

GREENHOUSE GASES AND FOREST PLANTATIONS¹

Gases de Efeito Estufa e Florestas Plantadas

Robert Flynn²

Abstract: The issue of pollution “abatement” by trading the rights to emit pollutant gases has been operating for some years, notably with sulfur dioxide. The recent impetus given to international recognition of the impact of gas emissions on the health of the planet has, however, come initially from a conference on global warming held in Kyoto, Japan, in December 1998, when representatives of 170 countries met to discuss emission controls. An agreement in principle was reached for 38 industrialized countries to reduce six greenhouse gas emissions by an average of 5.2% by 2012, compared with 1990 levels, as a first step to limit rising temperatures blamed for more frequent floods, droughts, heat waves and storms. These included reductions of 7% for the USA, 8% for Europe and 6% for Japan. No detailed formulae about how this might be achieved were agreed at Kyoto. But the Kyoto Protocol will enter into force only if it is agreed by nations responsible for 55% of emissions of carbon dioxide in rich states. In early 2004 it had reached 44% and still needs Russia’s 17% after the US pulled out its 36% share. Much controversy still surrounds the agreement, but the major news during 2003 was that Russia was reconsidering ratifying the Kyoto protocol. Russia’s presence is crucial to a successful conclusion to Kyoto, as the international Treaty does not become legally binding on the parties unless countries with a combined 55% of total 1990 emissions ratify the Treaty. With United States and Russia out (and Australia) it cannot be ratified. In early 2004 Russia rejected any linkage between Kyoto and its relations with the EU, as some EU leaders have intimated. And in February 2004, the Russian Power Minister rejected any linkage between Kyoto and Russia joining the WTO. He commented on the prospects of Russia signing up to the Kyoto Protocol, by saying “*We need to think it over and calculate how advantageous it is for Russia.*” In particular, he recalled, “*..... the Kyoto Protocol envisages limitations for industrial growth and quotas for emissions into the atmosphere. By 2010-2012, Russia will reach the Soviet level of industrial output and be able to buy quotas for emissions. We would not like our joining the Kyoto Protocol to obstruct our economic growth after 2010.*”

Key words: Kyoto Protocol, gas emissions, CO₂.

Resumo: O tema “abatimento” da poluição pela comercialização de créditos de carbono tem seu foco principal no dióxido de enxofre. O recente ímpeto dado ao reconhecimento internacional do impacto de emissões de gás na saúde do Planeta começou com uma conferência sobre o efeito estufa ocorrida em Quioto, no Japão, em dezembro de 1998. Nesta ocasião, representantes de 170 países se encontraram para discutir o controle da emissão de gases poluentes. Ficou estabelecido que 38 países industrializados deveriam reduzir, em média, 5,2% da emissão de seis tipos de gases de efeito estufa até 2012, comparados com os níveis observados em 1990, como um primeiro passo para limitar o aumento da temperatura global. Os níveis de redução da emissão de gases estufa são maiores para países como os Estados Unidos (7%) e Japão (6%) e para a Europa (8%). Nenhuma fórmula detalhada sobre como esta meta poderia ser alcançada foi definida em Quioto. Porém, o Protocolo de Quioto só entrará em vigor após ser ratificado por um número de nações que somem mais de 55% das emissões de gás carbônico. O

¹ Trabalho convidado.

² Director, Consulting Services – Wood Resources International, 6824 19thSt. West, University Place, Washington.

início de 2004 foram alcançados 44%, faltando ainda a ratificação da Rússia, que representa 17% das emissões mundiais, depois que os Estados Unidos tirassem sua parte (36%). Ainda existe muita controvérsia acerca do acordo, e em 2003 havia rumores de que a Rússia estaria reconsiderando a ratificação do Protocolo. A presença da Rússia é crucial para uma conclusão próspera para Quioto, visto que este tratado internacional não se torna legal a menos que países com uma contribuição de 55% do total de emissões ratifiquem o tratado. Com os Estados Unidos e a Rússia fora (e Austrália), o tratado não pode ser ratificado. Em fevereiro de 2004, o Ministro do Poder russo, pressionado por líderes da União Européia, rejeitou qualquer ligação entre Quioto e Rússia que une o WTO. Ele fez um comentário sobre os prospectos da Rússia que se inscreve o Protocolo de Quioto, dizendo *“Nós precisamos refletir sobre isto e calcular qual seria a vantagem para Rússia”*. Em particular, ele recordou, *“..... o Protocolo de Quioto oferece limitações para o crescimento industrial. Antes de 2010-2012, a Rússia alcançará o nível soviético de produção industrial e poderá comprar cotas para emissões. Nós não gostaríamos de prejudicar o crescimento econômico russo após 2010 com a ratificação do Protocolo de Quioto.”*

Palavras-chave: Protocolo de Quioto, emissões atmosféricas, CO₂.

1 CONTROVERSY OVER CARBON CREDITS

While various carbon trading initiatives are already underway, a more controversial approach has been taken by the New Zealand government. It has decided to expropriate carbon credits on all forests in the country, even those owned by private owners on freehold (fee simple) land. This move has outraged private forest owner groups. And in another controversial move it is finalizing negotiations to exempt major high energy using industries in New Zealand (e.g. aluminum smelting, paper) from having to be responsible for any future carbon taxes, so long as they adopt world-best practice operations. This has incensed forest owners even more, as effectively the carbon credits have been nationalized, and then given away, sometimes to competing companies. The major opposition party, which presently leads in pre-election polls, has stated that it will return carbon ownership to private owners if elected. While the carbon issue will probably not be a major election issue, the propensity of the present government to expropriate private property rights may well be.

And in addition to the New Zealand case, which has ratified the Treaty, all is not well

within other countries that have also ratified. Rather than rely on actually reducing CO₂ emissions to a percent of 1990 levels, as was envisaged by Kyoto, an increasing number of countries now realize that their 2010 emissions will exceed targets, in some instances by huge margins.

In February 2004, for instance, Pricewaterhouse Coopers has identified the looming problem in just one European country, Spain. This is a useful case study.

According to PwC, **Spain will exceed its Kyoto greenhouse gas emissions target by 123 Mt CO₂e, and buying carbon credits in the market will cost Spanish businesses between 1,800 and 3,600 million Euros a year.** This contrasts with the plan under the Kyoto Protocol stating that Spain must limit the growth of greenhouse gas emissions from 1990 to 2008-2012 to 15%. In the period 1990-2000, emissions actually grew by 33.7%.

PwC state that if these trends continue, Spain's emissions will reach a 56% increase by 2010, compared to 1990, while its economy grows 66.4%. And, to avoid paying **the 40 Euro fine per excess ton**, it will have to resort to emissions trading (managed by

the EU), carbon funds, and the development of clean projects, known as CDM and JI (see discussion on this in the following section). If these emission rights are priced between 15 and 30 Euros per ton (as is envisioned by the EU), then this would imply an annual cost for emission rights between 1,800 and 3,600 million euros per year, or a total of 9,000 to 18,000 million Euros in five years. This would presumably be intolerable for Spain (and many other countries which are in a similar position).

