

A fuel of convenience

By Jackie Jones



Why pellets are packing the power



The latest designs of pellets stove are highly engineered and stylish, needing attention only once every couple of weeks CALIMAX

Suddenly, it seems, everyone is talking about pellets. The time certainly seems right for this rapidly growing branch of the biomass sector. High oil prices make pellets an increasingly attractive option for domestic and district heating, while the coal-power generation sector, especially in Europe, is keen to reduce its carbon emissions and try shifting towards co-firing with pellets. Meanwhile research is underway into manufacturing 'agropellets' from a wider range of agricultural residue and energy crops. Jackie Jones reports.

'It is quite possible that total pellet consumption in Europe will triple in the coming five years.' This is the view presented by Matti Hilli, CEO one of the world's largest pellet producers - Vapo Oy - speaking at the Bioenergy in Wood Industry 2005 conference, held in Finland last September. While growth in medium-sized district heating plants was steady, there was a marked increase in the co-firing of pellets with coal. On the home heating front, 2005 was a boom year for pellets in Germany, and as the likelihood of a European directive on renewable heating and cooling increases, that trend seems set to continue. Meanwhile, in industry, pellets are also being adopted as a source of on-site heat, often in CHP installations.

Compared with wood chip, for example, wood pellets are highly sophisticated form of packaged energy. First, their energy density is about four times that of good quality wood chip - about 3100 kWh/m³, meaning that their storage and transport is considerably easier and more efficient. And unlike briquettes, the other compacted wood fuel, pellets can be bulk handled like a liquid, as they are small enough to flow freely.

This means that they can be transported by tanker and 'pumped' into storage bins, then fed automatically into boilers.

Typically, wood pellets have a moisture content of only 6%-9% yielding advantages of increased combustability, reduced bulk and weight, and a greatly enhanced 'shelf-life'. At these levels of moisture, the fuel is not open to attack by mildew or other fungal spores, nor will microbial decomposition take place. Essentially the wood fuel becomes an easily transportable, and internationally tradeable commodity, which can be used just as readily in a pellet stove in a living room as in a power plant.

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WHAT'S IN A PELLET?

The composition of wood pellets will depend on the source material (more on this later), although in all cases avoiding contamination and maintaining the right moisture content is essential. There were some early experiences with low-quality pellets, which tended to combust poorly or have undesirable emissions. The industry is acutely aware of the damaging effect that low-quality product could have on the market as a whole, and is rigorous about maintaining standards.



They may look like a healthy-eating breakfast option - but one kilo of these wood pellets will provide about 5 kWh of energy, with heating value equivalent to half a litre of heating oil

A large proportion of pellets have up to now been produced from compressed sawdust from the wood processing industries - typically furniture-making. This has two main implications: first, the sawdust generally comes from seasoned wood, so already has a lower moisture content than freshly harvested wood and needs less (or no) drying. Secondly, it means that these pellets can be manufactured wherever that industry is located. Interestingly, although Austria has a large forestry industry, a high percentage of the pellets produced there are made from imported Scandinavian wood that is used for furniture manufacture. However, this can only be done realistically in plants that are large enough to ensure a good flow of clean material, for the purity of pellet content is essential. That's why waste wood, from pallets or demolition, and which has most likely been treated with some type of preservative or coating, is unsuitable for pellet manufacture.

Other pellets, however, come straight out of the waste from the sawmill industry - as the massive pellet production figures from Sweden, Canada and the Baltic attest. These pellet mills make use of the waste that is produced as raw timber is processed into cut timber - using the sawdust and wood shavings.

With their low ash content, the quality of pellets from these two sources (furniture or sawmill) makes them excellent for the consumer (home heating) market. Pellets boilers and stoves tend to need a consistent, high quality of pellet to optimize their function, and it is important

that the supply market delivers this.

CANADA - OVER A MILLION TONNES A YEAR

Canada is currently producing just over a million tonnes of wood pellets each year, and according to John Swaan, Executive Director of the newly formed Wood Pellet Association of Canada, that number is expected to double in the next 18 months. 'By 2010 we'll be producing 3 million tonnes in British Columbia alone'. British Columbia is already a major producer of pellets, together with its western Canadian neighbour, Alberta. In fact, western Canada is currently responsible for over 70% of Canada's production, exporting over half a million tonnes of pellets overseas each year.

