# Report on Biomass heating tour South Island New Zealand 5-7 Nov, 2012

## Andrew Lang (funded by City of Ballarat)

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**Summary**

The tour began and ended at Dunedin, and within the three days the group visited chip-fuelled heating systems of a range of sizes in various institutions, visited two sites due for conversion from coal to woodchip fuel, and discussed many others.

The sizes of systems visited ranged from 100 kW to 8.5 MW, the backup systems were either diesel fired boilers or retained LPG fired boilers, and the institutions included two swimming pools, a large home and hospital for the elderly, a university campus (two sites and three systems), a large meatworks, a high school and a high school hostel.

We also met with and visited three businesses supplying chip to these and other sites and looked over their chipping, handling, and delivery equipment and systems. We met with the mayor of the city of Dunedin and a city councillor. As well we met with the maintenance person and/or operations manager at most of the sites, and the person who manages some of them for the state-owned business Energy For Industry (based at the Dunedin Energy Centre).

Overall we were given what seemed a warts-and-all tour of many of Living Energy's installations in the area bounded by Dunedin, Invercargill, Wanaka and Ranfurly.

**Impressions**

In New Zealand conversion to use of biomass for heating is principally driven by the following factors:

- high cost of fossil fuel (particularly LPG, diesel, and (in some areas) coal
- a pressure to achieve better air quality – particularly in reduction of smoke
- high cost of compliance for emissions from coal-fired systems in urban areas
- demonstrating leadership in installing a low GHG emission source of heating
- anticipation of a carbon tax on price of coal or LPG (that so far has not eventuated)

Where coal is cheap (and this is most of east and south of the South Island) it is significantly cheaper than wood chip on a dollars per gigajoule ($/GJ) basis, though where reticulated gas is available (some parts of the North Island) the $/GJ is roughly similar to wood c hip. So coal, with its advantages of low moisture content, easy flowing and high energy density, might cost about $6/GJ delivered where woodchip costs about $12/GJ delivered.

However the issues of air quality (most importantly particulates from coal-fired systems, plus sulphur dioxide and nitrous oxides emissions), significantly higher labour cost for managing a coal-fired system,

costs of disposal of large ash volumes from coal fired systems, and high likelihood of woody biomass soon being on par or cheaper than coal, are increasingly part of the considerations.

**Note: In Victoria production of space and water heating using wood chip should be significantly cheaper per unit of energy than by LPG, heating oil, briquettes or electricity.**

## Some immediate insights gained from this tour

Existing heating systems in Victoria for which wood chip would be a cost-competitive option include those systems due for replacement and particularly when the previous energy is electricity or those fuelled by brown coal briquettes, LPG or heating oil. The tour visited a range of different conversions and installation or modification of different systems for loading and holding adequate volumes of chip.

<u>The main messages from this tour for me were that</u>

- Almost anything is possible in converting from some existing system to wood chip or pellet-fuelled systems, provided there is adequate space - including for chip delivery vehicle access
- In each case the maintenance person or energy manager appeared positive about the experience with the new system
- In each case in a replacement/conversion process the cost of boiler and buffer tank was usually about half the total conversion cost – with the other half being removal of the old system and modification of the fuel bunker, piping, chip transfer, and sometimes modification to the building – including for getting the often higher, or sometimes physically larger, replacement system in
- While cost of wood chip is up to double cost of coal per GJ (in the NZ South Island situation), the savings in labour (compared to coal-fuelled systems), and the far greater energy efficiency of the new system often brought overall running costs of chip fuelled systems ahead (particularly in the case of electric, diesel or LPG fuelled systems).
- The key element in setting up a chip-fuelled system is obviously having a smooth, reliable and high quality supply. In the case of some regions of NZ there was an issue with not enough demand to warrant a full-blown dedicated supply business
- The decision on appropriate size of a system to replace some relatively old system needs to allow for a) the higher efficiency of a modern system, b) the evening out of demand (and some reduction in required system output capacity) due to addition of a suitably sized buffer tank (rule of thumb 25-30 l/kW capcity)
- The size of chip bunker needs to cover at least 5 days of steady demand, and that normally refilling of a fuel store should be timed to happen before the fuel volume is much more than half gone.

