JULY 2026

Case study

Alsco Uniforms

Switching from coal to wood pellets for laundry services in central Christchurch.

ENERGY EFFICIENCY & CONSERVATION AUTHORITY
TE TARI TIAKI PŪNGAO

aurecon

Executive Summary

Project Introduction

Alsco Uniforms provides laundry services across several sites in New Zealand. Their Christchurch site replaced a 50-year-old coal-fired boiler with a 3 MWth wood pellet-fired boiler and fuel handling system. The project was driven by the need to replace the coal boiler, increase reliability of the steam supply, secure a long-term energy supply and achieve emissions reductions targets. The project took 1 year and 9 months from concept to completion and the photos below show the boiler (left) and silos (right). This project helped Alsco Uniforms achieve its sustainability goals and be selected as a finalist in the Large Energy User category at the 2025 NZ Energy Excellence Awards.

Project Financials

The total capital costs are listed below:

#	Item	Capital Cost (NZ$ exc. GST)
1	Boiler Cost from MHM Automation	$780,000
2	Kelford Engineering Turnkey Cost *including temporary boilers and some other minor projects costs	$2,302,000
3	Total Capital Cost	$3,082,000 *1.4% points over the cost estimate
4	Specific Capital Costs	1.03 $/MWth
5	GIDI Co-funding	$1,070,000

The cost of pellets is approx. +50% higher than the cost of coal. Annual survey and maintenance costs are around a third, or $12,000, lower than the coal boiler, and the survey can be completed in a single weekend. The auger system with the previous coal handling system required a lot of maintenance. Maintenance on the water and steam systems are practically the same. Manual operation costs are the same. Ash removal is outsourced to the ash bin hiring company at approx. $4,800 per annum. There was no payback related to the project because this was an asset replacement project.

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 - external energy specialists can be engaged with government support through EECA b) Experience from previous decarbonisation projects at other sites helped inform the selection of biomass technology and storage solutions c) Leverage prior experience, or review relevant publicly available information, such as case studies d) Ensure fuel supply chains are mature and reliable to minimise operational and delivery risk e) Size equipment to match actual demand to lower costs and improve efficiency f) Sustainability goals can be progressed alongside asset management plans g) Complete pilot tests were practical, for example trial burning pellets in an existing solid fuel handling and boiler system
2	Detailed Design & Procurement	a) Long-term pellet supply contracts of up to 10-years are possible b) MHM Automation in Christchurch manufacture well proven fire-tube boilers which require limited attendance and are cost effective for daily utilisation at the 3 MWth scale c) Silo suppliers, such as Central Silo Systems, can supply silos which 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) The project was delivered under a turnkey model with Kelford Engineering managing the decommissioning of the old boiler, installation and commissioning of the new boiler and fuel handling systems, and coordination with suppliers b) The existing boiler house and flue infrastructure was reused c) Temporary diesel boilers were used to ensure continuous supply during boiler changeovers - fortunately Alsco Uniforms had existing tie-in points for temporary steam boilers d) The main challenge during project delivery was the discovery of contaminated soil during excavations for the silo, which did not lead to a delay in commissioning the boiler due to use of a temporary silo, but required additional work. This highlights the importance of ground assessment reports
4	Commercial Aspects	a) Use standardised cost classifications (e.g., AACEi Class 1–5) to communicate estimate accuracy and manage stakeholder expectations b) The project received board approval based on a business case which benefited from Government Investment in Decarbonising Industry (GIDI) co-funding, which reduced capital costs and financial risk c) The capital cost of $3,082,000 for a 3 MWth steam boiler, at this delivery quality, pace and scale, which is good value at 1.03 $/MWth d) Resource consent approval for a pellet boiler in a city, was ensured through early engagement with specialists and installation of grit arrestor and bag house to reduce particulate matter (dust)

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Acronym List

Acronym	Description
AACEi	Association for the Advancement of Cost Engineers International
ACOP	Approved Code of Practice
BFD	Block Flow Diagram
EECA	Energy Efficiency and Conservation Authority
ETA	Energy Transition Accelerator
GIDI	Government Investing in Decarbonising Industry
PLC	Programmable Logic Controller
RETA	Regional Transition Accelerator

1 Introduction

This Chapter introduces Alsco Uniforms and its sustainability efforts to reduce emissions from energy-intensive laundry operations. It focuses on the transition from coal to biomass at its site across the South Island of New Zealand, including key stakeholders, timeline, and fuel types.

1.1 Alsco Uniforms

Alsco Uniforms, referenced as Alsco Uniforms in this case study, supplies and launders uniforms, mats, towels, bed linen, and hygiene products, on a rental/service basis, for businesses such as hospitals, hospitality venues, and industrial workplaces. Founded in the United States in 1889, the company has grown into a global organisation. It has operated in Australia since 1963, and in New Zealand through New Zealand Towel Service (NZTS), which was established in 1910. NZTS was later acquired by Alsco Uniforms in 1998.

Alsco Uniforms' Sustainability Goals

Alsco Uniforms established formal sustainability goals in 2017 as part of a wider global shift toward low-carbon operations. With high thermal energy use across multiple laundry sites, process heat represented the largest decarbonisation opportunity. These goals are shown in the figure below.

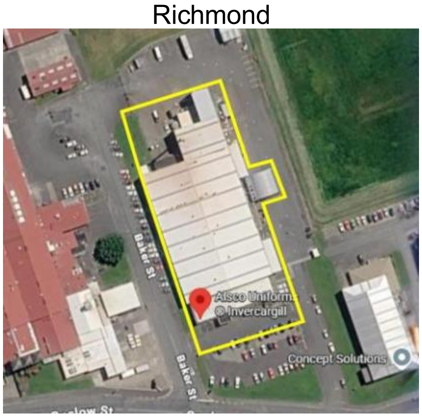
Figure 1: Alsco Uniforms' Sustainability Goals

1.2 Alsco Uniforms' Sites

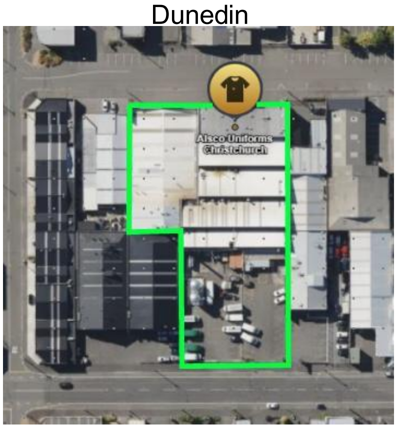
Alsco Uniforms invested in low carbon emitting fuels, such as biomass heat plants in New Zealand and solar energy in Australia. Alsco Uniforms phased out coal from its New Zealand operations, which includes Invercargill, Dunedin, Nelson and Christchurch, five years ahead of its sustainability goal of 2030, resulting in its selection as a finalist in the Large Energy User category at the 2025 NZ Energy Excellence Awards. This extended case study focuses on the conversion from coal to biomass at Alsco Uniforms Christchurch.

