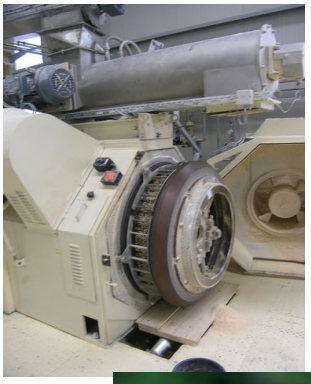

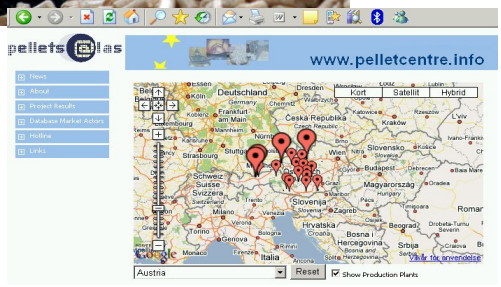

Development and promotion of a transparent European Pellets Market

Creation of a European real-time Pellets Atlas

Pellet market country report

FINLAND

Intelligent Energy Europe

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September 2009

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This report is available at the pellets@las website at www.pelletsatlas.info

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1. Summary

The share of 28.5 % (2005) RES in final energy consumption makes Finland one of the leading uptake concerning RES market uptake in the EU (average 8.5 %). Biomass has been an important fuel during the history. After WW II the use of biomass for energy decreased until the 1970s but started to increase again afterwards. The reasons for this were increasing oil prices and subsequent government policies aimed at increasing the share of bioenergy in total energy supply [Ericsson *et al*. 2004].

Finland is one of the most interesting countries in EU in terms of bioenergy and pellet production. Biomass is widely used for industrial purposes (e.g. in the paper and pulp industry) and is also used for power generation within these sectors. Biomass and peat based energy is also sold in the Nordic energy market where it has to compete with large scale hydro power from Norway, wind power from Denmark and nuclear power from Sweden. The Finnish success story is providing an example for future opportunities for biomass energy use in other countries (Latvia, Estonia etc.) where the market is not so developed yet. Finland is not only the 3rd country in terms of renewable energy share in energy consumption in EU but it is also a showcase about economical success, market development, energy security and local energy cooperation.

The development of the pellet marked started in Finland in 1998. Since then, the pellet market has developed from a strictly exporting market to a multilevel functioning market where the share of domestic consumption is almost as high as the export. This development is not only important for the sector to lower the market risks but it shows that the market is crossing the gap from a highly supported “project” market to a fully viable market that can compete with other fuels like oil products. Still the market is developing and normal market risks like the lack of raw material and increasing production prices can harm this process.

2. Introduction

The biggest share of renewable energy (37.5%) in Finland is used in the industry.

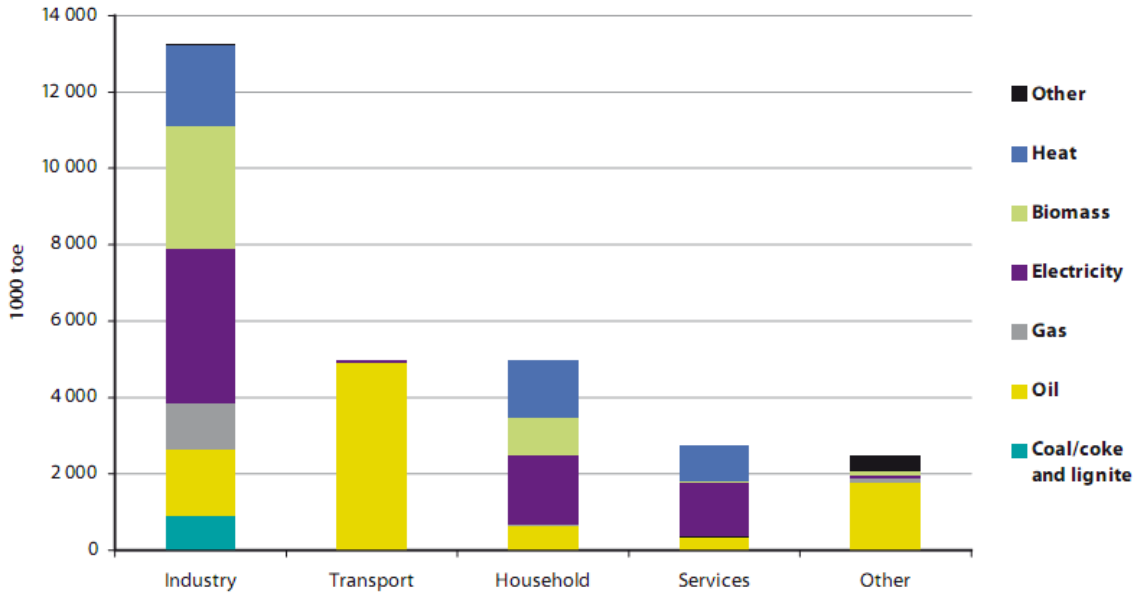

Figure 1: Final energy and non-energy consumption by sector and type of fuel , 2006 [European Communities / Eurostat 2007].

There have been some studies about pellet technologies in Finland already during the 1980s but the brake-trough was achieved with rising oil prizes and a strong demand from Sweden during the end of the 1990s. Even today, a large share of the produced pellets is exported and in this respect Finland is competing with Norway, Canada, Estonia-Latvia and even Denmark and the Netherlands (both are also pellet importers at the same time) but not yet with Russia. The Finnish pellet market started as export market and today about 75 % of the pellet production is exported.

