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Title of Paper: **The Contribution of Woodfuel to Delivering the Sustainable Society of the Future**

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Abstract

Wood fuel has come and gone throughout the ages, but its use currently amounts to nearly a billion tonnes of oil equivalent, a level comparable to the consumption of natural gas or coal. This makes it the largest renewable energy resource in use today.

With spiraling oil costs, concerns over security of supply and the impacts of global warming looming, a number of developed countries have made great strides in increasing the use of wood as a fuel, with some seeing startlingly rapid increases in uptake of the technology at a commercial and industrial level. In the EU in particular, woodfuel now plays a significant role in heat markets. Of the total energy used across the EU, 8% of this is classed as renewable, and 60% of this is derived from woodfuel and other forms of biomass.

This paper will explore the journey of the UK woodfuel sector from a handful of systems in 2003, to over 300 commercial and industrial installations in 2008. The paper will examine the environmental and economic credentials of woodfuel, and detail its application to a range of industrial and commercial uses.

New Zealand grows wood fibre as fast as anywhere in the world, has a mature and well-distributed forestry industry and has a relatively heat-intensive primary sector. Case studies and learnings from Europe will be explored to demonstrate how this abundant and sustainable energy source could provide New Zealand heat users with a large percentage of their energy requirements cost-effectively, whilst also providing many manufacturers with a competitive advantage to off-set the food/product miles debate.

The Contribution of Woodfuel to Delivering a Sustainable New Zealand

Introduction

The use of wood as a source of energy for heating, cooking and to power industrial processes is arguably the oldest application of any form of fuel by mankind to serve our needs. However, with the discovery of ever-denser and more refined sources of energy throughout recent history, wood as a fuel, in most developed countries at least, largely fell out of favour. Today however, woodfuel in the UK had gone from a handful of systems in 2003, scattered across the country and regarded as left-field novelties, to mainstream technology which can be found as the heating mainstay in hospitals, hotels, schools, military bases and a wide range of commercial and industrial applications.

Globally, wood fuel use currently amounts to nearly one billion tonnes of oil equivalent, a level comparable to the consumption of natural gas (UN FAO, 2005). This makes it the largest renewable energy resource in use today. This paper will explore the journey of the UK woodfuel sector from 2003, to over 300 commercial and industrial installations in 2008. The paper will examine the technological, environmental and economic credentials of woodfuel, and detail its application to a range of industrial and commercial uses.

With current concerns over security of energy supply, and the threat of the effects of global warming looming ever closer, a number of industrialised nations have shown interest in developing the use of wood as a fuel, with some making rapid progress to increasing market penetration of technology at a domestic and commercial level. In the EU in particular, predominantly the Alpine, northern and Scandinavian states, woodfuel now plays a significant role in heat provision. Of the total energy used across the EU, 8% of this is classed as coming from renewable sources, and around 55% of this is derived from wood and other forms of biomass.

Heat production is widely accepted as the most appropriate energy use of woody biomass in a global context, as it is here where it can make the greatest contribution to reducing CO_2 emissions (UK Forestry Commission, 2007), and although the combustion of wood and other biofuels does release CO_2 to the atmosphere, it is only equal to the amount which the plant absorbs during its lifetime. This simple reality means that wood fuel is classed internationally as carbon neutral, and assuming the feedstock is sourced either from sustainable forestry or is a waste product, offers one of the best lifecycle greenhouse gas emissions profiles of any form of energy, renewable or otherwise. In fact, when substituting wood fuel for fossil fuel, levels of greenhouse gas emissions savings can be as high as 97-98%, depending on the method of feedstock collection and processing used (Wihersaari 2005).

Woodfuel Systems – State of the Art

Wood fuel has the advantage over most other renewable energy technologies in being schedulable, i.e. the energy contained in the wood can be utilised on demand. Geothermal is the one exception to this rule, but highly localised occurrence restricts its application in many countries. Best practice in the production of heat energy, either in the form of hot water or steam, from wood, relies on the thorough combustion of wood chips or pellets in a modern boiler system which will deliver outstanding performance when compared to traditional wood burners.