One reason behind the fast growth in the region is the vast amount of forestry timber in the region that has suffered attack from the mountain pine beetle. In the past, this pest has been killed off by the low winter temperatures, but warmer winters are allowing it to survive. A vast area of forest has been affected - 8.5 million hectares, representing over 400 million m³ of timber. While this is a serious problem, it represents a massive biomass opportunity for the next 25 years. The industry, says John Swaan, is 'aggressively going after 85 million m³ a year'. Does this mean that, once the dead wood has been cleared, there will no longer be a resource? Not according to Swaan, who says the forest is being replaced with new material all the time.

With so much production being exported, mostly to Europe, it begs the question how long it will be until the potentially huge North American market opens up. Swaan expects it to take a long time to develop, especially as it has no CO₂ or carbon credits attached. 'We have to compete on cost only', he says. However, he notes that with the oil price remaining high, the move into the North American market 'will happen over time'. As that shift happens, production volume will be so great that 'exports will continue to increase', he adds.

The Wood Pellet Association of Canada is a non-profit association that serves the pellet producers across Canada, advocating for the industry on a national and international level. It represents 23 pellet mills across Canada.

Within the sawmill, another material which can easily be included in pellets is wood bark. This tends to be included in pellets for larger applications - large power plants or maybe CHP - where the requirements may not be so critical. (In fact, some pellet producers optimize the 'recipe' of batches of pellets specifically to meet the requirements of individual large power plants.) It then becomes a natural progression for pellets to start to include forestry and felling residues, although up until now this has not been carried out on any significant scale.

WHO IS PRODUCING PELLETS?

In December 2005, *Bioenergy International* published its latest survey (with the disclaimer that information on smaller plants is very hard to come by, and thus excluded plants producing less than 5000 tonnes of pellets per year, so these figures should be treated with

some caution).

TABLE 1. Estimated production of pellets by country in 2005, from plants larger than 5000 tonnes/year. Sources: Bioenergy International December 2005 (see note in text); Wood Pellet Association of Canada

Sweden	1,356,000 tonnes	Two plants producing over 130,000 tonnes per year, 15 producing over 30,000 tonnes
Canada	1,000,000 tonnes	Five plants over 80,000 tonnes, several plants in the 200,000-tonne range
Russia	758,000 tonnes	Two 100,000-tonne plants, seven over 30,000 tonnes
US	600,000 tonnes	
Denmark	535,000 tonnes	One 280,000-tonne plant and two over 80,000 tonnes
Finland	460,000 tonnes	Six plants over 30,000 tonnes
Austria	409,000 tonnes	Four plants over 30,000 tonnes, three in 80,000-100,000 tonne range
Germany	388,000 tonnes	Six plants over 30,000 tonnes
Poland	356,000 tonnes	One 100,000 tonne plant and three over 30,000 tonnes
Estonia	345,000 tonnes	Three plants over 80,000 tonnes
Latvia	340,000 tonnes	One 100,000 tonne plant, and four over 30,000 tonnes
Italy	169,000 tonnes	Estimated three over 30,000 tonnes, many small plants
Norway	138,000 tonnes	One plant over 30,000 tonnes
Lithuania	110,000 tonnes	One 60,000-tonne plant
UK	110,000 tonnes	Two 50,000-tonne plants
Netherlands	100,000 tonnes	One 100,000-tonne plant
Slovenia	90,000 tonnes	Two 40,000-tonne plants
Spain	70,000 tonnes	One 40,000-tonne plant
France	62,000 tonnes	
Switzerland	60,000 tonnes	One plant over 35,000 tonnes
Slovakia		Seven plants, production not available

Producers vary in scale and approach. Just a few are mentioned below:

- **Fulghum Fibrefuels Ltd** is based in the United States, and was set up in the late 1990s to supply bulk, cleanburning biofuel to power plants in northern Europe. Its current annual production averages 80,000 tonnes. The company is a wholly owned subsidiary of Fulghum