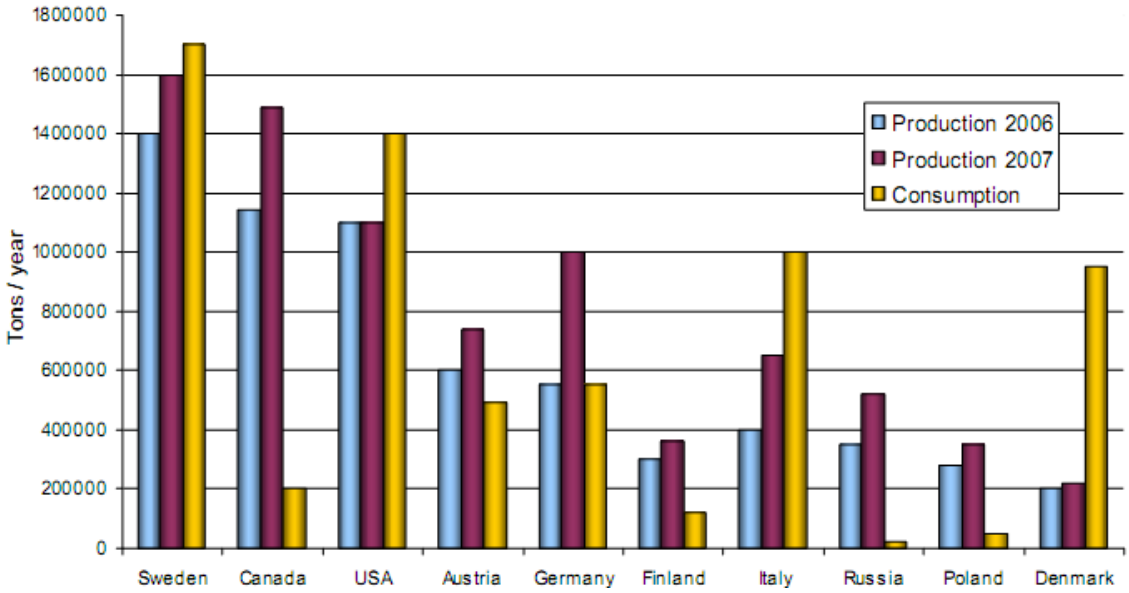

Figure 2: The pellet production and consumption of the leading pellet countries in 2006-2007 [Pelletime Report 2008].

The trend of the 21st century is that also the domestic consumption (from 20 – 25 % of the production in 2006 up to 35 % in 2008) is rising (fastest in EU), mostly in the small-scale sector (smaller then 25 kW; households). This trend is very promising as this is the most reliable customer group and at the same time most difficult to involve. The rest of the production is exported to power plants in Sweden, the Netherlands and Denmark.

Table 1: The current use and the production potential of the most important biofuels in Finland [Heinimö 2008].

Fuel	Use in 2006 [PJ]	Production potential [PJ/y]
Black liquor	156	-
Solid processing industry by-products and residues	81,5	-
Forest fuels (forest chips)	24,6	80…140
Firewood	45,3	-
Wood pellets	1,5	9…25
Biogas	1,7	8…64
Agricultural biomass	0,9	54
Biofuels in road transport sector	0	-
Peat	93,6	-
In total	405,1	-

The share of wood pellets in domestic biofuel consumption is about 0.4% but it has a large potential especially in small scale energy production. The usage could reach amounts from 9 (national targets) to 25 PJ/y which would need a multiplication of the todays domestic consumption (1.5 PJ in 2006).

The development of domestic pellet market is more understandable in a learning curve for bio-energy technology [M. Junginger *et al* 2006]:

- Learning-by-searching;
- Learning-by-doing ;
- Learning-by-using;
- Learning-by-interacting;
- Upsizing (or downsizing) a technology;
- Economies of scale.

Finland is on this scale at the “upsizing a technology” level.