Richmond

Dunedin



Invercargill



Christchurch

Figure 2: Alsco Uniforms Sites in South Island

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	Alsco Uniforms	Christchurch, New Zealand	Laundry service provider	Connecting with our Planet - Alsco Uniforms New Zealand https://alsco.co.nz/sustainability/our-planet/
2	MHM Automation	Christchurch, New Zealand	Boiler supplier	Scotts and Vekos Boilers and Heat Plants | MHM Automation https://mhmautomation.com/product/scotts-oil-gas-boilers
3	Kelford Engineering	Christchurch, New Zealand	Decommissioning and removal of coal boiler and bunker, installation and commissioning of pellet boiler and fuel handling system	About Electric Steam Boilers and Kelford Engineering https://www.bioenergy.org.nz/living-energy
4	Lumen	Christchurch, New Zealand	Feasibility study and funding support partner	Alsco Christchurch Laundry Coal Boiler Replacement | Lumen https://www.lumen.net/case-studies/alsco-christchurch-laundry-coal-boiler-replacement
5	Deta	Christchurch, New Zealand	Energy Transition Accelerator (ETA) report	Energy Efficiency Consultants & Services Across Australia & NZ https://www.deta.global/
6	Azwood	Nelson, New Zealand	Pellet supplier	Commercial Wood Fuel https://azwood.co.nz/product/commercial-wood-fuel
7	Central Silo Systems	Palmerston North, New Zealand	Silo supplier	Central Silo Systems Ltd | Grain Silo - Feed Milling - Meal Feed Specialists https://www.centralsilosystems.co.nz/
8	Specialist Environmental Services	Wānaka, New Zealand	Air quality consultants	SES Air Quality | Air Quality Expert Evidence https://www.sesconsulting.co.nz/
9	Tonkin & Taylor	Auckland, New Zealand	Soil decontamination consultants	Home - Tonkin + Taylor https://www.tonkintaylor.com/nz/
10	Energy Efficiency and Conservation Authority (EECA)	Auckland, Wellington and Christchurch New Zealand	Leadership, support and co-funding	Co-funding and Support | EECA Biomass boilers for industrial process heat | EECA https://www.eeca.govt.nz/insights/eeca-insights/biomass-boilers-for-industrial-process-heat/ Case studies: biomass boilers for process heat | EECA EECAEnquiries@eeca.govt.nz https://www.eeca.govt.nz/

1.4 Project Timeframe

Table 2 below shows a high-level project timeframe which shows a 21-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	2023				2024				2025			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Concept, Feasibility & Preliminary Design												
Final Investment Decision (FID)												
Detailed Design & Procurement												
Project Delivery												
Operational Boiler *Temporary silo in 2024 Q4												

1.5 Types of Biomass

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/m^3) 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

Alsco Uniforms has undertaken a series of initiatives to transition away from coal-fired steam generation across its New Zealand operations. Through a combination of internal capability development, government-supported programmes, and engaging engineering consultancies, Alsco Uniforms investigated and implemented alternative low-emissions technologies for process heat. This Chapter outlines the front-end work that supported these decisions and summarises the decarbonisation projects completed at Alsco Uniforms sites and how that influences the Christchurch site.

2.1 Front-End Work

To make progress towards the sustainability goals, Alsco Uniforms completed the following steps:

a) Hired a Graduate Energy Engineer supported through Energy Efficiency and Conservation Authority's Energy Graduate Programme

b) Completed Energy Audits through EECA's Energy Audit Programme

c) Completed an Energy Transition Accelerator (ETA) with DETA Consulting, assisted by Alsco Uniforms Graduate Energy Engineer. The ETA programme is administered by EECA, it is a study that maps a pathway to decarbonise industrial sites

d) Investigated electrification and biomass fuel pathways highlighted by the ETA with engineering consultants Lumen

Through such investigations completed internally and by consultants as listed above, Alsco Uniforms have completed the following projects to transition away from coal combustion across their operations. As listed in the following sub-sections:

- 2012 - Nelson: Converted from coal to wood pellet boiler
- 2020 - Dunedin: Investigated Electrode Boiler (the Pioneer Energy Centre that provides steam to site was later converted from coal to wood chips in 2023)
- 2023 - Invercargill: Converted from coal to wood chip boiler
- 2024 - Christchurch: Replaced coal boiler with new pellet boiler

2.2 Biomass Boilers

Alsco Uniforms have installed three biomass boilers to date.

2.2.1 Nelson

Alsco Uniforms had a coal-fired Vekos fire-tube boiler in Nelson. A change to their resource consent requirements meant that Alsco Uniforms' emissions were in breach of their air discharge emissions limits. Options to reduce emissions included installing a taller flue stack or converting the boiler to run on wood pellets, and Alsco Uniforms decided to convert the boiler to wood pellets. Alsco Uniforms initially installed a concrete bunker-style wood pellet storage system; they found that truck unloading was too difficult and therefore replaced it with a wood pellet silo from Central Silo Systems.

Furthermore, Alsco Uniforms constructed a new production facility in Richmond in 2021 to replace its existing operations in Nelson and Motueka. The new site was designed to provide additional floorspace for growing production needs and introduce more efficient washing equipment. This move also allowed the diesel boiler at Motueka to be fully decommissioned. The pellet-fired Vekos boiler previously used at the Nelson site was relocated to the new Richmond facility and meets all of site steam demand.

2.2.2 Dunedin

The Dunedin site is unique among Alsco Uniforms' operations because it does not operate its own boiler. Instead, it purchases steam from Pioneer's Dunedin Energy Centre, which also provides steam to heat Dunedin Hospital, the University of Otago, and Dunedin Fire Station. In 2020, the energy centre used coal-fired boilers to produce steam, which did not align with Alsco Uniforms' sustainability goals. To address this, Alsco Uniforms conducted a feasibility study for an electrode boiler to meet their coal-free by 2030 goal. A biomass boiler was screened out due to space constraints onsite in the city. Electric and electrode boilers were screened out due to power constraints and the costs of water treatment with low condensate returns. Fortunately, the Pioneer Energy Centre was converted from coal to wood chips in 2023.