The EU burden-sharing agreement (splitting EU's total target of 8% emissions reductions from 1990 to 2008-2012 between countries) allows Germany and the UK to emit more than 11 tons per capita a year, while Spain is only allowed 8 tons per capita.

Fourteen of the European Union's 15 member states missed a December 31, 2003 deadline for putting into law an EU directive on emissions trading, possibly delaying the establishment of penalties for exceeding pollution limits.

Only the UK enacted a law to enforce planned caps on carbon dioxide emissions linked to global warming. EU countries' national plans for allocating pollution rights are due by March 31, with trading of credits to start fully in 2005. Companies that exceed their allowances will have to cut emissions or buy more.

The compulsory EU system may force power plants and refineries owned by companies such as E.ON AG and Royal Dutch/Shell Group to buy rights to produce carbon emissions. Norwegian research firm Point Carbon estimates the global market for the permits may be worth \$10 billion a year.

But the push for emissions trading could collapse if the commission fails to gain compliance – so all countries are watching the reaction of the Commission to this failure to comply by most EU countries. The European Commission usually sends warning letters to countries that fail to comply with EU

agreements. If they do not respond or change the commission's mind, it may sue in the European Court of Justice in Luxembourg. Cases can take years.

There is expected to be a flurry of "exemptions" provided to key industries by Governments which have already signed the Protocol.

It is too early to fully assess the actual impact of the agreement on pulpwood fiber balances. Opinions range from a future flood of wood as Europe plants up its heavily subsidized farms in tree plantations, through to a shortage developing as countries/companies defer felling to avoid felling forests established before 1990.

1.1 Afforestation and carbon emissions reductions

Although the Kyoto Protocol has been rejected by the United States, there are signs that the USA will eventually impose caps on carbon dioxide emissions. In late February for instance, the CFO of American Electric Power (the largest burner of coal in the western hemisphere) is reported as saying, "*We don't expect Kyoto timeframes to be enforced in the United States but we do expect international consensus on these issues (CO₂ emissions) will prevail in the United States*".

The expectation that Kyoto, or a Kyoto equivalent, will be progressed in future appears to be the basis for most of the efforts to reduce greenhouse gases (GHG), and as discussed above, many European and other countries have already established targets for reducing GHG by 2008 – 2012 (the first commitment period). The reduction targets established in the Kyoto Protocol can be met by reducing domestic GHG emissions, or by utilizing three flexible mechanisms allowed under the Kyoto Protocol: *Emissions Trading*, *Joint Implementation* and the *Clean Development Mechanism (CDM)*. The CDM is a mechanism

for project-based emission reduction activities in developing countries. Certificates will be generated through the CDM from projects that lead to certifiable emissions reductions that would otherwise not occur.

In the Marrakech Accords at COP 7^{1/}, the parties agreed to allow afforestation and reforestation projects under the CDM, but did not agree on the detailed rules for such projects. Under Kyoto, rich nations will be allowed to store up to one percent of their annual emissions of carbon dioxide in such forest sinks. In the recently completed COP 9 at Milan (December 2003), the parties finally adopted modalities and procedures for afforestation and reforestation project activities under the clean development mechanism. The agreement probably vindicated the Japanese government and industry, which for some years has had a policy of offsetting future carbon emissions with plantation credits (see Chapter 2).

The main issue under question has been how to address the non-permanence of carbon sinks projects. That is, if a sinks project is destroyed – through forest fire, clear-cut, etc. – and the carbon that had been sequestered is re-released into the atmosphere, who should be liable: the project developer, the host country, or the holder of the “certified emissions reductions” (CERs)?

The COP 9 decision adopts the latter approach, by making CERs generated from sinks projects of limited duration. The decision defines two types of sinks CERs: tCERs (temporary CERs), which are valid for only one commitment period; and ICERs (long-term CERs), which are valid for the project’s full crediting period. Thus, when a plantation is harvested, the tCER must be replaced with

an ICER (e.g., by a forest which will not be harvested) or by another tCER (e.g., another plantation).

The COP 9 decision also addressed the issues of additionality, leakage, uncertainties, and socio-economic and environmental impacts. The latter was the most controversial, in particular due to efforts of some European countries to exclude sinks projects involving genetically-modified organisms (GMOs). The European Union (EU) had opposed inclusion of GMOs under Kyoto, fearing they can threaten native species. Nations like the US or Argentina supported GMOs as giving benefits because they are faster-growing and disease resistant. Rather than ban projects involving GMOs, the COP 9 decision requires only that they be evaluated in accordance with the host country’s national laws, and that information on the species used be identified in the project design document (PDD). These afforestation and reforestation projects will also be subject to general regulations the host Parties establish according to their own national norms, including perceived risks associated with the use of potentially invasive alien species.

One of the other controversial rules from COP 7 in Marrakesh stated that an afforestation project could only count if there was no forest existing on the site in 1990. At COP 9 there was an effort to extend this date to 1999, although this apparently was not accepted. It was loudly opposed by a number of environmental NGOs, whose general animosity towards the agreement may signal to some in industry that things are on the right track (i.e., if certain groups are opposed to the program, it must be a good idea). Greenpeace and the WWF, who had opposed GMOs and other aspects of the Kyoto Protocol, said the forest rules were “*two steps forward, one step back.*” They faulted failure to rule out plantations of single species forests like eucalyptus, acacia or pines. Many environmentalists want to stifle emissions at

^{1/} COP = Conference of the Parties. A series of meetings have been held since 1997 to work out the details and mechanisms to achieve the goals established by the first meeting in Kyoto.

the source, by shifting from coal and gas to solar or wind power, rather than cleaning up emissions by trying to store carbon in forests. We note that the forestry rules were the last main negotiating barrier to Kyoto, apart from some minor technical issues. This is an indication of the efforts by environmental groups to try and block any forest industry benefits through establishing tree plantations.

Not all of the items agreed upon were favored by industry observers. Canada objected that some rules, such as taking account of cultural and religious sites in deciding where to plant, were too complex. The rules set in the COP 9 agreement even stipulate that trees must be at least 2.0 meters (6 ft 7 in) tall and their canopies have to cover at least 10% of an area before they can count as a forestry project.

Not all countries will necessarily accept planting projects under the CDM. According to the Bangkok Post (December 9, 2003), Thailand will not accept projects involving reforestation and afforestation in exchange for carbon credits under the Kyoto Protocol's clean development mechanism.

1.2 Carbon trading

According to a World Bank study (December 2003), worldwide trading of greenhouse gas emissions more than doubled in 2003 over the previous year, with governments and multi-lateral agencies accounting for over half of the purchases. Trading in carbon dioxide emissions totaled 29 million tons in 2002, and rose to 71 million tons in 2003. Of course, that is still a tiny amount of worldwide energy-related carbon emissions, which are expected to rise from 6.6 billion tons in 1996 to a total of 8.3 billion tons by 2010, according to U.S. government data. The World Bank study also reported that the prices paid in emissions trading rose to a range of \$4 to \$6 per ton of carbon in 2003. The vast majority of the emission cuts were created in Latin America, Asia and Europe.