- The use of a container, or double-height container, housing both chip and furnace (up to 200 kW can be used if a double height 20' container) is an option that can obviously work for some sites where either there is a constraint on the building availability, or the system may be only a temporary solution, or for some other reason.

- The specifications of a chip-fuelled system should ideally allow other than premium chip to be used. When a slightly larger or less homogenous grade of chip of higher moisture content and higher ash is able to be used, the ease of organizing supply can be far better and cost of chip/GJ is often significantly less.

**Sites visited –**

**Day One, Dunedin to Invercargill**

1. Little Sisters of the Poor hospital , Dunedin

A large nursing home and hospital (36 residential rooms, 20 convent bedrooms and 28 hospital rooms) where a coal fired system was replaced by an 900 kW LPG fired system, and this now replaced with a 300 kilowatt thermal energy output capacity (kW-th) moving grate Binder boiler fired with wood chip, and heating a 15,000 litre buffer tank. The LPG system is retained as backup. This system supplies a large single story set of contiguous buildings of in-patient living space, administrative space, workers' living space, bathrooms, kitchens and laundries. Chip is delivered to the storage via an in ground trough with auger and vertical auger, capable of moving about 50m3/hour. The storage (a converted 3-car garage) is about 120m3 (6x6x5 m). Total cost of the conversion was about NZ$ 600,000, with the actual cost of the new equipment being about half of that.

2. Otago University, Dunedin

First point – 100 kW chip fired Hargassner boiler with supplementary 100 kW pellet fired boiler, supplying one building for space heating.

Second point – 1100 kW chip-fuelled Binder boiler supplying heat to 10 buildings for space heating. Backup is a small LPG boiler. Cost of new system including high specification ceramic flue gas filters, turbolators, compressor etc., approx NZ$500,000 (this cost not including feed store and buffer tank).

3. Dunedin Polytechnic

A site where three 1500 kW (so 4.5 MW) coal-fired boilers will be soon replaced with two 650 kW wood chip-fired Binder boilers, plus a large accumulator or buffer tank. The current system requires regular removal of coal ash, and this also incurs a significant disposal fee. The current system is very over-capacity and also is about to lose compliance for emissions. The changeover cost to a wood-fired system is far more cost-effective over time compared to the alternative of using LPG.

4. WENZ wood chip production site

Owned by government business Wood Energy NZ (WENZ) for supply to biomass heating system demand in the Dunedin area. It mainly uses radiata log shorts (billet wood 1-3m long) bought in at about 60% MC for $25-30 delivered, and holds for 8-12 months (logging contractor dispatches from log-making landing, where the alternative is to burn on site or push over the edge).

It usually is supplying chip at up to 35% MC. The plant chipper is a 3 PL, PTO-driven Heizohack with capacity of about 25,000 t/yr. Business is currently selling about 10,000 t/yr. Deliveries usually with a bulk truck with chain discharge through rear opening. The business also produces and sells firewood.

5. Silver Fern Farms meatworks, Balcutha

A 8.5 MW bubbling fluidized bed (BFB) boiler using sawdust with 5% black coal and dewatered abbatoir residues to help provide heat to one of NZ's larger meatworks

**Day Two – Invercargill to Clyde**

6. Splash Palace aquatic centre, Invercargill

An 840 kW chip-fuelled Binder boiler replacing a coal fired system. Heat goes to a number of pools plus water for showers and to space heating of site. Backup is a 620 kW diesel-fired boiler. This swimming pool is used by up to 340,000 visitors a year, covering all ages of the regions inhabitants. Fitting of the chip-fuelled boiler has eliminated the $15,000 per annum cost of disposal of coal ash and means the services manager is freed up to perform other pool management tasks. The present chip storage only holds about 2 days supply at peak demand periods, when the boiler will be using up to 4 tonnes of chip per day or 150 m3 a week.

