is often difficult because of several reasons:



**Figure 3.** Overview of bioenergy imports and exports in the T40 member countries in 2004 (with the exception of Belgium and the UK: 2005). Source: Various task 40 country reports. The numbers above the percentages indicate the size of the traded volumes as share of the domestic primary biomass supply in 2003 (IEA, 2006). These numbers should be considered (rough) estimates, possibly not including all biomass streams. For more details, see the text.

1. Biomass can be used for several (energy) purposes, such as residential heating, electricity production or transportation fuels. In figure 3, these volumes have been added up for each country, but in some cases, some for some biomass uses, no data was available.
2. In our analysis, only biomass imports or exports are included, for which the intended end-use was energy. For example, we needed to make estimates on how much of Brazilian bio-ethanol exports is used as transportation fuel abroad, or how much of the waste wood exported by the Netherlands is co-fired for electricity or heat production.
3. International biomass trade can be divided in direct and indirect trade. Direct trade comprises biomass to be used directly for energy purposes (for example wood pellets imported for co-firing), while indirect trade consists of flows of raw materials that end up as energy fuel after a prior production process (e.g. roundwood imports to Norway or Finland, of which (after being processed in e.g. paper mills) a fraction is used for energy purposes in the form of saw dust or black liquor). Again, estimates were necessary to calculate the respective volumes of indirect biomass trade.

In many cases, the data is (partially) incomplete, or may only cover either import or export. Thus, the figures should be considered (rough) estimates. Nevertheless, they can provide a general overview of the current international trade activities per country, and also indicate how dependent the biomass-based economy is on international trade. The situation in the individual countries is briefly described below.

*Belgium* - Data was available only on biomass import for cofiring in gas and coal power plants. The data includes imports of wood pellets (400 ktonnes in 2005) and vegetal oils (100 ktonnes in 2005). More biomass

streams have been imported for energy production (e.g. olive cake, coffee ground), but exact amounts are not known. Furthermore, significant amounts of e.g. round wood, wood waste and scrap, bio-ethanol and peat have been both imported and exported, but the end use (e.g. energy or material) is not known, and thus has not been included in figure 3. Even when excluding these volumes, the amount of imported biomass is substantial (ca. 43%) compared to the domestic primary biomass supply. For more information, see Marchal and Ryckmans (2006).

*Brazil* - The export data is based on 2.5 billion liters of bio-ethanol, and small amount of green wood chips and wood pellets. The main countries importing Brazilian bio-ethanol are India, the US, South-Korea and Sweden. It was estimated that approximately 75% of bio-ethanol sold to EU countries, USA, India, and China, ends up as transportation fuel, for all other countries this was estimated to be 25%. No data was available on the import of biomass for energy, but this is expected to be negligible. Brazil currently only exports a relatively small amount of biomass (3%) compared to its domestic biomass production, though this amount may increase significantly in the future. For more information, see Walter et al. (2006).

*Canada* - Exported biomass takes into account amounts to 400 ktonnes of wood pellets in 2004. This is a very small amount compared the domestic biomass production (an estimated 1%), but as in the case of Brazil, these amounts are expected to increase strongly in the near future. Unfortunately, no data was available on the import and export of round wood, i.e. how much direct and indirect other biomass trade may occur. For more information, see Bradley (2006).

*Finland* - Within the frame of IEA Bioenergy Task 40, probably the most detailed and complete analysis of all biomass flows have been collected for Finland. The

wooden raw material streams of the forest industry were included in the international biofuels trade in addition to biomass streams that are traded for energy production. In 2004, as much as 45% of the raw wood imported into Finland ended up indirectly in energy production. The total international trading of biofuels was evaluated at 72 PJ, of which the majority, 58 PJ, was raw wood. About 22% of wood based energy in Finland originated from imported raw wood. Tall oil and wood pellets composed the largest export streams of biofuels. The annual turnover of international biofuels trade was estimated at about €90 million for direct trade and at about €190 million for indirect trade. The forest industry as the biggest user of wood, and the producer and user of wood fuels has a central position in biomass and biofuels markets in Finland. Lately, the international aspects of Finnish biofuels markets have been emphasised as the import of raw wood and the export of wood pellets have increased. Total use of imported biomass expanding the use of biofuels in the road transportation sector would increase the international streams of biofuels in Finland. In coming years, the international trading of biomass for energy purposes can be expected to continue growing. For more information, see Heinimö and Alakangas (2006).

