Transitioning to a low emission business by using biomass fuel

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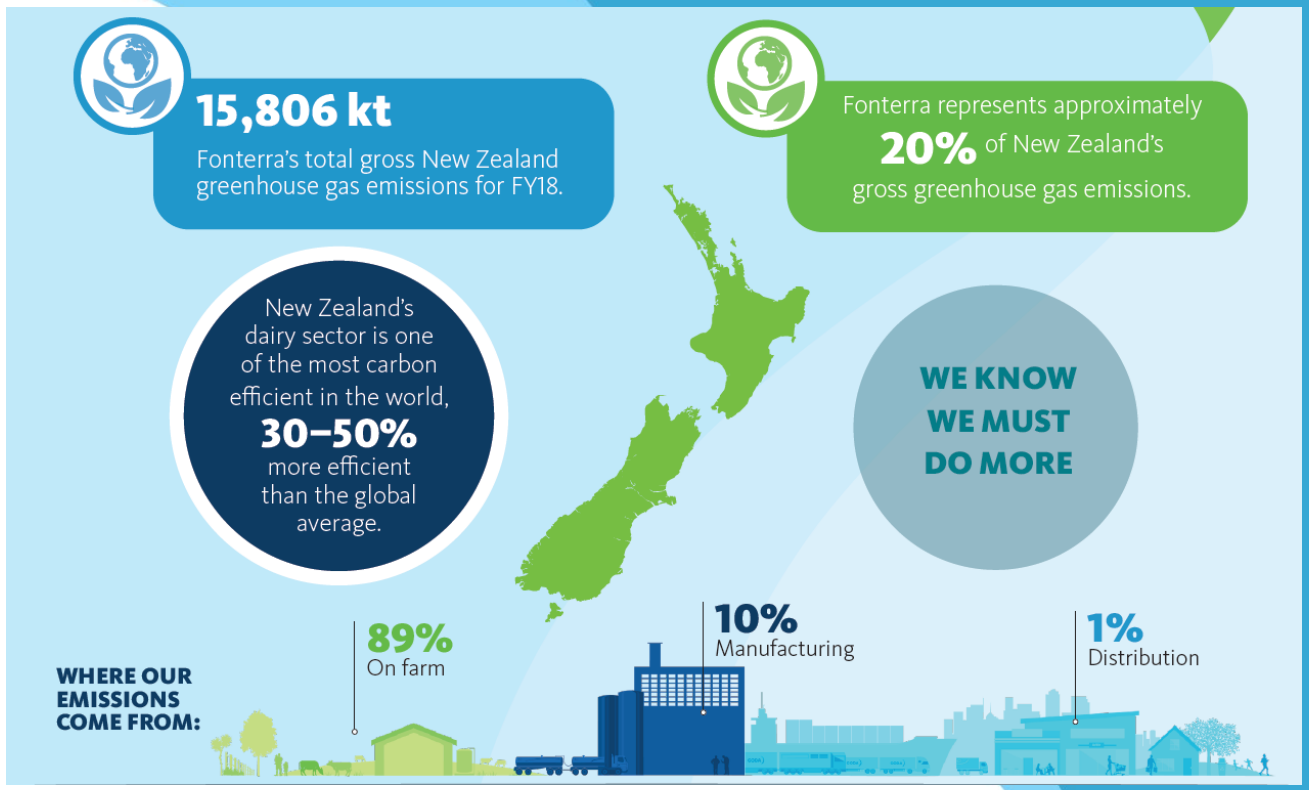