While various national and local governments have been studying greenhouse gas emissions trading programs for several years, private sector leaders in many countries have financed mitigation projects and conducted trading in informal markets (carbon credits). According to World Bank reports, this informal market has included several dozen significant trades, with the dollar volume of over-the-counter transactions already surpassing \$100 million. The Economist magazine projects an annual amount of trading in the future ranging from \$60 billion to \$1 trillion.

Although the Bush administration has refused to participate in the Kyoto treaty, several U.S. companies, States, and cities have already set up emissions registries and offsets programs. In October 2003, the Chicago Climate Exchange was launched for member companies and governments to buy and sell greenhouse gas reduction credits. Members agreed to cut their North American emissions by one percent a year over four years, and can trade allowances that reflect their emission cuts. Four major forest products companies are among those participating in the CCX, including International Paper, MeadWestvaco, Stora Enso North America, and Temple-Inland. Trading remained light through the end of 2003. As of December 12, 2003, the total aggregate "baseline" of the CCX was 226.3 million metric tons of CO₂. Prices have generally been between \$0.95 – \$1.00 per ton of CO₂, and the CCX charges \$0.025 for every ton of CO₂ traded on the Exchange.

The initial categories of eligible offset projects on the CCX are:

- Landfill methane destruction in the United States.
- Agricultural methane destruction in the United States.
- Carbon sequestration in U.S. forestry projects (if undertaken after January 1, 1990).

- Carbon sequestration in U.S. agricultural soils.
- Fuel switching, landfill methane destruction, renewable energy and forestry projects in Brazil.

An embryonic market for trading of EU Allowance Units has developed in Europe in 2003, as part of the EU ETS (Emissions Trading System). Reportedly, prices for carbon have increased from Euro 6/t CO₂ in April 2003 to Euro 12.50 t⁻¹ CO₂ in mid-December. This trading system is expected to become more standardized and accelerate in 2004. Most activity to date in Europe has been by the public sector, whereas most private sector purchasing of CERs has occurred in Canada and Japan.

The World Bank's Prototype Carbon Fund (PCF) began in 2000, and has developed relatively slowly. To date, the only forest plantation project for which the PCF has completed preparation and has successfully negotiated an Emission Reduction Purchase Agreement with the Host Government is the Plantar project in Brazil. Through the Plantar project, the Bank's carbon finance program is supporting the reduction of greenhouse gas emissions by helping to establish 23,100 ha of eucalyptus plantations. These plantations will produce charcoal to avoid the use of imported coal as a cooking fuel in pig iron production.

In addition, the eucalyptus plantation will reduce pressure on natural forests as a source of charcoal production in the state of Minas Gerais in Brazil. The information available to the Bank indicated that Plantar's plantation management practices are compliant with World Bank and Forest Stewardship Council (FSC) standards. Plantar is one of the first Brazilian plantation owners to obtain FSC certification, and it received a certification on social responsibility practices from ABRINQ (a Brazilian Civil Society Organization) certification on social responsibility practices.

Nevertheless, the Plantar project has been the subject of some hysterical hand-wringing

on the part of international environmental groups, and it is evident that this type of project will not be accepted easily. The World Bank has already agreed to at least one "independent review" of the project, even after its own exhaustive review.

A good example of the use of plantations to generate income from the sale of carbon credits is the V&M do Brazil "Avoided Fuel Switch Project". V&M (formerly Mannesmann S.A.) is a steel company in Brazil with one of the largest plantations of eucalyptus in the country, and a major steel plant in Barreiro, Belo Horizonte, and other places in Minas Gerais. The project is based on avoiding a switch from charcoal to coke for pig iron manufacture. The company had evaluated a switch from charcoal to coke in the late 1990s through 2001, because coke was the most economically attractive alternative. However, the sale of CERs under the Clean Development Mechanism was expected to generate an attractive return, and reportedly has the potential to reduce CO₂ emissions by 20.2 million tons during the 21-year life of the project.

In February 2003 V&M do Brasil, the International Finance Corporation, and Toyota Tsusho Corporation announced what they described as "*the world's largest CDM emissions reduction deal to date*". The transactions were structured by EcoSecurities Group Ltd., including the sale of 5 million tons of CO₂ emissions reductions to the IFC-Netherlands Carbon Facility for a total value of €15 million. At the same time, a contract for the sale of an additional volume of CO₂ was signed with Toyota Tsusho Corporation (at an unknown price). EcoSecurities Group notes that "*This project has been validated according to the CDM rules of the Kyoto Protocol by the Norwegian company DNV, and verification of carbon flows are being finalized by the Swiss company SGS. Both these companies are in the process of receiving accreditation by the CDM Executive*

Board.” Of course, there had been vociferous opposition to the project, based on concerns over “monoculture”, damage to biodiversity, etc. But V&M had FSC certification on its plantations, and pointed out that use of eucalyptus reduces pressure on charcoal from native forest. Also, in this case, stakeholders consulted on the project (and reportedly in favor of the project being financed) included Greenpeace Brasil, WWF Brasil, and Amigos da Terra (Friends of the Earth) Brasil.

EcoSecurities Group is the same company that was involved in the development of the Dutch National Afforestation Programme, which is now in full operation and run by the Dutch National Greenfund (Stichting Nationaal Groenfonds). Under this program, Dutch landowners who wish to carry out afforestation on their lands can register and receive certificates for the amount of carbon sequestered by their future forests. The Greenfund will buy these certificates from the project owners to sell them later on the market.

The Greenfund’s national carbon offset afforestation programme received financial support from the Dutch ministries of VROM (Housing, Spatial Planning and Environment) and LNV (Agriculture, Nature Management and Fisheries) to cover the development costs and the first purchases of carbon from neighboring land owners. Future purchases will be financed by the sales of carbon offsets to the Dutch private sector.

Brazil is not the only country trying to move forward in using plantations as carbon sinks. For example, the Australian state forestry agency, State Forests of NSW, has put together a deal with a European company to establish carbon offset plantations. An A\$172 million deal was signed in Rome in 2003 between State Forests of NSW and the European semiconductor manufacturer ST Micro-electronics, which calls for up to 12 million trees to be planted on the mid-north coast of New South Wales. The agreement is

designed to offset ST Micro-electronics’ greenhouse gas emissions in tree plantations that will absorb carbon dioxide.

The Chilean company Terranova Forestal is launching a new project aimed at supporting afforestation among small rural property owners in Region 8, the first to be approved by the Government under the framework of the Kyoto Protocol. Terranova has already negotiated the sale of carbon funds with the World Bank to support the construction of a hydroelectric project amounting to US\$8 million. About 200 properties and their families will benefit from the project, in which 6,000 hectares are being planted between 2003 and 2008 for a cost of US\$4 million.

This whole Kyoto – carbon trading arena is rapidly evolving in 2004, and forest owners and investors considering entering the fray are advised to seek current independent advice.