2.2.3 Invercargill

In 2023, Alsco Uniforms Invercargill converted a coal-fired 4.5 MWth Vekos fire-tube boiler to run on wood chip and wood pellets. The boiler conversion cost only $347,000, increasing thermal efficiency by 5 percentage points from 77% to 82% and reducing total emissions by 4,075 tCO_2e per annum. The conversion involved trials of both wood chips and wood pellets, with pellets selected due to the large onsite space available for installation of a wood chip bunker and a reliable regional supply from Niagara Wood Fuels NZ. The converted boiler and new wood delivery, storage, and handling system are much cleaner than the previous coal system.

Figure 3: Wood Pellet & Chip Store at Alsco Uniforms Invercargill

2.3 Christchurch

The last site Alsco Uniforms still using coal was in Sydenham, Christchurch. The previous Christchurch boiler was approximately 50 years old and required a $300,000 overhaul on new tubes. Engineering consultants Lumen conducted feasibility studies on the replacement of the Christchurch boiler with renewable alternatives. They considered wood pellets, wood chips and an electric boiler. Electric boilers were screened out due to lifetime costs and wood pellets were selected over wood chips due to the limited storage space on site in the city. Wood pellets are more energy dense than wood chips, and can be moved with pneumatic hoses, stored in compact silos, and can be fired in coal-boilers whilst providing the same thermal output. Lumen also found that the existing 4.8 MWth boiler was oversized for the site and estimated that a 3 MWth boiler replacement would be sufficient. Lumen was then engaged by Alsco Uniforms to assist with applying for a GIDI co-fund.

3 Detailed Design & Procurement

This Chapter covers the selection, detailed design, and procurement of the pellet-fired boiler system and associated biomass handling infrastructure at the Christchurch site. Key activities included choosing the boiler supplier and specifying the boiler, and specifying the fuel delivery, storage, and handling systems.

3.1 Boiler Supplier

Alsco Uniforms chose to procure a new pellet-fired 3 MWth Vekos Powermaster 3 boiler from MHM Automation. The driving factor for selection was Alsco Uniforms experience with firing coal, wood chips and wood pellets in these Vekos boilers in Nelson and Invercargill. Other biomass boiler options from Europe and Lyttelton Engineering were investigated but were higher cost at this scale. MHM Automation manufactured the boilers in Christchurch. The Vekos boiler in Alsco Uniforms Christchurch was installed and commissioned by Kelford engineering.

3.1.1 Boiler Design

The Vekos Powermaster 3 is a fire-tube, dry back, two-pass boiler that produces 3 MWth of saturated steam at an operating pressure of 9 bar(g); it has a design pressure of 10.9 Bar(g). It has a fixed grate with manual ignition and manual deashing. Figure 4 shows a diagram of the Vekos Powermaster.

