JULY 2026

Case study

Glenholme School

Containerised wood pellet boiler replaces natural gas for space heating in school

ENERGY EFFICIENCY & CONSERVATION AUTHORITY
TE TARI TIAKI PŪNGAO

aurecon

Executive Summary

Project Introduction

New Zealand has around 2,500 primary and secondary schools. At least half of these have central heating systems, made up of a central boiler and hydronic system with heat emitters (radiators and fan coils). Glenholme School in Rotorua replaced two separate natural gas-fired boilers that were around 37 years old and end-of life, with a modern wood pellet-fired boiler and fuel handling system, to heat the central heating system and the school pool during the summer months. The project took 2 year and 9 months from concept to completion and the photos below show the existing boiler house and energy box.

Project Financials

The total capital costs are listed below:

#	Item	**Capital Cost** (NZ$ exc. GST)
1	Engineering Design, Drawings, Reports, Site Meetings, Scope Documents	$11,500
2	Resource & Building Consent	$600
3	Installation of Boiler, Pipe Work and New Radiators	$319,000
4	Installation of Pool Heating System	$31,000
5	Project Management	$16,500
6	Total Capital Cost	$378,600
7	Specific Capital Costs	$2M/MWth

The operational and maintenance costs are similar and there are no longer any fixed gas charges (the average cost was $192 per month). For the year of 2024 when the pellet boiler was commissioned, the fuel costs reduced by a third compared to natural gas, this saving has since increased to an estimated two thirds reduction in 2026.

The fuel cost comparison for Glenholme School using either natural gas or wood pellets is listed below:

#	Year	**Energy Required** (kWh)	Cost of Natural Gas per Annum	Cost of Pellets per Annum
1	2023	102,000	$14,700	$9,200*Estimated
2	2024	102,000	$20,900*Estimated	$9,400
3	2025	102,000	$25,500*Estimated	$9,900
4	2026	102,000	$29,600*Estimated	$10,400*Estimated

Shared Learnings

#	Category	Key Industry Lessons
1	Concept & Feasibility Design	a) Set-up energy projects for success early by completing structured energy transition studies to identify practical, financially viable and low risk options independent consultants can be engaged with government support through EECA b) Leverage prior experience, or review relevant publicly available information, such as case studies c) Ensure fuel supply chains are mature and reliable to minimise operational and delivery risk d) Size equipment to match actual demand to lower costs and improve efficiency e) Simple and low-cost biomass boiler and fuel handling systems are available at small scale, in the tens and hundreds of kWth range
2	Detailed Design & Procurement	a) Containerised plantroom solutions, known as energy boxes in this case study, can be used for simple and low-cost enclosures for pellet boilers and fuel stores b) Containerised plantrooms solutions can be installed to meet building codes, seismic requirements and have long lifetimes c) Containerised storage can provide compact dry storage for wood pellets with pneumatic handling that allows for fast deliveries with a blower truck and the pellet store to be installed away from the boiler house
3	Project Delivery	a) Turnkey contracts are available for wood pellet boiler and fuel handling systems b) Well proven OkoFEN integrated boilers, requires limited attendance and maintenance, and are cost effective at this scale c) The existing boiler house and associated infrastructure was reused to reduce costs d) Temporary heating can be avoided with staged construction and installation and commissioning when existing heating systems are not required e) There were no significant surprises during project delivery and operation f) Since commissioning, the caretaker has had minimal involvement and reports no significant issues
4	Commercial Aspects	a) Use standardised cost classifications (e.g., AACEi Class 1–5) to communicate estimate accuracy and manage stakeholder expectations b) The capital cost of $378,600 for a 192 kWth hot water boiler, at this delivery quality, pace and scale, is good value $1.97M/MWth c) Removal of gas boilers can allow for removal of the gas connection and associated fixed connection charges d) Removal of natural gas energy reduces exposure to volatile gas prices and fluctuating carbon charge e) Wood pellets can be cost competitive with natural gas on an energy basis f) Resource and building consent were granted pre-commissioning due to early engagement with local authorities

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Acronym List

Acronym	Description
AACEi	Association for the Advancement of Cost Engineers international
ACOP	Approved Code of Practice
BMS	Boiler Management System
CBRP	Coal Boiler Replacement Programme
EECA	Energy Efficiency and Conservation Authority
FID	Final Investment Decision
GETS	Government Electronic Tendering Service
MoE	Ministry of Education
HMI	Human-Machine Interface
MCR	Maximum Continuous Rating

1 Introduction

This Chapter introduces Glenholme School's boiler replacement project, its alignment with Ministry of Education (MoE) sustainability goals, key stakeholders, and the project timeline.

1.1 Ministry of Education Sustainability Goals

During the early 2020s, the MoE established sustainability goals focused on reducing greenhouse gas emissions associated with infrastructure and energy use in schools, in alignment with the Government's Carbon Neutral Government Programme at the time.