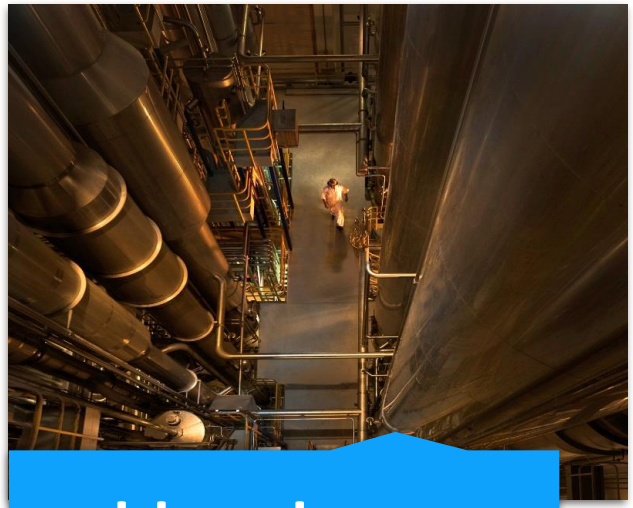
Fonterra Manufacturing Carbon Emissions Overview

~ 1,686 kT CO_2-e/annum

Fonterra's Carbon Reduction Commitments

- **30%** reduction in absolute emissions by **2030** (FY18 baseline)
- No new coal boilers to be installed
- Prioritise the phase out of coal use by **2037**
- **Net Zero** emissions by **2050,** on the way to using **100% renewable energy**

Overview of our 30% by 2030 Carbon Reduction Plan

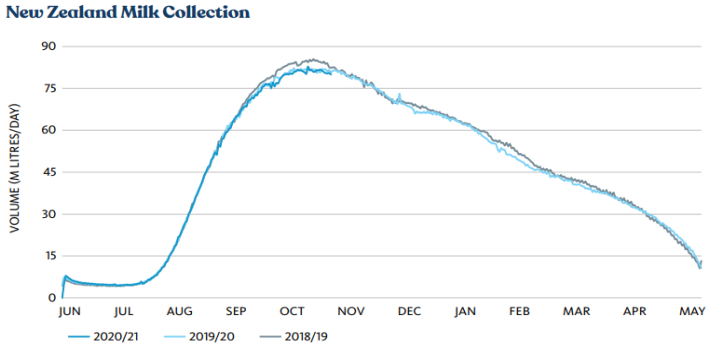


Use Less

Emit Less

Key Considerations:

- The ability to process all of our farmer's milk;
- Ensuring the business remains economically viable in a globally competitive market;
- Long term security of supply of alternative energy sources;
- The impact of ongoing operational costs of using alternative energy sources; and
- Sustainability considerations.



Fonterra
Dairy for life

At Te Awamutu, we're taking another step forward with our commitment to renewable energy. The site will be moving away from coal to wood pellets.

Reducing

When the full conversion is complete it will reduce carbon emissions by around **84,000 tonnes** of CO_2 per year. That's equivalent to taking **32,000** cars off the road.

Reduction Goal

This conversion equates to a **75%** carbon emission reduction at site and will contribute to **16%** of Fonterra's 2030 carbon reduction goal.

Reducing

It will reduce our coal usage in New Zealand by **10%**. At Te Awamutu we burnt **42,000 tonnes** of coal last season and we expect to burn **50,000 tonnes** of wood pellets once we have shifted away from coal.

Partnership

We know we can't do it alone, that's why our partnership with Nature's Flame our **sustainable wood pellet** supplier is so important.

