ASSESSING THE FEASIBILITY OF INSTALLING A WOOD-FIRED BOILER AT THE TATUA CO-OPERATIVE DAIRY COMPANY

A summary of the report into the feasibility of installing a wood-fired boiler.

1 Introduction

Wood fuels are a cost-effective and sustainable source of energy. Wood-fired boilers are now common in sawmills and wood processing plants, where wood residue is readily available on-site.

However, at present no New Zealand dairy factories are using wood-fired boilers.

This paper looks at the feasibility of installing a wood-fired boiler to produce steam at the Tatua Co-operative Dairy Company. This would involve buying wood residues, having it delivered to the Tatua factory and storing it on-site.

It is based on an investigation carried out for Tatua by Auckland company Living Energy. The investigation found that a medium-sized wood-fired boiler, producing 11 tonnes of steam an hour, could supply 97% of the steam the Tatua factory uses each year. The rest would have to be supplied by one of its existing gas-fired boilers.

The wood-fired boiler would cost $3.8 million to buy and install, and would have a simple payback of about five years.

The factory would need space for four 350m³ silos to store the wood residue, a drive-through receiving building for the delivery trucks and a 15 metre-long tipping floor.

The investigation did not look at the long-term availability of wood fuel nor where it could be bought most cheaply. It recommended looking at these two things as the next stage of the process.

According to Tatua's site engineer, Jack van Lankveld, finding a reasonably-priced, long-term source of wood residue is vital if the project is to go ahead.

"If we're going to spend this much money on a new boiler we need to be guaranteed a 10-year supply of wood residue."

2 The company

Tatua Co-operative Dairy Company Ltd was formed in 1914 by a group of 10 farmers to make cheddar cheese.

It now has over 116 farmer shareholders and produces a wide range of protein and cream products, including an aerosol cream range sold under the Dairy Whip brand, and a range of long-life food and dairy products sold in sachets, pouches and bags.

Tatua is the only dairy co-operative that has never been part of an amalgamation, and it has a reputation for independence and innovation.

3 Energy Use

Like all dairy factories, Tatua uses a lot of energy, particularly natural gas. Its factory at Tatuanui, 35km east of Hamilton, uses about 240,000 GJ of natural gas every year. Of that, 65% is used to generate the steam that is needed for processing food products and washing down equipment.

The company currently has two boilers, one of which can produce 17 tonnes of steam/hour and the other 12 tonnes of steam/hour. The smaller boiler is only used when the larger one is closed down for maintenance.

Both are run exclusively on natural gas.

The rising price of natural gas means that Tatua is interested in finding a lower-priced source of energy to run its boilers. According to Mr van Lankveld, the company would also like to reduce its dependence on natural gas, and find a more environmentally-friendly source of energy.

“With gas there is no reserve availability onsite,” he says. “If the supply went down we would have to stop operating. There’s also the whole carbon issue to think about – this is something that is becoming increasingly important.”

4 Using wood fuel

One possible alternative source of energy is wood residue. Under the terms of the Kyoto Protocol wood is considered to be carbon neutral and, unlike natural gas, it is a sustainable form of energy.

At current prices, energy obtained from wood residue is about half the price of natural gas.

According to Rob Mallinson of Living Energy, using a sustainable source of energy such as wood residue offers commercial advantages as well.

"It reduces your environmental footprint, and this is becoming increasingly important for consumers, especially in Europe," he says. "There's been a shift in public opinion – people want to buy produce that has been made with a renewable resource."

The Tatua factory is well-located to use wood residue. In particular, Fletcher Building's recent decision not to rebuild its Laminex MDF plant in Taupo means there are currently large quantities of unused wood residue available in the area.

But while wood-fired boilers are now commonly used in the New Zealand forestry industry, none have yet been installed in a dairy factory.

Using funding provided under the new bioenergy initiative being coordinated by EECA, the company commissioned Living Energy NZ to look at the feasibility of installing a wood-fired boiler at the Tatua factory.

5 The study

The feasibility study looked at several different issues. These included:

- how much steam the factory uses each year
- how much the demand fluctuates
- what size boiler would best meet the factory's needs
- how long it would take to achieve simple pay back
- practical considerations such as how wood residue could be delivered and stored.

In addition, the study looked briefly at the feasibility of using a wood-fired boiler to co-generate electricity.

6 Steam use and fluctuation

A wood-fired boiler is only viable if it can provide steam in the quantities and at the times required. Wood-fired boilers are less able to cope with big fluctuations in demand than gas-fired ones because they are slower to turn up and down.