Fibers, Inc. which is a forestry/timber processing operation closely affiliated with specialist machinery producer Fulghum Industries, Inc. Currently, Fulghum is delivering bulk shipments from its Nova Scotia mill, which produces custom blends of biofuel pellets (manufactured from both wood sawdust and bark) for power plant customers in Europe. This mill was originally built in partnership with MacTara Lumber, which owns and operates the mill. The company says it has the capacity to build additional pellets mills at sites around the world to meet the power industry's future needs. Fulghum's in-house laboratory performs many tests including moisture content, pellet durability, particle size, and pellet size distribution. You can take a virtual tour of a Fulghum pellet mill at www.fulghumfibrefuels.com/milltour.htm

- **Vapo Oy**. Finland's Vapo Group focuses on production of heat and power from local sources, which include forest, peat (widely used in Finland though protected in many countries where peatlands are scarcer) and wastes. Vapo produces pellets at over ten plants in Finland, Sweden and Estonia, with the 'energy pellets' being divided into wood pellets and peat pellets. Total production in 2005 was in excess of 500,000 tonnes.



Sawdust from timber sawing or furniture manufacture is compressed to make a clean, durable, biofuel EDWARD MILFORD

- **SIA Gaujas Granulas** of Latvia, a member of the **Baltic Bioenergy Group (BBG)**, is the largest and most modern producer of wood sawdust pellets in the Baltic countries. Currently around 95% of the wood pellets produced in Latvia are exported to Europe and Scandinavia, where they are used for both heating and electricity production.

- **SCA Bionorr**, of Sweden, produces 140,000 tonnes of pellets a year from Forest Stewardship Council-certified timber, and sells its product mainly for heating purposes - to homeowners, owners of medium sized heating plants and large district heating plants.

- **German Pellets GmbH** currently has a 70,000 tonnes/year plant operating in Baden-Württemberg, southwest Germany, and a 120,000 tonnes/year plant under construction in Wismar, on the Baltic coast east of Hamburg. Second phases for both these plants are planned, sized at 220,000 and 240,000 tonnes/year, respectively. Once built, the company's total capacity will be 650,000 tonnes/year.

- **Ökowärme** of Austria produces 95,000 tonnes of pellets a year at its state-of-the-art production plant, manufactured from sustainable forest enterprises. It claims 10,000 regular customers in Austria and abroad. Earlier this year the company opened up a new plant in

Baden-Württemberg, Germany, in conjunction with BioPell, which will produce 45,000 tonnes per year of pellets, along with wood and bark briquettes. Heat for wood drying at the new plant comes from an on-site CHP plant run on locally-produced rapeseed oil.

PELLETS IN CHINA

China plans for renewables to meet 10% of total energy consumption by 2020, and has extensive biomass resources. These include straw and wood waste, and feed grain that is now too old to use. According to Professor Liu Dehua of Tsinghua University (speaking at the 14th European Conference and Exhibition in Paris, last October) China plans to produce 50 million tonnes of pellets by 2020.

Johan Vinterbäck, organizer of the upcoming 2nd World Pellets Conference (being held in Jönköping, Sweden, in May) the Chinese government has declared that 50 combined heat and power stations are to be built using straw pellets as fuel. China has serious energy issues but has seen the potential in pellets not least from local and global environmental perspectives', says Dr Vinterbäck.

Other businesses are smaller, regional, and proud of it. One of many examples is ante-holz of Bromskirchen-Somplar in the Sauerland region of Hessen in Germany - the company stresses the regional quality of its pellets product, the benefits for the local forestry economy and to the environment if lengthy transport is not required.

WHERE IS PELLET PRODUCTION GOING?

Customers of all sizes need to be confident of getting hold of not only the right quality of pellets, but the right quantity when needed

Vapo's Matti Hilli said he expects to see a significant consolidation among the producers of pellets within the coming five years. He believes this will increase the cost efficiency, and allow more precise quality control, as well as 'remarkable savings' in logistics. Larger companies will also be able to time and finance their investments better, he says. A few companies in Europe will dominate 70%-80% of the total production by 2010, but small producer companies will operate regionally.

