Programme Reviews
Wood Energy South

Document purpose:	This document is the result of the programme reviews EECA and MBIE conducted across EECA's programme portfolio in 2016. The reviews were in response to a requirement to reprioritise the EECA's portfolio in the context of the new NZEECS, the new EV programme, and expanded levy. The framework for the review is available here. The reviews were based on existing documentation and workshops with MBIE, PwC and EECA staff.

About Wood Energy South

In 2013 the Minister of Energy and Resources commissioned EECA to investigate new opportunities for energy efficiency and carbon savings outside EECA's mainstream programmes. The Wood Energy South (WES) pilot programme is one of four small-scale and innovative programmes designed to meet this request.

The programme focuses on the transition of existing boilers to wood energy fuels in Southland to build a functioning and sustainable wood energy supply chain that reduces emissions from the region's industrial and commercial sector. This intervention includes:

- credentialing heat specifiers (consultant engineers)
- subsidising feasibility studies (75% up to $15,000 for small sites, and 40% up to $50,000 for large sites)
- providing information and case studies on the use of wood energy
- providing capital grants (40% up to $100,000) and Crown loans to aid conversion of the boilers

The delivery partner is Venture Southland[1], which manages the project and brings in local knowledge, contacts, and credibility to WES. EECA provides oversight, funding and support delivery.

Conclusions

- As a pilot, the direct engagement aspects of the Wood Energy South programme proved to be sound. However the cluster development aspects need to be better understood before further replication. It was optimistic to attempt to develop a cluster in three years.
- There is a strong role for government to address multiple failures – information, nascent market and unpriced externalities. The programme also has strong alignment with the proposed NZEECS priorities.
- More analysis is required on the economic potential of private sector boiler switching in New Zealand, and a better understanding of the drivers and decision factors involved in this.
- A higher rate of return on public investment would be achieved if large clients were targeted for switching and a supply chain cluster was then developed around this large client.
- Wood fuel does not work out economically at an organisational level in Southland. Where wood fuel is currently being considered there are usually drivers beyond the strictly economic (e.g. corporate social responsibility, impending air quality standards).

Recommendations

- Utilise MBIE and EECA's analysis of opportunities for private sector boiler switching (in particular, evidence of public benefits and market readiness), and then consider the opportunities for further development around potential large clients.
- EECA should establish whether there are sufficient benefits and willingness to justify programme intervention in terms of switching government boilers, and what lessons from this pilot can be picked up in the refocused business programmes.

[1] Venture Southland is the regional economic development agency in Southland.

Contents

1 The problem

1.1 Problem description

Businesses are not prioritising opportunities to improve their energy efficiency and reduce carbon emissions by switching their heating fuel sources from fossil fuels to wood. This is not occurring because:

- they are not incentivised to switch – coal remains the cheapest option
- businesses do not know about alternative options
- businesses do not know or understand the other benefits of alternative fuels
- the market for alternative fuels is still small and new, so there are few participants
- assets are long-lived and only replaced at certain points in time
- businesses can lack capital to invest in more expensive plant

The biggest issue hindering uptake is that in addition to greater capital costs, wood fuel in general costs more per GJ than coal (Figure 1). However, wood energy is much cheaper than LPG, electricity and diesel.

Figure 1: *Fuel costs per GJ by fuel type for industrial heat*

This pricing information is based on EECA monitoring and the Ministry of Economic Development's New Zealand Energy Data File 2009 Commercial Prices.

Source: Figures calculated from Wood Energy Programme, EECA, April 2008.

1.2 Why is it a problem?

Industrial heat accounts for around 32 per cent of New Zealand's energy use, 80 per cent of which comes from fossil fuels. In Southland, this fossil fuel combustion is primarily coal which produces greenhouse gases and air pollutants. Industrial heat users could be producing less greenhouse gas emissions and air pollutants if they switched to alternate fuels, such as wood energy.

1.3 The programme

1.3.1 Origins

In 2013 the Minister of Energy and Resources commissioned EECA to investigate new opportunities for energy efficiency and carbon savings outside EECA's mainstream programmes. The Wood Energy South (WES) pilot programme is one four small-scale innovative programmes designed to meet this request.

The other three pilot programmes were the Fuel Efficient Tyres programme (2014 – 2016), Heavy Vehicle Fuel Efficiency programme (2014 – 2017), and Lower Carbon Meat and Dairy programme (2014 – 2016). Each pilot programme was funded from a small amount of retained earnings rather than baseline.

1.3.2 Purpose

Wood Energy South aims to reduce carbon dioxide emissions and facilitate the development of a sustainable wood energy supply chain in Southland by facilitating the switch in heating fuel sources from coal to wood. The project builds on the thermal energy switching opportunities identified in the 2011 Southland Wood Energy Demand Assessment[2] and it represents the implementation phase of the Demand Assessment. WES is funded over three years (2014-2017) and aims to lower energy-related carbon[3] emissions in Southland, improve air quality and demonstrate the cost and life-cycle benefits of wood-fuelled boilers using local wood resources.