The first step was to work out how much steam the factory uses each year, and how much the demand fluctuates.

The study found that steam-use at the factory varies according to the season. It peaks during the spring and summer, when milk volumes are high, and falls to almost nothing for a couple of weeks during the winter. The highest peak load of 14.8 tonnes of steam an hour occurred on just one day during the year.

Altogether, the factory uses about 50,000 tonnes of steam a year, or an average of 6 tonnes of steam every hour. For most of the year, steam use ranges between 5 and 10 tonnes of steam an hour. The demand for steam fluctuates between 5 and 12 tonnes and hour during a 24-hour period.

The study concluded that a wood-fired boiler would be able to meet the factory's steam needs.

7 What size boiler

The next step was to assess the suitability of the three different sized boilers. They were:

- a small boiler capable of producing 6 tonnes of steam an hour
- a medium-sized boiler with a capacity of 11 tonnes of steam an hour
- a large boiler with a capacity of 16 tonnes of steam an hour.

Of the three, only the large boiler would be able to meet all of the factory's steam needs. The 6-tonne boiler would be able to supply 79% of the steam needed, while the 11-tonne boiler could provide 97%. In both cases, the additional steam would have to be produced by one of the existing gas-fired boilers.

8 Simple Payback

The cost-effectiveness of the boilers depends on a number of factors. These include the cost of buying and installing the boiler, the relative cost of the two sources of energy, and the fixed charges the company pays for gas.

The boilers would cost between $3.1 million to $5.5million to buy and install (see table below). This includes the cost of fuel-storage tanks and drive-through access for delivery trucks.

Because of confidentiality issues it is not possible to say exactly how much Tatua pays for natural gas. The cost of energy from wood residue can also vary, depending on how much the wood residue costs. However, assuming that energy from wood residue is about half the cost of natural gas, a wood-fired boiler would save between $431,000 and $590,000 a year (see table below).

Additional savings would come from a reduction in the fixed gas charges paid by the company. These are charged at a set rate for every GJ of gas that is used. When gas use falls so does the amount paid as a fixed charge. This would save another $161,000 to $263,000 a year (see table below).

Total savings would be between $592,000 and $835,000 per year, and simple pay back would be between 4.7 years and 6.4 years.

Boiler size	**6T/hour**	**11T/hour**	**16T/hour**
Cost to buy and install	$3.1m	$3.8m	$5.5m
Amount of steam produced a year (tonnes)	39,000	48,500	50,000
Annual reduction in natural gas use (GJ)	124,000	153,000	157,500
Cost savings from using a cheaper fuel	$431,000	$548,000	$590,000
Fixed gas price savings	$161,000	$254,000	$263,000
Net annual savings	$592,000	$802,000	$853,000

Simple payback	**5.2 years**	**4.7 years**	**6.4 years**
After-tax payback	**6.3 years**	**6.1 years**	**7.4 years**

Based on these calculations, the study concluded that the 11-tonne boiler would be the most cost-effective. Apart from a few days of very high demand, it could produce more than enough steam to meet the factory's current needs. It would also have the capacity to provide additional steam should the company increase production or add a new line.

9 Co-generation

The study looked at several possibilities for co-generation, using an 11-tonne boiler in conjunction with three different types of generators. They were a back-pressure turbine, a two-stage turbine and a steam engine.

It found that the two-stage turbine would generate the most electricity (more than 4 million kWh/year) but would cost almost twice as much to install ($2.4m).

The simple payback time ranged from 7.9 years and 10 years.

The study concluded that, in the short-term, co-generation was not an economic option.

10 EECA – supporting the use of woody biomass

This resource is one of a number of feasibility projects being publicised under a new forest bioenergy initiative co-ordinated by the Energy Efficiency and Conservation Authority (EECA).

Representing the woody biomass stream of the Government's Forest Industry Development Agenda (FIDA), the initiative is designed to increase renewable energy use, and industry participants' incomes, through the use of wood residue from tree harvesting as well as residue produced from wood processing sites.

Sharing the results of these demonstration projects will help other businesses understand their bioenergy options and increase the utilisation of woody biomass.

This case study is part of a set available to industry. To source the others in the series, or for more information visit www.bioenergy-gateway.org.nz

11 Further information

For more information on the use of wood residue and bioenergy, please contact the Bioenergy Knowledge Centre.

Bioenergy Knowledge Centre

Providing information on the utilisation of wood residue for bioenergy

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