Between 2020 and 2025, the MoE transitioned all schools heated by coal-fired to renewable heating supplies, through Coal Boiler Replacement Programme (CBRP). The MoE have since developed a policy where all new heating systems should be renewable.

1.2 Glenholme School

Glenholme School is an urban primary school in Rotorua, New Zealand with approximately 350 students and 40 staff. It is a public school, receives funding from the Ministry of Education (MoE) for all school related upgrades and running costs.

Glenholme School has a central heating system that was originally heated by a gas-fired boiler. The school also has a swimming pool, which was previously heated by a separate gas-fired boiler.

In 2024, Glenholme replaced both gas-fired boilers with a new wood pellet boiler system, which provides space heating for the school and heats the swimming pool. This case study follows the project lifecycle and discusses the learning which can be applied elsewhere.

The existing hydronic system was in good condition and reused but it was not sufficiently sized to fully heat the school. Additional radiators were added, some radiators were replaced with larger modern types, and a new section of the loop was installed.

This boiler replacement was identified in the schools 10-year property plan and then initiated by the school. Funding was applied for and received from the MoE.

Figure 1: Location of Glenholme School

1.3 Resources & Stakeholders

Table 1 below highlights the key stakeholders in the project and their expertise. All information in this report has been obtained from the stakeholders listed in this section.

Table 1: Resources & Stakeholders

#	Who	Location	Role & Expertise	Useful Links & Contacts
1	Glenholme School	Rotorua, New Zealand	School	Home - Glenholme School https://glenholme.school.nz/
2	Apricus Eco Hot Water & Heating	Whakatane, New Zealand	Boiler supplier and installer	Sustainable & Renewable Solutions | Apricus Eco Hot Water & Heating https://www.ecohotwater.co.nz
3	Carling Architects 2017 Limited	Rotorua, New Zealand	Project Management	Carling Architects https://carling.co.nz/
4	2E Consulting	Tauranga, New Zealand	Design Engineer	Home - 2E Consulting | Mechanical Design and Engineering https://2econsulting.nz/
5	Renewable Energy Limited	Rotorua, New Zealand	Boiler and Pool System Installation	Hot Water & Central Heating Systems | Renewable Energy Limited https://renewableenergy.org.nz/
6	Bay of Plenty Regional Council	Bay of Plenty, New Zealand	Consenting	Resource consents https://www.boprc.govt.nz/environment/resource-consents/
7	Rotorua Lakes Council	Rotorua, New Zealand	Consenting	Rotorua Lakes Council https://www.rotorualakescouncil.nz/
8	Ministry of Education	Wellington, New Zealand	Funding and Advice	Reducing emissions in schools and kura - Ministry of Education https://www.education.govt.nz/
9	Energy Efficiency and Conservation Authority (EECA)	Christchurch, Wellington and Auckland New Zealand	Leadership, support and co-funding	Co-funding and Support | EECA Coal-Boiler-Fact-Sheet.pdf EECAEnquiries@eeca.govt.nz

1.4 Timeline

Table 2 below shows a high-level project timeframe which shows a 2-year 9-month total project timeframe from concept to completion. This extended case study will run through the project in chronological order.

Table 2: Project Timeframe

Project Phase	2022				2023				2024			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Government Electronic Tendering Service (GETS)												
Front End Design												
Final Investment Decision (FID)												
Detailed Design & Procurement												
Project Delivery												

1.5 Types of Biomasses

Common types of solid biomass fuel are listed in the Table 3.

Table 3: Common Types of Solid Biomass Fuel

Biomass Type	Description	Image	Typical Pricing
Wood Pellets	Wood that has been pulverised and densified (pelletised) under heat and high pressure to produce a cylindrical wood derived fuel of consistent size. The tend to be made from forestry residues and timber shavings.		17.1 - 25.4 $/GJ 61.6 – 91.4 $/MWh
Wood Chips	Chipped woody biomass in the form of pieces, with a defined particle size produced by mechanical treatment with sharp tools such as knives.		13.5 - 20.5 $/GJ 48.6 – 73.8 $/MWh
Hog fuel	Fuel wood in pieces of varying size and shape produced by crushing with blunt tools such as rollers, hammers or flails. These fuels are typically of a lower quality compared to wood chip.		11.2 – 17.9 $/GJ 40.3 – 64.4 $/MWh
Urban Wood Fuel	Wood residues derived from the urban activities including packaging materials, off cuts from manufacturing, construction and demolition used wood residues, yard trimmings, arborist trimmings, urban tree residues and from land clearing		Highly variable
*Pricing obtained from EECA's Regional Transition Accelerator (RETA) Programme			

Wood pellets can meet the following international fuel standards (which includes the European DIN Plus and EnPlus). Pellets have low moisture <10% by weight and high energy density of 16-17 MJ/kg. Wood chips, hog fuel and urban wood fuel can have a range of fuel properties, which can be classified according to technical standard *'ISO 17225-1:2021(en): Solid biofuels — Fuel specifications and classes'*. A guide for biomass fuel specification is provided by the Bioenergy Association which is based on ISO 17225. Biomass fuel is typically described by the following properties: particle size (P), fine fraction, moisture content (M), ash (A), bulk density (kg/m3) and energy density (MJ/kg). Classified biomass fuels must be free from non-wood contamination, such as soil and stones.