3. History of market development

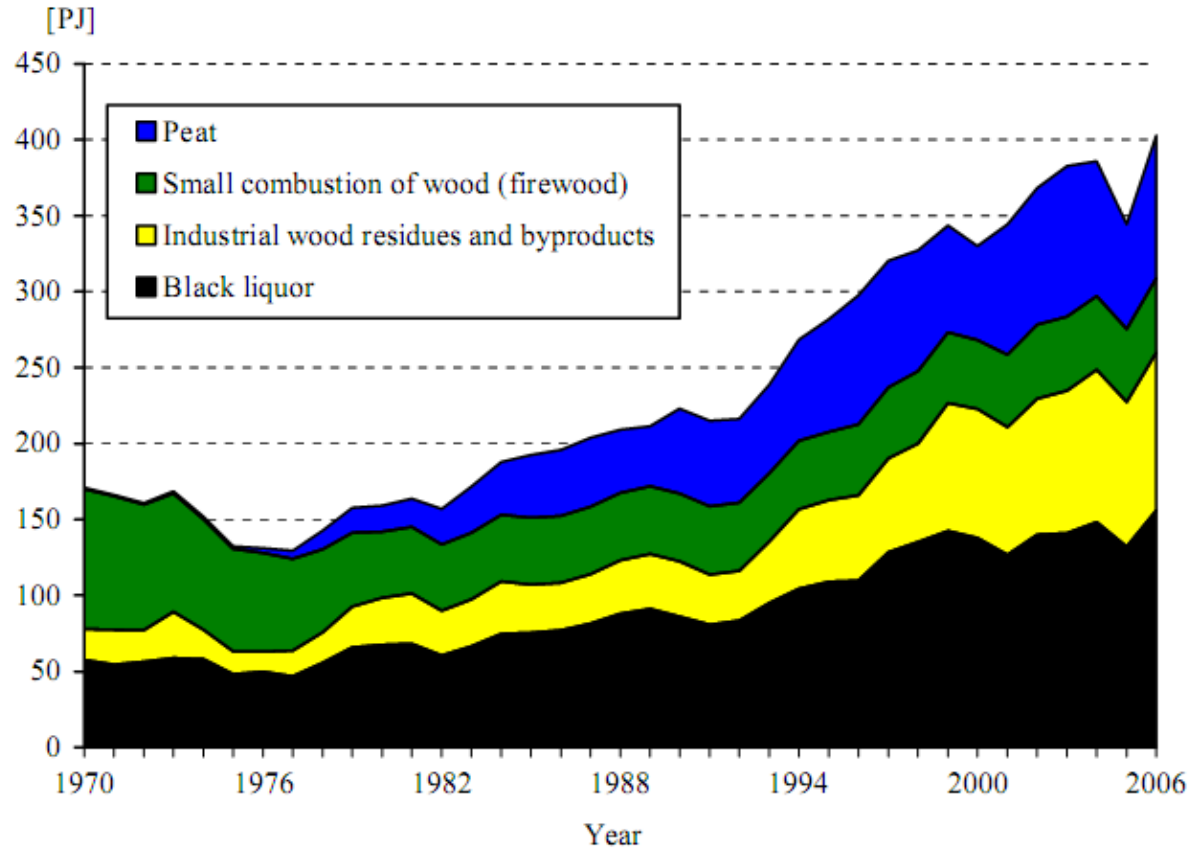

Figure 3: Consumption of wood fuels and peat in Finland 1970-2006 [Heinimö 2008].

Wood has been an important source of energy in Finland for centuries. Today about 90 % of the land area is covered by forests. The share of wood in total energy consumption is about 21 % in Finland. This development was enabled by large scale forest and wood industries that provide almost 80 % of the necessary residues and by-products that are the raw material for energy production. At the same time it is also the most important consumer of wood energy (70 % of produced wood fuel) [Heinimö 2008].

There is an abundance of raw material in Finland. By-products of mechanical wood-processing industries amount to 3.6 TWh/a or 13 PJ [Helynen 1999]. According to Finnish sawmill owners, 700,000 to 800,000 solid m^3 of dry raw material are produced annually, being equal to 300,000 to 400,000 tons of pellets. According to Vapo Oy, it would be possible to produce 1 million tons of pellets per year from this readily available dry or wet raw material [Alakangas & Paju 2002].

The most significant reasons for this are improved marketing and information and the low price of pellets compared to that of oil. In spring 2001, the number of pellet-heated one-family houses was about 400 and that of pellet heating stations in a size class of 50 –500 kW about 100. These figures are growing rapidly. In addition, the power plant of Turku Energy used 10 – 15 % pellets mixed with coal. In January

2001, the price of pellets ranged between 5.6 and 9.4 €/GJ (20.1 – 33.8 €/MWh), depending on the delivery system and distance, while the price of oil was about 11 €/GJ (39.6 €/MWh). Originally, the pellet equipment was mainly imported, but today many Finnish burner and boiler manufacturers have started their own production [Alakangas & Paju 2002].

The competitiveness of pellets is significantly dependent on taxation. The Finnish energy taxation system favors wood fuels since 1998. Contrary to the combustion of fossil fuels and peat, no energy tax is levied on the combustion of wood. For example, the tax for coal combustion is 41.37 €/t, i.e., 1.6 €/GJ (5.8 €/MWh), and that of heavy fuel oil is 0.05 €/kg, i.e. 1.3 €/GJ (4.7 €/MWh). In power generation, the tax subvention on wood was (in 2002) 4.2 €/MWh [Alakangas & Paju 2002].

4. Pellet production

The first pellet plant (capacity 25,000 tons/year) was constructed in 1997 by Fincamby Oy in Vöyri (western part of Finland, right across the Baltic Sea from Sweden where also all the production was exported to). Now there are around 20 plants with capacities from 2,500 (Punkaharju) up to 70,000 (Turenki owned by Biowatti Oy) tons per year. Total production was about 300,000 tons in 2006, in 2008 it was already around 370,000 tons. The current prize of pellet energy in Finland is ca. 4.2 c/kWh [Motiva Oy 2009].

Table 2: Pellet market actors on Finland.

Biowatti Oy	2100	Espoo	Revontulentie	8A	www.biowatti.fi
Formados Oy	93600	Kuusamo	Ouluntie	52	
Green Energy Life Oy	86400	Vihanti	Asematie	11	http://www.greenenergy.fi/
Haminan puunjalostus Oy	49540	Metsäkylä	Metsänummentie	390	
Keurak Oy	FIN-42700	Keuruu	PL 73 / Mäntymäentie	9	www.keurak.fi
Lapin Ekolämpö Oy	94450	Keminmaa	Kallijärventie	10	
Oy Kari Nummela Biopellet Systems	16670	Lappila	Koskipääntie	60-66	www.pelletti-pel.fi
Oy Lardella Ab	29270	Hormisto	Pyssykankaantie	171	www.lardella.fi
Paahtopuu Oy	35500	Korkeakoski	Tapulitie	8	www.paahtopuu.fi
Parkanon Pellet	39700	Parkano	Sahatie	29	www.parkanonpellet.net
Pellettilämpö/A.J.A. Import	85560	Nivala	Järvikyläntie	584	www.pellettilampo.com
PP-Hot Oy	35500	Korkeakoski	Tapulitie	8	www.pp-hot.fi
Punkaharjun Pelletti Ky	58500	Punkaharju	Palomäentie	35	
PuuPrisma Oy	59800	Kesälahti	Salmelantie	11	http://personal.inet.fi /yritys/puuprisma/
Sievin Konepalvelu Oy	85310	SIEVI AS	Koivusaarentie	6	www.sievinkp.fi
Turveruukki Oy	90570	Oulu	Teknologiantie	12	www.turveruukki.fi
Vapo Oy	FI-40101	Jyväskylä, P.O.Box 22	Yrjönkatu	42	www.vapo.fi