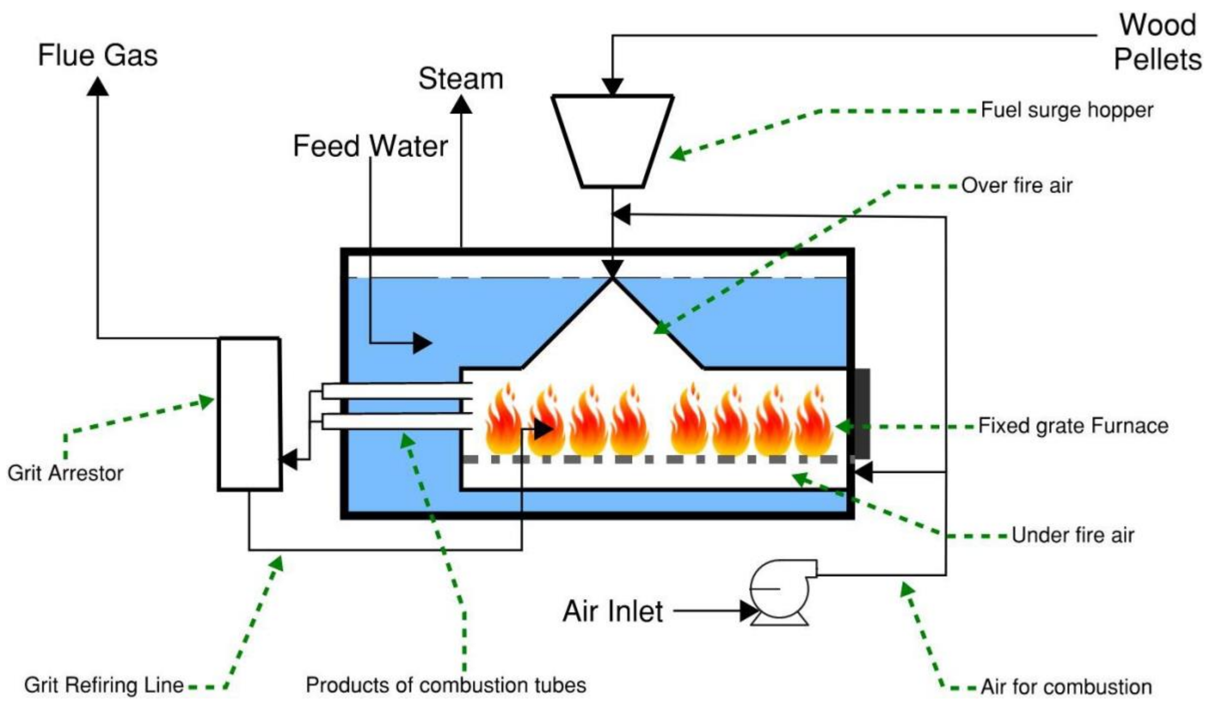


Figure 4: Diagram of the Vekos Powermaster Boiler

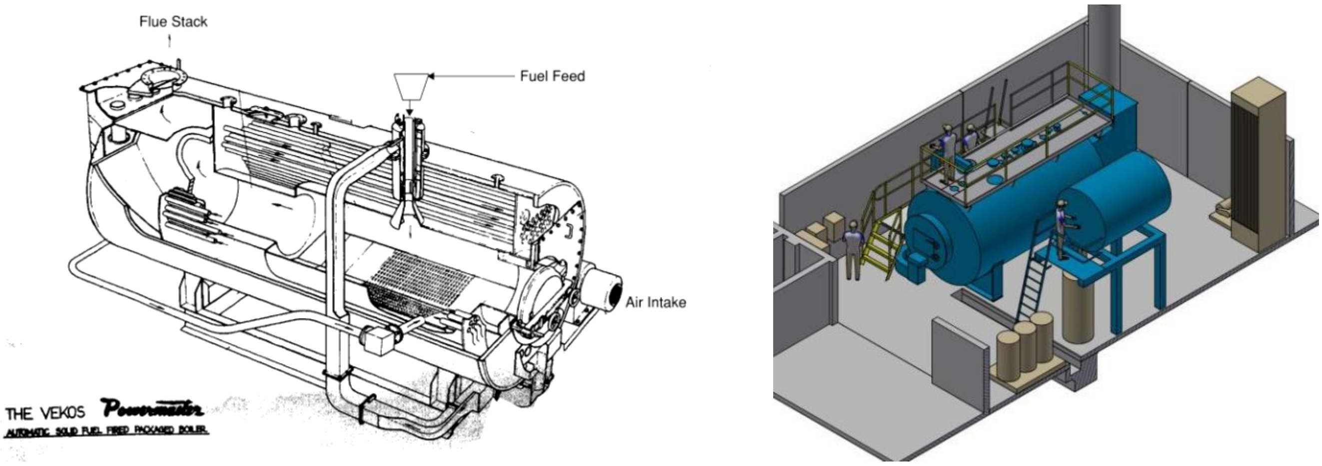


Figure 5: Vekos Boiler in Design

Figure 6: Vekos Boiler in Construction

3.1.2 Water Treatment

The boiler feedwater is obtained from the municipal water supply and undergoes chemical treatment prior to use. Chemical dosing is applied to maintain appropriate water chemistry and to prevent corrosion, scaling, and oxygen-related damage in the boiler system. The treatment chemicals include:

a) **Oxygen scavenger** – added to remove dissolved oxygen and minimise corrosion within the boiler and associated piping

b) **Sodium hydroxide** (35–45 g/L) – used to control and maintain the alkalinity and pH of the boiler water

c) **Sodium metabisulphite** (300–350 g/L) – functions as an oxygen scavenging agent to further reduce dissolved oxygen levels in the system

3.1.3 Fixed Grate Furnace

Wood pellets are blown into a cone shaped surge hopper mounted on the top of the boiler and fall at a known flow rate onto a fixed grate. Overfire air causes turbulence which spreads the pellets out across the fixed grate. A fixed grate furnace means that all stages of combustion occur in a similar place, which are also listed below and illustrated in Figure 4, 5 and 6:

a) **Pre-drying** to remove all moisture prior to pyrolysis and combustion

b) **Pyrolysis** is where the gaseous volatiles are released from the fuel

c) **Volatile combustion** is where the volatiles are burned in the gaseous phase

d) **Char burnout** is where the larger organic polymer structure breaks down and oxidise, such as hemi-cellulose, cellulose and lignin

e) **Bottom ash** is removed manually by opening the fire door and scraping the ash from the fixed grate out of the boiler. For Alsco Uniforms Christchurch, this is done once per day at the beginning of the shift and takes around 15 minutes.

f) To increase combustion efficiency, any large particles entrained in the flue gases are knocked out of the flue gases and blown back into the furnace via a refiring line.

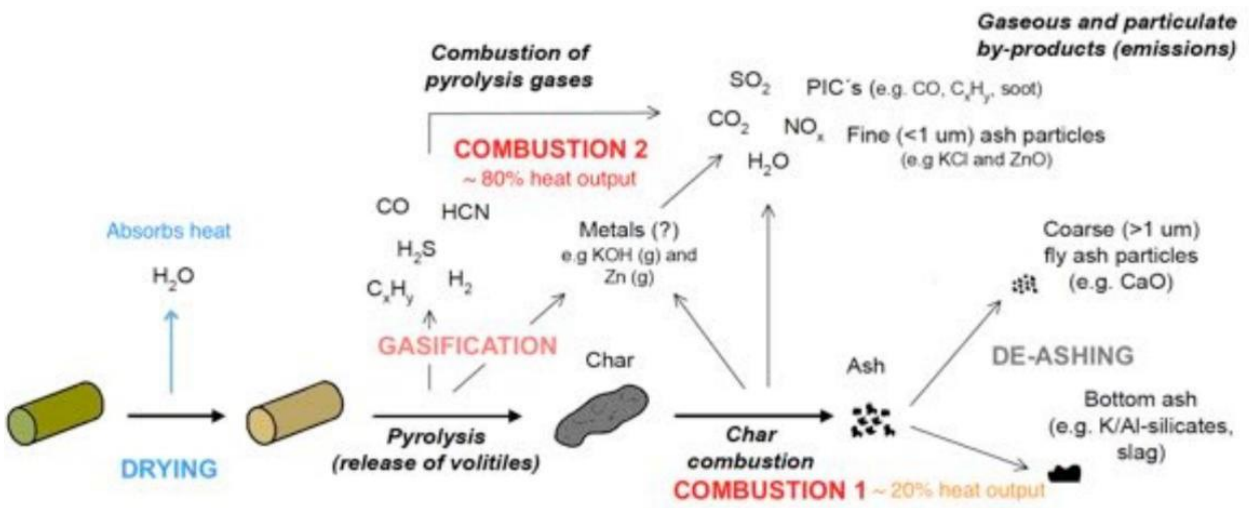


Figure 7: Stages of Combustion (Polytechnik)

3.1.4 Combustion Air

Combustion air is blown in from the boiler house into the furnace, through the over fire air, under fire air, and grit refiring line through the forced draft fan. The combustion air flow is regulated by a damper which operates on a feedback loop with the steam header pressure.

3.1.5 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, as is illustrated in the figure below.