As of 2026, there are three large-scale industrial wood pellet suppliers in New Zealand:

1. North Island: Natures Flame based in Taupo
2. South Island: Azwood based in Nelson
3. South Island: Niagara based in Invercargill

2 Concept & Feasibility Design

This Chapter outlines the evaluation process Glenholme took to transition from natural gas to wood pellets. It summarises the energy transition analysis, technology screening process, boiler sizing methodology, and the selection of biomass fuel handling systems that informed the final project design.

2.1 Geothermal to Gas

Glenholme School was historically heated using the geothermal heat via an individual bore. The geothermal bores had a closed loop water circuit between the geothermal field and a shell & tube heat exchanger. The bore was decommissioned in 1987; this could have been related to conserving geothermal heat for nearby power stations. In the late 1980s the school transitioned to gas boilers. In 2023 the school had a 155 kWth gas boiler for space heating and a 68 kWth gas boiler for pool heating, both were at the end of life, due to corrosion, as identified in an asset management plan.

Figure 2: Previous Gas Boilers

2.2 Gas to Wood Pellets

Carling Architects 2017 Ltd were engaged to evaluate various options including geothermal, heat pumps and biomass boilers.

Geothermal was screened out due to:

a) High level of complexity of opening a new bore

b) High capital cost associated with a new bore

c) Longevity of heat supply from bore uncertain

Electrification was screened out due to:

a) High electricity rates

b) Extensive maintenance requirements

c) Electrical infrastructure upgrade requirements

Wood chips were screened out due to:

a) Higher labour requirements

b) High capital cost

c) Large space requirements for fuel delivery, storage and handing

Wood pellets were selected based on:

a) Proven wood pellet supply chain at the required scale

b) Low labour requirements

c) Low capital cost

d) Small space requirements for fuel delivery, storage and handing

e) Proven performance with previous installs managed by the MoE in South Island schools

Following selection of the heating system type, 2E Consulting were engaged as the design engineers for the project.

2.3 Heat Demand & Boiler Sizing

Table 4 summarise four methods to estimate heat demand for heating buildings, with more detail in the following sub-sections. 2E used the building fabric heat loss method for Glenholme School.

Table 4: Heat Demand Estimate Methods

#	Method	Invasiveness	Accuracy	Cost	Timeframes
1	Floor Area Heat Loss	Non-invasive, desktop exercise	+/- 50%	Low – labour costs	Can be done anytime
2	Gas Metering	Requires gas provider to install on pipeline	+/- 30%	Cost depends on provider	Winter monitoring recommended Lead time required for equipment
3	Water Heat Metering	Non-invasive, ultrasonic flow meter clamped onto pipes	+/- 20%	~$8,000 per boiler	Winter monitoring recommended Lead time required for equipment
4	Building Fabric Heat Loss	Non-invasive; requires building data and design temperatures	+/- 10%	Low to high – labour costs	Can be done anytime Peak load based on design conditions
*Indicative numbers only					

2.3.1 *Floor Area Heat Loss*

Figure 2 shows a map of climate zones in New Zealand with indicative peak heat loss rates for schools, where Zone 1, Zone 2 and Zone 3 have a heat loss of 90, 100 and 110 W/m^2 respectively. This is used to get an indicative peak thermal power which is used to size the heating system at the feasibility concept phase only.

Figure 3: New Zealand Climate Zones

2.3.2 *Gas Meter*

Another option in estimating the heat demand is to install a smart meter on the natural gas pipeline to the school. This will allow for more accurate metering of the natural gas consumption and give a more accurate value to how much natural gas is used compared to cost and consumption data from invoices. An added advantage will be correct billing and reduction in amount of billing errors. The pricing requires further investigation as the gas provider must upgrade the current system on site.

The issue with this method is that it assumes the school is heated to the correct temperature, but it could be under or overheated. This method also doesn't account for other gas users or the boiler efficiency.

2.3.3 *Heat Meter*

To more accurately estimate the heat demand, the flow and return pipes to the boiler could be metered. An ultrasonic meter can be clamped onto the pipes and measure the flow, return, flow rates in cubic metres and the temperature differential which is used to calculate the energy in kW. After this data collection and logging a heat load is graphed and a true load profile of the school is established. The key months to monitor would be the winter months where the most natural gas is used in the boilers (July – September). The issue with this method is that it assumes the school is heated to the correct temperature, but it could be under or overheated. Indicative pricing for heat metering one boiler would be around $8,000.