Contrary to the general perception of burning wood as old, dirty, labour intensive and expensive as a result, modern technology has helped wood fuel come of age as a form of renewable energy which can meet the heating and process energy needs of a wide range of customers. Utilising processed wood fuel, usually in the form of either wood chips or pellets, modern wood-fired boilers offer levels of automation, control and efficiency which rival, and can often beat, fossil fuel systems. Add to these credentials the benefits of carbon neutrality, reduced particle emissions, near-zero SOx, increased energy security and running costs which can be half or quarter that of fossil fuels, and it becomes clear why woodfuel is now achieving rapid market penetration in many industrialised economies.

European countries, particularly Sweden, Germany, Austria, Denmark and Finland have not only seen the rapid uptake of woodfuel as an energy source, but have also witnessed significant economic growth in the companies that provide the necessary technology. In Austria for example, the woodfuel boiler and allied industries contribute hundreds of millions of Euro's per annum to the national economy, and Austrian-made woodfuel systems can be found as far afield as Chile, Japan and soon, New Zealand. While the energy taxes which kick-started and sustained the growth of this industry were resisted at first, Austria now leads the world in the design and manufacture of modern wood-fired boiler systems, and the sector is a strong contributor to the 2 billion Euro's of Austria's GDP which comes from exporting clean energy technologies.

The growth of the industry in Austria and other European countries has also seen significant advances in the technology, with corresponding shifts in performance. In the sub-100kW boiler range for example, average performance efficiencies rose from around 60% in 1980 to 90% in 2000 (Simader 2001), and the more advanced systems now deliver net efficiencies as high as 94%.

Larger wood-fired boilers also deliver equivalent levels of efficiency, as well as the kind of reliability which makes them suitable for use in industrial and critical-setting applications such as hospitals. The UK currently has 3 wood-fired steam boilers in hospitals, the most recent of which was a 1.5MW unit installed in Dumfries Hospital earlier this year. Several more are at the planning stage as the UK public sector slowly wakes up to the benefits of low-cost, carbon neutral heating from wood.

Modern, fully automated 500kW wood-fired boiler providing space heating for a factory, Bärnbach, Austria

Progress on Policy – The UK & New Zealand

In terms of market penetration and awareness, New Zealand currently sits where the UK was roughly five years ago, although woodfuel already constitutes somewhere around 20% of New Zealand's total renewable energy supply (New Zealand Energy Statistics: September 2007 Quarter) thanks to the widespread deployment of wood-fired boilers in the timber processing industry.

Rising energy costs, shifts in government policy and targeted support in the form of grants and other measures have, in recent years, given a significant boost to the uptake of woodfuel in a wide range of settings in the UK. This boost (although it came significantly later than support programmes for other forms of renewable energy) is a recognition of the important role which it can play in the energy mix. That heat has been largely disregarded by renewables policy until relatively recently is surprising, given that energy consumed for heating accounts for just under half of total UK final energy consumption, and nearly four fifths of energy use outside the transport sector (BERR, 2006).

Perhaps some of the explanation for the low profile and lack of support for woodfuel lies in the complexity of measuring the impacts of providing support for the sector compared to electricity-only renewables. For example, whilst the energy provided from a wind farm, hydro dam or other large-scale electricity generator is relatively simple to measure at a single point, the production and consumption of heat in a boiler of 100, 500 or even 1,000kW is a more complicated proposition, and often not an operational requirement. In providing support for anything, whether a new hospital or a renewable energy project, governments are generally driven by the demonstration of delivery against measureable targets.

The lack of understanding and relative complexity of collating and aggregating meaningful data on the CO_2 savings provided by multiple, widely-distributed wood fuel projects means that, in the UK at least, the majority of Government support for wood-fired boiler projects has come not from CO_2 reduction policies, but from funds allocated for the creation of employment. That woodfuel installations create five to ten times more jobs than passive-collection renewables, such as wind and solar (Sustainable Development Commission Scotland, 2005), has been a useful draw for Government funds, and market stimulation projects with a combined value well in excess of $10m NZD are currently operating across the UK. This figure does not include the grants available to subsidise system installation or to assist the growth of the supply chain, which swell this figure to well over $50m NZD in 2008.

Meaningful Government support for woodfuel in the UK only effectively began to take shape in 2004, with the publication of the Royal Commission on Environmental Pollution's report, *Biomass as a Renewable Energy Source*. This report from a highly influential and independent Commission effectively kick-started the UK into taking policy-level action on stimulating the uptake of woodfuel for heating. The subsequent Biomass Task Force reported back to Government in October 2005 and prompted the production of a Government Response document in April 2006. Woodfuel strategies for England and Wales followed in March 2007, with a UK Biomass Strategy hot on their heels in May of the same year. This raft of documentation is intended to provide a stable and positive environment within which the UK wood fuel industry can grow.

