Snapshot report

AUSTRALIAN MEAT PROCESSOR CORPORATION

Biomass Energy

Multi-Fuel Biomass Boiler Pilot

Project code
2021-1211

Prepared by
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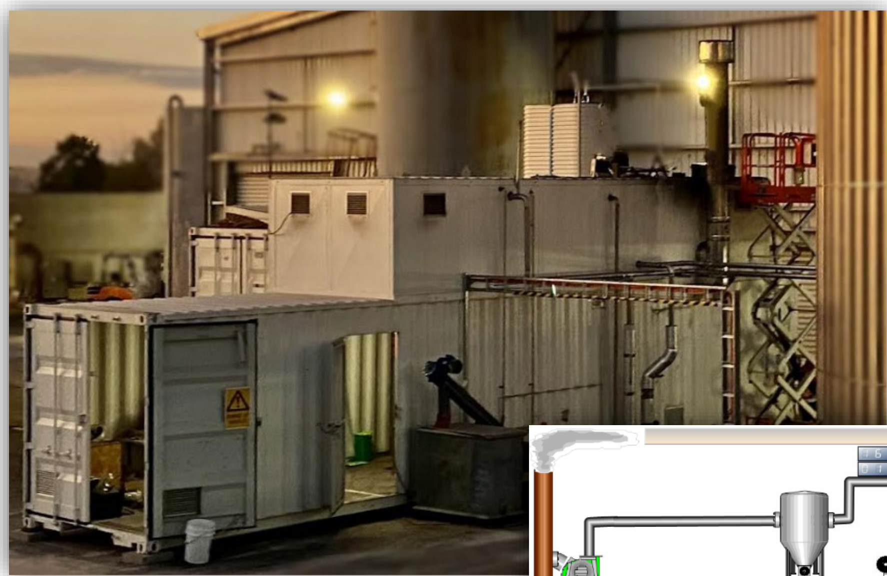
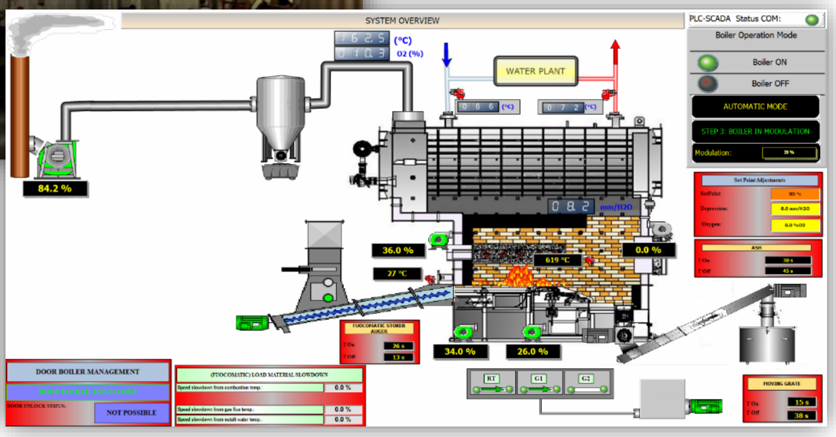
Date submitted
30/08/2024





Project description

A containerised biomass boiler (523 kWt) was run on:

- 100% paunch air dried for 6 weeks or more; free issue from RMP,
- paunch / woodchip blends; 80% / 20% at $1.24 / gigajoule (GJ) ; 50% / 50% at $3.10 / GJ and 20% / 80% at $4.95 / GJ,
- waste nut shells from walnut manufacturing; delivery cost only of $2.63 / GJ,
- paunch / nut shells / woodchips blends,
- 100% woodchip; byproduct of saw milling operations; $6.32 / GJ (supply and delivery, based on $28.05 / m^3), which **is considerably lower than current LPG costs (~$40/GJ), natural gas (~$20 to 30/GJ) and coal (~$12 to 16 / GJ).**.

This project was a true example of industrial ecology / circular economy where organics produced by the process plant from local industries were utilised to generate thermal energy.

This project specifically addressed the energy trilemma by showing how to:

(1) Reduce GHG emissions by >97% by replacing fossil fuels with biomass (no CO2 emissions associated with biogenic materials, refer below),

(2) Reduce energy costs (refer results above)