2 BIOMASS ENERGY MARKETS

2.1 Introduction

Wood is still a primary heat source in much of the world, and consumption of fuel wood has been linked with deforestation and environmental problems in many poor countries. However, in recent years there has been considerable focus on “bio-energy”, “biomass energy”, and “renewable energy sources”, as a way to reduce carbon emissions and greenhouse gases. While some countries, such as Finland, have a surplus of woody biomass and have been exporting wood pellets, other countries such as Italy have long been fuel-wood importers. This year has seen a surge in interest in both the international trade in woody biomass and production of wood pellets.

In this section, we will focus on the use of biomass energy, and especially wood pellets, in Europe. While we will discuss the woody biomass exports to Italy, in general the high cost of ocean transport will more likely lead to

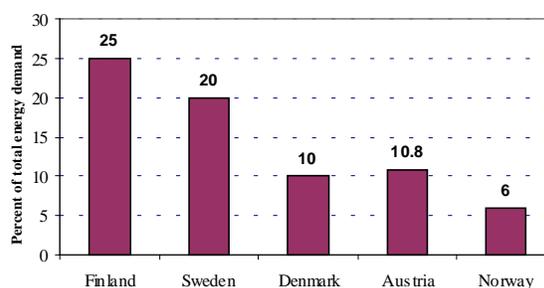
increased trade in concentrated woody biomass, such as wood pellets or liquid bio-fuels. Other markets besides Europe will likely emerge in the future – for example, a new law in 2003 in Japan has spurred interest by that country in importing biomass. Next year's report may include a focus on Japan's wood energy needs, as well as a profile on likely biomass wood suppliers around the world.

Under agreements signed as part of the Kyoto Protocol, the EU is committed to reducing their greenhouse gases by 8% from the 1990 level, by 2008-2012. Renewable energy is to increase to 12% of total energy consumption by 2010, including a 200% increase in biomass. By the year 2000, renewable energy only accounted for 6% of total energy needs in the EU, indicating that some aggressive measures may be needed to achieve their goal. Total bioenergy consumption in the EU is scheduled to increase from 45 Mtoe^{2/} in 1995 to 135 Mtoe in 2010. However, in the first five years of effort (1995 – 2000) they only achieved an increase of 6 Mtoe. Of this increase, Finland accounted for 30% and Sweden for 17% (Figure 1).

In 2000, the primary sources of biomass in Europe included wood 80%, straw 1%, biogas 4.5%, waste/secondary material 13%, and liquid biofuels 1.5%. The following chart shows the amount of primary energy produced from wood sources in various European countries in 2000. Note that France, with the largest volume, is not described in the following section, as most of their wood usage is fuelwood. A wood pellet market has not yet been developed in France (Figure 2).

Vergote, in his 2003 report *“EU Initiatives to Promote Bioenergy for CO₂ reductions”*, describes the EU Emission Trading Scheme,

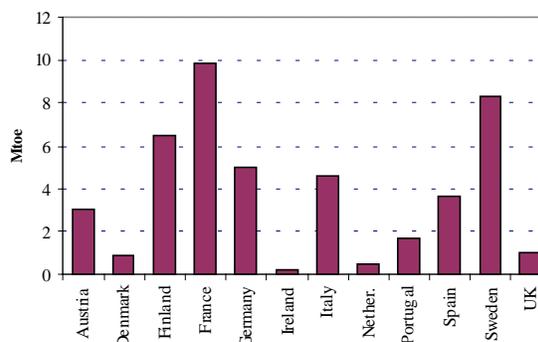
which is to be operational Jan. 1 2005. This will be the world's largest cap and trade scheme, covering 45% of carbon emissions. The EU has set an indicative target of 2.0% by 2005 and 5.75% by 2010 for biofuels as a percent of total fuel consumption in the transport sector. For total production of electricity, the indicative target by 2010 is for 22% of electricity produced to be generated by use of renewable resources.



Source: EUBIONET Survey (2002).

Figure 1 – Percent of energy consumption from biomass, 2001.

Figura 1 – Porcentual de consumo de energia a partir de biomassa, 2001.



Source: EUObserver (2001).

Figure 2 – Production of primary energy from wood, 2000 (million tons oil equivalent).

Figura 2 – Produção primária de energia a partir da madeira, 2000 (milhões de TEP).

^{2/} Mtoe = million tons of oil equivalent = 11.63 MWh = 41.868 GJ.

2.2 Wood pellets

Large-scale wood pellet installations (CHP^{3/} and district heating) are predominant in Nordic countries whereas small-scale central heating installations, mainly in the residential sector, are common in Austria and Germany, and the market share of wood pellet stoves is very high in Italy

The recently started "Pellets for Europe Project" aims to contribute to this positive market trend by providing technical and market information to pellet market factors across Europe. The program is funded by the European Commission's Altener Program, and runs until mid-2005.

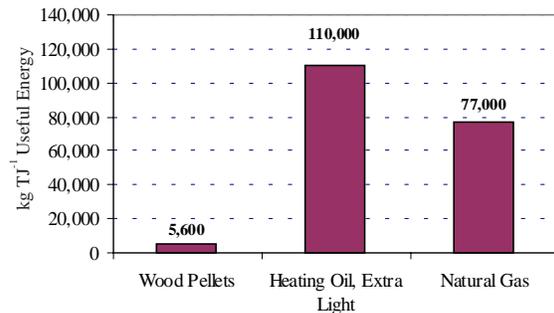
It is easy to see why a number of countries have focused their efforts to increase the use of wood pellets for heating in Europe. The following chart compares carbon dioxide emission factors, in terms of kilograms of CO₂ emissions per unit of energy production. Because wood pellets are releasing the CO₂ sequestered by the growing tree, net emissions are only a fraction of that released by heating oil or natural gas (Figure 3).

The following section will review the current markets for wood pellets in Europe on a country by country basis. While Sweden and Denmark certainly dominate in terms of pellet production, consumption and production in some other countries is increasing at a fast rate. Also, countries without substantial pellet production, such as the Netherlands, are becoming important trading centers for wood pellets in Europe (Figure 4).

Netherlands

The Port of Rotterdam in the Netherlands is rapidly becoming the center of wood pellet imports in northern Europe. European Bulk Services owns two terminals in Rotterdam, and

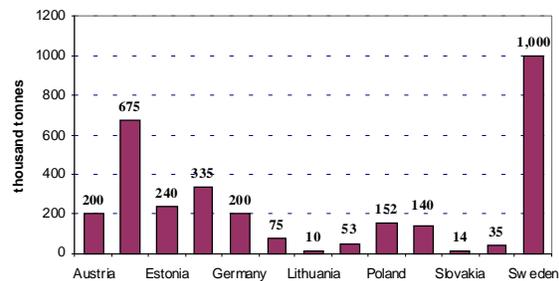
^{3/} CHP = Combined Heat and Power.



Source: Institut Fur Energieforschung Joanneum Research, Graz 1997 and 1995.

Figure 3 - Carbon dioxide emission factors (kg tj⁻¹ useful energy).

Figura 3 – Emissões de dióxido de carbono (kg tj⁻¹ de energia útil).