Figure 4: Example Ultrasonic Clamp-on Heat Meter

2.3.4 *Building Fabric Heat Loss*

To size a boiler using the building fabric heat loss, engineers estimate the amount of heat lost through the building's structural elements, such as the walls, roof, floors, windows, and doors. The heat loss from each component is calculated based on its surface area, insulation quality, and the temperature difference between the inside and outside of the building. These losses are then added together to determine the total heat demand of the building. Additional heat losses from ventilation and air leakage are usually included, and a safety margin is applied. The final value represents the boiler capacity required to maintain comfortable indoor temperatures during cold conditions.

2.4 Energy Box

A sufficiently sized boiler and a pellet store could not fit within the existing boiler room Apricus Eco and 2E Consulting worked together to develop the practical configuration options as shown in Table 5.

The 20ft container, or Energy Box, was fitted out and installed to meet seismic loads, all penetrations were weather tight, the pellet fuel supply and return lines were installed inside plastic pipes for protection and support, and the outside was painted in the same colour as the school buildings.

Table 5: Boiler & Storage Configuration Options

#	Attribute	Option 1	Option 2	Option 3
1	Existing Boiler House	Two 64 kW boilers	Empty	One 64 kW boiler
2	External Equipment	Shipping container: 1 x 64 kW + 7 t storage)	Two shipping containers: 1 for 3 x 64 kW boilers, 1 for 20 t pellet storage	Shipping container: 2 x 64 kW + 7 t storage
3	Total Boiler Capacity	3 x 64 kW	3 x 64 kW	3 x 64 kW
4	Pellet Storage	8 tonnes	20 tonnes	8 tonnes
5	Boiler Location	2 in house, 1 in container	All in containers	1 in house, 2 in container
6	Capital Cost	Moderate	High	Moderate
7	Advantages	Uses existing infrastructure	Large pellet storage	Balanced use of existing and external
8	Disadvantages	Limited space in boiler house	High capital cost, all boilers external	Smaller pellet storage than option 2
9	Decision	Screened out	Screened out	Progressed to detailed design

3 Detailed Design & Procurement

This Chapter outlines the biomass supply chain, biomass handling and boiler system design which included:

- One 64 kWth boiler in the existing boiler house
- 20ft shipping container capable of storing 8 tonnes of pellets and two 64 kWth boiler

3.1 Biomass Supply Chain

The wood pellets supplied from Nature's Flame meet the following quality standards:

a) Standard: DINplus A1, BioGro certified

b) Wood Type: New Zealand Radiata pine

c) Moisture Content: 7-8%

d) Calorific Value: 16-17 MJ/kg

e) Ash Content: <0.5%

f) Sulphur: < 300 ppm

g) Chlorine: < 800 ppm

3.2 Biomass Handling System

The Energy Box is a 20-ft shipping container which has an isolated pellet storage section and boiler section. The storage section is boxed of with laminated plywood that can hold up to 8 tonnes of wood pellets. Figure 6 shows a Block Flow Diagram (BFD) of the main components of the biomass handling system. Note this does not include the hydronic circuit for simplicity.

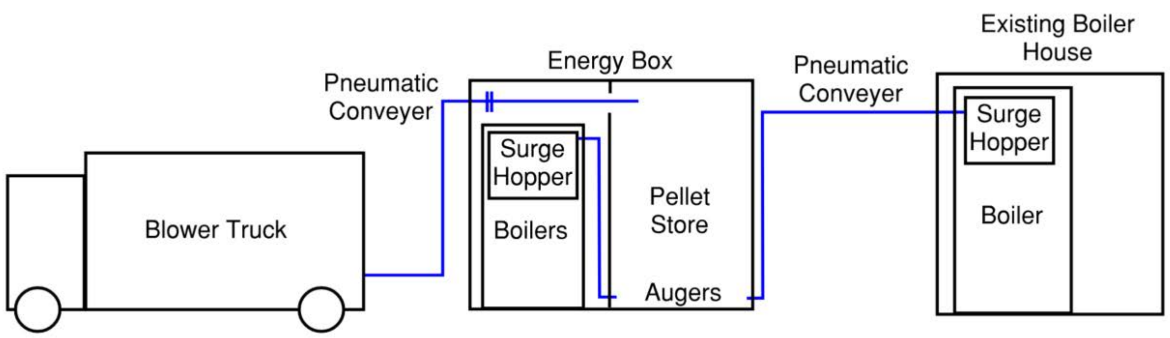


Figure 5: Pellet Handing System Diagram

The following list describes how the process works:

a) Trucks to pellet store:

i) There is a filling port located internally beside the boiler where the blower truck connects into for delivery.