*Norway* – In Norway, direct trade of biofuels is currently limited (less than 3 PJ), and consists mainly of firewood from Estonia, Latvia and Sweden. Norway is a net exporter of refined solid biofuels, but the quantities are quite minor (<1 PJ). The overcapacity of refined biofuel production units does presumably reflect expectations of a growing market for bioenergy domestically. Indirect trade of biofuels is more substantial (an et import of about 3.8 PJ). For more information, see Bolkesjø et al. (2006).

*Netherlands* - Until the year 2000, the Netherlands barely imported biomass for energy production. Over the last few years, both the import and export of biomass for energy purposes have been strongly increasing, over a factor of seven in terms of electricity produced between 2003 and 2005 alone. The biomass imported is used to almost 100% in Dutch power plants (mainly coal and two gas-fired plants), and can be roughly divided into the following categories: liquid bio fuels like palm oil and fatty acids, and solids, such as agro residues (e.g. palm kernel expeller), wood chips and wood derived fuels (wood pellets), and solid waste streams (e.g. bone meal) In total, in 2004 about 9.9 PJ was imported. The exported biomass consists mainly of waste wood and construction wood, accumulating to 13.4 PJ. As the Netherlands do not have a large wood-processing industry, no indirect trade volumes were taken into account. Thus, in 2004, about 24% of the total primary biomass supply was imported, while an amount equivalent of 32% was exported for energy production. For more information, see Junginger et al. (2006).

*United Kingdom* - It is difficult to obtain detailed information concerning the level of bioenergy imports into the UK since information at a company level is commercially sensitive in nature and at sectoral level little information is collected centrally. At the same time, international trade statistics often do not classify products (such as wood pellet) in sufficient detail. Much of the material imported is for co-firing in coal-fired power plants. Over 1.4 million tonnes of biomass was co-fired in 2005. At two thirds of this mass was derived from

imported biomass. It is difficult to determine trade patterns for co-firing since imported feedstocks are typically purchased on spot markets through intermediaries and operators have the ability to switch between different suppliers and different feedstocks to pursue best value for money. However, the UK co-firing market has developed into a key market for agricultural residues that have few alternative uses. For example, the UK accounted for over 55% of imports of dry olive cake into EU Member States. The UK is a nascent producer and consumer of many forms of bioenergy. This means that trade in bioenergy exists for products consumed for energy in the UK that are not yet produced domestically. For example, 85 million litres of bioethanol were consumed in road transport in 2005 even though the UK does not yet produce bioethanol commercially. This represented 0.17% of total fuel sales by volume (DfT, 2006). By contrast, over 40,000 toe of biodiesel was produced in 2005, while only 25,000 toe was consumed in road transport.

Summarizing, it is evident that the European Task 40 member countries import significant amounts of biomass, varying from 12-43%, and that these shares tend to increase over the next years. On the other hand, Brazil and Canada so far only export a minor fraction of their domestic biomass use (1-2%), but again, this share is expected to rise rapidly.

### 3 TRENDS DRIVERS AND BARRIERS FOR INTERNATIONAL BIOENERGY TRADE IN T40 COUNTRIES

Below, a short selection of topics is presented, that were indicated in one or several of the T40 country reports as main trends, drivers and barriers for international trade. This list is not exhaustive. For a more comprehensive overview, see also the individual country reports and the opportunities and barriers for trade (Task 40, 2006).

#### 3.1. Bioenergy trade: from local to regional, and now more international

A development seen all over Europe is the growth of international bioenergy trade. A typical example is Sweden: the bioenergy sector in Sweden started as a local demand and supply in the late 70-ies and 80-ies. In the 90-ies energy facilities started a regional market for biomass by import of cheap recycled demolished wood from Holland and Germany and thereafter also wood chips from the Baltics. Now steps are taken to an international market in which prices of biomass for energy are set in competition with products from sources far away, e.g. from south of Europe as well as from North and South America. Some years ago Sweden was almost the only country in Europe when it came to demand for import of biomass for energy. This created a favourable situation with low prices and reliable sourcing. Now, as the demand in other parts of Europe is emerging and the cost structure in e.g. the Baltics is rising the cost argument for import is diminishing. The imported biomass is often a more expensive material compared with domestic material.

