

## 3. National, regional and global markets for woodfuels

This chapter presents an overview of woodfuel markets for key countries and regions, focusing on the predominant types of woodfuel. Globally, the international bioenergy trade has grown exponentially in recent years. In the case of solid woodfuels, the main commodities traded are fuelwood, wood waste, woodchips and wood pellets. The international trade in industrial roundwood also has implications for bioenergy use and trade, since further processing produces residues that can be used; regional shortages in industrial roundwood suggest that international trade in this commodity will increase in coming decades (Smeets and Faaij, 2007).

### EUROPEAN UNION

The EU has specific policies to support renewable energy, and woodfuels have a central role. The policy goal is that renewable energy should constitute 20 percent of the EU's energy supply by 2020; it is expected that a significant part of this will be biomass-based (Pekska-Blanchard *et al.*, 2007). Currently about 5 percent of the energy consumed in the EU is derived from biomass (all sources); the main uses are in stand-alone biomass plants, co-firing with coal, and small-scale applications in households and small businesses.

The production of pellets began in a number of European countries as a way of using the abundant residues produced by sawmills – wood product industries are the largest source of woodfuels in Europe. Pellet production increased four-fold in the EU between 2001 and 2009 (Figure 1) and there is a fluid trade both within the EU and with external producers, particularly the Russian Federation and Canada (European Pellet Centre, 2010).

Germany, Sweden and Austria have the highest pellet production capacity, accounting for nearly half of total EU capacity in 2008 (Table 17). In 2008 the EU was a net importer of wood pellets. In the EU as a whole, production was 61 percent of total capacity, suggesting that market opportunities exist for those producers able to reduce costs to the extent necessary to compete with the major non-EU exporters. Interestingly, the country with the lowest average capacity, Italy, had the highest overall production capacity utilization; the main reason for this is that many Italian pellet producers are integrated with nearby sawmills, whereas in most other EU countries the pellet producers must source and contract their feedstock externally (European Pellet Centre, 2009). Integrated pellet producers face less uncertainty in feedstock supply and can generally control production and costs more easily.