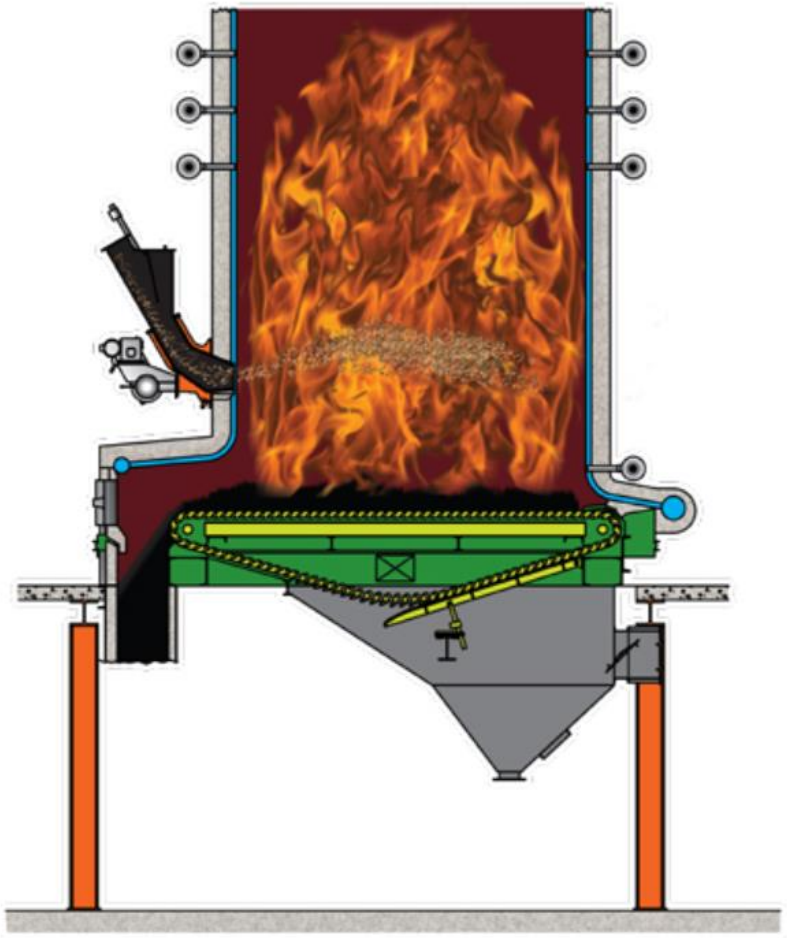
Sustainable

Nature's Flame wood pellets are truly renewable and sustainable, made from wood waste, shavings, sawdust and off-cuts. They also use **renewable geothermal energy** to make these wood pellets.

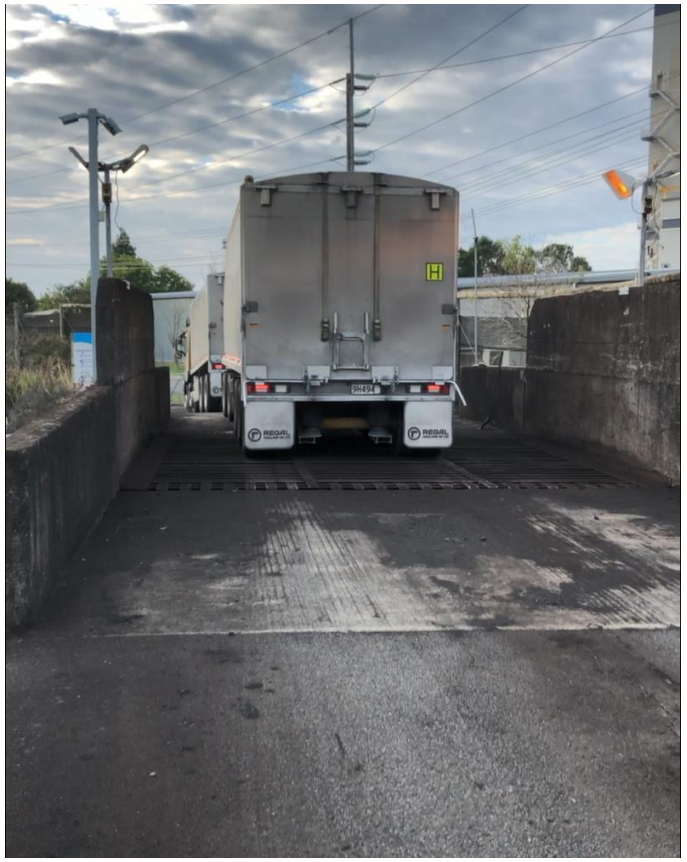
Te Awamutu site

- Site located at the Te Awamutu town, Waikato
- ~3 million litres milk over the peak
- Milk powder (skim, butter and WMP), butter and AMF
- Coal + gas boilers
- 80% electricity steam turbine generated

- Coal Boiler – 43 MW, 40 barg, superheated steam
  - 42,000 tonnes of coal per year to process milk
  - B&W Towerpak design
  - Detroit Rotograte Stoker



Te Awamutu B&W boiler – Fuel Reception



Te Awamutu B&W boiler – Boiler plant

- 1 – Fuel conveyor
- 2 – cross over conveyor
- 3 – Fuel day hopper
- 4 – Boiler
- 5 – Baghouses
- 6 – duct to ID fan
- 7 – fly ash bin

What's Wood Pellet?