#### 3.2 Low data availability and methodological issues regarding direct and indirect trade

In most cases, national customs and energy statistics include a varying amount of usable statistical information on international biomass trade. A positive example is Finland, as the Finnish energy statistics include the export of wood pellets and fuel peat, and the volume of imported wood fuels in primary energy consumption. In most other Task 40 member countries, such as the Netherlands or the UK, the national statistics do not include such information. Therefore, the compilation of statistics on international biomass trade should be further developed to provide a better view of international biofuels trade. Next to the lack of information compiled centrally by government departments or trade organizations, this is also due to the reluctance of suppliers and consumers to provide data as this is often regarded as commercially sensitive, and difficulties with classification of trade statistics as most imports are not necessarily classified as energy.

Another aspect is the indirect import of biomass, mainly occurring in countries with a large pulp and paper sector, such as Finland, Norway and Sweden. Both in Finland and Norway, the indirect trade of biofuels is emphasized within the import of raw wood for the forest industry. International streams of wood and wood-based products and the indirect trade of biofuels have yet to be extensively studied and would offer interesting subjects for further research in order to learn more about biofuels markets.

### 3.3 Dependency on (varying) policy support

In many European countries, such as Belgium, Sweden, the Netherlands and the UK, favourable policies for renewable electricity energy production and use (e.g. electricity, heat and transportation fuels) are a main driver for the import of biomass. However, experiences show that this may drive up prices, as was apparent over the past few years for wood pellets and other biomass streams. Also, varying policy incentives can disturb market mechanisms, as was recently shown for biomass trade between Germany and the Netherlands (Faber et al., 2006).

### 3.4 Sustainability criteria and certification systems for biomass

Within several of the Task 40 member countries, companies, NGO's and national governments have realized the necessity to safeguard the sustainable production of (imported) biomass. Certification of biomass is seen as one possibility to ensure sustainable production, though there are several approaches possible (e.g. national vs. international systems, mandatory vs. voluntary), and a number of apparent drawbacks. For examples of initiatives in amongst others Belgium, Germany, the Netherlands and the UK, and an extensive discussion on possibilities and drawbacks of certification issues, we refer to another Task 40 paper by van Dam et al (2007). Here, we conclude that the sustainable production of biomass is an issue that will likely increasingly influence international bioenergy trade in the future.

## 4 SUMMARY AND CONCLUSIONS

The use of biomass for energy varies between a few percent of the national energy supply up to significant

shares (e.g. 15-25% in Finland, Sweden and Brazil). In many European countries such as Belgium, Finland, the Netherlands, Sweden and the UK and, imported biomass forms already a significant part of the total biomass use (between 21-43%). International bioenergy trade is growing rapidly, far beyond what was deemed possible only a few years ago. For example, wood pellets are currently exported by Canada, Finland and (to a small extent) Brazil and Norway, and imported by Sweden, Belgium, the Netherlands, and the UK. In the Netherlands and Belgium, pellet imports nowadays contribute to a major share to total renewable electricity production. Major drivers for international demand are the large resource potentials and relatively low production costs in e.g. Canada, and high demand for biomass due to various policy incentives in importing countries. However, developing the required logistic infrastructure both in exporting and importing countries is required to access larger physical biomass volumes and to reach other (i.e. smaller) end-consumers. Trade in bio-ethanol is another example of a rapidly growing international market. With the EU-wide target of 5.75% biofuels for transportation in 2010 (and the recently announced target of 10% in 2020), exports from Brazil and other countries to Europe are likely to rise as well.

An extended version of this paper is currently submitted for publication to Biomass and Bioenergy. For more information on IEA Bioenergy Task 40, please visit the Task 40 website [www.bioenergytrade.org](http://www.bioenergytrade.org)

## 5 ACKNOWLEDGEMENTS

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