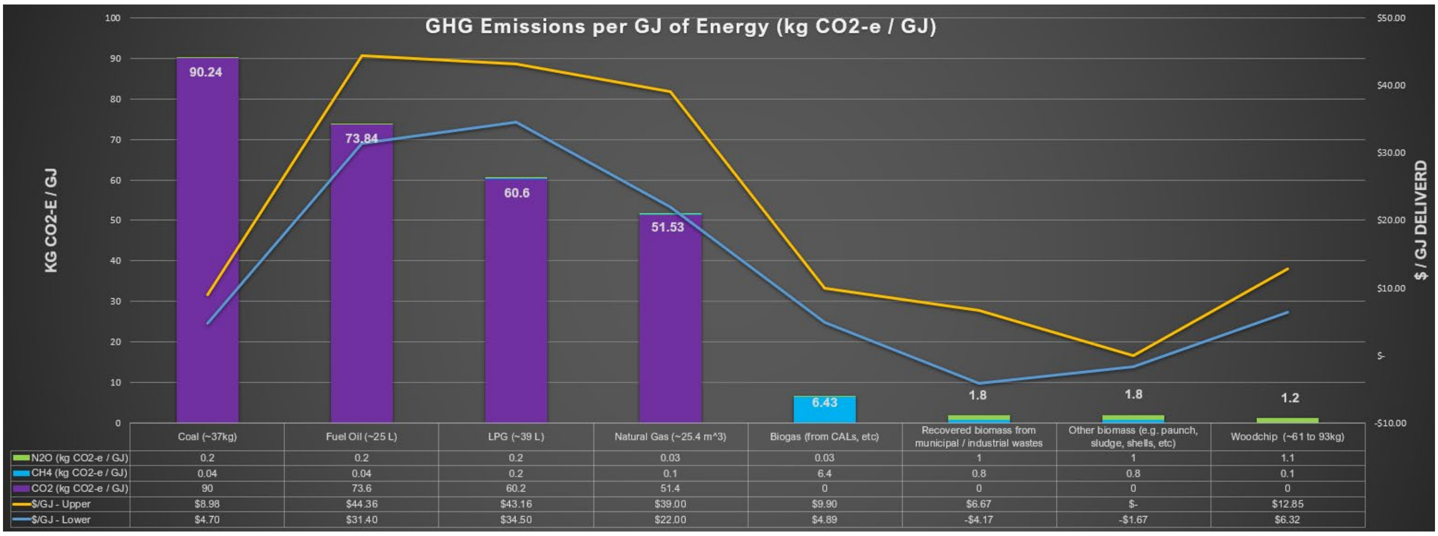
(3) Increased energy resilience by using materials sourced on-site or from local industries (all <47km).

Note: whilst this boiler design is able to generate medium pressure steam, for ease of approvals the system was derated to generate 95 Deg C hot water (i.e. suitable for use as sterilization water) so as to avoid the need for pressure vessel design verification and registration.

Project content

A detailed summary of the fuel specification from the vendor compared to the fuels trialled. Taking paunch as an example, the ash content exceeded the vendor recommendation however did not impact the operability of the system (with the obvious impact that the bottom ash and fly ash collection hoppers were emptied ~11 times more often compared to woodchip, and a high particulates emissions was measured hence an industrial scale system may require additional particulates removal). Using a high ash fuel such as paunch may increase particulates which would require further attention during consideration of dust removal technologies to meet statutory requirements (e.g. multi-cyclones, bag houses, electrostatic precipitators, etc).

Assay	Vendor Specification for Fuel	Walnut	Paunch (6 weeks air dried)	Air dried Woodchip (NSW)	Walnut-Paunch Mixture to match vendor CV @ high level	Walnut-Paunch Mixture to match vendor CV @ low level
Net CV (LHV ar)	11 MJ/kg or higher. Ideally 13 to 16 MJ/kg	19.0	11.3	Calculated at 13.45 MJ/kg as received	16.0 achieved with 61% walnut and 39% paunch	13.0 achieved with 22.1% walnut and 77.9% paunch
Moisture	35% (up to 45%)	7.5%	37.6%	31.63%	19.2%	30.95%
Ash	~7%	1.0%	11.1%	~0.9% to 1.37%	4.94%	8.87% (slightly above vendor threshold)
Fuel density	230 - 400 kg/m^3	251	440	330	325	398
Particle size	30mm (up to 50mm manageable)	~<45mm	<30mm	~<50mm (may be spearing through screen)	~<45mm	~<45mm
$ /GJ LHV		$2.63/GJ (transport only)	$0.00 (available at plant)	$6.32GJ	$1.60/GJ	$0.58/GJ



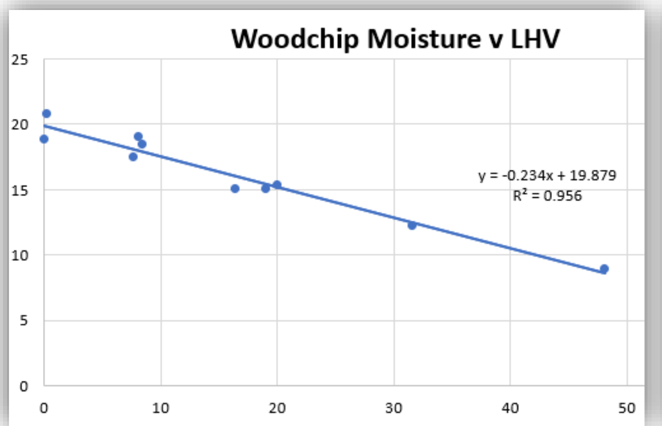
	Coal (~37kg)	Fuel Oil (~25 L)	LPG (~39 L)	Natural Gas (~25.4 m^3)	Biogas (from CALs, etc)	Recovered biomass from municipal / industrial wastes	Other biomass (e.g. paunch, sludge, shells, etc)	Woodchip (~61 to 93kg)
N2O (kg CO2-e / GJ)	0.2	0.2	0.2	0.03	0.03	1	1	1.1
CH4 (kg CO2-e / GJ)	0.04	0.04	0.2	0.1	6.4	0.8	0.8	0.1
CO2 (kg CO2-e / GJ)	90	73.6	60.2	51.4	0	0	0	0
$/GJ - Upper	$8.98	$44.36	$43.16	$39.00	$9.90	$6.67	$-	$12.85
$/GJ - Lower	$4.70	$31.40	$34.50	$22.00	$4.89	-$4.17	-$1.67	$6.32

