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ABSTRACT: The wood pellet use in the heating and electricity sector has recorded a steady growth in the last years. IEA bioenergy task 40 carried out an update of the situation on the national pellet markets in the most relevant pellet producing countries and the global development as well. Various country specific data is collected and compiled for more than 30 countries, containing updated information about regulatory framework, production, consumption, price trends, quality standards and trade aspects. The analysis confirmed the positive development in terms of production and consumption of wood pellets in almost all countries. In 2015 more than 26 Mt of wood pellets have been produced and consumed worldwide. Technologies and markets become more mature. Increased international pellet trade needs to be supported by adequate frame condition not only for commerce, but also with regard to sustainability issues.

Keywords: wood pellets, trade, production, consumption

1 INTRODUCTION INTO THE WOOD PELLET INDUSTRY AND MARKETS

Wood pellets are renewable energy carriers which are produced from sawdust or other ground woody materials. International standards define product requirements for i.e. moisture, energy density, abrasion resistance, particle size and shape for wood pellets (ISO 17225-2) which turn wood pellets into a commodity. Over the past ten years, the production of wood pellets increased steadily, driven by an also constantly rising demand. For 2006, the production was estimated between 6 and 7 Mt (excluding Asia, Latin America and Australia), expanding to 14.3 Mt in 2010 and surpassed 26 Mt in 2015.

There are different wood pellet types and qualities

available today (Figure 1). So far, dedicated qualities are delivered and consumed in two different markets:

- (1) In the electricity generation sector they are co-fired in coal based power plants to reduce greenhouse gas emission of the electricity generation. Therefore pellets with lower product quality demands are used. Their distribution structures are characterised by large scale provision and intercontinental trade.
- (2) In the residential heating sector they are widely used as a convenient solid biofuel application in automatic stoves and boilers. Therefore pellets with a dedicated quality (e.g. ENplus A1) are dominant, which are produced close to the consumer and characterised by trade within the

country or between neighbouring countries. Delivery is realised in small scale units.

Additional applications are their use as a fuel for mid-size supply systems (district heating, CHP plants) and as a renewable resource for green chemistry. But they do not play a major in market development role yet.



Figure 1: Pellets examples from different materials and processes (source: DBFZ)

The distribution of wood pellets starts at the wood pellet plant and ends with the arrival at the end user e.g. at the boiler storage of an individual household, for a co-fired power plant or at the storage for a large scale gasifier for the production of chemicals. Depending on the distance of distribution as well as the time lag between sending and arriving, most sensitive parameters for calculating distribution costs are costs with regard to (un-)loading, transportation and intermediary storage. For the calculation of emissions, fuel consumption of only the transport modes is estimated to be sufficient. Never the less, pellet prices are influenced by additional parameters, so far often relevant on national or even subnational level.

2 INVENTORY OF THE WOOD PELLET PRODUCTION, TRADE AND CONSUMPTION 2011 - 2015

With this report we provide an inventory of the wood pellet industries and markets for more than 30 countries with regard to regulatory framework, production capacities, consumption and price trends, trade, logistics and country specific standardisation aspects. With the considered countries we cover different regions of the world, driven by different national energy, climate and resource policies and characterised by different levels of export and import orientation. Summing up the overall pellet flows from the considered countries and comparing them with other studies, the conclusion can be drawn that all relevant pellet producing countries are included.

Production and consumption patterns differ between the countries (Figure 2). On a country basis, the U.S. stands out by far as the largest pellets producer with 7.4 Mt in 2015. With 2.2 Mt, Germany follows in second place, Canada and China sharing third with each ca. 1.9 Mt.