Source: EU BIONET (2003).

Figure 4 – Europe: wood pellet production capacity by country (thousand tons).

Figura 4 – Europa: produção de pellets de madeira – capacidade instalada por país (milhões de toneladas).

stores up to 30,000 tons of biomass at their terminal. Imports of wood pellets had been running at a rate of 5,000 tons per month in early 2002, but are currently close to 40,000 tons per month. These pellets are not just for Holland, but are also shipped by barge and coastal vessel to Belgium, UK, and Denmark. In the past, this terminal imported only wood pellets from Western Canada, but today also imports wood and bark pellets from

Eastern North America, wood pellets from the Baltic, and agricultural residue pellets from USA and Far East. Whereas biomass used to be imported only in 10,000 ton vessels, it now arrives as partial cargo in Handymax and Panamax vessels up to 60,000 tons.

Biomass is also consumed in the Netherlands. As of January 2003, in the Netherlands there was a new energy law which provides a subsidy of 97 euro per MWh produced from bioenergy, for 10 years. In the late 1990s, Siemens led a consortium to build the BEC-Cuijk Biomass Energy plant, one of the largest consumers of biomass. This plant burns all clean woodchips. It burns 34-38 tons per hour, or 130 m³ hour⁻¹, producing 25 MW, or 200 GWh. Annual consumption would be around 300,000 tons per year. An even larger consumer of wood pellets is the Dutch energy company Essent. Located close to the Port of Rotterdam, this company plans to co-fire 600,000 tons of wood pellets in 2004, according to industry sources. We believe this would make Essent the largest single consumer of wood pellets in the world.

Russia

Russia has a huge quantity of forest waste and mill residues that can be used to produce energy. Of course, in many parts of Russia this wood is utilized by local companies and communities. Exports, however, are relatively scarce, due to transport difficulties. In the past three years, six wood pellet producers have started production near St. Petersburg, where they can take advantage of good freight logistics to sell into Western Europe. Total capacity of these six wood pellet producers is 140,000 tons per year. To date, all of these pellet companies have been started with Russian capital, although there are certainly opportunities for foreign investment. The most logical location for this would be at some of the new sawmills being built in Western Russia by Stora Enso and UPM Kymmene.

Poland

There are six wood pellet producers in Poland, with a total capacity of 152,000 tons per year. The largest producer is Krojanty in northern Poland, which has a capacity of 60,000 tons per year of wood pellets, all manufactured from pine sawdust. Krojanty's pellets are primarily exported to Scandinavia and Western Europe.

Finland

Finland has the highest percentage of total energy consumption coming from biomass energy of any country in Europe, and likely the world. Some 25% of Finland's energy needs come from biomass energy (including peat). In Central Finland, 45% of the energy consumption is from biomass energy. The largest biomass powered CHP (combined heat and power) plant in the world is the Alhomens Kraft power plant in Pietarsaari, Finland. Located at UPM-Kymmene's pulp and paper mill site, the plant produces 550 MW from a mixture of 45% wood (forest residues, bark and other mill residues), 45% peat, and 10% coal. This plant started operations in January 2002, and produces steam for the forest industry as well as district heat for the municipality.

Most woody biomass energy is produced from burning fuel chips produced from forest residues. The Wood Energy Technology Programme is seeking to increase consumption of fuel chips to 5 million solid cubic meters by 2010. During the first four years of this program the annual use of forest chips in Finland has increased from 0.5 million m³ to 1.7 million m³. This means an annual reduction in CO₂ of 3 million tons, depending on the fuel replaced. New bundling technologies have been developed in this project, and as of late 2003 Timberjack had delivered 26 specialized machines that collect and bundle forest residues. Each machine can produce 1000 bundles per day, and each bundle

contains 1MW (3.6 GJ) of energy. Typically about 100 bundles are produced per hectare. With this improved technology, forest residues have become competitive where hauling distances are less than 100 km.

Production of whole-tree chips from early thinning is also becoming attractive, and the companies involved are even working on extraction of stumps and roots. Fuel payments are based on the energy content of the bundles (measured moisture and net calorific value of the fuel). In general, the pricing of peat and forest residue chips in Finland follows the price of coal. Today there are 400 forest chip-fired power or heating plants in Finland, including the Alhomens Kraft plant.

Wood pellets are relatively new in Finland – the first pellet plant was built in Finland in 1998, partly because of a sharp rise in oil prices. Also, tax policies favor wood pellets: a CO₂ tax on fossil fuels used for heat is 17.20 Euros /ton of CO₂, but there is no tax with pellets. There are currently 16 pellet plants in Finland, with a total capacity of 335,000 tons. Capacity in 2001 was 200,000 tons, but production was only about 90,000 tons. As the market is relatively new, production is still very much in an expansion stage. Until 2000 all wood pellet production in Finland was exported to Sweden, and in fact the Swedish pellet standard is the one currently used in Finland. As of 2002, only about 20% of pellet production in Finland was consumed in the country.

The largest pellet producer is Vapo Oy, which has four pellet plants in Finland, as well as six “partner plants” in Finland, Sweden, and Estonia. Vapo is owned two-thirds by the State of Finland and one-third by Metsälitto. Annual production capacity in 2004 will be 300,000 tons, using both wood and peat. Most pellet consumers in Finland are homeowners, using pellet stoves that increasingly are made in Finland. The largest industrial consumer of wood pellets is Turku Energia Oy, a power company in the city of Turku, which co-fires pellets with oil.

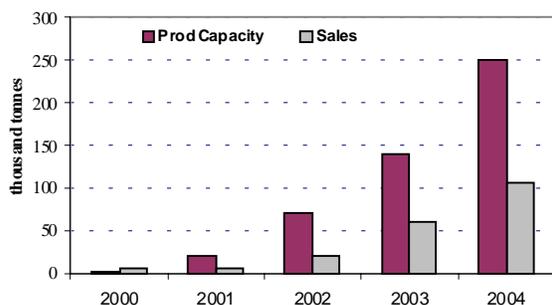
There is a substantial amount of raw material available for pellet production. One study estimated that 700-800,000 solid m³ of dry raw material is produced annually by sawmills in Finland, which could be used to produce 300-400,000 tons of high-grade pellets. Vapo thinks Finland can produce 1 million tons of pellets in the future. According to a study carried out by Electrowatt-Ekono (2002), there is technical/economic potential for wood pellets to replace light oil in home heating in Finland, with total potential demand of about 1.6 million tons of pellets per year.

Germany

Biomass utilization, especially wood pellets, is relatively new in Germany, but growing quickly. New bio-energy legislation was passed in Germany in June 2001 which offers biomass power generators a guaranteed electricity price for 20 years. These rates vary depending on the size of the power plants, and will be lowered 1% annually to slowly phase out the subsidy.

Wood pellet production in Germany began in 2000, but installed capacity has expanded rapidly, to an estimated 250,000 tons of annual production by the end of 2004. Sales have not kept up with capacity expansions, due reportedly to scarcity of raw materials in some cases, lack of good distribution channels, etc. However, the market is expected to mature and develop quickly. At present there are 16 wood pellet producers in Germany, with five more plants in the planning stage (Figure 5).

