

Wood energy heating and boiler options for Southland schools

Wood energy can be a good choice for schools as it is a renewable energy option with relatively low running costs and is the Ministry of Education's preferred choice in Otago and Southland. The purpose of this document is to inform Board of Trustees of their boiler and fuel options when their existing plant is due for replacement.

Wood energy is a cheaper long-run option, and it is relatively easy to convert to using wood energy if your school has an existing hot water heating system. Wood provides a safe, clean, reliable and economical alternative to other forms of energy. In the past, fuel for heating schools came from non-renewable sources like coal, gas or oil and was used in hot water heating systems. However, energy sources like coal have a much higher rate of particle emissions (particle emissions from wood fuel are between 1/3 and 1/5 of those from coal).

What is wood energy?

Wood energy is generally supplied from forest logs and is known generically as 'woody biomass'. All this fuel at one stage began life in a local forest and is a by-product of forest harvesting or wood processing. Low grade offcuts from logs are stacked and dried for a period before being turned into woodchip. Sawdust from milling is an ideal feedstock for compressing and producing wood pellets. The two most common forms of wood energy for boilers are wood pellets and wood chip.



Opportunities and motivations to switch fuel

Given the relatively cheap cost of coal, in most cases the motivation for schools to switch to wood fuel was primarily related to environmental or regulatory (consenting) constraints or the fact that the coal boiler was aged and close to failure. In air sheds where burning coal is not a permitted activity for environmental reasons, the project economics should be based on a comparison between investment in plant to burn wood and other alternatives to coal, rather than the comparison of wood and coal.

Discharge consent expiry

Some schools have switched to wood fuel because of actual or anticipated difficulties achieving emissions reduction targets or more stringent resource consent requirements. As discharge consents for schools with coal boilers expire, or where the limits are tightened and continuing to burn coal is no longer feasible, converting or switching to wood energy can be economically viable. After coal, wood energy is often the next cheapest alternative, and an effective way of reducing emissions. Environment Canterbury and the Otago Regional Council are requiring emission reductions from schools with coal boilers in order to renew their discharge consents, and Environment Southland have signalled a move in the same direction. If your school has an existing consent to discharge emissions you will not be required to meet any reductions unless you make changes to your boiler or

your consent expires. If your school does not have consent to discharge, you will be required to make any necessary changes within the timeframe provided by Council.

Old or failing boilers

These are boilers which have reached the end of their economic life or have surpassed the end of their economic life but are still in service. Such boilers typically have high operating costs due to the high maintenance required to keep them in service. Although imported wood boilers have a relatively high capital cost, in situations where an existing boiler is coming to the end of its life, fuel switching to wood can be an economic choice when evaluated on a whole-of-life basis. Coal quality is also impacting on boiler life and several school boilers have failed recently as a result of high sulphur coal causing significant damage to boilers.

What are the main considerations?

The main considerations for a school considering wood fuel boilers are outlined below:

Fuel deliveries

If you have an existing coal boiler you will already be familiar with the infrastructure such as augers, bunkers and fuel delivery. A wood boiler is very similar though much cleaner and efficient. Fuel is delivered by truck and stored in a bunker next to the boiler. The number of deliveries per month relates to the size of the storage bunker and heating demand. Fuel can be delivered by tipper, blower or conveyor and careful consideration must be given to the most suitable option and routes for trucks within the school boundaries. The main type of delivery in Southland is by tipping.



Bunker storage

Wood fuel is stored in a bunker and transferred to the boiler using an auger. Woodchip is less energy dense than coal meaning a bunker will need to be filled more regularly. Increasing the storage capacity of the bunker is one solution and in most cases is just a matter of framing up extra height walls. A wood fuel bunker needs to be dry as moisture will reduce the energy content of the fuel. For schools that do not have existing coal infrastructure, a storage bunker can usually be built onsite or can occupy a space next to the boiler house.

Space requirements

In comparison to diesel, LPG or electric boilers, wood fuel boilers are much bulkier. Space is required for the boiler, bunker, deliveries and hot water tanks (accumulators).