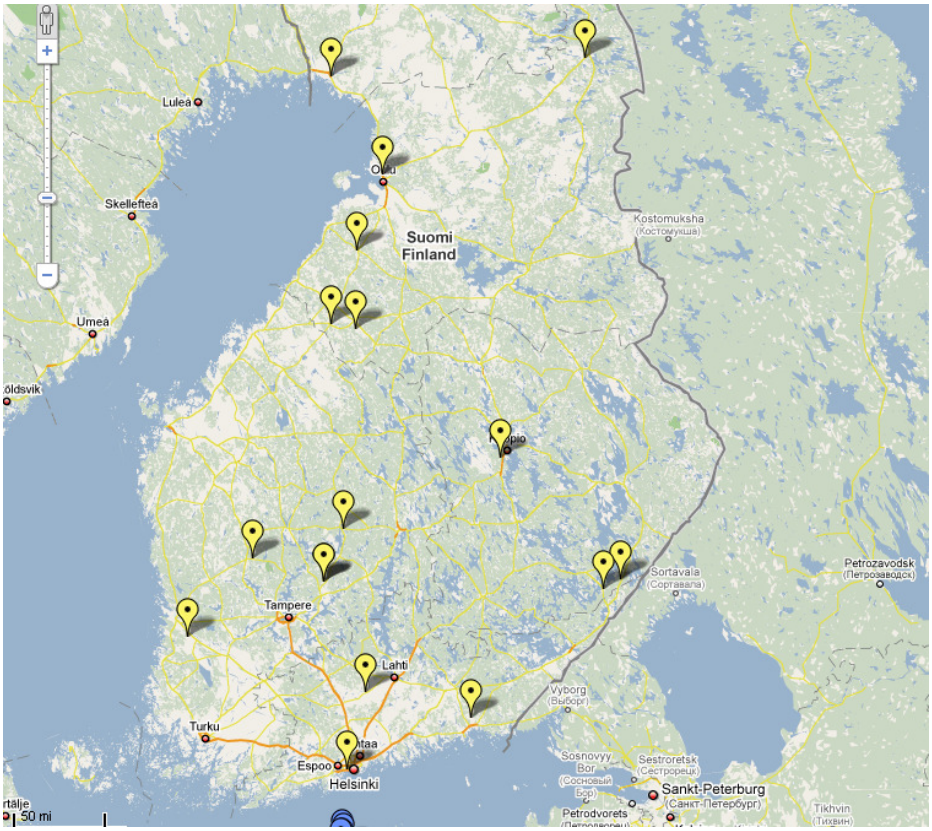

Figure 4: Pellet market actors in Finland [Google maps].

About 75 % of the produced pellets are still exported but the trend is changing rapidly. On the one hand the tough competition in the pellet market with new exporters like Latvia and Estonia is decreasing the profit of export. On the other hand, the domestic consumption is rising, especially the small scale consumption (<25 kW boilers).

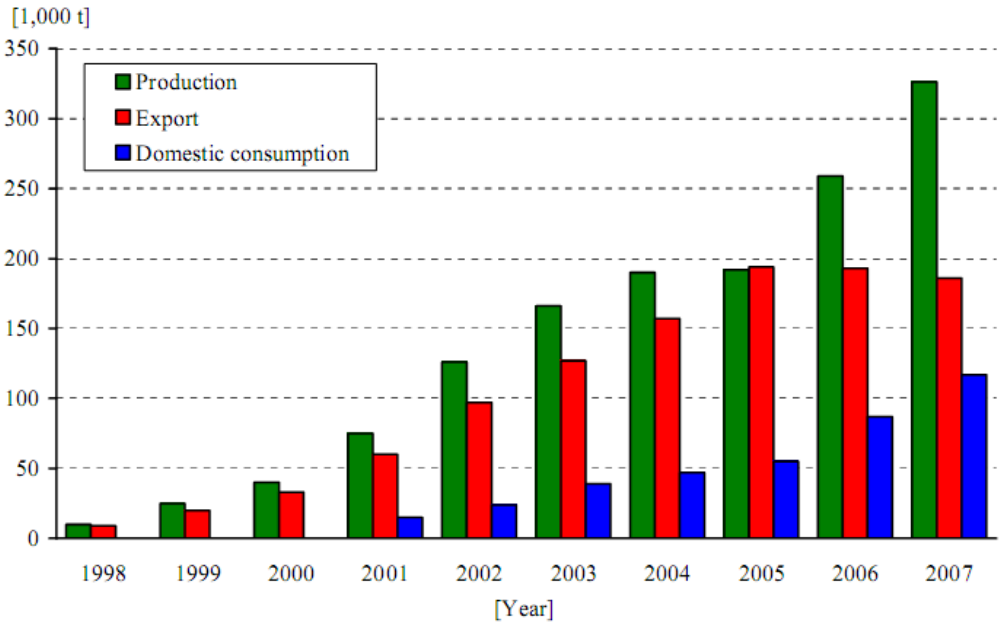

Figure 5: Wood pellet production, domestic consumption, and export in Finland in 1998–2007 [Heinimö 2008].