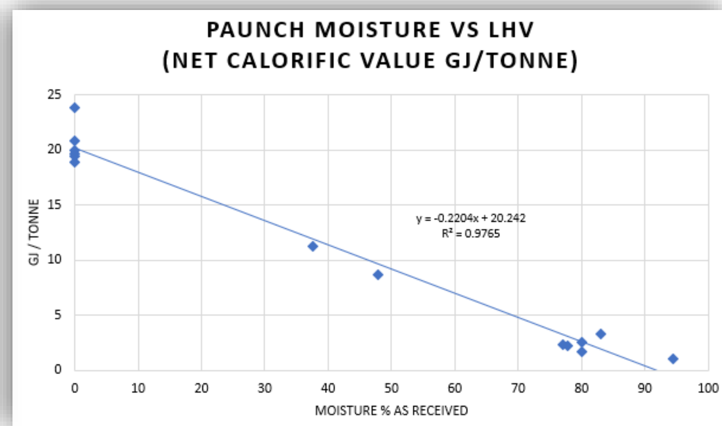
Detailed GHG emissions comparison between common RMP boiler fuels based upon NGERS emissions factors. Energy cost guides "delivered including storage" on a $ per GJ Lower Heating Value (i.e. taking moisture into account) have been estimated based upon H1 2024 east coast Australia data.

Project outcome

A key aim of biomass fuel procurement is to get the lowest moisture fuel with the highest energy density as biomass haulage is generally volume limited as opposed to tonnage limited, with the aim of maximising the GJ lower heating value per m^3 (thereby minimising the $ / GJ lower heating value). The lower heating value (sometimes called heating value as received ("ar")) is the critical parameter as the gross heating value or dry weight heating value does not take into account the moisture content.

Moisture content was confirmed as being strongly correlated ($R^2 > 0.95$) to the lower heating value for both paunch and wood samples considered, hence is a rapid method of estimating energy content of fuels.





Benefit for industry

It is estimated that most RMPs could generate ~20% of their thermal energy needs via the use of air dried paunch and other solid biomass materials generated onsite (paper and cardboard that cannot be recycled; broken pallets; demolition wood; combustible sludges).

Some high level estimated economics for an 11 MW boiler[1] (2 shifts per day, 5 days per week, 50 weeks pa) the fuel cost savings are estimated at:

- $7.3mil pa versus LPG,
- $5.2mil pa versus natural gas and
- $1.4mil versus coal.

Additionally, the value of emissions abatement (assuming $35.05 / t CO2-e)[2] is in the range of $0.6 mil pa for coal to $0.3 mil pa for natural gas. The simple payback period assuming $12.2mil for an 11 MW biomass boiler with 80% of fuel from purchased woodchip and 20% of fuel from on-site sources, is estimated at:

- 1.6 year payback for LPG,
- 2.2 years for natural gas, and
- 5.8 years for coal.

Some additional advantages not included in the above economics:

- Reduced paunch / waste haulage costs,
- Reduced landfilling / waste management costs,
- Reduced greenhouse gas emissions (Scope 3) associated with reduced landfilling of organics.
- Compared to coal, towards 90% or more reduced ash due to the very low ash content of woodchip (<1% w/w).

Where a RMP is in an urban area and/or does not have suitable area for a paunch drying pad, then biomass drying systems are available that utilise flue gas heat / excess heat.

Hence, assuming that 80% of thermal energy is procured as woodchip at $6.32 / GJ, then $141 mil per annum could be saved in fossil fuel costs[3], with a further 353,263 t CO_2-e pa[4] equating to ~$12 mil in revenue via Emissions Reduction Fund projects / avoided future emissions costs assuming $35.05 / t CO2-e[5].

[1] This sized boiler supports a RMP of approx. 880 – 1100 head per day; ~66,000 – 82,500 HSCW pa.
[2] ACCUs.com.au, accessed 29th August 2024.
[3] AMPC Environmental Report FY21/22; Livestock Products, Australia methodology, March 2024 | Australian Bureau of Statistics (abs.gov.au).
[4] National Greenhouse Emissions Reporting Scheme, Measurement Determination, https://www.legislation.gov.au/F2008L02309/2022-07-01/text.
[5] ACCUs.com.au, accessed 29th August 2024.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