Report on Bioenergy 2015 conference, Jyvaskyla, Finland 30.08-4.09 2015

- covering all commercial aspects of biomass to energy, policy development, monitoring, regional economics, R&D, and national collaboration opportunities.

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Finland provides many useful models for Victoria and Australia – we should be aware of these and investigate them (send people there on focused study visits), and adopt and adapt them to enable us to leap as much as one or two decades in progress in the following areas.

Biomass in all its many forms is the largest source of renewable energy worldwide, within the EU and in Australia. In all of these regions the energy from biomass is equal to (and often significantly exceeds) the energy from all other forms of renewable energy combined. Energy from biomass receives little support in Victoria and Australia even though by the most common technologies it is more than competitive with any other renewable source, is the only baseload source we have that can be developed at an industrial scale, and is the only source able to provide electricity, heat and transport biofuels. It is time that policy on renewable energy in Victoria and Australia recognized this fact.

The Bioenergy 2015 conference was held in Jyväskylä, Finland, over 1-2 September, and the information-packed tour which started from Helsinki airport at 9 am on the day beforehand included people from Canada, USA, Australia and Japan. As in the past, the tour arranged by Benet, the Finnish bioenergy consulting company and conference organizer, was full of interest. The first stop was at the new 320 million euro waste-to-energy plant at Vantaa.

Vantaa is Finland's fourth largest city, with about 230,000 residents, and this state-of-the-art plant achieves an impressive 95% energy conversion efficiency and produces about 50% of the heat energy demand (about 900 GWh or 100 MW-th) and 30% of the electricity demand (about 600 GWH or68 MW-e) for the city. The plant, commissioned only a year earlier, replaced a natural gas fired plant. The change of fuel has meant an estimated reduction in greenhouse gas emissions by Vantaa of about 30% (130,000 t of CO2-e), as well as meaning waste going to landfill has now been slashed to only about 2%. As just said, the plant now supplies about 30% of Vantaa's electricity and about 50% of its winter heat needs. In summer the heat from the plant is directed also to supply the district heating systems of urban communities to the north and south of Vantaa, and the local DH systems dedicated to these are closed down for this period.

The intake of 320,000 tonnes of mixed municipal waste produced by about 1.5 million people resident in the province (which includes nearby cities of Helsinki, Porvoo and Espo) means a steady flow of 140-180 trucks a day through a sophisticated recording and monitoring process developed by the Finnish company Protocon. The trucks' arrival times and net load weights of between 9 and 24 tonne of wastes are recorded against each truck's company, and the load content at the unloading point into the 38 metre deep bunker is recorded by CCTV cameras. An occasional random truck is directed to unload on a sorting apron and the content is checked for compliance. On average it takes 11 minutes between a truck entering and leaving the gate.

Waste to Energy plants usually use either moving grate furnaces (as this one does) or bubbling fluidized bed furnaces (though some systems in Canada, the UK, Japan and elsewhere are using plasma torch technology or other forms of gasification). Treatment of flue gases is by a number of systems and it is this, along with the complex feedstock reception and handling requirements, that helps account for the significantly higher capital cost/MW-e capacity compared to biomass fueled CHP plants of a comparable size. In this case, due to the highly efficient combustion, and high steam temperature and pressure, the capital cost of US$5.3 million/MW-e capacity is well below the more normal capital cost for larger WTE plants, that is closer to US$7-8 million/MW-e capacity. So with the Vantaa plant about 5000 tonne/year of mixed MSW is used per MW-e capacity, while it is more common to find the fuel required per MW-e capacity to be closer to 10,000 tonne/year.