One of the most critical issues for Finnish wood industry is the import of raw material. In the past, the import of raw wood has raised from 8 % of consumption to 25 %. Today, Finland is the 3rd largest wood importer in the world. This process has many drivers and one of the latest is the availability of cheap Russian raw wood after the collapse of the Russian wood industry in the mid-1990s. About 78 % (in 2006) of the raw wood import to Finland is coming from Russia. But the trend is changing. Russia is planning to develop more its own wood industry and is using a special program for export duties for round wood in 2007-2011 to finance the process and consequently, the price will rise by 80 %. This will definitely harm the Russian wood imports to Finland and increase prizes of raw material in the local market.

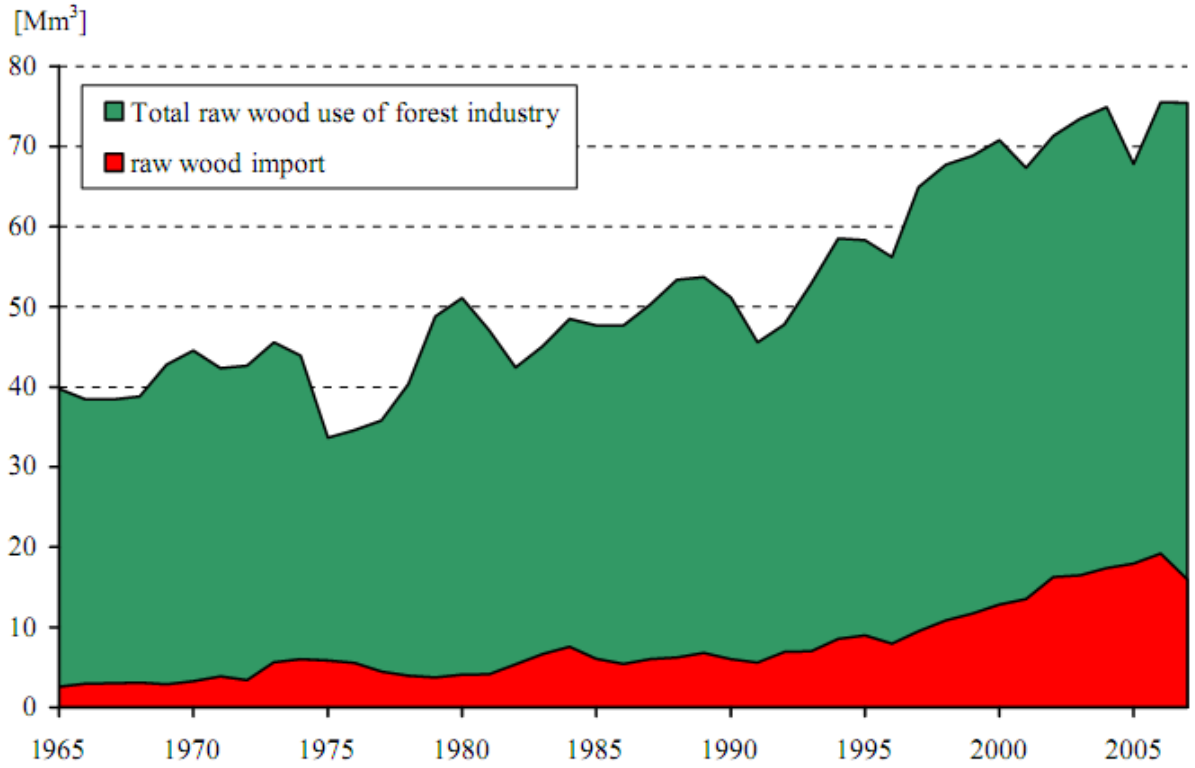

Figure 6: Raw wood use of the forest industry and raw wood import in Finland, 1965–2007 [Heinimö 2008].

The size of pellets manufactured in Finland is usually 8 mm in diameter and 10 – 30 mm in length. The moisture content is low, 7 – 12 %. The ash content is also low, about 0.5 %. The bulk density of pellets ranges from 650 – 700 kg/m^3. The net calorific value of pellets ranges from 4.7 – 5.0 kWh/kg (16.9 – 18 MJ/kg). Hence, the energy content of pellets is 3,000 – 3,300 kWh/loose m^3, which is equal to 300 – 330 liters of light fuel oil. One ton of pellets takes about 1.5 m^3 of storage space and is equal to 470 – 500 liters of light fuel oil. When exposed to water, the wood pellets get damp, swell and disintegrate. The pellets stand poorly direct moisture [Alakangas & Paju 2002].

5. Pellet trade and logistics (wood pellets)

Pellets are distributed by producers or by local retailers in Finland. The producers may deliver the pellets directly to final users or through retailers, especially to small-scale consumers. In Finland, Vapo Oy has the most extensive distribution network for pellets in about 140 Agrimarkets. Pellets of Biowatti Oy are for sale in K-Agricultural shops. Wood pellets are sold either as bulk goods or in large or small bags. In Finland large bags are more popular than small bags [Alakangas & Paju 2002].

Small bags

The size of small pellet bags ranges from 15 to 25 kg, and they are packed on interchangeable pallets. The pallets are delivered to retailers, who deliver the pellets to final users. Small bags are meant for consumers, who use pellets in small scale in stoves or as additional fuel. The small proportion of fines is an advantage of small bags, provided the bags are handled carefully. The higher price is of course a disadvantage [Alakangas & Paju 2002].

Large bags

The size of large bags ranges from 1 to 1.5 m^3, i.e. 500 – 1,000 kg . Transports of pellets in large bags are more economical, but a forklift lorry, a crane or a front loader is needed for unloading. Hence, this transport system is unpractical for small-scale consumers, who do not often have any hoisters for conveying large bags. Large bags are especially used in farms, which have equipment to handle these bags. As regards especially one-family houses, it is not always possible to discharge pellets directly into the bin. Conventional lorries can transport large bags in the same way as small bags. A deposit is paid on bags, as they are recyclable [Alakangas & Paju 2002].