- Made by Nature's Flame at Taupo
- Renewable biomass fuel
- Wood waste - saw dust and shavings
- Hard and rigid but hydrophilic

	Coal	Wood Pellet
Gross CV (MJ/kG)	20	18.5
Moisture (%wt)	30	8
Ash (%wt)	6 – 10%	<1
Size	Variable and high in fines	Consistent – low in fines
Sulphur dioxide (ppm)	120	low

Start with a desk top analysis

- OEM – Windsor Engineering
- Key areas to assess
  - Feeders
  - Grate
  - Fans
  - Steam capacity, temperature
  - Flue gas and emission
  - Fuel reception
  - Ash collection
  - dust

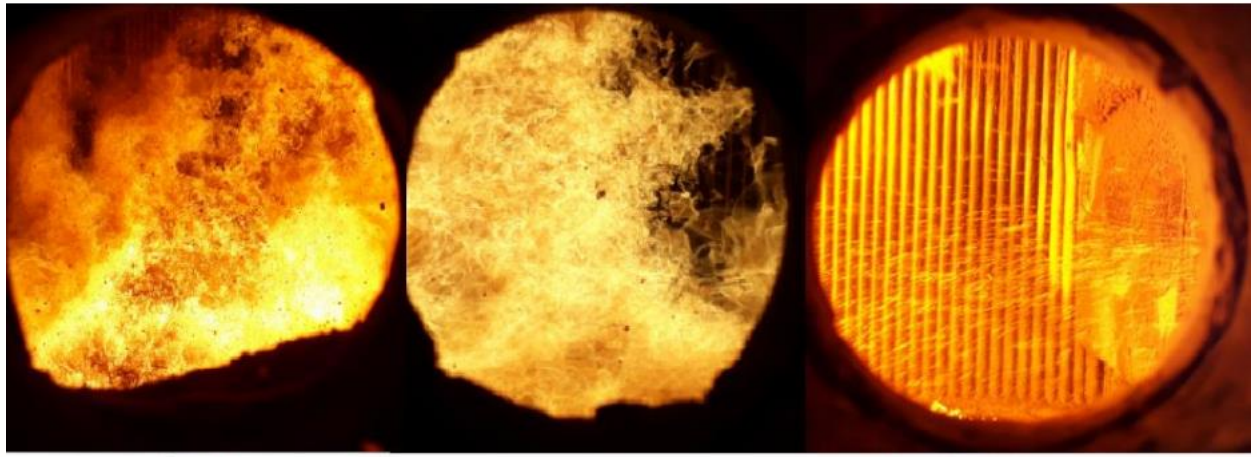
- Study shows:
  - 80% MCR
  - Risk of potential baghouses fire and mitigation approach
  - Do a combustion trial next

Followed by trial - Conveyor Trial

Combustion Trial – Findings and Constraint

- 4 days combustion trial
- Fuel hopper inventory management – logistics
- Throw pellet evenly across the beds
- Boiler tuning

- Combustion more consistent than coal
- Thin layer of ash on grate
- More overfire air



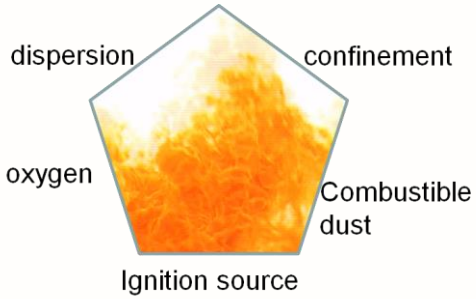
Rear of Grate | Centre of Grate | Front of Grate