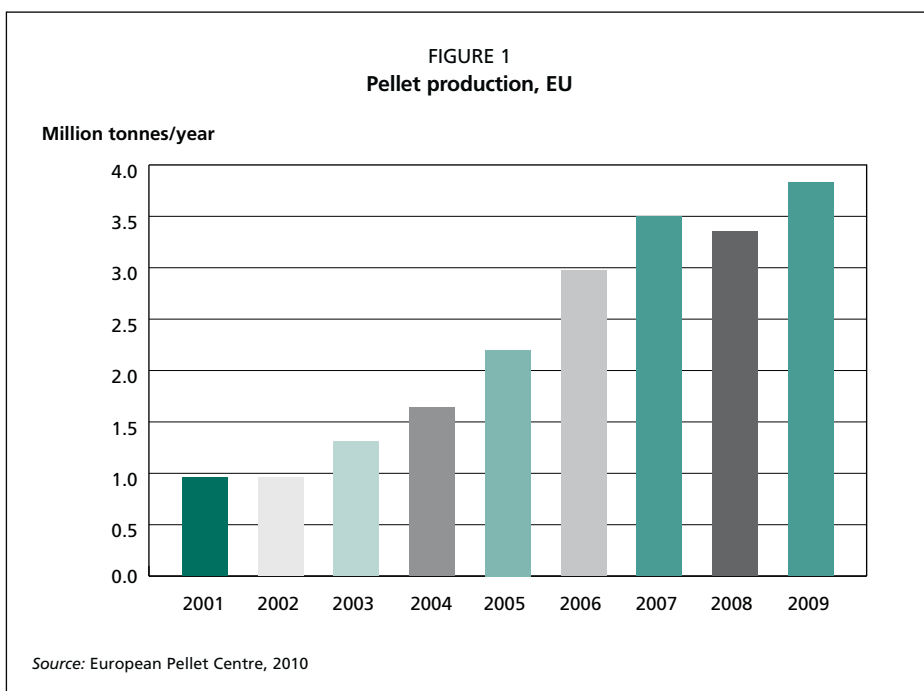


TABLE 17

**Estimated wood pellet production and consumption in the EU, 2008**

Country	No. of registered producers	Production capacity ('000 tonnes)	Average capacity ('000 tonnes)	Production ('000 tonnes)	Capacity utilization (%)	Total consumption ('000 tonnes)	Net (production minus consumption) ('000 tonnes)
Austria	25	1 006	40.2	626	62	509	117
Finland	19	680	35.8	373	55	150	223
Germany	50	2 400	48.0	1 460	61	900	560
Italy	75	750	10.0	650	87	850	-200
Latvia	15	744	49.6	379	51	39	340
Poland	21	665	31.7	350	53	120	230
Sweden	94	2 200	23.4	1405	64	1 850	-445
Others	203	3 828	18.9	2 234	58	3 535	-1 301
<b>EU total</b>	<b>502</b>	<b>12 273</b>	<b>24.4</b>	<b>7 477</b>	<b>61</b>	<b>7 953</b>	<b>-476</b>

Source: European Pellet Centre, 2010

**OTHER EUROPE AND THE RUSSIAN FEDERATION**

Outside the EU the largest potential source of woodfuels in Europe is the Russian Federation, which has been an important supplier of biomass for energy to Western European markets for several years via its exports of roundwood for processing, primarily to Finland and the other Baltic states. Belarus and Ukraine

have also developed pellet markets, with eight producers in Belarus and 15 in Ukraine as of the end of 2008 (European Pellet Centre, 2010). The primary source of raw material for wood pellet manufacture in those countries is sawdust. The export of raw roundwood from the Russian Federation is due largely to the relative underdevelopment of the Russian Federation forest and wood products sector. The Russian Federation already exports nearly 1 Mt of pellets per year (European Pellet Centre, 2010). Pellet production began in the mid-1990s using Soviet-era agricultural equipment and second-hand machinery imported from Europe (Pekska-Blanchard *et al.*, 2007).

## **NORTH AMERICA**

North America has significant woodfuel potential. The United States of America has a large internal market, whereas Canada has a small domestic market and therefore looks to international markets to sell its surplus. Rapid growth and land-use pressures in Asia have opened up export markets for Canada's wood and wood products, particularly from the west coast, which has ready access to Asia. Mexico has significant forest resources for its size but these mainly supply the domestic market.

### **Canada**

With one of the world's largest forest sectors and as a major exporter of lumber, Canada can be regarded as a biomass storehouse. In 2007–2008, for example, the country produced 21 million bone dry tonnes (Mbdt) of mill residue and had a surplus of 1.8 Mbdt, which is expected to increase substantially when the lumber market recovers from the recent downturn. There are also 21 Mbdt of bark in old mill piles, much of it in Quebec and Ontario, and nearly 10 Mbdt of urban wood waste (Bradley, 2009). The total Canadian forest resource designated as commercial growing stock stands at 40 billion m<sup>3</sup>, the second-largest in the world after the Russian Federation (Pekska-Blanchard *et al.*, 2007; Bradley, 2009). Surplus woody biomass will also be available for energy over the next decade due to an infestation of the mountain pine beetle in pine forest in western Canada. It is estimated that, by 2012, 1 billion m<sup>3</sup> of wood will have been killed by the beetle in British Columbia alone (Bradley, 2009).

The wood products industry is declining in Canada in the face of international competition and the industry is looking increasingly to divert wood resources to energy, both for domestic use and export. Although Canada has renewable energy targets, growth in domestic demand for pellets and combined heat and power is slow; there is, therefore, an excellent opportunity for export. The production of wood pellets in Canada began in the late 1980s and has grown from around 0.5 Mt per year in 2003 to over 2.5 Mt in 2008, of which more than half was exported (Pekska-Blanchard *et al.*, 2007; Bradley, 2009). Canadian exports of wood pellets comprised more than 10 percent of EU consumption in 2008 (Junginger *et al.*, 2009).

## **United States**

The woodfuel potential in the United States is smaller than that in Canada but the domestic market is considerably larger. There are various laws, executive orders and regulations to promote bioenergy. Presidential Executive Order 13101 (Greening the Government through Recycling and Waste Prevention) and Presidential Executive Order 13134 (Developing and Promoting Bio-based Products and Bioenergy) are good examples. It is likely that most biomass produced in the United States will be used domestically rather than exported. The wood pellet market has been expanding at a similar pace to that of Canada and amounted to 2 Mt in 2008 (Junginger, Sikkema and Faaij, 2009).