During the 3 year policy vacuum, the UK wood fuel industry, aided by local government recognition of the multiple benefits of a vibrant wood fuel sector and a small number of key companies and individuals in the private sector, underwent a spectacular period of growth. Aided by rising awareness of climate change impacts and fossil fuel prices, one leading company in the sector posted a 2000 percent growth in sales between the 2005/06 and 2006/07 financial years, with other companies experiencing a similar boost.

The current policy vacuum in New Zealand is similar to that which existed in the UK prior to the publication of the Royal Commission report in 2004, although there is a limited amount of grant aid available through the Energy Efficiency and Conservation Authority via the Wood Energy Grant Programme. Prior to this grant scheme, the only assistance came from the Projects Mechanism (whereby 10,000,000 tonnes of Assigned Amounts Units were awarded by Government to carbon reduction projects. This best suited large scale geothermal and wind projects, so in policy terms, heating with wood is the Cinderella of the energy sector.

Woodfuel – The Benefits to Business

Regardless of the lack of a long-term strategy for stimulating the uptake of renewable heat, wood fuel in New Zealand appears to be on the cusp of making the same rapid progress which the UK experienced in the first half of this decade. The recent record oil prices highs, increased pressure from overseas markets on suppliers to reduce the carbon intensity of their products, and growing consumer pressure at home are pressing producers and service providers alike to consider wood fuel as a viable option.

Whilst current oil prices and recent historical price fluctuations serve as a strong driver to firms seeking increased cost competitiveness and greater financial certainty over their energy costs, longer term trends in the global economy are potentially more worrying for New Zealand businesses. Concerns over 'food miles' and the carbon intensity of production are driving overseas consumers, and the retailers which serve them, to look more closely at their purchasing decisions. Climate change and the potential contribution of CO_2 emissions to global warming have now eclipsed animal welfare and wasteful packaging as the number one concern of consumers in developed market economies, with many manufacturers and retailers in the UK leading the world in pioneering approaches to reducing their emissions.

For manufacturers, reducing the energy intensity of production processes makes sound sense financially, and is even more compelling if the Board of Directors can be persuaded to view long-term investments in energy infrastructure over a more relevant timeline than other capital projects where obsolescence is a stronger possibility. For retailers faced with pressure from public and press, the main avenue left open to them is to apply the pressure of their considerable buying power to those that supply them with goods and services.

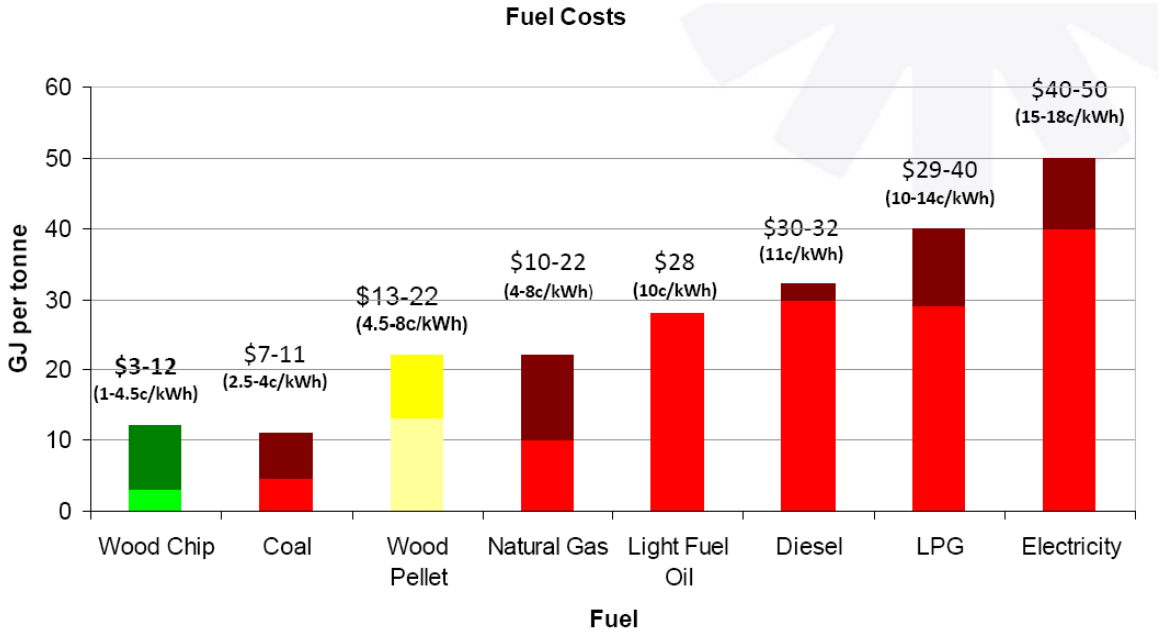
The powerful forces of consumer awareness/guilt and rising energy and transportation costs will, before too much longer, make the locally produced equivalents that are the staples of New Zealand's export-oriented economy less and less attractive to large sections of retailers and consumers alike. Projects such as the Carbon Trust's "Carbon Reduction Label" are putting information in front of consumers which has never previously been available, and will play an increasingly important role in guiding the purchasing decisions of consumers. The Carbon Reduction Label project already has the support and participation of large global manufacturers, including Pepsico, Cadbury Schweppes and Coors Brewers.