Bulk pellets

Pellets can be transported in bulk by tractors or lorries under a tarpaulin. Bulk pellets are distributed with a lorry by using pressurized air for blowing the pellets direct into the store of the final user. Hence, the pellets are distributed like fuel oil. The lorry may be designed especially for wood pellets, or lorries designed for animal fodder can be used. It does not pay to use expensive special lorries, especially in longer distances, but it is feasible to transport the pellets to the store of the retailer with a normal lorry. From the intermediate store, the pellets are distributed with a blow lorry [Alakangas & Paju 2002]. Bulk distribution is increasing due to lower costs [Malisius et al. 2000].

Vapo Oy Energy, the Association of Ecological Energy and FEG Oy Forest and Environment Group Ltd have developed the first lorry solely for the distribution of wood pellets in Eastern Finland. Mr. Jari Muona of JPK-Tuote Oy invented the idea of this pump lorry. The delivery equipment of pellets is constructed on an interchangeable container and hence does not bind the vehicle solely to pellet transports and distribution. The power source of the equipment is the hydraulics of the lorry, and hence no external power source is required. The container takes a load of 18 m^3. It is divided into three compartments of 6 m^3 that can be emptied separately. This makes it possible to deliver pellets directly to retail customers and to dose, e.g., a pellet load for one heating season of a one-family house. The pressurized air flow carries the pellets through a hose directly into the hopper of the customer even from a distance of > 20 m. The unloading capacity of the delivery lorry is about 10 t/h. The price of the pellet delivery lorry is about € 16m,500, i.e. clearly lower than, e.g. the fodder delivery lorries used in Sweden. The lorry has delivered

pellets to tens of residential houses and to a one-family house for several months and has proved to be a feasible alternative [Alakangas & Paju 2002].

Biowatti Oy has tested pellet deliveries with interchangeable containers and with chips lorries to delivery stores, from which the pellets have been delivered with a pumping lorry designed for animal fodder deliveries. This way the use of expensive pumping lorries is minimized. By using chips lorries and lorries with interchangeable containers it is possible to utilize to-and-from transports in order to reduce costs. Grain silos have been used as delivery stores, as these offer empty storeroom during the greater part of the year [Alakangas & Paju 2002].

Table 3: Import and export balance of biofuels in Finland in 2004-2006, in PJ [Heinimö 2008].

	Wood pellets	*Fuel wood*	*Wood residues*	*Round wood*	*Chips*	*Sawdust*	*Other*	***TOTAL***
Import	0	0,9	0,02	55,52	5,26	0,37	4,39	**66,46**
Export	3,26	0,08	0,02	2,61	0,35	0,12	5,04	**11,48**

6. Pellet consumption

Problems of domestic consumption:

- Lack of information – there are several myths around concerning small scale pellet heating; Energy production and the usage of pellet stoves are not familiar to house owners;
- Lack of good quality distribution – pellet distribution needs special handling and can not be done by any lorry (especially for small stoves that are used in households);
- Lack of standards – although there are several producers in the market, the pellet quality can vary a lot (again that is especially problematic for small stoves);
- Lack of economical motivation – there are (and will always be) also cheaper alternatives (see Figure 7.);
- Lack of maintenance and service – there are not so many skilled professionals in the market and it's hard to get good service.