Economiser Ash | Baghouse Ash

Combustion Trial – Findings and Constraint

- Dry fuel
- Dust at areas

Scope for Conversion

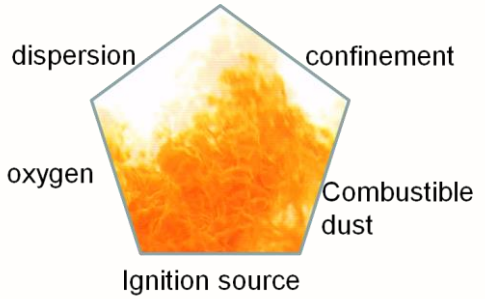


- Fuel reception – weatherproof
- Fuel handling – capacity, fire & explosion mitigation
- Fuel handling – review and update EEHA
- Increase fan capacity and more overfire air
- Boiler tuning
- Consent
- Boiler verification
- Emission controls – future proof for air discharge requirement in 10 years time
- Long term fuel supply – security supply
- 3rd party fuel storage

Conversion – Fuel Reception

Conversion – fuel handling

- Spill mitigation along the conveyor and a new conveyor belt
- Cross over conveyor to En-masse conveyor
- Sealed day hopper with dust extraction
  - Explosion panels
- Fire suppression
- Smoulder detection



Conversion – fuel handling

- Conveyors to feeders

Conversion – Boiler Combustion

- Overall combustion was similar to the trial time
- Load ramp up similar to coal
- 100% MCR – 55 t/h steam
- Thrower automated so fuel distributed evenly
- Boiler tuning
  - Boiler efficiency improved
  - Fuel to energy output ratio

Conversion – Boiler Combustion

- Extra overfire air header ducts and nozzles installed to the boiler
- Cut back under grate air
- Each overfire air duct has its individual damper and control
- Tuning and setting the air flow rate at various load
- ID fan output remains the same