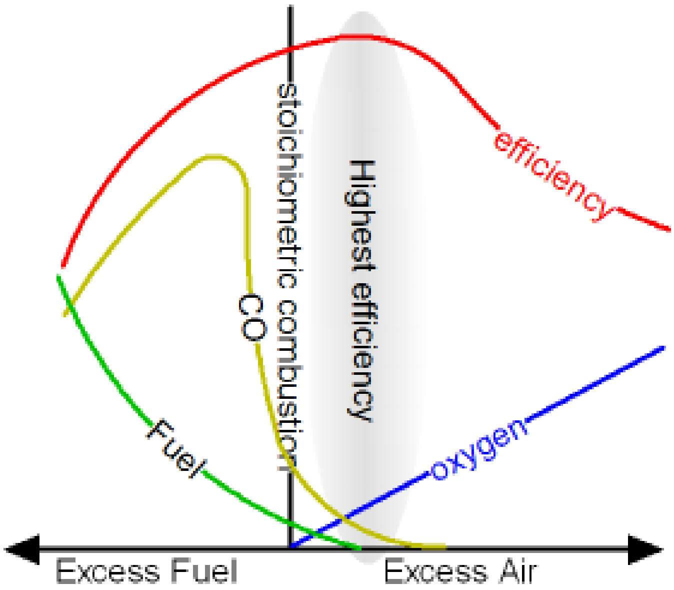


Figure 8: Optimum Air-to-Fuel Ratio

3.1.6 Heat Exchange System

Hot gases from the furnace pass through a fire-tube heat exchanger, which transfers heat from combustion gases to the boiler feedwater. Hot gas enters at approximately 700°C and generate saturated steam at 9 bar(g). The flue gas temperature exiting the Firetube heat exchanger is approximately 180°C. The new boiler tied into the sites existing steam and condensate return lines. There is around a 60% condensate return, because around 40% is directly injected into appliances. Alsco Uniforms are currently investigating installing a steam demister downstream of the steam outlet header to increase steam quality.

3.1.7 Particulate Controls & Flue Stack

Particulate matter is reduced by the grit arrestor and a pulse-jet bag house. The existing flue stack was reused. The flue gas temperature is 173°C.

3.2 Biomass Handling System

3.2.1 Biomass Supply

Alsco Uniforms have been procuring wood pellets from Azwood since 2012 to fuel their other conversion in Nelson and Motueka, and due to their proximity to Christchurch, and therefore competitive delivery costs, Alsco Uniforms Christchurch partnered with Azwood for their wood pellet supply. The initial contract term is three years with options to extend the agreement to 10 years.

3.2.2 Pellet Silos and Pneumatic Lines

The previous coal bunker was undersized and too damp for use with wood pellets. Alsco Uniforms engaged Kelford as an engineering partner to investigate wood pellet storage options and the team selected silos which have pneumatic delivery and handing, due to their compact site footprint for a given amount of storage and cost effectiveness. The silos use approx. 60 m^2 which is roughly double the storage of the previous coal boiler. This larger footprint in the back year did not remove any car parks, due to pellet deliveries with a pneumatic hose as opposed to a reversing coal truck. Alsco Uniforms dealt directly with Central Silo Systems to design the system.

The silos are imported from Symaga in Spain and are constructed from galvanised steel, rather than the powder-coated steel that is typically used in the United States. This specification is selected due to the higher humidity and salt-laden air present in New Zealand, which increases the corrosion classification under ISO 12944 to approximately C4–C5, compared with C1–C2 conditions typically available. The silos are also designed to comply with New Zealand seismic design requirements. Standard silo capacities generally range from 10 to 150 tonnes, although larger silos with capacities exceeding 7,000 tonnes are available. Lead times typically range from 6 to 12 months, depending on the project scope and configuration.

Figure 9 shows a Block Flow Diagram (BFD) of the main components of the biomass handling and feed system.

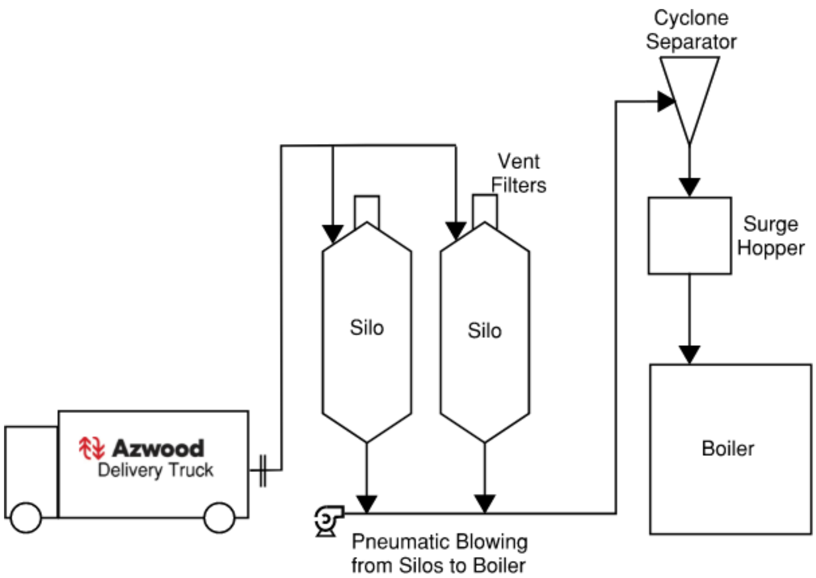


Figure 9: Pellet Delivery, Storage and Feed System Diagram

The following list describes how the process works:

a) Trucks to rotary valve:

   i) Trucks enter the site and pneumatically feed pellets into the top of each silo

   ii) A truck load can contain approximately 14 tonnes of pellets, which takes 30 minutes to unload, but deliveries are often less tonnage than this

   iii) A flexible hose is attached to the truck and at the bottom of the silos at a fill port

   iv) The truck is tipped slightly and an internal auger feeds pellets through a fan which blows pelted through the flexi hose, up through a galvanised pipe into the top of the silos

   v) The air pressure is around 1.8 bar(g) to prevent damaging the pellets and turning them into dust, which can create all sorts of feed issues

   vi) There is a filter vent mounted at the top of a silo to prevent the vessel being over pressurised by the airstream, and there are emergency explosion relief panels

b) Rotary valve to surge hopper:

  i) The pellets are fed from the silos into the boiler surge hoopers, through a rotary valve, short auger feed and then blown through a galvanised pipe via a forced draft fan

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

  iii) Both silos feed into the same boiler pellet supply circuit

  iv) The rotary valves at the bottom of silos were tie-in point between Central Silo Systems and Kelford Engineering

  v) The silos have level sensors, and the boiler operator can see when the levels are low, and they decide when to make an order from Azwood

  vi) The silos store 36 tonnes of pellets each, which totals 72 tonnes. Consumption is around 4.5 tonnes per day. This equates to approx. 16 days of fuel storage

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

4 Project Delivery

This Chapter describes the delivery, installation, and commissioning of the pellet-fired boiler and associated biomass handling systems at the Christchurch site. It covers the project management approach, temporary arrangements during construction, and the operational performance of the new system, including boiler supervision, fuel supply, and system reliability.