Large multiples in the UK, including the country's two largest supermarkets, Tesco and Asda - the latter owned by US retail giant Wal-Mart, are making significant inroads into reducing their own carbon emissions through transport and energy projects (including installing wood fuel boilers in a number of stores), and are also applying pressure to their suppliers to do the same. Tesco, as well as accounting for one pound in every three spent on food in the UK, are leading in many fields of carbon reduction.

Commitments to *"restrict air transport to less than 1 per cent of our products and [wil]l put an aeroplane symbol on all air-freighted products in our stores"* and *"label all our products so that customers can compare their carbon footprint as easily as they can currently compare their price or their nutritional profile"* (Leahy, 2008) spell out a clear direction for retailers in the UK and other industrialised countries. In addition, the spread of these and other like-minded retailers into emerging economies like China and India means that the list of countries which will present an "easy" market for goods produced with little consideration for their carbon intensity will get shorter year-on-year.

Carbon labeling on fruit juices, Tesco Store, UK

New Zealand's export earnings are heavily dependent on the primary sector and tourism, both of which are at risk from the trends outlined above. The adoption of wood fuel however, offers manufacturers and tourism operators, particularly hotels, the chance to not only reduce their carbon dioxide emissions, but also to significantly reduce energy costs. As the graph below shows, New Zealand has high energy prices which are currently impacting significantly on the economy, as in other industrialised nations. New Zealand's distance from then majority of its markets however, should make reducing both the cost and the carbon intensity of its primary and secondary processing sectors a top priority.