As in Austria, the consumption of wood pellets in Germany has so far expanded primarily in the small-scale sector. By the end of 2003, an estimated 20,000 pellet installations (central heating and single stoves) will be in operation. The VAT on wood pellets in Germany is only 7%, compared with 16% on most items.



Source: Rakos (2003).

Figure 5 – Germany: pellet production capacity and sales, 2000-2004f (thousand tons).

Figura 5 – Alemanha: capacidade de produção e comercialização de pellets (milhões de toneladas).

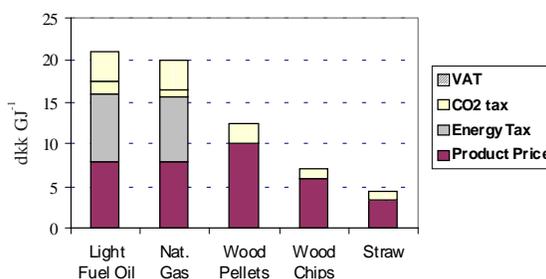
Denmark

In Denmark some 1.3 million tons of wood and 750,000 tons of straw were used for energy in 2001 (Tabela 1). According to the “Energy 21” plan, Denmark’s blueprint for reducing carbon emissions, the use of wood and straw should be doubled to 4 Mt in 2005 and then nearly doubled again to 9 Mt in 2030. This plan aims to reduce CO₂ emissions by 20% by 2005 and by 50% by 2030, compared with 1998 levels.

Consumers of fossil fuels in Denmark pay energy taxes, CO₂ taxes, and sulfur taxes, but biomass consumers are exempt from all these.

Prices in 2003 were DKK1275 ton⁻¹ for loose pellets, excluding VAT. In the chart below, Bjerg (2002) compared the prices of various fuels, including taxes. Note that VAT is applied for small/retail consumers of wood pellets, but large industrial users are also exempt from paying VAT for wood pellets. In addition to these tax benefits for using wood fuel, there were also subsidies for installing small boilers (<250kW) from 1995 – 2001, although these subsidies have now ended (Figura 6).

Denmark was one of the first countries in Europe to utilize wood pellets for energy, and is second only to Sweden in wood pellet production and consumption. Pellet production began around 1990, and pellet imports in 1994.



Source: Bjerg (2002).

Figure 6 – Denmark: price comparison among various fuels (dkk GJ⁻¹).

Figura 6 – Dinamarca: comparação de preços entre vários combustíveis (dkk GJ⁻¹).

Table 1 – Fuel characteristics

Quadro 1– Características dos combustíveis

Type	Form	Density (kg m ⁻³)	Moisture content	Energy-Density (GJ m ⁻³)
Straw	Big bales	130	13	1.9
Wood	Sawdust	160	20-50	1.4-2.5
	Chips	300	40-50	2.7-3.4
	Pellets	650	<10	11
Coal	Bulk	1.000	10-15	25

Source: Danish Energy Authority.

When Denmark first started to use pellets in the late 1980s, they were mainly used in district heating to replace coal firing. From 1993 onwards, annual pellet use in district heating remained steady at about 110,000 tons per year. The increase in pellet consumption in the last few years has been mainly due to an increased consumption in both public buildings (25,000 tons year⁻¹) and the residential sector (160,000 tons year⁻¹). Total consumption of wood pellets in Denmark has expanded from 300,000 tons in 2001 to 400,000 tons in 2002, and was expected to jump to an estimated 600,000 tons in 2003.

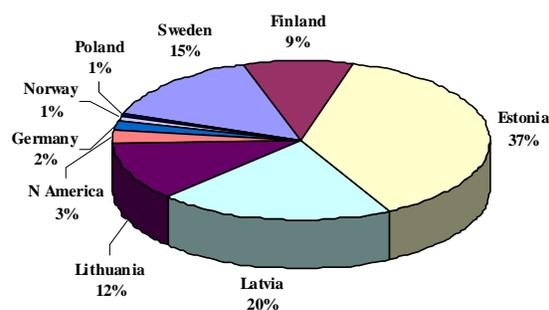
The primary reason for the big jump in wood pellet consumption in 2003 was the construction of a very large wood and straw pellet plant by one of the major power companies. The Køge plant, south of Copenhagen, is likely the largest pellet plant in the world, producing 180,000 tons of wood pellets, and 130,000 tons of straw pellets. The plant is owned by Energi 2, a power company that uses 450,000 tons of pellets per year in six power plants. The wood pellet plant is located on the property of Junkers woodworking plant (a big flooring producer). The plant only began operations in late 2003, and it reportedly may use some imported raw material. The wood pellets are used at the new combined heat and power (CHP) plant of Energi E2, at Avedøre, near Copenhagen. Another electric utility, ELSAM in Fredericia, is also a large consumer of wood pellets.

After this Køge plant, the next largest producers of wood pellets in Denmark are H.P. Brikketer – 120,000 tons capacity, Dangrönt – 75,000 tons annual capacity, and Bodilsen – 25,000 tons capacity. An October 2003 press release by the Norwegian energy company Statoil ASA states that it intends to become the leading producer of wood pellets in Denmark, through its acquisition of 40% of the company EcoNordic. Annual production claimed by EcoNordic is 180,000 tons, although this appears to include not only wood

pellets but also bark, briquettes, and wood chips.

Wood briquettes are also used in Denmark, although the volume consumed is only about 10% of that of wood pellets. In terms of wood pellet production we believe the Køge plant of Energi 2 is larger. We note that helping to boost pellet production in the country is the fact that there are eight companies in Denmark producing pelletizing equipment, including the well-known Sprout-Matador.

The amount of dry raw material (sawdust and shavings) available in Denmark has been stable for the past few years, but prices have risen sharply. Imports of pellets have increased to meet demand, although the construction of the Køge pellet plant, and Statoil's stated plans to be a leading producer of pellets may reduce the need for wood pellet imports in the future. (Of course, this assumes adequate raw material can be sourced within the country. The following chart indicates that Baltic wood pellet producers have been the largest source of wood pellet imports in Denmark. In 2001, North America was a relatively minor supplier of wood pellets to Denmark (Figure 7), but in 2002 imports of North American pellets surged to an estimated 60,000 tons (mostly from Canada).



Source: Berggren (2003).

Figure 7 – Denmark: wood pellet imports, 2001 (volume percent).

Figura 7 – Dinamarca: importação de pellets de madeira, 2001 (porcentual do volume).

In 2001, there were also two shipments to Denmark of low-value wood chips from Mid-Atlantic Terminals in Norfolk, Virginia. These hardwood chips had been in storage for months, after the chip exporting company-terminated business with Marubeni. We understand these were not converted into pellets, but were consumed by one of the major power companies. According to Berggren (2003), there are studies indicating the technical potential in Denmark for 1.5 M tons of pellets to replace fossil fuels in small plants (<20kW) and single family houses, and 500,000 tons in block heating (100-500 kW). For total consumption of wood pellets to jump from the current level of about 600,000 tons per year to 2.0 Mt per year would require substantial imports, because raw material supply within the country is not expected to increase.