4.1 Project Management

The project was delivered under a turnkey model. Alsco Uniforms engaged Kelford Engineering to decommission and remove the old coal boiler, and design, construct and install and commission the new biomass boiler, fuel handling and silo systems. Alsco Uniforms purchased the boiler directly from MHM Automation to decrease the cost of the project by removing margin from Kelford Engineering. Kelford worked with MHM to coordinate the boiler delivery. Figure 10 illustrates this turnkey model for major contracts only - there were other minor contracts. The Alsco Uniforms Regional Engineering Manager was appointed internally to manage the boiler project. This turnkey model works for smaller projects where the main contractor is willing to work with Client nominated suppliers, such as Central Silo Systems

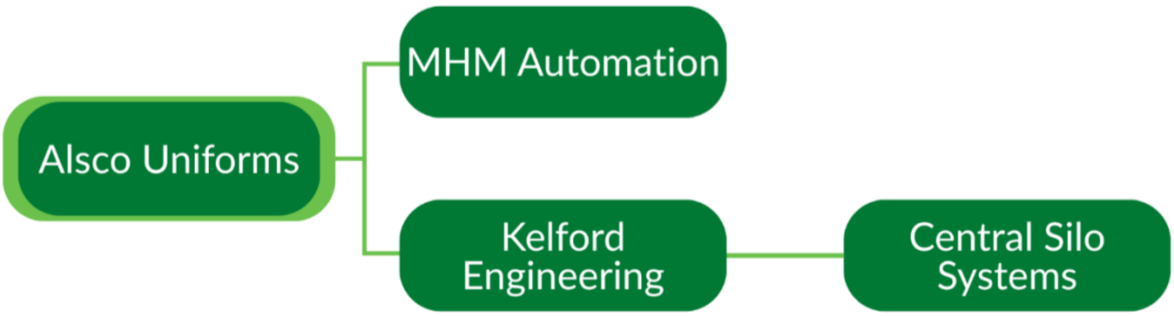


Figure 10: Turnkey Model

4.2 Boiler Transfer

As shown in Figure 11, the boiler house roof had to be temporarily removed for 3 days to allow a crane to lift the old boiler out and lower the new boiler in. The boiler foundations were inspected and MHM altered the boilers steel skid for it to sit on the existing concrete foundations. The boiler house was cleaned via water blasting and the new boiler lifted into place.

Figure 11: Old Boiler Removal and New Boiler Installation

4.3 Temporary Diesel Boilers

During the installation, three diesel boilers were hired to provide steam to site. The total cost of the temporary boiler hire and fuel was $280,000 for the three weeks they were in operation. Such cost was planned for and included in the cost estimate. Tie-in piping for the diesel boilers was previously installed to allow for temporary boilers should the coal boiler fail.

Figure 12: Temporary Diesel Boilers

4.4 Biomass Silo System

During construction of the foundation for the silos the soil was found to be contaminated. A soil decontamination process was followed which took six weeks. The silo foundations were modified to reduce the impact caused by contaminated soil. The new boiler was installed and ready to be commissioned whilst the silos were onsite but not assembled.

After 3 weeks of running the diesel boilers as planned, the soil decontamination works still ongoing, so a temporary plastic silo was installed to allow the boiler to be commissioned as planned and reduce costs with the diesel boilers. The temporary silo was used for 5 weeks and during this time daily deliveries of pellets were provided by Azwood to keep the small plastic silo topped up.

4.5 Operation

The boiler operates for approximately 10 hours per day, 5–6 days per week, matching the steam demand profile of the laundry plant. Each morning, the boiler heats from approximately 4 bar to 9 bar within one hour. Startup is initiated by the operator using the local programmable logic controller (PLC) interface, followed by manual lighting of the pilot flame. Prior to ignition, the fixed grate is raked to remove residual ash and prevent airflow blockages.

Routine maintenance requirements are low; annual servicing can be completed within a single weekend, compared to the previous coal boiler which required two separate weekends and incurred roughly double the maintenance cost.

Ash production is significantly lower than the previous coal-fired system. The former boiler generated around 20 wheelbarrows of ash per week, which required off-site disposal. The new biomass system produces approximately one wheelbarrow of ash per week. The cost of coal ash removal was built into the cost of coal as the coal truck would take away ash after coal was delivered.

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 4 is a simplified version of the supervision requirements. This new boiler at Alsco Uniforms is a limited attendance boiler. The system is capable of remote monitoring and control. All engineering staff are trained to Boiler Operator Level 3.

Table 4: Simplified Supervision Requirements

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

4.6 Performance

The boiler was supplied with a 12-month warranty. During the initial commissioning phase, minor performance issues were observed, where the boiler struggled to achieve the expected firing characteristics under certain load conditions.

To address this issue, several solid plates within the furnace were removed and replaced with additional grate sections. This modification improved airflow distribution and fuel burnout, resolving the problem and allowing the boiler to operate as intended.

Steam quality and supply pressure remain consistent with the previous system, and the site has not experienced any significant issues since commissioning. The Vekos firetube boiler has an expected service life of over 30 years, and Alsco Uniforms reports that the design performs particularly well under their daily start-stop operating regime, providing strong reliability and suitability for industrial laundry applications.