Ash disposal

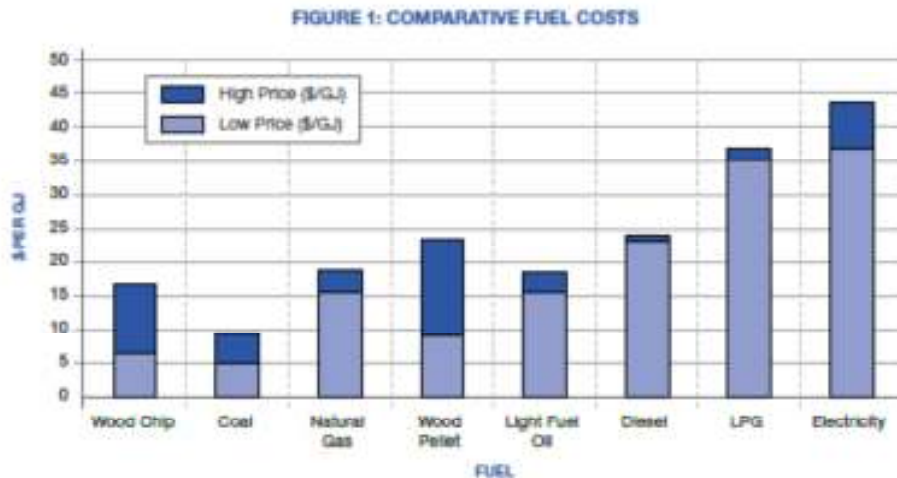
The Wood-fuel Classification Guidelines sets out the fuel properties for woodchip and pellets. The ash and sulphur content for both fuels is less than 1% and 0.05% respectively. In comparison, Kai Point coal has a specification of 4.7% and 1.5% ash and sulphur respectively. Wood-fuel ash can be added to the compost, spread on plants or disposed into the bin and is safe for adding to the vegetable garden.

Who else is using wood boilers in Southland?

The use of wood boilers is steadily increasing in Southland and several schools have already made this move. Recent schools to convert to wood boilers are Donovan and Takitimu Primary (woodchip), Waihopai and West Gore Primary (woodchip), New River Primary (pellets) and Menzies College (pellets). Many businesses have also converted including Splash Palace, Slinkskins and McCallum's Dry-cleaning. Sometimes the easiest way to get a better understanding of what's involved is to visit one of the sites. We would be happy to arrange this so please get in touch with your request.

The cost of wood energy

One of the major hurdles that can slow or prevent the use of wood energy is the relatively cheap cost of coal, against which renewable fuel sources struggle to compete. This is shown in Figure 1 below.



(Pricing information is based on EECA monitoring and the Ministry of Economic Development's New Zealand Energy Data File 2009 Commercial Prices)

However, taking into account the full lifecycle cost of a boiler shows the true cost. In 2013, the Ministry of Education commissioned an energy options report for Southland schools. The report summary is outlined below and a full copy is available on request. The general conclusion was that over a 25 year period the woodchip boiler option has the lowest life cycle cost for all three sizes of school.

Small sized schools

For a typical small sized school, the LPG and diesel boiler systems are worth considering as a replacement for an existing boiler system. These boilers have a very low initial investment cost, are low maintenance, clean burning with only a small plant space required. The coal boiler only starts to become cost effective towards the end of its economic life and with the uncertainties around coal supply and clean air regulations coal would likely not be a suitable solution. The wood chip boiler becomes the lowest overall after year 15 when there should be a further 10 years economic life left depending of servicing etc. If sufficient funds are available, a sustainable

energy source is preferred and there is sufficient space for the boiler, buffer vessel and fuel store, the wood boiler solution is worth considering.

Medium sized schools

For a typical medium sized school, the LPG and diesel boiler systems are worth considering as a temporary replacement for an existing boiler system in an emergency situation where an existing boiler has failed or where funding is limited. The coal boiler becomes the cheapest option after year 7 but increases again at year 19 due to expected replacement and with the uncertainties around coal supply and clean air regulations coal would likely not be a suitable solution. The wood chip boiler becomes the lowest overall after year 19 when there should be a further 6 years economic life left depending on servicing etc. If sufficient funds are available, a sustainable energy source is preferred and there is sufficient space for the boiler, buffer vessel and fuel store, the wood chip boiler solution is worth considering and is the Ministry of Education's preferred choice in Otago and Southland.

Large sized schools

For a typical large sized school, the wood chip boiler has the lowest life cycle cost. If a long term sustainable energy source is preferred and there is plenty of space for the boiler, buffer and fuel store, the wood boiler solution is worth considering. The coal boiler has the next best overall life cycle costs and a reasonable initial investment cost but with the uncertainties around coal supply and clean air regulations coal may not be the best long term solution.

A cheaper initial investment cost could be achieved if a dual wood and a diesel boiler system was installed. This would also provide a backup which is beneficial especially for the larger schools. The diesel boiler should not need to operate very often except on very cold winter's days and only for a short period this helps reduce the annual fuel costs and the initial investment costs.

