Energy from wood – a key part of Australia's future

Australia could within 15 years be producing at least 20% of its energy needs from woody waste, but this fact to date has been almost totally ignored in the present energy debate. The media is informative about nuclear and fossil fuels energy, with the occasional mention of renewable sources of electricity production being of wind and solar energy. Yet in central Finland up to 45% of industrial and household energy consumption is produced from woody biomass. This is mainly sourced from thinning or harvest of private forest, or timber processing waste. Overall in Finland, the world leader in energy production from biomass, it is over 22%.

Finnish family forest owners produce up to 80% of the logs for industry. As well they, through the ubiquitous grower associations, are the major suppliers of woody biomass to the energy plants in towns and cities across the country. This may be from first thinnings which are usually chipped by mobile plants at the roadside dump, or from harvested material from later operations that is unuseable for milling or pulp. Conifer stumps are increasingly also being removed after final harvest and sold to be munched into chip. Increasingly the tops and slash are being bundled, or chipped on site, and sold to larger biomass plants that are equipped to handle it in this form.

High capacity machinery capable of processing slash into bundled biomass is presently made by the Finnish companies of Valmet (the Woodpac) and Timber jack (the John Deere 1490D slash bundler). The Valmet 801c Bioenergy and the Swedish-made Logset Chipharvester are designed to harvest and convert first thinnings into chip in a single operation within the forest.

The European Economic Community has a short-term goal of 12% of energy to be produced from renewable sources by 2010. Austria already produces about 18% from renewables, with over 8% from woody biomass, mainly as fuel for the district heating or combined heat and power plants in many towns. Smaller plants, including in individual schools, apartment blocks or small communities, are often supplied with their wood chip fuel by farmer syndicates. For an example of how this works in practice, in the Austrian community of Mureck a cooperative of farmers supplies two 2 MW boilers serving a 12km hot water system which serves 180 customers, including apartments and schools (Mureck also has seven farmer syndicates producing biogas and other groups producing biodiesel. (www.lebensministerium.at)

In Sweden the share of the national energy total produced from woody biomass is over 20%, approaching the energy produced from the seven remaining nuclear plants. The Swedes have recently decommissioned two nuclear plants, and have announced the intention of decommissioning their remaining seven as they can replace them with renewable energy sources, mainly with biomass fueled plants. The Swedish prime minister’s country residence at Harpsund has two biomass-fired boilers (one of 250kW fired by chip harvested on the estate, the other of 400kW fueled by pellets) producing all the heat energy for the many buildings. Further self sufficiency in energy is provided by 327m2 of solar panels.

The Swedes have set clear targets for independence from imported fossil fuels, and aim to have ceased fuel imports by 2025. Current commercial biofuels include biogas from fermented organic wastes and green plant material, biodiesel from esterification

of animal fats and vegetable oils, and bioethanol distilled from wheat and sugar beet fermentation. The Swedes, along with the Americans and other countries actively ramping up biofuel production, see this agricultural production only as a stopgap, and that perhaps 75% of required volumes must come from two new processes. One is by the breakdown of ligno-cellulosic material, including woody biomass and straw, into simple carbohydrates able to be fermented to produce ethanol. The other, which is the real hope for economic production of volume, is by the pyrolysis of woody biomass. The Swedes aim to have energy from biomass increased from the present 20% to 40% by 2025.

The pyrolysis process is being worked on by many other countries including the Czech Republic, Austria, Norway and China. In its simplest form it was the WW2 gas producer for petrol-engined vehicles. Woodchip or sawdust heated in a pressure container gave off the volatile gases which fueled the motor. Off-the-shelf power plants using the same basic principle are presently available in northern Europe and Scandinavia. These convert woodchips into electricity by a generator driven by a gas fueled engine, all housed in a comparatively compact and portable unit. However on the industrial scale, as in the experimental gas pyrolysis plant at Varnamo in central Sweden, the volatile gas mix is captured, cleaned, and converted into a range of products including fuels suited to petrol engines, diesel engines, and gas fueled systems, plus a number of industrially valuable chemicals such as formic acid and acetic acid (www.vvbgc.com).

The move away from near-total reliance on nuclear energy and fossil fuels at all levels in these countries has required serious commitment and legislative changes by governments. In Bavaria taxes on fossil fuels are redirected to subsidise municipalities to develop co-generation plants fired by a mix of municipal waste and woody waste. Denmark and the other Scandinavian countries use the same general principle. There heating oil and vehicle fuels are taxed on the basis of their energy value, and part of the revenue raised is used to lift the price paid for chipped forest thinnings and harvest waste delivered to the power plants. In Finland there is some incentive subsidy paid for the thinning process and to offset transport and chipping costs. Generally through these countries petrol is priced from A$2.20-2.60/litre, and heating oils are similarly costly.