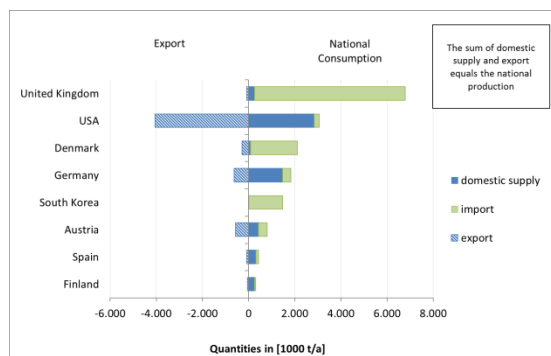


Figure 2: domestic production + Import | Export per

country for chosen countries in 2015

The overall pellet market has increased dramatically since 2011, with an average increase rate of 14% per year (Figure 3). New countries have entered the market for both, pellet production (such as South-East Europe) and pellet consumption (such as South-East Asia). Also the global wood pellet trade increased. The industrial pellets trade is dominated by the trade relation between the U.S. and the UK, while the non-industrial use is still mainly an intra-Europe business. Russia and the Baltic states are becoming here increasingly important. The Asian markets show also a strong growth, with Japan and South Korea as the main consumers. Reflecting the major demand in Europe, it is also by far the largest producer (2015: 54%), followed by North America (2015: 35%), which is mainly export driven. Asia, the Russian Federation, Australia and Latin America play minor roles in the global pellet production (2015: 11%).

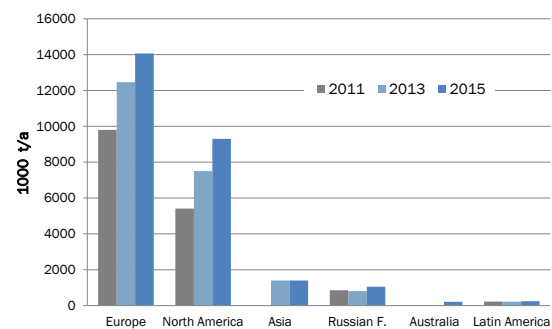


Figure 3: Pellet production by continent in 2011, 2013 and 2015

The ongoing development of the wood pellet market also leads to new challenges: Appropriate trade infrastructure has to be developed and built, such as storage, loading and handling capacities in the pellets production regions, as well as in commercial areas and harbours. Additional conversion capacities lead to resource demand, which has to be provided in a sustainable way.

3 CHALLENGES ON SUSTAINABLE WOOD PELLET TRADE

With regard to the resource base, in the past years sustainability requirements for solid biomass have been established and implemented in a number of countries in the European Union, namely the United Kingdom, the Netherlands, Belgium and Denmark and has led to the creation of different national initiatives to govern the sustainable production of wood pellets in the European Union. Partly as a response to this, the Sustainable Biomass Partnership (SBP) was established in 2013. It is a certification scheme designed for woody biomass, mostly in the form of wood pellets and wood chips, used in industrial, large-scale energy production. The SBP is committed to a core strategy that identifies and uses, wherever possible, existing forest certification schemes (such as Forest Stewardship Council (FSC) and Programme for the Endorsement of Forest Certification (PEFC)) as the principal building blocks for its approach. SBP aims to complement those systems with carbon footprint information. Over the course of 2014 to 2016,

the number of SBP certified wood pellet producers and traders grown strongly to over 70 certificate holders, amongst which some of the largest wood pellet producers worldwide. As such, it is the largest voluntary system certifying woody biomass for energy purposes.

Additionally Japan and South Korea have introduced sustainability certification schemes for wood pellets. Wood pellets sold into Japan must be forest management certified, if electric utilities want to purchase electricity generated from renewable energy sources such as biomass on a fixed-period contract at a fixed price. In Korea an attempt has been made to introduce sustainable forest management criteria, but after problems with fraudulent certificates from neighbouring countries, it is unclear if Korea will impose forest management requirements again in the future.

So far, the legislation and support schemes have, to a certain degree, different goals and targets whilst there are also differences among various sustainability criteria and reporting requirements. This situation may cause trade barriers for solid biomass, and thus, a harmonisation of sustainability requirements would benefit the global trade in wood pellets. Within the EU this is under severe discussion. Open questions are on the format (directive versus more open principles for member states support schemes), on the considered biomass (forest biomass only or also agricultural biomass), on considered effects (including land use change and indirect land use change or not), on thresholds for greenhouse gases etc. If sustainability requirements are only mandatory for certain countries and (a limited number of) bioenergy applications, but not for others/ material purposes, the power of certification is limited. Clear policies and guidance is necessary to increase investor confidence and importantly make sustainability a meaningful approach of the bioenergy sector to combat climate change whilst securing energy supply. This has to be done in the recast Renewable Energy Directive as well as in the national legislations, and ultimately by alignment on a global level (e.g. with other regions such as East Asia) to avoid unintended side-effects and to facilitate global trade of wood pellets.