WHAT ABOUT DISTRIBUTION?

Pellets can be produced and used locally, but can also be shipped internationally to match up production and markets. At present, much of the North American produce is shipped to Europe for use in power generation, and within North America, pellet use tends - at present - to be concentrated on home heating. Much of the Scandinavian and Baltic product is also shipped to Europe. With the pellet market still being relatively new, it has experienced some imbalances of undersupply and oversupply, but stability is now being achieved.



Once this timber has been sawn and planed for the market, the sawdust and shavings will be ideal for pellet production EDWARD MILFORD

This is essential, for customers of all sizes need to be confident of getting hold of not only the right quality of pellets, but the right quantity when needed. At present, the pellet suppliers can be large, international businesses or small, local firms or farmers.

Being able to produce and use pellets on a local or regional basis has great appeal in terms of pellets' sustainability footprint. All the same, Hilli said he believes it is important for consolidation to occur in the distribution of pellets if the market is to expand rapidly. There will be tough competition, he believes, and only distributors who can add value at their stage of the supply chain will succeed.

He envisages that national distributors and possibly even Europe-wide distributors will serve the consumer market, ensuring supply and providing homogenized product quality and services. Some producer-distributors will concentrate on distribution, as they discover their core competence is in marketing and sales. Others will generate national sales networks and effective delivery systems and become large producers.

The needs of the three distinct markets - consumer, the medium-sized district heating or industrial plant market, and large condensing power plant market, will continue to differ.

GERMANY - PELLETS HEATING COMES OUT OF THE NICHE

2005 saw unprecedented demand for pellet heating systems in Germany, with 14,000 new systems installed (representing 2% of all new heating installations in Germany in 2005). This brings the total number of pellets heating systems installed in Germany up to 40,000.

According to a market scenario recently released by the organizer of the Pellets 2006 trade fair and the 6th Pellets Industry Forum, taking place in October in Stuttgart, annual market growth of 15% can be expected in 2006. This would give pellets an 8% share of the German heating market by 2015, with an estimated 57,000 new installations being made each year and an annual industry turnover of €1.35 billion. (The market forecast assumes a stable policy environment and an oil price of between \$50 and \$100 a barrel.)

The Pellets 2006 trade fair and the 6th Pellets Industry Forum are being

organized by Solar Promotion GmbH, Pforzheim. The event is supported by the German Energy Pellet Association and the German Solar Energy Society. For further information: www.pellets2006.de

BEYOND WOOD - AGROPELLETS

It is not only wood that can be 'pelletized' for energy production. Agricultural residues - in particular, straw - are the obvious next step, with specific energy crops being investigated. One of the drivers is economics, since the agricultural residues are readily available for use and can boost production as demand for pellets grows. In southern Europe, for example, where there is little forest residue to pelletize, there are significant possibilities for using agricultural residues. This is also true of some of the new EU Member States, particularly Poland.



The next step for wood pellets is to start to use forest thinnings

Straw has a naturally low moisture content, so does not usually need to be dried prior to pelletization, though it does need to be finely milled. Pelletized, however, it is far less bulky to store or transport than in straw bales, and again, it is protected from deterioration.

Depending on the crop the straw comes from, and the fertilizers used in its production, straw can have higher levels of nitrogen, sulphur, chlorine and potassium than wood. Emissions obviously need to be minimized, and this can be controlled to some extent during pellet manufacture, and then in combustion. At present however, it seems that straw pellets are more likely to be suitable for larger-scale use than in domestic heating.

The next step is the use of specific energy crops. As we reported in REW March-April 2005, (see *Pellets appeal* on www.renewable-energy-world.com) a Danish project carried out research on a range of different materials, including grains and seeds, for pellets production. Others are working with miscanthus (elephant grass) as a source of pellets. Vapo reports positive experiences of growing reed canary grass for energy purposes and for pellet raw material. With proper harvesting, says the company, reed canary grass does not have the same chemical problems as straw in the burning process.