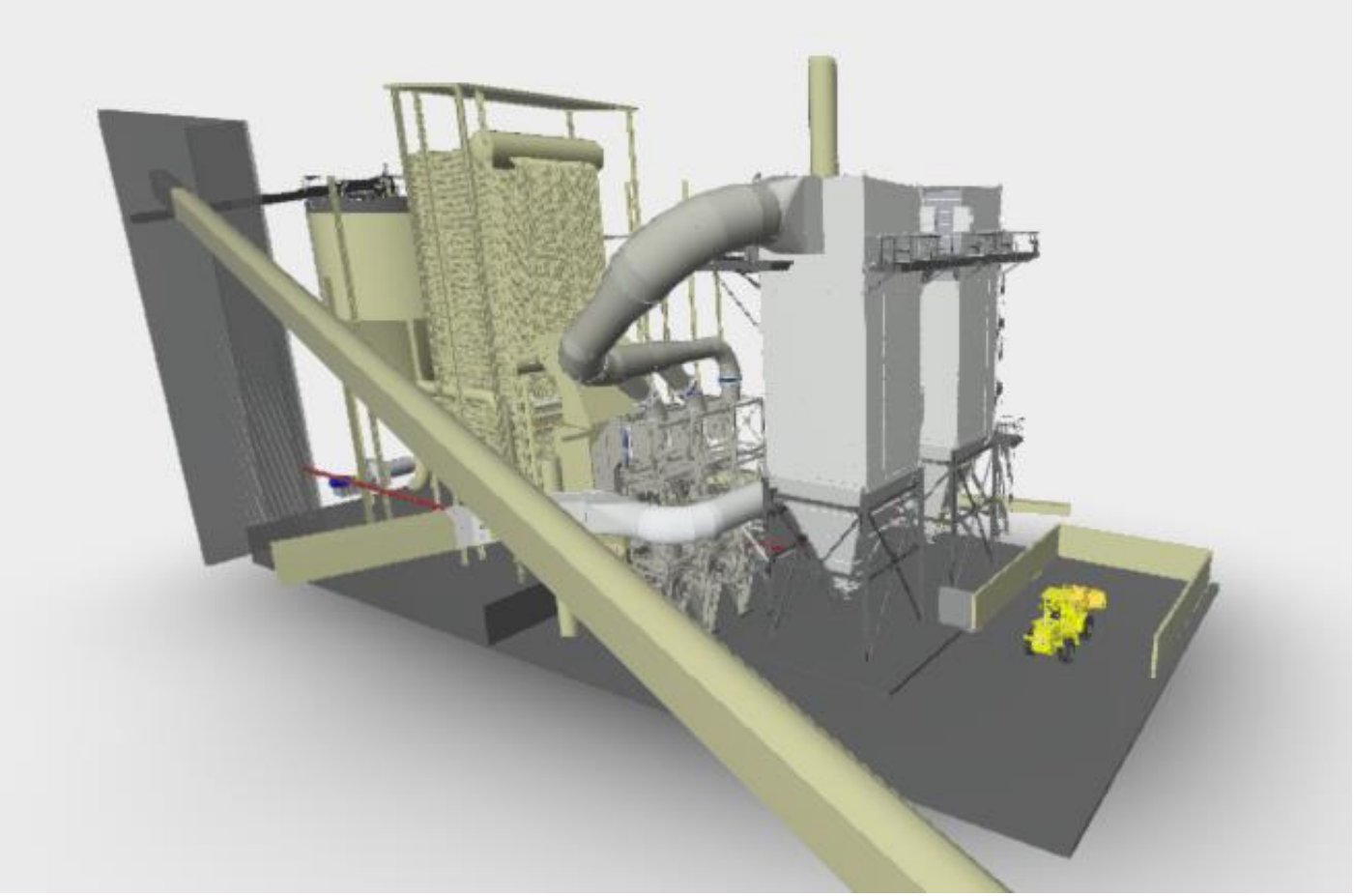
Conversion – Boiler Combustion

- Crushed refractory used to provide heat shield to the grate
- Grate ran more often than expected – 10 min per hour at 2% speed – 60 hours to run off all grate
- Manual top up – 10 L/hr
- Longer and more tuning to minimise the refractory addition but maintain temperatures to steam, grate and baghouse inlet

Conversion – Emission Control Equipment

Conversion – Fly ash collection

Conversion – Overview and Timeline



- Trial – March 2019
- Construction – Feb - Aug 2020
- Commissioning – Aug/Sep 2020

The People

The team that built it

Despite COVID19 the team had the project ready for commissioning in August

Equipment delays were mitigated by the project team

Local construction utilised local bubbles

The People

Commissioning

The People

The team that run it

Experienced boiler team

Other live plant during construction and commissioning

Whole team involvement and operational readiness

Lesson learnt #1 – Understand your asset condition

Identified additional items

- Economiser
- Feed grizzly hopper
- Grate

Lesson learnt #2 – Plan trial for longer

- Weeks rather than days
- Engineering solution to be implemented for refractory addition
- Asset condition understood and maintenance

Lesson learnt #3 – dust mitigation

- New area of dust accumulation
- House keeping or engineering solution to mitigate/eliminate

Summary: Practical Realities of Converting Coal Boilers to Renewable Energy

- Coal boiler can be converted to burn wood pellet
- Boiler can still achieve 100% MCR and improve efficiency
- Plan your conversion with steps and prepare for continuous improvement
- Fully assess all equipment in the boiler system and factor in upgrades to project timeline and costings
- Assess dust from a fire/explosion and health and safety perspective for dry fuel
- Bring the people with you in this journey as we can't achieve it without a good team work

Celebrate the carbon reduction

Nature’s Flame

Windsor Engineering

EECA

Stewart & Cavalier Engineering

Curles Electrical

Kelvin Yates Electrical

A-Z Rigging & Scaffolding

and more