nature's flame

Case Study - Rotorua Girls' High School

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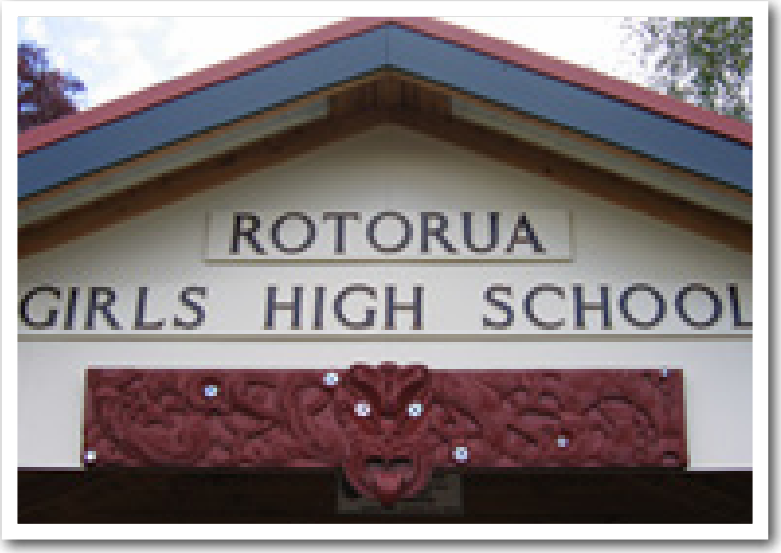
Conversion of a 1 MegaWatt (MW) school boiler from coal to wood pellets.



Rotorua Girls' High School (RGHS) is attended by 1,500 students, housed in numerous single story classrooms with sports facilities and a large events centre. All of this is heated by a single 1970's boiler heating the radiators in the classrooms and other areas.

Project Background

Rotorua is a warm part of New Zealand but the school still requires heating for around 16 weeks annually – around 40% of the school year.

The school is not only concerned about its own impact on the environment, it also sees a role in providing leadership in environmental issues to its students, and to the wider community.

Historically many schools have used coal boilers, largely for lower running costs, but now particulate and carbon emissions from coal boilers are being targeted for reduction.

The options for RGHS were to:

1. replace the entire heating system with some form of electric heating, which would have incurred a high capital cost and a major additional load on the local electricity network
2. replace the boiler with another type, possibly a gas boiler or new pellet boiler, which would still have incurred a significant capital cost and would still have produced carbon dioxide in the case of gas
3. or to convert the existing boiler to use another fuel.

The school chose to convert their boiler.

As wood pellets are essentially another form of solid fuel it was possible to convert the existing coal boiler to burn pellets at a minimal capital cost, whilst significantly reducing its environmental impact.

A further benefit is that pellet boilers produce much less ash than coal boilers which had to be cleaned daily and the accumulated ash taken to a landfill site. Wood pellet boilers need cleaning less often and the ash can be used as a fertilizer for the schools gardens.

Background stats

- **Existing coal boiler converted to run on wood pellets for only $9,500**
- **No need to purchase new boiler or entirely new heating system**
- **Carbon dioxide emissions reduced by 100%**
- **Ash reduced by 90%, saving on maintenance**
- **Sulphur dioxide emissions reduced by 100%**

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The Boiler Conversion

Coal and wood pellets are both 'solid fuel' and therefore the boiler already used two critical components needed for wood pellets:

1. The Fuel storage, often called a bunker or hopper. This is necessary as solid fuel needs to stored on site as it cannot be reticulated like electricity or gas.
2. The Fuel delivery mechanism designed to move the solid fuel automatically from the fuel storage to the boiler. A rotating auger is used, otherwise known as an auto-stoker. The rate of fuel delivery is controlled by the speed of the auger.

Solid fuel boilers tend to be bigger than gas or oil boilers as more space is needed for combustion, so this need is also met by existing coal boilers.

The coal boiler at RGHS was manufactured by Taymac and installed in the 1970s. It produces 1MegaWatt of heat, equivalent to 1000 1kW bar fires, or approximately 100 log burners burning at maximum output.

The original manufacturer was sold to Vortex engineering who is a major supplier of industrial scale energy systems in New Zealand. They provided advice on the conversion of this boiler.

Converting this boiler simply required the installation of two additional variable speed motor drives to the fuel feed auger, and fan and a fire safety 'anti-burnback' system to bring the installation up to modern standards.

Anti-burnback

As the firebox of the boiler is directly connected to the fuel bunker there is a very small risk in some circumstances that the fire in the boiler will burn back towards the bunker.

In some solid-fuel boilers this is avoided by using an intermediate hopper and an additional auger which breaks the direct physical path between the boiler and fuel bunker.

The RGHS boiler doesn't have intermediate hoppers and so a fail-safe electronic system was installed which extinguishes the fire in the fuel feed mechanism if excessive heat is detected.

Fuel and air supply

The wood pellets have a different energy density to coal meaning a greater volume have to be supplied to provide the same amount of heat, therefore the auger has to turn at a higher speed.

Once the fuel supply rate had been set up the fan is adjusted to optimize the fuel-air mix, increasing efficiency and reducing emissions.

Two new variable speed drives were fitted (right)

The school boiler house with large doors for delivery of fuel by truck

Operated by Charlie, the school caretaker.

An audit of the boiler system identified the key issues of fuel and air supply rates and fire safety

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