The LPG and diesel boiler systems are worth considering as these boilers have a low initial investment cost. Both options return reasonable life cycle costs for up to year 10 but coal, wood chip and wood/diesel all have lower life cycle costs so are the preferred option for the Ministry of Education in Otago and Southland.

Undertaking an energy options report

The first step to take if you're considering a boiler upgrade is to commission an energy options report. This report will provide Board members and Ministry with the information for making an informed decision. The report will cover the different heating options for your school and determine which is most suitable. The key components of the report are outlined:

Understanding the current costs and energy use

This will assess the current boiler costs and quantify energy use. Boiler costs will include the monthly cost of fuel, maintenance and servicing, staffing, ash removal and disposal (if coal) and other costs such as LPG bottle rental fees. Energy use will be quantified and a unit cost developed (in \$/kWh) for comparison against other fuels.

Confirming boiler capacity

The capacity of a boiler is measured in kilowatts (kW) and is a term used to describe a boiler's power or ability to do work. A simple analogy would be filling a bucket with water using a hose. The rate at which the bucket fills relates to the volume of water that can pass through the hose. A large diameter hose will fill the bucket quicker than a smaller one. The volume of water in the bucket is equivalent to the energy consumed (kWh).

A boiler may have been specified correctly when it was first installed but usage patterns may have changed over the life of the boiler. It is not unusual to find boilers that are only operating at a fraction of their boiler capacity

(especially large school boilers). Furthermore, boilers that have too much capacity operate inefficiently, require more maintenance and cost more to purchase so it's important to get this right.

Boiler options

There are likely to be a number of heating options for all schools with the main boilers being electric, LPG, Diesel, Coal or Woodchip. The configuration of your current boiler may also determine the best-fit heating option for your school. A comparison between the heating options will determine:

- Annual fuel operating costs
- Life expectancy
- Operation and maintenance requirements
- Sustainability and carbon emissions
- Boiler emissions and efficiency
- Capital expenditure
- Staffing requirements

Life cycle cost analysis or simple payback?

Investing in large capital intensive plant like boilers is a decision that will set and determine your heating decisions for the next 20+ years. Which boiler option is better? The low capital cost LPG boiler or the much more expensive wood chip boiler?

There are two ways of assessing the options, namely simple payback or life cycle cost. Simple payback is a method of calculating the time required for the savings to equal the cost of the investment. This method only works when shifting from a high (LPG) to low cost (Woodchip) fuel and is not really the best option for assessing complex projects with numerous variables.

Life cycle cost analysis (LCC) accounts for all current and future costs and benefits over the lifetime of the boiler. Where simple payback stops, LCC continues to account for the entire boiler life bringing into consideration loan repayments, variable fuel pricing, plant upgrades, major planned maintenance, staffing reductions or increases, depreciation and any other foreseeable cost or benefit of the project. LCC provide an accurate financial picture which can be presented in terms of project savings, net present value or internal rate of return.

List of accredited service providers

A list of accredited service providers is under development. Individuals on this list will have the necessary experience with wood fuel projects so that schools can be confident in the information. Please get in touch directly for a copy of this list (once it is finalised) or check the website (www.woodenergysouth.co.nz) for more information.

Ministry of Education support

School boards are required to contribute up to a maximum of 50% of their 5YA capital funding allocation for major plant replacements that have reached the end of their economic life. Top up funding may be available for wood boilers if a feasibility study has evaluated all boiler options and takes into account full life cycle costs and is a sensible solution for the school. The project costs include the boiler condition assessment report, energy options report, consultancy fees, consent fees and the contract work. For more information on this, please get in touch with the school property advisor at your local Ministry of Education office.

Wood Energy South

Wood Energy South can assist with your boiler replacement project or boiler conversion to woodchip. Funding is available for the following:

- **Energy options report-** Funding for up to 50% is available for assisting with these types of studies¹.
- **Capital grants-** EECA offers low interest loans to assist agencies to implement energy efficiency projects. Loans are available to government departments, District Health Boards, Crown owned companies, territorial authorities, regional councils, universities, polytechnics, schools and Crown entities.

Wood Energy South also provides independent technical advisory support and can assist with the following:

- site visits to assess the suitability of wood fuels for your school
- non-partisan advice on boiler and fuel options
- assistance with funding applications and
- resources.

For more information please get in touch with:

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Or visit our website www.woodenergysouth.co.nz

¹ Project criteria apply see www.woodenergysouth.co.nz for more specific detail

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