ii) A flexible hose is attached from the blower truck to the filling port

iii) The truck is tipped slightly and an internal auger feeds pellets through a fan which blows pellets through the flexi hose

iv) The storage area can hold around 8 tonnes of pellets, which takes 20 minutes to unload, but deliveries are often less tonnage than this

v) There is rubber mat at the back of the storage container to prevent pellets from breaking up when hitting the plywood

vi) There is a filter vent mounted at the back of the container to prevent the storage container being over pressurised by the airstream

vii) When the school pellet store gets low, the caretaker gets alerts by the Boiler Management System (BMS). The caretaker contacts the pellet supplier, Natures Flame in this instance, to top up the fuel store on their next delivery, which is approximately once every two weeks during the winter

b) Pellet store to surge hopper:

i) The pellets are fed from the store into the boiler surge hoopers, through a small auger feed and then blown through a flexi hose via a forced draft fan

ii) The surge hopper is a small intermediate storage bin that acts as buffer control between the main pellet store and the boilers fuel-feeding mechanism – they ensure that the boiler receives a steady flow of pellets

iii) The two boilers in the energy box are fed via one auger and boiler in the existing boiler house is fed via a second auger

iv) The pellet stores up to 8 tonnes of pellets.

c) Mechanical augers convey pellets from the surge hopper to the boiler furnace

Figure 6: Blower Truck

3.3 Boiler Supplier

Three OkoFEN Pellematic PE 56 boilers with an output of 64 kWth, totalling 192 kWth of output, were supplied by Apricus Eco. The boilers are made in Austria and are shipped globally for use in small scale biomass applications. OkoFEN were one of the pioneering European companies in the pellet boiler industry having over 100,000 installations in 25 countries.

3.4 Boiler Design

The boiler schematic is shown in Figure 7. The key design features are shown in Table 6.