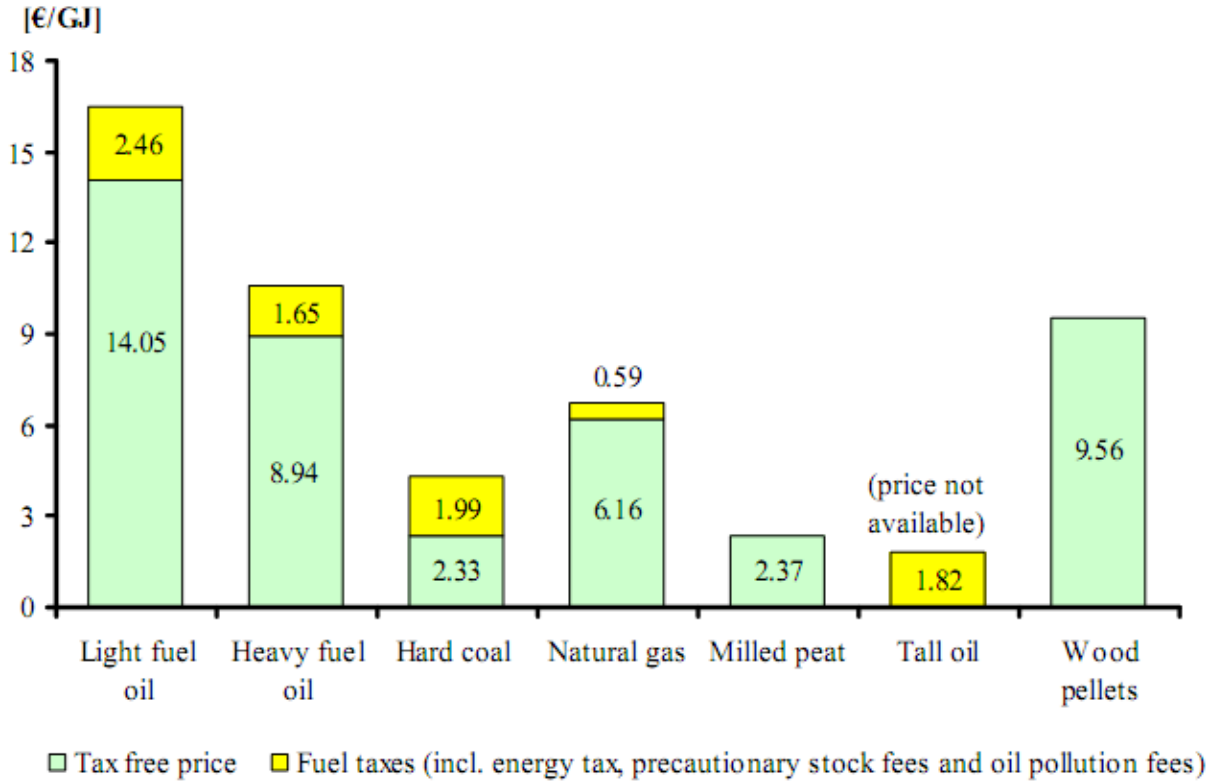

Figure 7: Fuel prices in heat production in January 2008 [Heinimö 2008].

The Finnish domestic pellet market has developed more towards small scale consumption. The main reason for that is that the process has been fast and the large scale facilities need more time to scale up industrial pellet consumption. On the other hand the small scale consumption is the main target group of the national pellet promotion. In total, the consumption in 2008 is estimated at roughly 150,000 tons for the small scale and medium scale heat applications.

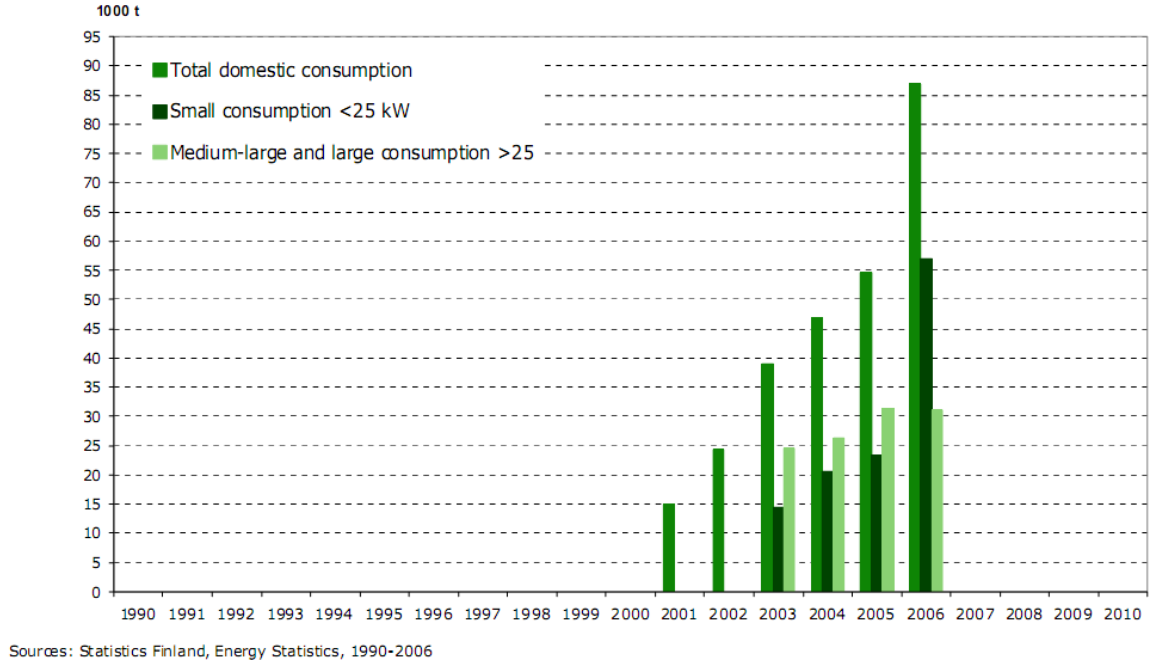

Figure 8: Domestic consumption of wood pellets in Finland [Motiva OY 2008].

There are about 300,000 oil-heated one-family houses in Finland. The majority of these houses were built in the 1960s and 1970s, and hence the greater part of heating boilers should be replaced soon. The use potential of pellets in houses fired with light fuel oil was shown in a study carried out by Electrowatt-Ekono at the request of Vapo Oy. The techno-economic use potential of pellets for replacing solely light fuel oil is estimated at about 7.5 TWh (27 PJ), i.e., 1.6 million tons of pellets [Vapo Oy, Huhtanen 2001; Alakangas & Paju 2002].

An electric utility company of Kainuun Sähkö Oyj had a market study made by Taloustutkimus Oy (an economic planning office), in which the interest of house-owners heating with oil to change over to pellet heating was analysed. Taloustutkimus Oy interviewed by phone 1,250 households and 1,000 enterprises in autumn 1999. The survey indicated that about a fourth of the present oil heaters would be ready to change over to using pellets as a source of heating energy. This would be equal to a consumption of 1.8 TWh (6.5 PJ), i.e. about 380,000 tons of pellet consumption annually, when considering the economically feasible sites. The growth potential is hence significant [Kakkinen 2000; Alakangas & Paju 2002].