## **Mexico**

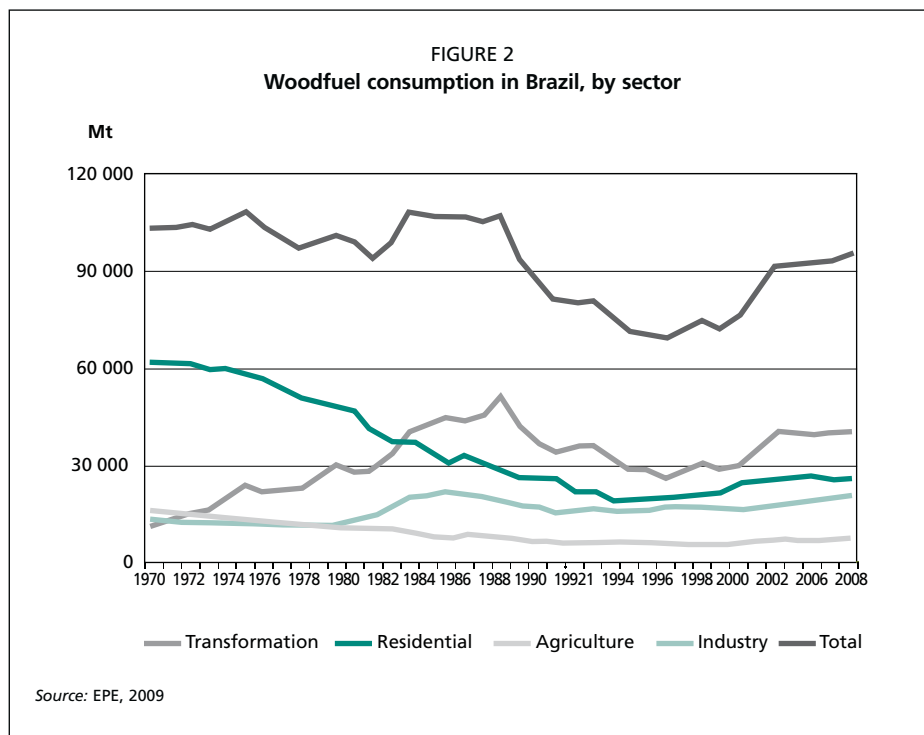
Native tropical and temperate forests cover one-third of Mexico and biomass harvested from them provide about one-third of energy use in the country's residential sector. The current level of consumption is 18.4 megatonnes of dry matter (MtDM) of fuelwood and 3.2 MtDM of fuelwood-equivalent in charcoal; the technical potential for woodfuel production has been estimated at 55 to 59 MtDM annually (FAO, 2010b). Fuelwood is consumed by households for cooking, heating (in colder regions) and small cottage industries (e.g. brick and ceramics manufacture and blacksmithing). Charcoal is a significant source of energy; although produced in rural areas it is consumed primarily by urbanites and is therefore regarded mainly as a commercial activity. Fuelwood, on the other hand, is primarily non-commercial and is poorly captured in official statistics.

## **SOUTH AMERICA**

Led by Brazil, South America has tremendous forest resources, although sustainable use for bioenergy is constrained by the important ecological and biodiversity values of the Amazon and other regions. Countries with the best-developed forest industries are Argentina, Brazil, Chile and Uruguay. The forest industries of some countries, such as Colombia, Ecuador, Guyana, Peru and Venezuela, are relatively underdeveloped for wood and energy production.

## **Brazil**

Brazil has undergone a significant transition in the use of woodfuel in the past 20 to 30 years. This transition has some similarities with the typical shift away from biomass-based energy that has accompanied economic development in nearly all countries (often referred to as "climbing the energy ladder") but it also has some additional characteristics. As has occurred elsewhere, the residential use of fuelwood has declined with increasing affluence and urbanization. In contrast to many other countries, however, declining residential use has been offset by significant increases in charcoal use for industrial applications (Figure 2). The upsurges in usage in the 1980s and mid 2000s were both linked to significant expansions in pig-iron production (FAO, 2010b). The industrial-sector use of charcoal accounts for 90 percent of charcoal consumption in Brazil, of which about two-thirds is used in pig-iron production.