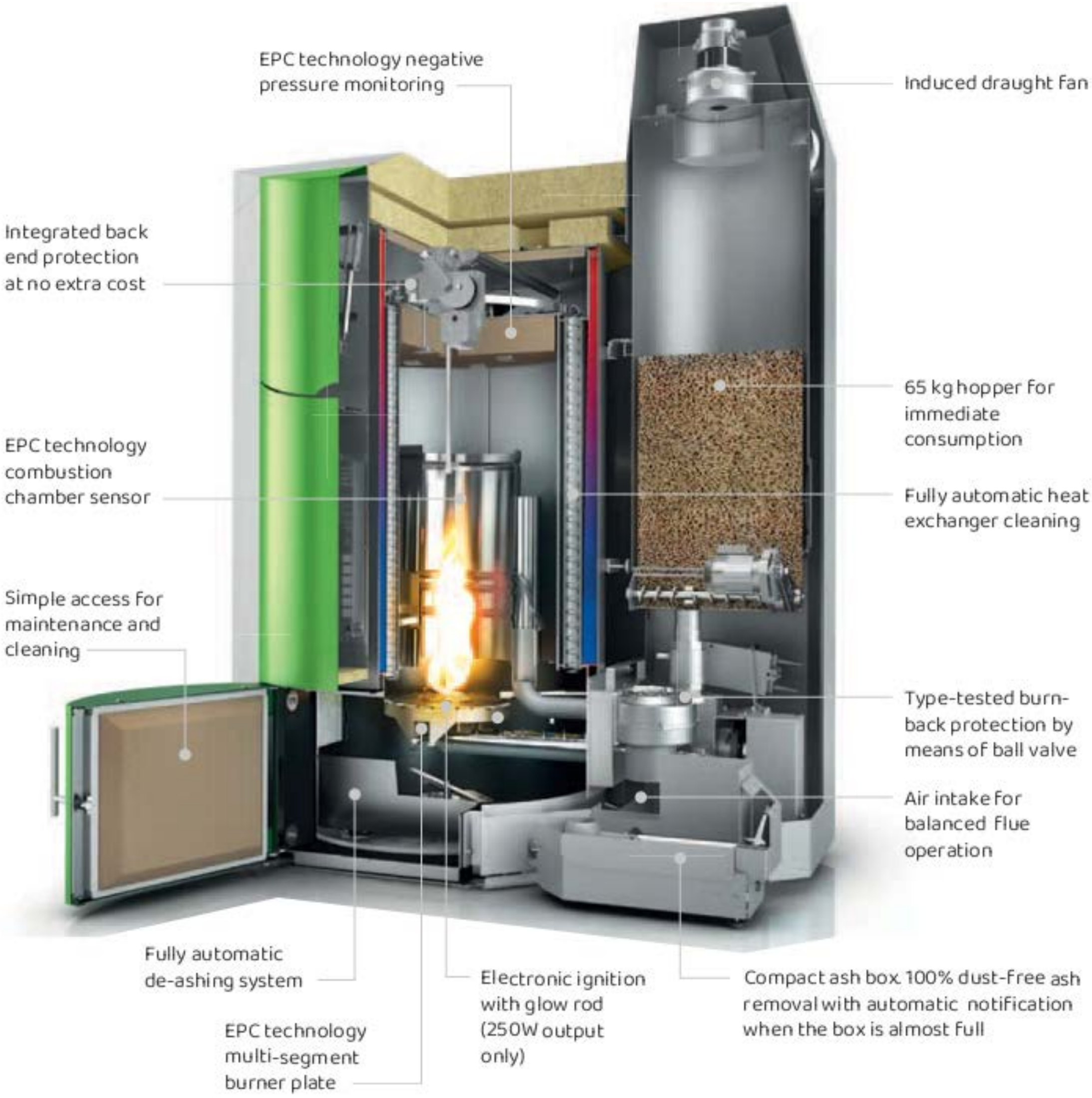


Figure 7: OkoFEN Pellet Boiler Schematic

Table 6: OkoFEN Boiler Features

#	Feature	Description
1	Surge Hopper	An auger moves pellets from the surge hopper to the underfed burner located at the base of the combustion chamber
2	Underfire Air	All combustion air is sourced from within the boiler house through a forced draft fan Underfire air is introduced beneath the fuel bed to support steady up-draft combustion Negative draft control stabilises airflow through the combustion chamber and ensures the correct amount of air flow is provided
3	Multi-segment Burner Plate	Pellets are underfed into the middle of a multi-segment circular burner plate that pushes pellets from the middle to the edge of the burner plate - some segments move to promote combustion and self-cleaning as described below: a) Pre-drying – incoming pellets are heated and moisture is driven off b) Pyrolysis –the heated pellets release volatile hydrocarbons c) Volatile combustion –released volatiles mix with combustion air and burn in the gaseous phase d) Char burnout – the remaining carbonaceous solids gradually oxidise as fresh fuel pushes the combusted material off the burner plate
4	Automated De-ashing System	Ash falls over the edge of the burner into the ash chamber below where it is periodically pushed into an ash box, which provides an automatic notification when it approaches full capacity
5	Overfire Air	Overfire air is supplied above the bed to promote complete combustion of volatile gases within the upper combustion zone
6	Air-to-fuel Ratio	The boiler is operated with excess air overall, which is a Lambda just over 1 An overall Lambda just over 1 provides the optimum combustion environment which achieves the highest combustion efficiency and minimises emissions of hydrocarbons, carbon monoxide and particulates
7	Turbulator	The flue gases then pass through a turbulator, where heat is transferred to the boiler's water jacket The turbulator consists of a coiled metal element within a spring assembly that oscillates periodically to knock-off accumulated fly ash into the ash chamber
8	Induced Draft Fan	An induced draught fan, powered by a Variable Speed Drive (VSD), extracts flue gases from the boiler and discharges them through the flue stack.
9	Boiler Management System (BMS)	Automated control loops in the BMS regulate key process parameters such as draught fan speed, pellet feed rate, fan speeds, and air pressure These functions are monitored and adjusted through a Human-Machine Interface (HMI) touch panel

4 Project Delivery

This chapter describes how the project was delivered, including the project management approach, biomass feed system, and installation of the biomass boiler plant. It also outlines the commissioning outcomes, operational arrangements, and key performance characteristics of the system.

4.1 Project Management

Carling Architects are assigned by the school to manage infrastructure upgrades. Carling Architects worked with 2E Consulting to develop a project specification. Through the Government Electronic Tendering System (GETS) the school appointed Renewable Energy Ltd to deliver a turnkey solution. Apricus Eco supplied equipment to Renewable Energy Ltd.

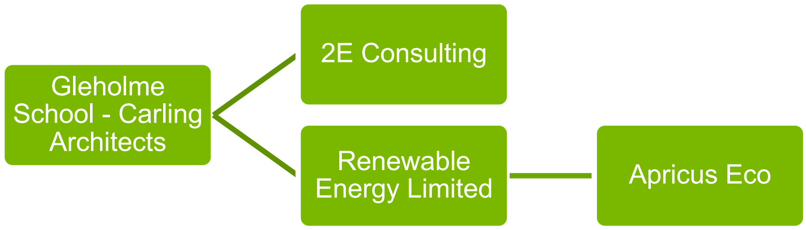


Figure 8: Project Stakeholder Hierarchy

4.2 Biomass Supply Chain

With 8 tonnes of storage on-site, the school stores approximately two weeks of fuel during the cold winter season. There have been no noted issues with delivery and pellet degradation has been minimal. During the first couple of year of operation there were low levels of dust accumulating in the energy box, however, this has increased due to the door into the pellet store not sealing correctly which is to be remediated. The boiler room requires weekly sweeping and general maintenance in the meantime, but this is not extensive work.

4.3 Boiler Performance

The boiler was commissioning in mid-2024 and the main performance details are listed in Table 7.