Italy

One of the primary factors stirring the interest in biomass around the world in 2003 has been efforts by the Italian company ICL to source biomass fiber for energy producers in Italy. To date we have confirmed two vessels of biomass from Australia, three from Brazil, and two from the US in 2003, and this likely only scratches the surface. According to an agent trying to buy wood for ICL, the company wants to import 2.5 Mt of fiber per year. Unfortunately for the company, rising freight rates have made it extremely difficult to deliver biomass fiber to Italy at a competitive price. (See section on freight rates in Chapter 2, Markets Japan.)

Biomass has played only a minor role in the Italian energy industry, representing only about 2-3% of primary energy usage in the country. In 1998, the "National Programme for Energy Valorisation of Biomass" was issued by the Ministry for the Agricultural and Forestry Policy with the goal of producing 8-10 Mtoe of energy from agro-forestry biomass and animal slurry by 2012. In 1999 a new Carbon tax was initiated to spur interest in renewable energy. The capacity for bio-power

has increased from 200 MWe in 1999 to 300 MWe in 2001, and is scheduled to increase to 2300 MWe installed by 2012. Some 15 new power plants with total capacity of 200 MWe are planned or under construction in Italy.

Bio-Energy International lists only two producers of wood pellets in Italy, although there are a number of smaller producers and several associations.

Belgium

According to the European Biomass Association, electricity production from renewable sources is to increase in Belgium from 1.8% (0.4% biomass) in 2000 to 8% (3.4% biomass) in 2010. Belgium has the distinction of having the highest wood pellet prices in Europe, according to the BIONET survey data published in 2003. We could locate no pellet producers in Belgium, and it is likely that any wood pellet consumption is based on imports, possibly coming in through the Netherlands.

Ireland

Ireland has the lowest production of wood-based energy in Europe, producing only an estimated 0.2 Mtoe in 2001, even lower than Belgium (at 0.3 Mtoe). However, with the growing importance of plantation forests in Ireland, and wood products production, interest in wood-based energy is growing. In 2003, a successful wood fuel conference was held in the country, and there are now three wood pellet plants under development. Each plant is to produce 50,000 tons of wood pellets. However, a market for the product also needs to be developed, and Ireland is not really a candidate for wood pellet imports, at least in the near term.

Spain

Briquettes are more common in Spain than wood pellets, and both products are produced only from dry mill residues. There

are 14 operating briquette plants and 5 inoperative plants, and there are 4 operating pellet plants and 2 inoperative plants. Spanish pellet plants include two in Pontevedra, one in Toledo, and one in Navarre. The primary briquette and pellet producers in Spain are listed in the table below – we include this to illustrate the variety of raw materials used and of sizes produced. Demand for pellets in Spain is reported to be greater than supply, and so pellets are imported from Canada and other European countries. However, Spanish pellet companies also export some of their production (Table 2).

Sweden

Sweden has the largest wood pellet industry in Europe, thanks to a plentiful supply of raw materials and a tax structure that favors renewable energy sources like biomass. In the early 1990s, Sweden introduced a new tax on fossil fuel carbon dioxide emissions, and this paved the way for a quick expansion in consumption of wood pellets in the country. Between 1992 and 2001, Swedish pellets consumption increased from 5,000 to 667,000 tons per year, making Sweden the largest pellet user and producer in Europe. In 2002, production of wood pellets in Sweden was approximately 700,000 tons from 26 plants.

The 12 companies which are members of the Swedish Association of Pellet Producers own 16 plants which produce most of the wood pellets in the country. Sweden exported 50,000 tons of wood pellets in 2002, but imports were 150,000 tons, so that total consumption was around 800,000 tons. Wood pellet production capacity in the country in 2003 is likely close to 1.0 Mt. A full utilization of all sawmill by-products (including bark, dry chips etc.) could theoretically result in a production of 6.9 million tons of pellets annually in Sweden, indicating the size of the raw material supply in the country.

A new certificate program started in Sweden May 1, 2003. Each renewable power source gets 1 certificate per MW of production. Consumers (utilities) have to buy certificates to 6.7% of power needs, increasing by 1% annually to 2010. This is meant to replace all government subsidies over time. Wood pellets are used primarily by district heating plants and in home furnaces, but at least two electric utilities also use wood pellets: Borås Energi AB and Enköpings Värmeverk AB.

Pellets only supplied about one-fourth of the energy derived from wood fuels in Sweden, with fuel chips and sawdust and bark each supplying 35-40% of wood fuel energy. The amount of energy provided by wood fuels in

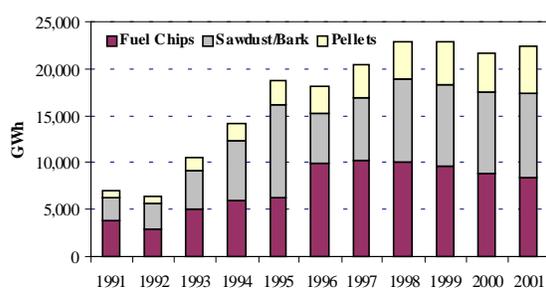
Table 2 – Primary briquette and wood pellet producers in Spain, 2003
Quadro 2 – Produtores primários de pellets de madeira e briquetes na Espanha, 2003

Company	City	Type	Raw Material	Size (mm)
J Rico	Valladolid	Briquette	Pine forestry waste	92 x 237
G. Gargia	Mallorca	Briquette	Sawdust pine	52 x 313
Brasil	(Imported)	Briquette	Tropical Wood	44 x 332
Vila Comesana	Vigo	Briquette	Sawdust Tropical	53 x 303
Briher	Soria	Briquette	Sawdust 90% Trop/10% pine	92 x 306
E.U.E.T. Forestal	Pontevedra	Briquette	Eucalyptus chips	63 x 74
Resifor S.A.	Pontevedra	Pellet	Plywood waste, sawdust – Tropical 70%, pine 30%	6.8 x 17.2
Ecoforest	Pontevedra	Pellet	Sawdust - Tropical	6.4 x 13.7

Sweden tripled during the 1990s, but remained stable between 1998 and 2001. The total harvest of wood fuel was 5.9 million m³ in 2002 (Figure 8).

Of the 10 largest bio-fuel suppliers in Sweden (based on energy content) there are four companies whose owners' main activity is in the timber or paper industry: SCA, Sydved Energileveranser, Stora Enzo and Södra Skogsenergi. They or their parent companies are also very large forest owners. The company SCA - Norrbränslen really takes the lead. This is a part of the very large Swedish forestry company SCA, the producer of pulp and paper. They deliver all kinds of bio-fuels, mostly residues from the industries such as bark but also residues directly from the forests (grot) and densified fuels such as pellets.