Wood used for charcoal production is increasingly sourced from forest plantations rather than native forests; in 1990, 60 percent of Brazilian charcoal production was from native forests and 40 percent from plantations but, by 2008, the share of native forests had decreased to 36 percent (IBGE, 2009). In 2005 there were 5.4 million hectares of forest plantations in Brazil; in addition to being used for charcoal, a large part of these plantations is devoted to wood-pulp production. Energy use from residues and surpluses typically amounts to 10 to 15 percent of the total biomass supply (World Resources Institute, 2008).

Brazil is becoming a major player in international bioenergy trade. Increasing exports of biomass from plantation forests offer possibilities for improving the efficiency of the pulp and paper industry. It is estimated that 50 million m<sup>3</sup> of forestry residues are produced annually but are generally not used for energy (Walter, Dolzan and Piacente, 2006).

### Argentina and Chile

In 2002 Argentina had 2 230 sawmills producing 94 million m<sup>3</sup> of wood (Rodriguez, 2006) and yielding 4 to 5 Mt of unused wood waste. There are also several million tonnes of waste forestry biomass on river banks that could easily be exported (IEA Bioenergy Task 40, 2009).

Chile's forest industry is about one-third the size of Brazil's. In 2007, Chile manufactured 60 000 tonnes of wood pellets and exported 20 000 tonnes. The

long distances to major markets, coupled with old port facilities, make pellet exports a challenge. Given cheap shipping rates and the fact that pellets have a lower transport cost per unit energy than liquid biofuels, Chile could nevertheless become a significant bioenergy exporter (Chadwick, 2006; Bradley, 2009).

### SUB-SAHARAN AFRICA

Africa has 16 percent of the global forest area, compared with Europe's 25 percent, but a greater mass of aboveground woody biomass (Table 18). Brief comments on the woodfuel production potential of South Africa, Mozambique and Tanzania are given below.

South Africa's forest plantation area (1.35 million hectares in 2000) exceeds its natural forest area (0.5 million hectares in 2000) (FAO, 2005). The small natural-forest area is due more to natural climatic conditions than the deforestation of a formerly large indigenous resource. Because the country has relatively good infrastructure, woodfuels in the form of woodchips and pellets are being exported by a number of companies.

Mozambique has the tenth-largest forest area in Africa but, unlike South Africa, does not have a large wood-processing sector, producing just 38 000 m<sup>3</sup> of sawnwood annually. Nevertheless, it has been identified as a country with large potential for bioenergy exports because of its favourable climate, long coastline and large land area. Mozambique has 30 million hectares of forest and 50 million hectares of agricultural area, of which less than 5 percent is currently used; there are only 38 000 hectares of planted forest (FAO, 2006b). The country has several Indian Ocean ports, such as Maputo, Beira and Nacala, with rail-links to the country's interior and some regional destinations, which would facilitate international trade in woodfuels.

Over 90 percent of Tanzania's energy is derived from wood. Tanzania has a total forested area of 35 million hectares, the fifth-largest in Africa, and about 150 000 hectares of planted forest. At a national level it is estimated that the mean annual increment of Tanzania's forests (67 million m<sup>3</sup> of solid wood) exceeds total demand (45 million m<sup>3</sup>) (TATEDO, 2005). However, regional surpluses and shortages of wood exist and a significant proportion of wood use is likely to be unrecorded. Deforestation is a serious issue in Tanzania; the main causes have been

TABLE 18  
Comparison of European and African woody biomass resources

Region	Forest area, 2005		Above-ground biomass, 2005		Roundwood production, average 2000–2002		Pulpwood and sawnwood, average 2000–2002		Woodfuel, average 2000–2002	
	Million ha	% of global total	Mt	% of global total	Million m <sup>3</sup>	% of global total	Million m <sup>3</sup>	% of global total	Million m <sup>3</sup>	% of global total
Europe	1001	25	71	18	581	17	306	35	105	538
Africa	635	16	96	25	605	18	19	2	6	30

Source: FAO, 2006a; Hillring, 2006.

cited as woodfuel use (including charcoal), agriculture (shifting cultivation) and forest fire. The annual deforestation rate is estimated to be in the range 100 000 to 500 000 hectares per year (Abdallah and Monela, 2007).

Tanzania has a sizable wood-processing industry and a number of sawmills. An estimated 944 000 m<sup>3</sup> of domestic sawnwood was consumed in 1998, implying that a similar quantity of residues could be made available for energy use. The forest sector accounts for around 10 percent of Tanzania's exports, mostly through the port of Dar es Salaam, which handles 95 percent of Tanzania's international trade (Tanzania Ports Authority, 2007). Forest residues from plantation operations are usually used for fuelwood or, in some cases, for generating heat and power. Residues from the wood-processing sector are less commonly used for energy and there is scope for increasing bioenergy use in the forest sector.