Table 7: Boiler Performance Details

#	Parameter	Unit
1	Maximum Continuous Rating (MCR)	192 kWth of hot water at 75°C
2	Water Pressure	3.5 bar(g)
3	Turndown	Approx 3.2:1 *Minimum operation per boiler is 17 kWth
4	Max Load / Partial Load Flue Gas Temperature	160°C /100°C
5	Design Lifetime	20 years
6	Carbon savings compared to natural gas	98% tonnes of carbon dioxide equivalent

4.4 Boiler Operation & Supervision

The boiler operates without the need for supervision. Daily checks on the boiler houses and pellet store are done by the caretaker (responsible person/operator) with monitoring available remotely using the OkoFEN app. Faults and status' (e.g. pellet storage level, boiler fire rates, temperatures) are shown on the app and can be configured to send SMS alerts if desired.

Boiler supervision requirements are detailed in the Approved Code of Practice (ACOP) for the design, safe operation, maintenance and servicing of boilers, which can be downloaded from the WorkSafe website. Table 8 shows a simplified version of the supervision requirements. This new boiler at the MoE is a hot water boiler and the caretaker is deemed a responsible person.

Table 8: Simplified Supervision Requirements

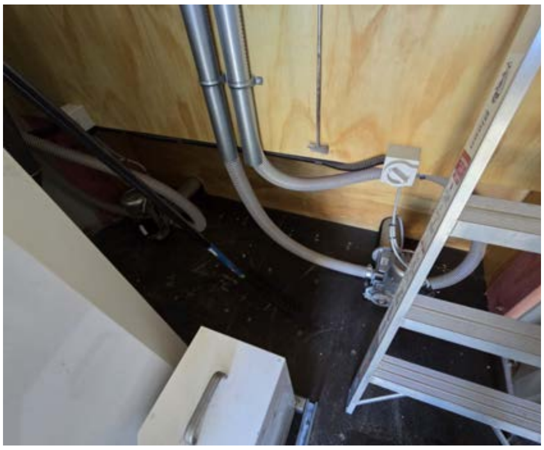
Mode	Boiler Size / Type	Who Checks	How Often	Maintenance
Attended	Up to 20 MW	Qualified operator	Continuous	Every 3 months
Limited attendance	Up to 6 MW	Qualified operator	Every 8 hours	Every 3 months
Unattended	Large boilers > 1.2 MW	Responsible person	Every 24 hours	Every 3 months
Small / Shell boilers	Up to 1.2 MW	Responsible person	Every 2 hours or as authorised	Every 3 months
Small boilers	Under 500 kW	Responsible person	As needed	Every 3 months
Hot water boilers	Over 100 °C or 200 kPag	Responsible person	As needed	Every 3 months

4.5 Photos

4.5.1 Pellet Handling System

Pellet Fill Port

Pellet Storage



Augers

Pellet Store Venting

Figure 9: Boiler Feed System and Storage

Flexi hose Supply Lines - Container

Flexi hose Supply Lines – Boiler Room

Pellet Transfer Lines & Hot Water Flow and Return Lines

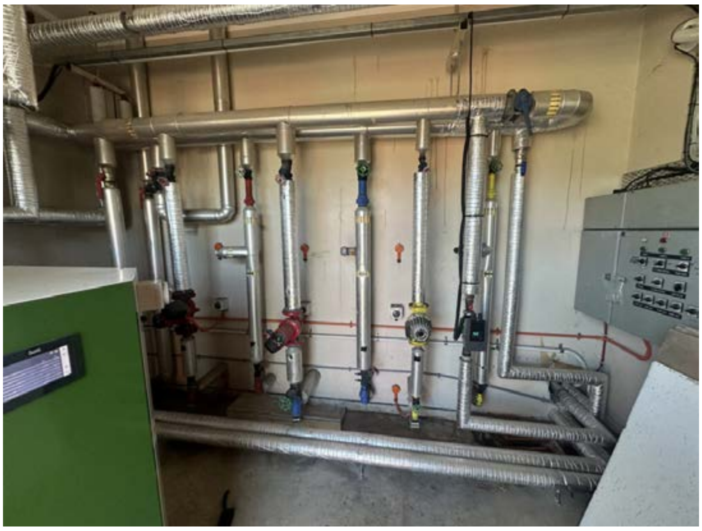
Pellet Store Vent Line

Figure 10: Boiler Feed System and Storage Continued

4.5.2 Boiler System Photos

Existing Boiler House

Energy Box



Hot water header

Energy Box Internal

Figure 11: Existing Boiler House (Left) & Energy Box (Right)

Boiler House Flue Stack

Energy Box Flue Stack

HMI

Ash Collection Bin

Figure 12: Ash Management & Flue Stack

5 Commercial Aspects

This section summarises the capital and running costs of the new boiler and pool heating system, alongside the building and resource consent requirements. It highlights funding, cost savings, and regulatory approvals that supported the project delivery.

5.1 Capital Costs & Approval

The Association for the Advancement of Cost Engineers international (AACEi) set out a classification system for cost estimates which follows the project development framework. Additional project definition provides a more accurate cost estimate, as shown in Table 9. A class 3 (-20% / +30%) estimate was completed for this project and funding provided to Glenholme School by the MoE approved on this estimate.