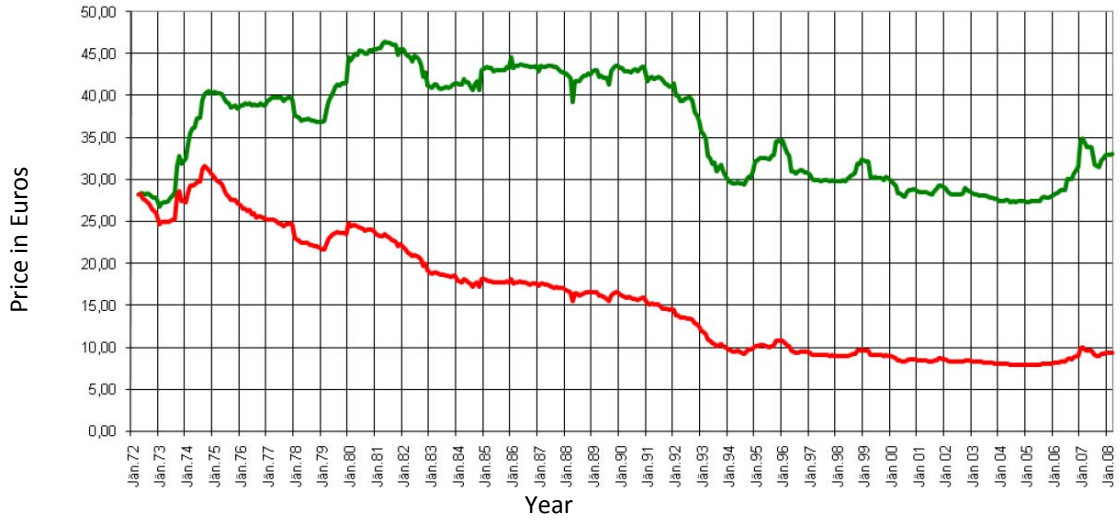


Source : NZ Energy Efficiency and Conservation Authority, April 2008

With a mean price of $6GJ, wood chips can be produced from a wide range of sources, including sawmill residues, tree surgery arisings, forestry material and waste wood, which are local to the point of use and are significantly cheaper than other forms of energy once the initial barriers to the adoption of the technology have been overcome. Thankfully, the barriers have been well documented and addressed in Europe and the US, although there is often no guarantee that having solved problems overseas, and developed technology to the point at which little further refinement it possible, that issues will not still present themselves. The question "*ah, but has it been proved in UK conditions?"*, or in New Zealand for that matter, is a common one, despite wood being just as combustible in the UK and New Zealand as in Finland or Austria. People will often not believe what is being presented to them until they can physically feel the heat from a system.

Thankfully, the current support programme from EECA will see a range of woodfuel boilers installed in schools, pools and a range of industrial applications in New Zealand in the next 12 to 18 months. This will effectively fill the demonstration gap that exists between the multi-megawatt sawmill installations and the handful of small-scale pellet burners which currently make up New Zealand's wood fuel sector. The comparatively high cost of wood pellet fuel, whilst more energy dense and demonstrating better flow characteristics, means that they are often only suited to small-scale applications where space constraints are the overriding consideration. The fact that New Zealand grows wood fibre as fast as anywhere in the world, has a mature and well-distributed forestry industry and has a relatively heat-intensive primary sector will mean that as the market matures, wood chips will provide New Zealand heat users with a large percentage of their energy requirements cost-effectively, whilst also providing a competitive advantage to off-set the food-miles debate. This will mirror developments both in continental Europe and the more recent experience of the UK.

A final interesting point, and a useful counter to the inevitable questions around woodfuel price rises, is the fact that in countries with well developed wood fuel markets and high forest cover (New Zealand has 30% forest cover, compared to 12% in the UK and 47% in Austria) typically do not see a rapid rise in timber prices as a result of the growth in the number of woodfuel installations. Austria for example, which arguably has the most-developed woodfuel sector in the world, has seen very little price fluctuation in its pulpwood prices (the grade of log most suited to chip production) since the mid 1970's, with real prices (the lower line on the graph below) currently well below the 1974 high of 30 Euro's a tonne equivalent. This is despite an increase in the consumption of wood for fuel uses in automatic chip burners from around 50,000 tonnes in 1989 to just under 4,000,000 tonnes per annum in 2004 (Nemestothy, 2008). Similar market trends can be observed in Finland, Sweden, Germany and a number of other countries in Europe.



Upper line, Nominal price in Euros
Lower line, Real price in Euros

Pulpwood prices in Euro's M^3 in Austria. 1972 – 2008
Source : Nemestothy, 2008

In contrast to woodchip prices, the market price for wood pellets is subject to significantly more fluctuation. Wood pellets' position as a globally-traded commodity means that, in common with other energy products, fluctuations in energy markets can have a significant impact on the price paid. For example, bulk pellet prices in Europe saw a 33% price increase from January 2006 to November of the same year, largely because of a predicted cold winter. Chip prices however, remained stable. Long-term supply contracts, short supply chains and an abundance of raw material all play a part in keeping chip fuel prices low. There is no reason to believe that the story will be any different in New Zealand as we see a greater uptake of wood chip fuel for heating.

Conclusions

The aim of the paper has been to provide a summary overview of trends and drivers for the uptake of wood energy in the wider New Zealand economy, and compare this to progress in the UK, which found itself in a similar position 5 years ago. The global economic climate is rapidly changing, with heightened concern for the environment, wildly fluctuating fossil fuel prices, the imposition of carbon taxes and rapid changes in patterns of global production and consumption. These trends are likely to continue, if not intensify, in the coming years.

New Zealand, with its huge forest resource and highly developed forestry industry, is well adapted to make the most of the opportunity that modern woodfuel boiler systems offer. The provision of low-cost, carbon neutral energy to industrial, commercial and public sector end-users is a growing opportunity, and one which will provide New Zealand's economy with the ability to lower energy costs, significantly reduce CO_2 emissions and negate many of the effects of consumer pressure for a lower carbon intensity in the products which they buy.

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