The driving factors for development of this plant were

- *legislation that no more waste would go direct to landfill in Finland from start of 2016, with municipalities being required (as in Sweden, Denmark and other EU countries) to develop waste to energy options.*
- *A high and increasing cost of landfill/tonne (and so the ability for the plant operators to charge this sort of amount as a gatefee, and resulting earnings allowing payback of investment in under ten years)*
- *A high cost of fossil fuels and government policy to reduce use of fossil fuels*
- *Sale of heat from the plant into district heating systems*
- *Availability of some co-funding from government*
- *Existence of proven technology and advice on the technology options*

The second visit was to a 10MW bubbling fluidized bed (BFB) boiler made by the Finish company Renewa that was supplying district heat to the township of Rajamäki. This BFB plant is fueled by any mix of forest chip, sawmill residues or milled peat, and is designed to be run with no staff on site and to be managed remotely. While it is visited once a day by one of the company staff it is managed from the control room of another of the company's four district heating plants. Capital cost of this plant on its greenfield site was about 4.5 million Euros in 1997.

The BFB furnace technology is increasingly used in Europe for wetter and non-homogenous fuels. In this desing the floor of the furnace consists of a bed of hot sand that has the air intake to the combustion process coming from a grid of jets under the sand. The sand both helps dry out the fuel and exposes all incoming particles of fuel to a high and very constant heat. Sand and unburned material including ash is gradually extracted, with the separated sand being reintroduced. This design of furnace is used at the Nestle plant at Gympie (fueled by coffee grounds and sawdust), at the Silver Fern meatworks south of Dunedin in New Zealand (fueled by sawmill residues and meat processing sludge), and at the Visy plant at Melbourne (fueled by wet recycling paper waste and non-PVC plastics).

The last visits on this tour were at a forest thinning site near Jyväskylä, where it was demonstrated that the Finns are still among world leaders in development of innovative forestry biomass to energy equipment and systems. At this site a fourth generation Fixteri bundler at work showed how this system

can offer significantly better economics for doing first commercial thinnings for energy use. Dr Minna Lappalainen, the Managing Director of Fixteri Oy, explained how this was done by a higher recovery rate of biomass per hectare along with less handling costs, better drying and improved chipping options.

The Fixteri bundler is mounted on a standard forwarder base and the forwarder crane is fitted with a Narva felling head. This feeds the butt end of each tree removed in the thinning process into the intake of the bundler. This then commences an automated process, cutting the trees to length and then when a bundle of required weight or volumes is accumulated the bundle is wrapped with netter (similar to that used for a haybale) and then weighed and ejected. The bundler can be set to strip off foliage and to cut the tip of the tree off at a pre-determined diameter. As each tree is being converted into the bundle the operator is continuing to cut more trees and feed them into the bundler receival.jaws.

The overall outcome is that the trees are thinning and bundled far more cost-effectively than by any other system yet developed. Because it is all done without the felled tree touching the ground it means no dirt and stones get incorporated into bark or leaves. The 0.5 m3bundles are cost-effective for a forwarder to collect, and then can be stacked so that they dry fast and evenly. Subsequent chipping can be at the landing when bundles have been stacked, or they can be transported to the chipper at the bioenergy plant. The question is if this sort of system could play a role in fuel reduction thinning in Victorian forests and thereby mean the increasingly risky practice of fuel reduction burning can cease – at least in the area around urban settlements.

At the same site Tommi Lahto, the managing director of LHM Hakkuri, demonstrated to the group how the fixteri bundles were suited to his Giant chipper. As his truck-mounted chipping system chipped bundle after bundle in a continuous stream into a waiting truck Tommi explained the design features of these high capacity chippers. In his chip supply contracting business he uses about 13 of these around mainly southern Finland. He said that some of these have been working continuously since the late 1990s, and he claims production is achievable of 3 million loose m3 of chip from a Giant chipper over its working life.

In Victoria there are few chippers of a significant capacity and those that exist tend to be at export points such as Geelong. By contrast truck-mounted chippers with integral crane loading systems are very common in Northern and central Europe and allow economic conversion of woody residues to chip for use in energy production in regional energy plants. At present in Victoria such plants do not exist and this means no market for woody biomass (incuding from farm forestry, urban wood waste, timber industry residues and plantation residues). The lack of a market means, among other things, that the economics of agroforestry is less good than it should be, and so it is harder to stimulate adoption of widespread agroforestry. Demand for biomass would allow a slightly better economics also for plantation forestry and this issue of fuel reduction thinning.