Table 9: AACEi Cost Estimation Classification

AACEi Classification	AACEi Accuracy Range
Class 5	Low: -20% to -50% High: +30% to +100%
Class 4	Low: -15% to -30% High: +20% to +50%
Class 3	Low: -10% to -20% High: +10% to +30%
Class 2	Low: -5% to -15% High: +5% to +20%
Class 1	Low: -3% to -10% High: +3% to +15%

Glenholme School applied for received funding of NZD$385,241.00 from The Ministry of Education (MoE) of the asset replacement project. Table 10 below breaks down the actual capital cost on project completion.

Table 10: Actual Capital Cost Breakdown

#	Item	Capital Cost (NZ$ exc. GST)
1	Engineering Design, Drawings, Reports, Site Meetings, Scope Documents	$11,500
2	Resource & Building Consent	$600
3	Installation of Boiler, Pipe Work and New Radiators	$319,000
4	Installation of Pool Heating System	$31,000
5	Project Management	$16,500
6	Total Capital Cost	$378,600
7	Specific Capital Costs	$1.97M/MWth

5.2 Running Costs

The maintenance and operational labour costs have not changed noticeably. Maintenance costs in 2025 were $4100, but this should be lower in 2026 due to a change in the maintenance provider. Table 11 below shows the natural gas costs for the gas boiler in 2023 which the school paid, and estimated gas costs through 2024-2026 should the school stayed on gas. The school was on pellets from 2024 and have paid the figures shown for 2024 and 2025, with 2026 estimated for comparison with natural gas only. Note that Glenholme is now completely disconnected from the gas network, which removes the associated fixed gas charges (the average cost was $192 per month).

Table 11: Fuel Cost Comparison

#	Year	**Energy Required** (kWh)	**Cost of Natural Gas per Annum**	**Cost of Pellets per Annum**
1	2023	102,000	$14,700	$9,200*Estimated
2	2024	102,000	$20,900*Estimated	$9,400
3	2025	102,000	$25,500*Estimated	$9,900
4	2026	102,000	$29,600*Estimated	$10,400*Estimated

5.3 Building Consent

Carling Architects asked Rotorua Lakes Council in Q3 of 2022 for a building consent exemption for the Energy Box, which was granted. The consent exemption dated 8 Nov 2022 was assessed against the 1st Schedule of the NZ Building Act 2004 and exemption granted under item 2.

5.4 Resource Consent

Carling Architects worked with Bay of Plenty Regional Council in early 2022 to renew the resource consent. A new resource was not required for switching the heat source, but written approval was required from the council. Early engagement ensured the council was educated about on the project and prevented delays in commissioning later in the project cycle.

6 Summary & Shared Learnings

Table 12 lists the industry learnings from this project that could be applied to similar energy transition projects.

Table 12: Shared Learnings

#	Category	Key Industry Lessons
1	Concept & Feasibility Design	f) Set-up energy projects for success early by completing structured energy transition studies to identify practical, financially viable and low risk options independent consultants can be engaged with government support through EECA g) Leverage prior experience, or review relevant publicly available information, such as case studies h) Ensure fuel supply chains are mature and reliable to minimise operational and delivery risk i) Size equipment to match actual demand to lower costs and improve efficiency j) Simple and low-cost biomass boiler and fuel handling systems are available at small scale, in the tens and hundreds of kWth range
2	Detailed Design & Procurement	d) Containerised plantroom solutions, known as energy boxes in this case study, can be used for simple and low-cost enclosures for pellet boilers and fuel stores e) Containerised plantrooms solutions can be installed to meet building codes, seismic requirements and have long lifetimes f) Containerised storage can provide compact dry storage for wood pellets with pneumatic handling that allows for fast deliveries with a blower truck and the pellet store to be installed away from the boiler house
3	Project Delivery	g) Turnkey contracts are available for wood pellet boiler and fuel handling systems h) Well proven OkoFEN integrated boilers, requires limited attendance and maintenance, and are cost effective at this scale i) The existing boiler house and associated infrastructure was reused to reduce costs j) Temporary heating can be avoided with staged construction and installation and commissioning when existing heating systems are not required k) There were no significant surprises during project delivery and operation l) Since commissioning, the caretaker has had minimal involvement and reports no significant issues
4	Commercial Aspects	g) Use standardised cost classifications (e.g., AACEi Class 1–5) to communicate estimate accuracy and manage stakeholder expectations h) The capital cost of $378,600 for a 192 kWth hot water boiler, at this delivery quality, pace and scale, is good value $1.97M/MWth i) Removal of gas boilers can allow for removal of the gas connection and associated fixed connection charges j) Removal of natural gas energy reduces exposure to volatile gas prices and fluctuating carbon charge k) Wood pellets can be cost competitive with natural gas on an energy basis l) Resource and building consent were granted pre-commissioning due to early engagement with local authorities