7. Niagara sawmill woodchip supplier, Invercargill

Chip is supplied to the Splash Palace by the biomass marketing part of the large Niagara sawmill site near Invercargill. Presently due to only having one significant customer the economics of supply is not good. However with new customers and a larger business this is expected to improve. The Sawmill had some initial difficulty in providing chip of the moisture content required.

8. Wanaka pool

110 kW chip-fuelled Hargassner boiler in 20' shipping container ( storage of chip in one end and furnace in other, plus second half container added above to double volume of chip store to 30 m3 or about 7 days supply) beside enclosed 25 metre community pool, providing water and space heating. The Hargassner boiler operates in parallel with roof solar heat collectors, and with electric heat backup. A heat exchanger is used for heating the pool water. The whole cost of this installation was in the order of NZ$200,000.

**Day 3 – Clyde to Dunedin**

9. Dunnstown High School

650 kW underfed wood chip Binder boiler with 15,000 l buffer tank, supplying all space heating for school of about 540 students in high cold region (replaced previous coal-fired boiler of 1100 kW).

10. Dunnstown High School hostel

250 kW chip-fired Binder boiler with pair of buffer tanks. Backup diesel fired system using same furnace with burner built into separate door able to provide about 75% of chip heating capacity (so about 200 kW). System replaced was an 850 kW coal fired boiler. Hostel has 50 students in 38 bedrooms plus bathrooms and common rooms, plus space heating for accommodation for 7 staff. Heating of water from same system via a heat exchanger. Chip transfer from tip receival trough via a 18 kW electric paddle fan – v. noisy and not recommended)

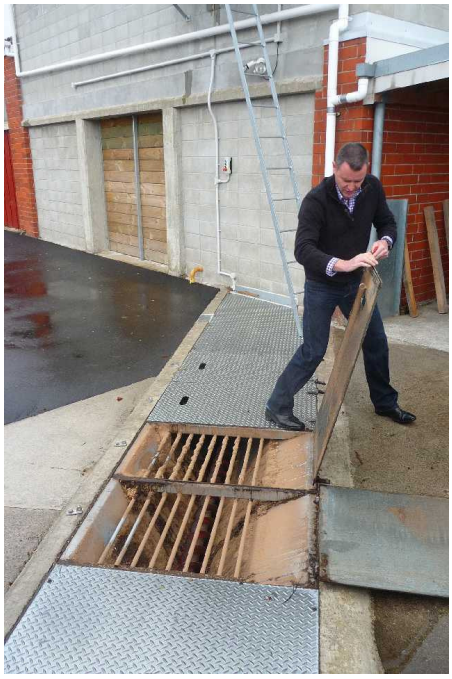
11. Dunstan Hospital, Clyde

Two obsolete 450 kW coal fired boilers to be replaced by a single 500 kW chip-fired Binder boiler with underfed grate. This will be backed up by a diesel boiler.

12 Naseby chip depot

This site supplies Dunnstown High School and hostel , plus sends chip to some users in Dunedin including Otago University. It receives thinnings and potentially harvest waste from the nearby 7000 ha Earnslaugh pine forest, buying this in at $25/green tonne. It maintains a stockpile of up to 7000 m3 (7000 green tonne) which is about enough for 9 months of sales, and holds for about 10 months before chipping, by which time the MC is about 17%.

It uses a Heizohack HM 6300 chipper (on trailer with own diesel engine and hydraulic pump) fed by a hydraulic feed log table. The chipper produces about 30 m3 chip per hour caught in the bucket of an industrial front end loader. This then stockpiles the chip in a covered 400 m3 bunker. Chipper cost about $150,000.



Inground chip transfer auger to vertical auger within storage immediately behind (see to right)

Little Sisters of the Poor storage for 300kW Binder boiler

Wanaka pool above-ground chip transfer auger to storage and 110 kW boiler in container

temporary storage and inclined chip transfer system for Otago University 1100 kW Binder boiler