The Balcas plant near Enniskillen in County Fermanagh, Northern Ireland, makes wood pellets from sawdust and woodchips, with a capacity of around 50,000 tonnes per year. Balcas chose to invest in the plant after a 40% increase in business had led to a surplus of sawdust and woodchips at their timber-processing plant. Its energy supply is provided by biomass-fuelled CHP (11.5MWth/2.7MWe) VYNCKE

In March, at the Bioenergy Europe 2006 conference in London, Dr Giuliano Grassi, Secretary General of the European Biomass Industry Association (EUBIA) aroused a great deal of interest when he told the audience about recent work on producing pellets from a wide range of energy crops and residues. The project has been trialling the pellets, testing their content and emissions to optimize them. Dr Grassi sees agropellets as going beyond heat and power. He believes that the pelletization process is a strategic key to substantially growing the bioenergy/biofuels sector, because of the great benefits the process offers in terms of stabilizing humid biomass. Dried and pelletized, the crop is protected from decay, is energy-dense, storable and transportable, making it suitable for later use in biofuels production, in gasification, or for syngas (to be converted to hydrogen). He estimates that the stabilization of biomass in Europe could be a market worth 26 billion by 2020.

The next step towards real energy-crop farming, according to Dr Grassi, is on-farm pelletization, using mobile pelleting equipment that can process crops or residues onsite. This would not only be a technical solution, but would give individual farmers the right motivation to get involved with pellets. They could store their product and release it onto the market as they wish. (And yes, quality control and labelling mechanisms would need to be in place.) Such energy crops could include miscanthus, though the trials for sweet sorghum, in particular, have been successful. Other purpose-grown grains, or surplus food grain, could also be converted into agropellets.

Growing energy crops specifically for conversion to pellets, rather than relying on wood residues, does start to change the economics. According to Dr Giuliano Grassi, the yield of sorghum is 25-28 dry tonnes/hectare, at a cost of €32/dry tonne while miscanthus comes in at 22 dry tonnes/hectare, at a cost of €30/dry tonne. However, a key opportunity for agropellets could be in replacing coal for power generation, by means of co-firing operations.



Ökowärme of Austria produces 95,000 tonnes of pellets a year at its state-of-the-art production plant EDWARD MILFORD

new EU member states rely particularly heavily on coal). An initial target of 10% biomass co-firing would mean a rapid 20,000 MWe contribution from biomass, requiring approximately 70 million tonnes/year of dry biomass - such as pellets. Co-firing with agropellets could technically be increased to a level of 20%-25%, says Grassi, which could in turn have a large impact on rural development.

He has calculated that 1 kg of agropellets would typically avoid the emission of approximately 1.45 kg of CO₂ if used to replace coal. The pellets are also free from sulphur emissions and produce smaller amounts of noxious ash than coal. He believes that the price of agropellets could be competitive with imported coal, at a cost of approximately €64/tonne (partly compensated by the cost benefit, in Europe, of avoiding carbon emissions from coal).

For, or against, the grain?

When it comes to using grain - which could in fact be combusted in its natural state - conversion to pellets offers a number of advantages, as Bengt-Erik Löfgren (of Åfab, Sweden) pointed out in his presentation at the pellets conference section of the World Sustainable Energy Days, held in Wels, Austria, in March. Combusting un-palletized excess grain leads to output of nitrous oxide, sulphur dioxide and hydrochloric and other acids that would rapidly corrode exhaust chimneys, even at high flue gas temperatures. Pelletization offers the chance to add other ingredients that can reduce the acidification. The simple addition of sodium bicarbonate - baking powder - to grain pellets binds sulphur, chlorine and other substances that are harmful in flue gas, to the ashes. And this even increases the value of the ash as a soil improvement material.

An initial target of 10% biomass co-firing would mean 20,000 MWe from biomass, requiring 70 million tonnes/year of biomass

CONCLUSION

Clean, convenient, internationally transportable - yet also workable and valuable on a local scale - it seems inevitable that pellets will swiftly become an increasingly mature sector of the renewables industry. They certainly have a role to play in reducing emissions from existing coal power plants, plus in dedicated power applications and certainly in heating. If confidence continues to grow and the right policy signals are given, new forms of pellets from the agricultural sector might take pellets into the next era.

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