Table 5: Boiler Performance Details

#	Parameter	Unit
1	Model	Vekos Firetube Boiler
2	Maximum Continuous Rating (MCR)	3 MWth, 5,450 kg/hr (F&A 100°C)
4	Steam temperature and pressure	192°C and 10.9 bar(g)
5	Gross thermal efficiency	82%
6	Scope 1 & 2 emission reduction compared to coal	95%+

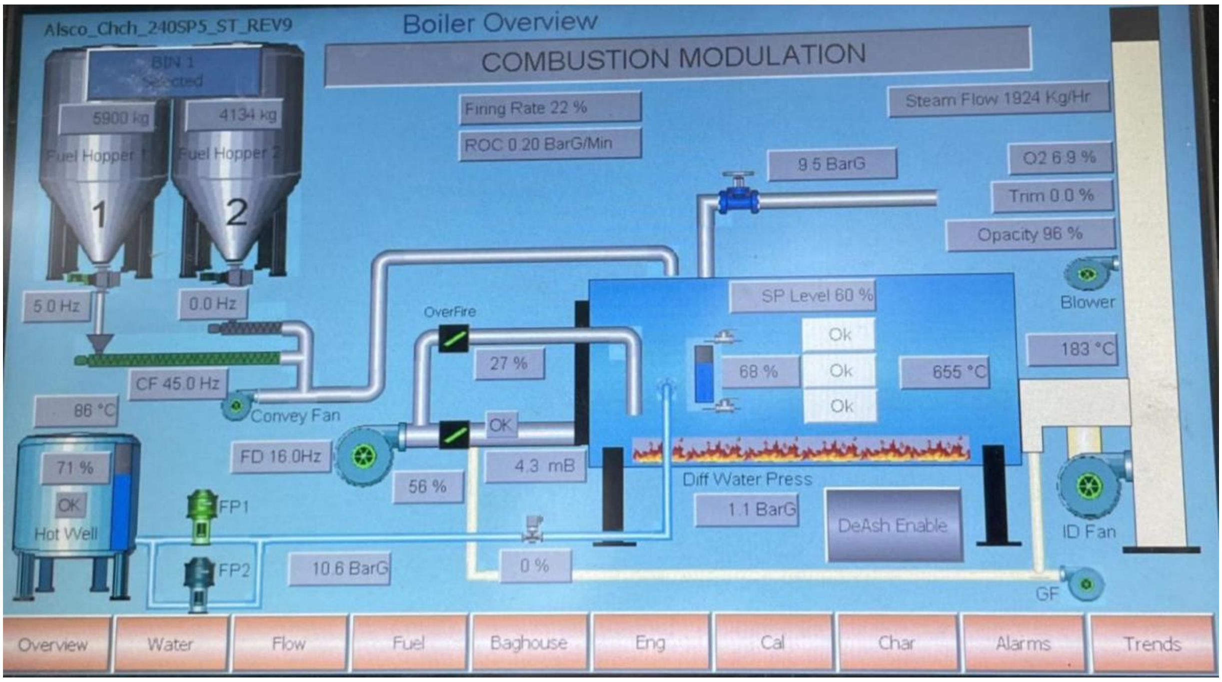


Figure 13: Silo & Boiler System HMI Panel

4.7 Biomass Supply Chain

Alsco Uniforms pay for the wood pellets on a mass basis payment with quarterly testing done on the wood pellets by an independent testing service called Verum group. The approximate moisture content is around 7-8%, the calorific value is 18 MJ/kg, and the ash content is 0.4%. The actual steam flow achieved from the boiler meets what Alsco Uniforms specified.

There have been no significant supply chain issues that have affected Alsco Uniforms' operations since their relationship with Azwood began. No blocks in the pipework have halted operation after the boiler and wood pellet system was fully commissioned.

There is no dust on delivery days nor during boiler operation which is important for an urban environment. The noise from wood pellet blowers and pipes outside the boiler house is low enough to not breach noise limits, and inside the boiler house it is said to be quieter than the boiler air fans. There has been one instance where a month's wood pellets supply did not meet specification due to a faulty machine. Alsco Uniforms received a full refund for this.