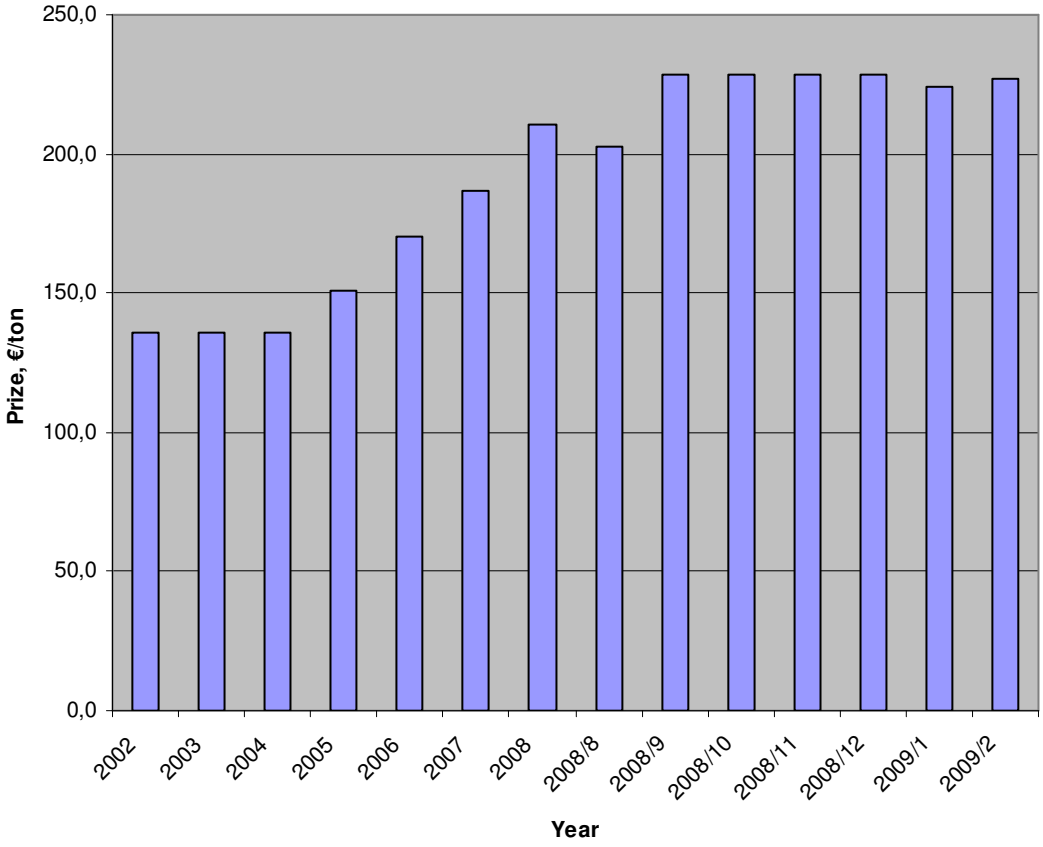

Figure 9: Wood pellet prizes for domestic use, I class, 6-8 mm, 5 tons bulk delivery [Alakangas 2009].

7. Legal framework & Policy

Climate and environment policy of Finland:

- Kyoto protocol (the crucial level is about 70 MtCO2);
- National Climate Strategy (2001/2005);
- EU RES directive;
- Act of Financing of Sustainable Forestry;
- New long term (up to 2050) climate strategy is in development;

One of the targets in the revised National Climate strategy is to raise the share of RES from 23 % in 2003 up to almost one third of the consumption in 2025. In the focus is the usage of forest chips and wood pellets but also agrobiomass fuels. A special strategy will be used for up scaling the use of these resources by 65 % from 2003 (63 PJ) to 2015 and by about 80 % by 2025. After EU regulations in the RES directive, Finland is targeting a 38.5 % share of RES in final consumption.

The Government employs funding of research and development projects, energy taxation, tax relief, production subsidies for electricity and forest chips and investment subsidies as financial measures to implement the energy policy. In addition, in the beginning of 2008 a new measure – the obligation to supply biofuels to the transport markets – was introduced. The competitiveness of renewable energy sources is promoted through investment in long-term technology research and development. Obstacles to getting the R&D findings and results onto the market will be lowered by supporting projects aimed at the commercialization of new technologies [Heinimö 2008].

The Finnish Funding Agency for Technology and Innovation (Tekes) is the main public financer of technology R&D. Renewable energy technologies, belonging to sustainable development solutions, are in the strategic focus of Tekes. Various national technology programmes and projects have involved RES technologies, the main focus being on bioenergy. Tekes funding for bioenergy R&D amounted to some € 15 million in 2006, which was € 5 million more than in the previous year. The total funding for renewable energy and climate change technology has been € 60–70 million annually. In the Energy and Climate Change Strategy, technology development and respective financing remain the major means towards the attainment of energy and climate policy objectives. A strong investment will be made in innovations mitigating climate change, with a special focus on competence areas that are strong from the Finnish point of view. The public funding appropriated to business-driven projects will be maintained at least at the previous years' level (about € 60 million annually) [Heinimö 2008].

Support schemes for Finnish energy market

The main support scheme is energy tax exemption combined with investment incentives.

Tax refund and investment incentives of up to 40 % for wind, and up to 30 % for electricity generation from other RES [DG-TREN 2008] can be provided.

8. Projections on future developments

The pellet market in Finland is developing fast. The main aspects of this are:

- High demand in international markets that guaranties a large scale production of pellets;
- Accessibility of raw materials – about 700,000 – 800,000 solid m^3 of dry material from sawmills [Alakangas & Paju 2002];
- National support for end-users;
- Potential market of small-scale users – about 300,000 oil fired one-family houses built in 1960-1970s with heating boilers soon to be replaced [Alakangas & Paju 2002];
- Availability of technology and equipment as there are several stoves and boilers built for the national market;
- Rising awareness about pros and problems of pellet heating.

Finland has been traditionally an exporting pellet market but with a fast rising demand in the local market the situation can change and pellet producers will more focus on local consumer. Today more then 35 % of the produced pellets are used in domestic consumption but if the trend is continuing the share can already be 50 % in 2010.