The following two days of the Bioenergy 2015 conference included the usual wide range of information concerning policy and targets, forestry management, industry and research in Finland, and also information from a significant number of international speakers. Some standouts among talks on developments in Finland included the progress in the building of the new Metsä plant at Ääneskoski,

which will see a near-tripling of wood going into the processing up to about 6.5 million m3/year, and with energy production being sourced mainly from residues, and a widening of the product line to include biofuels and fibre.

International speakers were from Argentina, USA, Canada, Austria, Korea, Japan, Australia, Estonia and Germany. The changing uses of biomass, particularly in the form of pellets, in the EU were clarified by Jori Sihvonen from Aebiom (the European Biomass Association), while the current world picture and direction for the coming decades was provided by Dr Heinz Kopetz of the World Bioenergy Association. Overall, while the EU and Finnish policy development in relation to bioenergy and biofuels has stalled temporarily, it is clear that there is no alternative to ongoing development in bioenergy, and that Finland is in the box seat to supply plant, equipment, technology and expertise. This message was reinforced a number of times, with countries at the rear in bioenergy development, including USA, Argentina and Australia, clearly being potential clients for some of this array of services and equipment.

Some of the Finnish companies that are world leaders in their technologies and who presented at the conference included Renewa and kpa unicon. These are companies who both make and install a range of smaller to larger biomass-fueled furnaces – of both grate and bubbling fluidized bed type. Biogas and biofuels companies included BioGTS with the pilot plant demonstrating their innovative anaerobic digester design. At the expo that ran in parallel with the conference many sites were taken up by other leading Finnish manufacturers of forestry and bioenergy equipment, including Kesla cranes, heads and chippers (including their prototype hybrid-powered chipper), AFM heads and Hewsaw one-pass milling systems.

The optional post-conference tour went first to a small district heating plant in a village near Joutsa. Here the boiler was in a modular housing with an integrated feed supply. The 150 kW-th boiler and all of the system carried the name Säätötuli, a maker well known in Finland but one of many not widely known outside that country yet.

The second site visit was to a newly completed 3000 m3/year municipal anaerobic digester also near Joutsa. Here the produced biogas was upgraded using the Metener system (developed in Finland) into a near-pure biomethane comparable in energy value to natural gas, and compressed to 2000 psi for fueling cars and buses. The site is just off the E75 highway and the tour group was at the filling station when two people in their V70 AFV Volvo wagon heading north came in to top up with its cheapest fueling option of biomethane (the V70 AFV is able to run on methane, gasoline or ethanol).

This system at Joutsa was one third owned by the local municipality. The advised capital cost of this plant was 1.6 million Euros. It had a 750 m3 reactor, 2000 m3 digestate storage, and annual feedstock was of 1000 m3 of food residues (at 120 Euros/m3 receival charge) and 2000 wet tonne of sewage sludge (at receival charge of 30 Euros/m3). Digester temperature was 40 C. Stored digestate residue was used in summer to fertilise about 300 ha of pastures a year.

The final visit was to VTT (the Finnish National Research Organisation) in Jyväskylä, for an overview of the organization's activity and to see over the test rigs for bubbling and circulating fluidized bed furnaces. This was an appropriate end point as many of the innovative systems seen in practice have

been developed based in some way on the detailed work done by VTT in this and its other laboratories over the last 25 years.

An informative magazine covering some of the activity and developments for this city and region in Finland can be found on http://jyvaskyla.netpaper.fi/2415

It includes articles on bioeconomy, nursing education, university research focus, sports education, the Jyväskylä symphony orchestra and annual festival and many other topics.