On their way to become a commodity, wood pellets need to have certain characteristics such as standardisation (fungibility), liquidity and competitive markets, usually business to business. The standardisation has proceeded very far both in the industrial and the residential sector. The latter one is usually only on a regional scale aiming at end consumers, which makes the consideration of commodity less applicable for this sector. The industrial market is characterised by a few large suppliers and consumers (notably the US and UK), which infringes the liquidity (ease of finding a seller/buyer) and competition. With the expected continuous growth, this might change and industrial pellets may achieve the full characterisation as commodity and the benefits leading to this status. One crucial factor here is the removal of (political) uncertainties to attract more actors and trade volumes.

4 TORREFACTION AND INTERNATIONAL TRADE

Torrefaction is a thermal pre-treatment technology

used to upgrade lignocellulosic biomass to a higher quality and thus to more attractive biofuel. In the torrefaction process, biomass is heated to a temperature between 250-350°C in an atmosphere with low oxygen concentrations, so that all moisture is removed. During the torrefaction process, the biomass partly devolatilises leading to a decrease in mass, however the initial energy content is preserved so that the energy density of the biomass becomes higher than the original biomass.

The properties of the final product highly depend on the process conditions and on the composition of the biomass feedstock (Table I). Influenced by factors such as time, temperature and residence time, the biomass can be torrefied to different torrefaction degrees/temperatures. Directly connected to the degree of torrefaction is the net calorific value (NCV) of the resulting product. Theoretically, NCVs of 28+ MJ/kg could be reached, even though the overall process efficiency seems to be best at 20-22 MJ/kg NCV (depending on feedstock).

Table I: Properties of transportable biomass and competing fuel.

	Fresh Wood	Wood Pellets	Torrefied Pellets	Coal
Moisture (%)	35-50	7-10	1-5	10-15
Calorific Value (GJ/T)	9-12	16-18	19-23	23-28
Bulk Density (T/m ³)	.2-.25	.6-.68	.65-.75	.8-.85
Energy Density (GJ/m ³)	2-3	9.6-12.2	12.4- 7.3	18.4-3.8
Ash (% by wt)		0.4-2	0.4-2.5	9.7-20.2
Grindability	Poor	Poor	Good	Good

Different tests have shown significantly improved water resistance and additionally that torrefied biomass, once compressed into pellets or briquettes, is of non-hazardous character in transportation. A number of full scale tests of co-firing in European power plants have confirmed the positive combustion results expected. Consequently, transportation and storage of torrefied pellets is much cheaper than normal wood pellets. In some cases there are also advantages in conversion to energy (i.e. better grindability in coal mills than wood pellets). The power sector could well be the leader in torrefied biomass's use, with industry behind. Torrefied biomass is proven for power-plant applications and may become in the coming years a central resource for co-firing of biomass with coal. Another way of succeeding in this sector may be through gasification of torrefied biomass. With the development of dedicated technical specification under ISO 17225-8, which is planned for 2017 and clarification that for the European market no REACH registration should be necessary, it seems all fundamentals for market success of torrefied biomass are today really provided and ready for market uptake.

5 OUTLOOK

During the last years the pellet market has been developed continuously worldwide and for the time being this trend is ongoing. Increasing demands is expected for both, industrial application in large scale power plants and small scale application in residential heating systems. For the overall consumed pellet amount of 26 Mt in 2015

more than one third has been intercontinentally traded, mainly from the Americas to Europe and Asia. The taken efforts for improving product qualities (torrefaction) and market information (contracts/indices) provide new opportunities for wood pellet application and trade, but their market uptake is not yet visible. The development of pellet prices is still divers between the countries. Additional effort should be taken to increase market maturity.

Further market development also depends on the regulatory frame conditions, especially the international effort to mitigate climate change and the sustainability requirements for the feedstock. Dynamics in frameworks can be observed in many countries and will be key for the further establishment of wood pellet industry and trade.

6 REFERENCES

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