## ASIA

Historically, Asia is the continent with the greatest use of woodfuels, in many diverse applications. The recent economic boom in many Asian countries has caused a sharp decline in woodfuel use followed by a revival. The two largest markets are China and India, but the Indonesian, Philippine, Thai and Vietnamese markets are also significant. The wood products and bioenergy sectors have been criticized as unsustainable and often leading to deforestation and desertification.

## China

The transformation of the Chinese economy, with its rapid industrialization and integration into the world economy, is having a profound effect on the use of woodfuels. Given the large internal differences between rural and urban dwellers, however, such effects are uneven. In the short to medium term it is difficult to predict the extent of this massive transformation away from traditional biomass use and its impacts on woodfuel consumption and supply.

The Chinese Government has a proactive policy to develop renewable energy, of which bioenergy is a top priority, focusing on electricity generation. The target is 30 gigawatts of biomass-based electricity generation by 2020, which will require many new stand-alone biomass plants in addition to co-firing with coal. China has plans to produce 50 Mt of pellets by 2020 (Pekska-Blanchard *et al.*, 2007).

China is the world's largest consumer of coal. In addition to the generation of electricity, coal is used in many applications both at an industrial scale and in small heating appliances and cooking stoves, some of which are highly inefficient. About 48 percent of the coal consumed in 2002 (720 Mt) was in thermo-boilers, which could be partially replaced by woodchips or wood pellets, representing a potentially huge market (Pekska-Blanchard *et al.*, 2007).

## India

India is the world's largest user of woodfuels (including fuelwood, twigs, branches and residues), primarily in traditional applications. Fuelwood is an integral part of the informal economy and is used primarily in rural areas by households,

cottage industries and restaurants, and for cremations. The daily use of fuelwood by households is estimated to account for 90 to 95 percent of total consumption (FAO, 2010b). India's rapid development and urbanization, and the increasing penetration of electricity in rural areas, has brought about a shift towards other forms of energy. Nevertheless, many of India's poor still use woodfuels because they are "free".

There is a lack of long-term reliable data on woodfuel use in India, as surveys are carried out infrequently or not at all (for example, there is no regular survey of wood consumption in cottage industries, hotels or restaurants). According to a recent study (FAO, 2010b) about 60 percent of Indian households (75 percent of rural households and 21.7 percent of urban households) used woodfuels in 2005, for a total consumption of 248 million m<sup>3</sup>. The average monthly per capita consumption was 17.7 kg in rural areas and 6.3 kg in urban areas. The volume of fuelwood estimated to be taken from forests per year is about 50 million m<sup>3</sup>, or 20 percent of total annual consumption; the remainder is sourced from farmland, community land, homesteads, roadsides, canal-sides and various types of "wasteland" that include abandoned agricultural areas (FAO, 2010b).

### Oceania

The Australian economy and energy sector is dominated by fossil fuels (coal, natural gas and oil) and, until recently, renewables have played a minor role. According to official statistics, the share of total energy consumption of all renewables combined was just 5 percent (285 petajoules [PJ]) in 2006–2007. Of this, wood waste provided 93 PJ and bagasse 101 PJ; the supply of all biomass in the same year was 200 PJ (ABARE, 2009). Australia's large woodfuel potential in the form of native forests, timber waste and plantations is beginning to be recognized.

Given its significant forest resources relative to population, New Zealand has a natural comparative advantage when it comes to bioenergy production. Its estimated annual production of woody biomass from forest plantations is 4 to 6 Mt, the equivalent of about 10 percent of national energy demand. The wood-processing industries also generate a significant amount of wood waste, which is only partly used. In 2006 there were five wood pellet plants with a total annual production capacity of 100 000 tonnes. Woodfuels have considerable potential for further expansion in New Zealand (Pekska-Blanchard *et al.*, 2007).

### Other Asia

Given the size of its energy market, Japan is an important potential user of woodfuels in East Asia. An import market is taking shape, with demand stimulated by legal incentives to promote renewable energy in Japan. The 2002 Biomass Nippon Strategy, for example, foresees a considerable increase in the use of biomass as an energy source (IEA, 2009a).