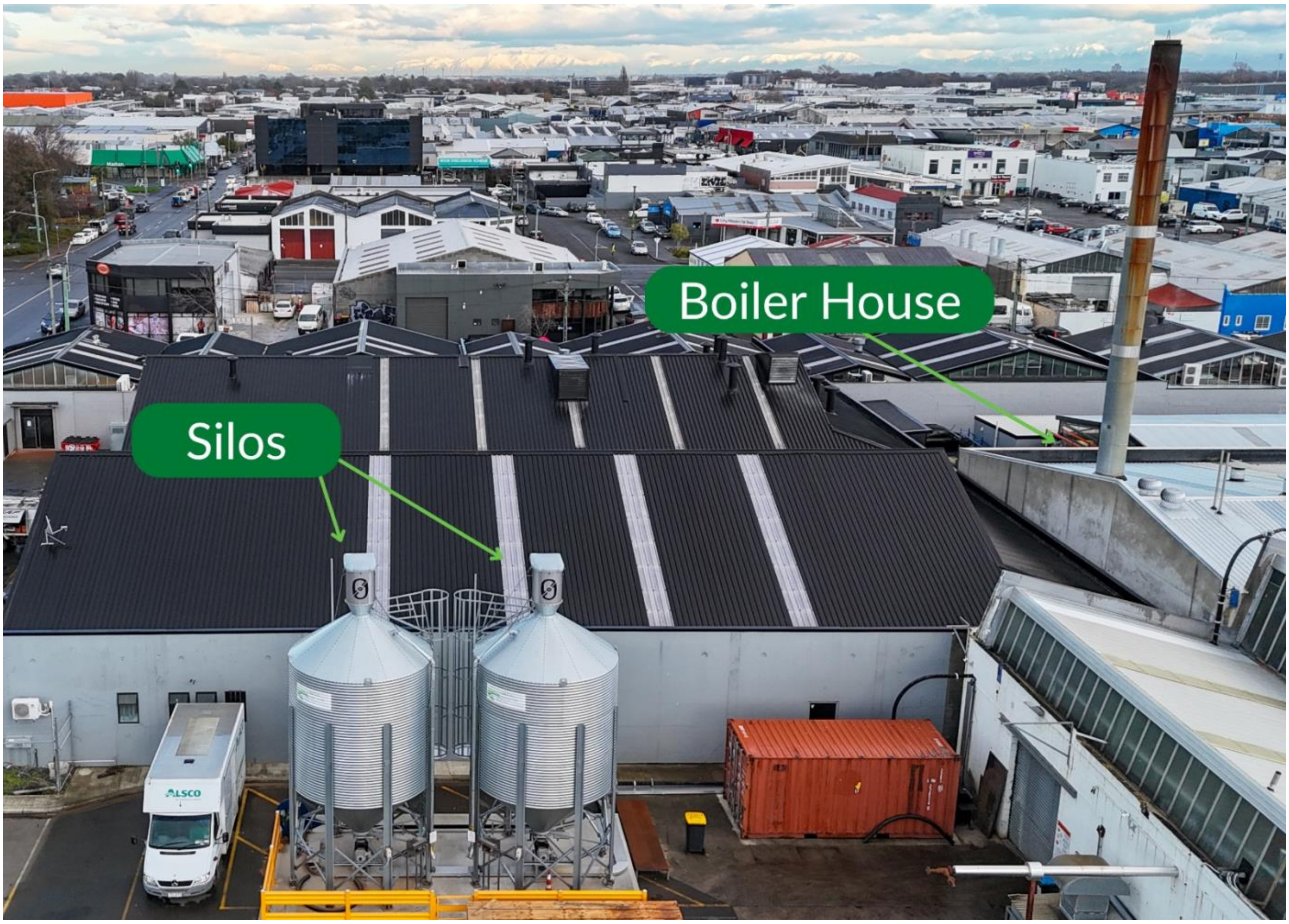


Figure 14: Silo System and Boiler House

4.8 Silo System Photos

Figure 15: Silo System Photos

4.9 Boiler System Photos

Figure 16: Boiler System Photos

5 Commercial Aspects

This Chapter outlines the key decisions, approvals, and financial considerations for the Christchurch pellet boiler project. It covers the business case and Board approval, capital and running cost estimates, and the resource consents required to proceed. The chapter highlights the rationale for replacing the coal boiler, the projected emissions reductions, funding support, and regulatory compliance.

5.1 Approvals

The Uniforms Board approved the project based on the business case. The decision criteria included:

a) The coal boiler required extensive maintenance

b) Long-term energy security of wood pellet supply and the low pellet price volatility

a) Pre-approval of a resource consent for a new pellet boiler

b) The availability of Government Investment in Decarbonising Industry (GIDI) co-funding:

    a. This lowered capital costs and which reduced financial risk

c) This project would allow Alsco Uniforms to eliminate coal from Alsco Uniforms' operations and meet its sustainability goal 5 years ahead of their 2030 goal,

    a. Annual emissions abatement was ~2,617 tCO_2-e/yr

    b. This project helped them to achieve a 60% reduction in carbon emissions in NZ based operations compared to their 2019 baseline

There was no payback related to the project because the coal boiler was due to be replaced.

5.2 Capital Costs

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 6.

Table 6: 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%

Lumen developed a Class 3 cost estimate (-20%/+30%) for this project. Table 7 shows the actual capital costs, which does not include the diesel boiler hire and fuel costs, as this was deemed to be an operational cost, as opposed to capital cost.

Table 7: Capital Costs

#	Item	Capital Cost (NZ$ exc. GST)
1	Boiler Cost from MHM Automation	$780,000
2	Kelford Engineering Turnkey Cost *including temporary boilers and some other minor projects costs	$2,302,000
3	Total Capital Cost	$3,082,000 *1.4% over the cost estimate
4	Specific Capital Costs	1.03 $/MWth
5	GIDI Co-funding	$1,070,000

5.3 Running Costs

The cost of pellets is approximately +50% higher than the cost of coal. Annual survey and maintenance costs are around a third, or $12,000, lower than the coal boiler, and the survey can be completed in a single weekend. The auger system with the previous coal handling system required a lot of maintenance. Maintenance on the water and steam systems are practically the same. Manual operation costs are the same. Ash removal is outsourced to the ash bin hiring company at approx. $4,800 per annum. There was no payback associated with the project because this was an asset replacement project.

5.4 Resource Consent

A new resource consent was required which was outsourced to John Iseli, who is an air quality consultant with Specialist Environmental Services. The new consent was gained before the project was approved. The flue stack was re-used. Testing has been done by Verum group for total suspended particles which found the boiler and flue stack to pass all council discharge emission requirements. This process went very smoothly and engaging a specialist is key.

A resource consent was also needed for excavation of contaminated soil, which was unexpectedly found when constructing the base for the pellet silos. This led to an unexpected delay of 6-8 weeks required to move the contaminated soil before the large silos could be installed. Note that this did not delay the boiler commissioning as Alsco Uniforms had installed a temporary plastic silo to allow pellets to be stored and handled.

6 Shared Learnings

Table 8 lists the industry learnings from this project that could be applied to similar energy transition projects.

Table 8: Shared Learnings

#	Category	Key Industry Lessons
1	Concept & Feasibility Design	h) Set-up energy projects for success early by completing structured energy transition studies to identify practical, financially viable and low risk options - external energy specialists can be engaged with government support through EECA i) Experience from previous decarbonisation projects at other sites helped inform the selection of biomass technology and storage solutions j) Leverage prior experience, or review relevant publicly available information, such as case studies k) Ensure fuel supply chains are mature and reliable to minimise operational and delivery risk l) Size equipment to match actual demand to lower costs and improve efficiency m) Sustainability goals can be progressed alongside asset management plans n) Complete pilot tests where practical, for example trial burning pellets in an existing solid fuel handling and boiler systems
2	Detailed Design & Procurement	d) Long-term pellet supply contracts of up to 10-years are possible e) MHM Automation in Christchurch manufacture well proven fire-tube boilers which requires limited attendance and are cost effective for daily utilisation at the 3 MWth scale f) Silo suppliers, such as Central Silo Systems, can supply silos which 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	e) The project was delivered under a turnkey model with Kelford Engineering managing the decommissioning of the old boiler, installation and commissioning of the new boiler and fuel handling systems, and coordination with suppliers f) The existing boiler house and flue infrastructure was reused g) Temporary diesel boilers were used to ensure continuous supply during boiler changeovers - fortunately Alsco Uniforms had existing tie-in points for temporary steam boilers h) The main challenge during project delivery was the discovery of contaminated soil during excavations for the silo, which did not lead to a delay in commissioning the boiler due to use of a temporary silo, but required additional work. This highlights the importance of ground assessment reports
4	Commercial Aspects	e) Use standardised cost classifications (e.g., AACEi Class 1–5) to communicate estimate accuracy and manage stakeholder expectations f) The project received board approval based on a business case which benefited from Government Investment in Decarbonising Industry (GIDI) co-funding, which reduced capital costs and financial risk g) The capital cost of $3,082,000 for a 3 MWth steam boiler, at this delivery quality, pace and scale, which is good value at 1.03 $/MWth h) Resource consent approval for a pellet boiler in a city, was ensured through early engagement with specialists and installation of grit arrestor and bag house to reduce particulate matter (dust)