Case Study:

Installation of a 10MW Wood-Fired Boiler at a Medium Size Sawmill

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Living Energy

- Origins in Carter Holt Harvey (CHH)
  - 330,000 hectares
  - Harvest of 7,000,000 tonnes per year
  - Sawmills and pulp mills using bioenergy
- Major gas field declining
- NZ ratified Kyoto

So in 2000 CHH Forests started CHH Biogrid

To Promote the broader use of woody biomass as an energy source for industry

Living Energy

- Strategic Review of Biogrid
- Management Buyout unsuccessful
- So Living Energy established in 2003
- Same mission
  - Large industrial heat users
  - Also at the smaller scale (hotels, schools, etc)
- Recently sawmill sector too, using same burner
- Turn-key Installation (via Visdamax)
- Carbon Credits and Wood Fuel Supply
Thames Timber

- Established in 1948
- Now owned by Southern Cross Forest Products
- SCFP also have a mill and NZWM in S.Island
- Two sites (Sawmill & Re-man, 1 km apart)
- Approx 80,000m$^3$/year of sawn lumber
- All radiata, mainly pruned
- Large volumes to USA
Kiln Drying

- 5 kilns
  - 3 x Windsor
  - 2 x Mahill
  - All at 90°C
- Can dry about 9000m³/mth

Heating Fuel

- CHH Kopine close so no disposal problems
- Used to be coal
- Not on natural gas pipeline
- So truck-in Butane
- Approx 135,000GJ/yr now (500,000,000KWh)
- Will be on wood-waste from end of August
8MW Butane Boiler

Butane

- 10 hour round-trip
- 2 hours to unload
- 23 tonnes/delivery
- 5 days per week
Butane

- Butane cheap, so ‘payback’ was too long
- Other projects were more ‘deserving’ of capital
- Things have changed fast (influence of Maui):
  - Butane was NZ$0.19/litre ($8/GJ)
  - Now NZ$0.46/litre ($19/GJ)
  - From Sept ’07 will be around NZ$1/litre!!
- Butane would cost approx NZ$15,000/day

When butane is $1/litre, sawdust is worth approx $240/tonne

The Project Timeline

- Considering it for years
- Got serious in 2005
- Tender issued in March 2006
- Submissions in April 2006
- Delays due to emissions consent
- Contract awarded mid-October 2006
The Tender Requirements

- Minimum of “8MW continuous”
- High Pressure Hot Water (180°C)
- 3 days fuel storage
- Emissions: Under 100mg/m³
- Conventional: Assumed 1 boiler, baghouse...

Project Schedule (as Tendered)

8-9 month delivery period from Order:

- Order
- Fabrication
- Ship & Deliver
- Site Preps (by TT)
- Installation
- Commission
- Commission
- Order
The Chosen Solution

- Two x 5MW Boilers, 1,000m³ fuel storage
- Emissions: 100mg/m³ with Cyclones
- Commissioned within 6.5 months of order
The Project Layout

- 4 x 250m³ fuel silos: 5+ days storage
- Blended fuel delivered to each boiler

The Chosen Solution II

Residues to Revenues Australia 2007
The Chosen Solution III

- Use coal bunker to receive fuel
- Deliver shavings by 20 footers (1km)
- Sawdust moved by loader (50 metres)
- Civils and Fuel input feed by local supplier

Distinguishing Features

- Operational Flexibility: 0.25MW to 10MW
  - Fuel shortage, so 5-10% turn-down = $’s
- Low Running Costs
  - Emissions control (no baghouse)
  - Electricity (1 x 37KW fan per burner)
- Fuel Flexibility
  - 100% wet Sawdust, without pre-drying
  - Shavings/bark/chips
  - Coal if needed (as top-up fuel or sweetener)
Installation Period

- 74 days from hand over of concrete
- Penalty clause if exceed this

Emissions Consent

- Environmentally sensitive area
- Temperature inversions
- Needed a guarantee of 100mg/m³
- Modelling based on 20 metre stack
- CONSEQUENCE: 20m stack is required
Visual Impact

Left: View from Kopu bridge

Right: View from road

20m Stack: Knock-on Effects

Stack costs only a bit more, but its above 15m so:

- It’s a “Non-Standard” activity
- Needs Building Consent
- More visual impact
- Need neighbours sign-off
- Delays to project
- Pushes into winter
- Civil work is delayed by “weather”
- Project completion delayed 3 months

Result: Approx $600k extra gas costs
Air Discharge: Warning!

We recommend the following process:

- Select supplier / equipment
- Then do discharge modelling based on:
  - Actual PM10 emissions (less than 100%)
  - Actual exit velocity, with exit cone
  - Actual number of stacks
  - Actual flue gas temp (affects buoyancy)
- All these factors will improve the outcome of the modelling

Result: Delays can be avoided

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Room for Improvement?

- Others were offering water tube boiler
- We offered 2 x fire tubes
  - We have 2 x 5MW: Can clean tubes without disrupting production
- More thermal mass
Learnings so far

- Do air discharge modelling based on equipment
- If winter, use pre-cast pits or a platform
- Offer water tube boilers

Burner Design

- Secondary Combustion Chamber or After Burner
- Temperature Sensors
- Refractory Lining
- Primary Combustion Chamber
- Understoked Fuel Pile
- Fuel Infeed
- Rotary Valve
- Horizontal Stoker
- Vertical Stoker
- Air Jacket
- Fresh Air Intake
- Hot Gas Outlet
- Modulating Dampers
- Combustion Air Fan
Low Emissions: How?

- 100 air nozzles
- Cyclonic motion
- Secondary chamber
- Baffle
- Heat X is separate

Cyclonic motion ensures residence time

Left: View into primary chamber. Notice the sideways motion of the fuel particles.
More angled inlet nozzles give “Swirl” and further increase residence time

Un-dried Green Sawdust: How?

Conical Roof

Lots of refractory ➔ radiant heat
20:1 Turn-down Ratio: How?

- Fuel bed is separate to the heat exchanging surface
- Stopping the air gives “instant” turn-down
- Large volume of fuel is still in chamber, pre-dried
- Heat from refractory enables rapid response

Left: View of refractory & pile when turned down

Value of High Turn-down Capability

- Able to slumber (versus “tick-over”)
- Rapid response
- Fuel can be preserved at the end of weekend, or during a change-over
- Bark is $30/T ex mill
- No need for heat dump

Left: View of refractory & pile when turned down
Fuel Flexibility

- Produces MCR on sawdust at 130% m.c. (56%)
- 93% of MCR at 145% (58%)
- Can blend a bit of shavings if sawdust very wet
- No drying loop, so less fire risk
- Can also handle bark and chip
- Can burn lowest value wood fibre

Right: Collecting sawdust samples. In the background is the coal reception bunker.

Progress at Day 21
Future Capacity

- Economisers can be easily retrofitted
- Will add over 1MW
- Total 11MW+

Right: Blocked port at boiler exit to allow easy diversion of flue gases through a retrofitted economiser

Summary: R2R

Certain features optimise the value of residues by
1. Minimising total cost of converting waste to energy (elec etc)
2. Enabling “value optimisation” i.e. burn lowest value fuel
3. Preserving fuel for off-site sale ($20-60/tonne)

But most importantly, if burning FF’s – Get on with it !!!
Questions…?