These companies own or have interests in four different pellet plants in Sweden. For example, SCA owns Bioenergi I Norrland AB, (known as BIONORR), which is doubling the capacity of its plant in Härnsöand to 140,000 tons of wood pellets per year and will be the largest pellet plant in Sweden. Another large producer is Skellefteå Kraft, which has a heat and power plant, and also a pellet plant which produces 130,000 tons per year of pellets.



Source: Svenska Trädbränsleförbundet

Figure 8 – Sweden: production of wood fuels by type, 1991 – 2001 (GWh).

Figura 8 – Suécia: produção de combustíveis a partir da madeira, por tipo, 1991 – 2001 (GWh).

The largest single industrial user of wood pellets is Hässelby power plant in Stockholm, which consumes 250,000 tons of pellets annually. In addition there were 25,000 home pellet burners with total capacity of 500 MW installed in 2001. In 2003, there are an estimated 37,000 small scale pellet burners installed, and by 2005 there are expected to be more than 50,000 units in Sweden.

Prices for fuel chips remained relatively stable through most of the 1990s, but recently (2002) moved up sharply. In contrast, wood pellet prices moved up slowly but steadily during the 1994 – 2001 period, and then almost increased quickly in 2002. By late 2002, prices for wood pellets had moved up to 192 SEK/MWh (Figure 9).

Austria

In Austria, a boom in wood pellets started in 1997 when the first systems were introduced into the market, and by the end of 2002 a total of 17,000 pellet central heating installations were in operation (See following chart.). Most of the pellet systems installed are fully automatic central heating systems for one family homes in the power range below 25 kWh. Pellet stoves are used for new homes

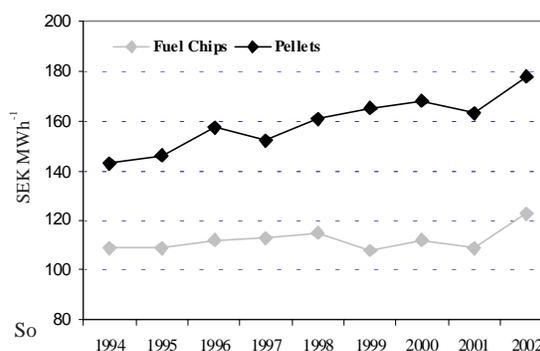
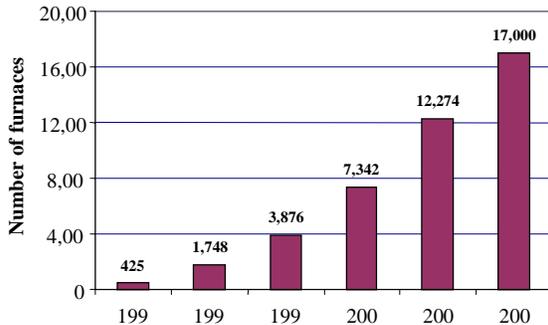


Figure 9 – Sweden: average prices of wood fuel chips and pellets for thermal power stations, 1994 – 2002 (SEK MWh⁻¹).

Figura 9 – Suécia: preços médios de cavacos de madeira e pellets para usinas termelétricas, 1994 – 2002 (SEK MWh⁻¹).

with very low heat demands (low energy and passive houses) (Figure 10).



Source: Rathbauer (2002).

Figure 10 – Austria: number of wood pellet furnaces installed, 1997 – 2002.

Figura 10 – Áustria: número de fornos de pellets de madeira instalados, 1997 – 2002.

Sweden and Austria are the only two European countries which have established national standards for wood pellets (in Austria it is ON M 7135). About 30 Austrian companies are manufacturing pellet boilers. Subsidies are available for converting to wood pellet heating: financial support (usually around 20-25 %) is provided for the installation of a pellet heating system, with a special bonus when switching from fossil fuel and for removing old oil tanks.

There are about 14 producers of wood pellets in Austria, with at least three of these producing more than 30,000 tons per year. Total production in 2001 was 120,000 tons, double the volume produced in 2000, and making Austria the third largest producer in Europe, after Sweden and Denmark. All pellet production in Austria is from dry sawdust and shavings, because they are to be used in small scale heating plants. Also there are about 100,000 tons of briquettes produced in Austria annually. Total production capacity of wood pellets in 2003 is about 200,000 tons. Forecasts of production in 2010 range as high as

900,000 tons, although raw material supply may be limiting.

Estonia

While wood pellets have been produced in Estonia for years, the use of wood pellets in the country is relatively new. In 2002 three light-oil burning power plants were converted to pellets, and total consumption in the country is estimated at 285,000 tons. Most pellet production in Latvia and Estonia has been exported to Sweden, Denmark, and the Netherlands.

2.3 Wood pellet suppliers to Europe

Canada

Wood pellets are exported from Canada to Europe from both coasts. From Halifax, Nova Scotia Fulghum Fibrefuels exports pellets to Sweden, Denmark, and Holland. The raw material for this plant is sawdust and bark from the adjacent Mactyla sawmill. The pellet plant has a capacity of 120,000 tons per year, and can produce pellets with a bark content ranging from 0 to 100%. This plant was built in 1999.

In British Columbia, the company Pellet Flame has been shipping wood pellets to Europe since 1998. As of December 2003, a total of 30 shipments had been made by the company's export marketing and shipping subsidiary, Pacific Bio Energy Corp. Shipments range in size from 5,000 tons to 22,000 tons, depending on the market and client. A total of 90,000 tons were shipped in 2002 and 110,000 tons in 2003. Markets for Pellet Flame pellets have included primarily Sweden, but also Denmark, The Netherlands, Belgium, and the UK. Raw material for Pellet Flame includes clean (no bark) whitewood residues from sawmills in the Prince George area of B.C.

The above two examples illustrate the potential for international trade in wood pellets.

Table 3 – Wood pellet prices in Europe (euros ton⁻¹ and euros MWh⁻¹)
Quadro 3 – Preços de pellets de Madeira na Europa (euros t⁻¹ e euros MWh⁻¹)

Country	Date	Small Scale Consumers		Large Scale Consumers	
		(Euros ton ⁻¹)	(Euros MWh ⁻¹)	(Euros ton ⁻¹)	(Euros MWh ⁻¹)
Áustria	Sep-02	170	33	120	24
Belgium	Mar-03	260	47	155	28
Denmark	May-03	200	41	133	27
Finland	Dec-03	130	26	95	19
France	Apr-03	219	44	122	24
Germany	Mar-03	170	34	140	28
Italy	Apr-03	215	44	136	34
Netherlands	Mar-03	---	---	115	23
Portugal	Mar-03	200	41	---	---
Spain	Mar-03	240	38	---	---
Sweden	Dec-02	170	34	102	21
UK	Mar-03	160	33	---	---

Source: EUBIONET (2003), various.

By far the majority of wood pellets produced in North America are bagged and sold in the domestic markets. However, a number of wood-chip exporters are exploring opportunities to use their reject wood for wood pellet production, and we expect that future reviews will contain more examples of international trade in wood pellets and biomass wood.

2.4 Prices

There are no regular price reporting newsletters for wood pellets or biomass fuel. However, we have compiled a table from EUBIONET Data, shown below.

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