Why is it that Biomass energy has had such a slow start in Australia? Information about the latest available technology of woodchip-fired heating, and combined heat and power (CHP) co-generators is widely available. These CHP plants come in all sizes from about 2 megawatts -enough for a small rural community- to over 500 MW, such as the one at Pietarsaari in Finland, enough for a city of hundreds of thousand residents. A number of informative conferences are held annually in northern Europe and Scandinavia. The world Bioenergy conference was in Sweden in May 2006 and attracted 1200 participants from 59 countries. Unfortunately no official representative attended from any Australian state or federal department, research body or energy business.

One reason why biomass energy works well for these northern European and Scandinavian countries is that by installing reticulated community heating systems they have effectively utilised the vast amounts of heat generated. Heat is naturally the

most economically produced product from a power station, and ideally power plants should be designed so that use of hot fluegases and boiler heat can be optimised.

The great potential on a national scale for energy sourced from wood can be found by a visit to the Finnish website www.finbio.fi. The Swedes have a similar one at www.svebio.se. and one including information on short rotation woody crops such as willow at www.energiskog.se. Denmark, Germany and Austria have many informative websites on national bioenergy. To see the wider picture of how a small country like Finland has used visionary, long range, strategic planning, and intelligent investment directed into education, research and industrial development, visit www.tekes.fi/opet.

In the USA, the primary areas of focus in renewable energy till the last few years have been with wind, solar and hydroelectricity. Though solar and wind energy were picked up and developed in the 1970s, low fossil fuel cost was a clear disincentive to continued progress. Now there is realisation of the potential for woody biomass as a source of fuels. As in northern Europe extracting biofuels from woody biomass is seen as the principal way to reduce reliance on imported fossil fuels (already the USA is producing bioethanol volumes from corn equivalent to Australia's annual petrol consumption, and they aim to be producing 15 times that volume annually by 2030).

A program to thin USA's fire-prone federal forests is producing vast amounts of biomass and small diameter roundwood. One recent federal program is subsidising schools and institutions to change from electric or oil heating to biomass heating. Thses conversions have usually demonstrated that even at the relatively low energy prices in the USA, energy from chip costs only half as much, and full pay-off of conversion can be within five to eight years (www.fuelsforschools.org). There are many websites detailing the growth in the USA bioenergy sector. Sites include www.bioenergy.ornl.gov and www.biomasscenter.org. For an international perspective visit www.ieabioenergy.com.

In the Australian context woody biomass will come from several main sources. The current source is from the chipping of secondary logs from public native forest harvest. Within ten years, for a 10MW or larger plant, it could also come from an extensive, sustainably managed, private forestry industry. Sawlog-producing plantations are normally thinned twice as part of good management. Five thousand hectares of managed sawlog plantings progressively established, whether as small sawlog woodlots on hundreds of farms, or as 10-20 large industrial plantations, will annually produce enough chipped thinnings and harvest waste to fuel viable-sized regional energy plants, possibly with other material added to the fuel mix. In Scandinavia and northern Europe it is increasingly common for plants to be co-fired with a mix of woody biomass and flammable industrial and domestic waste.

A 44MW powerplant to be fueled by woody biomass is currently being constructed near Lockerbie in southern Scotland. This will use about 475,000 tonnes per year, principally of 385,000 tonne of thinnings, harvest waste, and sawmill co-product from about 800ha/year of regional forestry management, and with 90,000 tonne/yr coming of chipped short rotation willow coppice (from about 4500ha). All biomass will come from 80 km radius. It is estimated this plant will power 70,000 homes, and create up to 300 jobs indirectly in forestry and farming.

Victoria currently exports over twice that amount of biomass, principally from chipped native forest logs. There are estimates for Victoria alone for a need of a bare minimum of 300,000 hectares needing to be planted over the next 30 years for sawlog production coupled with environmental repair. That 10,000ha a year of thinnings and harvest waste would total over 500,000 tonnes of woody biomass annually. For best management of this expanded plantation forestry there needs to be a ready sale for the biomass at a price allowing cost recovery. In many countries this is made possible by short freight distances to local and regional biomass-fired district heating or CHP plants.

Waste wood from building demolition or renovation is another significant source of fuel for energy plants, and still largely going to waste in Australia. In some countries, including Denmark, by law householders must separate out all flammable municipal waste for energy generation or recycling. Machinery is available for separating flammable from non-flammable material in complex manufactured objects, such as sofas which may contain wood, metal, plastics, padding and fabric.

A key issue in favour of bioenergy as a by-product of a sustainably managed plantation timber industry is that it is approximately carbon neutral. For each tree cut down normally at least one more is planted, or the coppice regrowth is managed. It can be argued that overall it is carbon positive as the use of woody fuels replaces the equivalent energy value of fossil fuels. In addition some fraction of the ash from the clean wood combustion process (particularly that recovered from the furnace exhaust) is a useful product in itself as a potential component of agricultural fertiliser. About a million tonnes of non-coal ash is produced every year in Sweden and much of it is recycled in some way (www.energiaskor.se).

Off-the-shelf power plants fueled by woody biomass are relatively cheap, have low visual impact, and come in all sizes. They can be fueled by alternative solid flammable wastes, such as straw, nut husks or olive pits, and can be the source of heat and steam for adjacent industry (www.talloil.se. www.saxlund.se).

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