1.3.3 Key components

The programme focuses on the transition of existing boilers to wood energy fuels in Southland to build a functioning and sustainable wood energy supply chain that reduces emissions from the region's industrial and commercial sector. This intervention includes:

- credentialing heat specifiers (consultant engineers)
- subsidising feasibility studies (75% up to $15,000 for small sites and 40% up to $50,000 for large sites)
- providing information and case studies on the use of wood energy
- providing capital grants (40% up to $100,000) and Crown loans to aid conversion of the boilers

The delivery partner is Venture Southland[4], which manages the project and brings in local knowledge, contacts, and credibility to WES. EECA provides oversight, funding and support delivery.

1.4 Market characteristics

The wood energy market in Southland involves heat users, heating system specifiers, boiler suppliers, wood fuel suppliers, forest owners and Venture Southland technical advisors. A variety of contracts may be needed to successfully execute a project. Key contracts may include fuel supply, major equipment supply and/or installation, project engineering and management, and operation and maintenance (and possibly heat supply).

Heat users

There are 160 boilers across 110 businesses in the Southland region, with a total capacity of 595 MW. As the owners of the boilers, the heat users are responsible for establishing and approving the level of heat demand and to gain permissions such as resource consent.

[2] X:\Grants & Funds (GF)\05 Business Programme grants\06 Renewable Heat\03 Clusters\Hub business case\Venture Southland - Wood Energy Demand Assessment - EIS Energy - Final Report.pdf

[3] In this report the terms 'carbon' and 'carbon dioxide' are used as catch-all terms for greenhouse gas emissions. Emissions are expressed in units of tonnes of CO_2-e.

[4] Venture Southland is the regional economic development agency in Southland.

The boilers are operated across a range of sectors covering large industrial activities such as dairy processing, meat processing, general manufacturing and wood processing, commercial sector activities such as accommodation and rest homes, and the public sector including local government, health care, community facilities, corrections, and education (schools and tertiary education). Boilers are part of hot water and saturated steam systems.

The 160 boilers represent 10% of New Zealand's total boiler capacity. Boilers range in size, with the majority being between 500kW to 10MW, although some larger boilers have a capacity up to 40 MW (see EECA Heat Plant Database).

Fifty-six per cent (62) of the total number of boilers use coal which makes up 81% of total boiler capacity in Southland (Table 1).

Table 1: *Fuel type of boilers in Southland*

Fuel type	% of boilers	% of capacity
Coal	56%	81%
Diesel	11%	1%
Electricity	7%	<0.5%
Wood	14%	14%
Unknown	12%	4%

The majority of the coal boiler capacity is in the industrial sector (93%), with a small amount in the public sector (7%) and a fraction of a percent in the commercial sector.

Boilers are long-lived assets that are replaced approximately every 30-40 years. Only around 17 per cent (27) of the boiler fleet are due for replacement in the next ten years.

The decision to replace a boiler can be triggered by different situations. In most situations, expert advice is needed either from heat plant suppliers (for small and medium systems) or an engineering consultant (for large systems). Use of wood energy is uncommon and varies regionally with the availability of fuel. Consequently, there is a risk that advisors without experience of wood energy and local knowledge of fuel availability will overlook wood as an option or discount it early in the decision process.

The situations that lead to consideration of wood energy at existing facilities[5] are:

1. Boiler failure – major component failure during period of heat demand or failure to get an operating certificate (more likely for smaller users with poor maintenance regime).
2. Boiler near end of life – maintenance or reliability issue with major components or an expiring air discharge consent (covers most planned replacement situations).
3. An opportunity exists to lower total cost of heat production (applies to high-cost fuels such as diesel, LPG and converting from manned to unmanned operation to reduce operating costs).

The process of option identification, evaluation and selection is outlined in Table 2. The timeframe for replacement of boilers or conversion to different fuel systems may vary from several days for small heating systems and boiler failure situations to several years for large systems requiring major capital investment.

[5] Note the choice of heat plant and fuel type for a new site will be similar to situation 2 and 3 above, but often with fewer physical constraints relating to fuel delivery and storage.

Table 2: *Trigger points and decision process for considering wood energy*

1. Boiler failure Focus: immediate reinstatement of heat, costs often secondary	2. Boiler near end of life Focus: long-term reliability; whole of life costs subject to capital availability	3. Lowering cost of heat Focus: whole of life cost, fuel conversion of existing heat plant or replacement of plant
Evaluate following options: a. Use of electricity b. Temporary heat generator (e.g. diesel) c. Rapid replacement	Determine existing and future changes in heat demand including reduction options	As for situation 2
Select option based on minimising down time of heat supply, availability of capital and impact on operations	Identify range of replacement options i.e. boiler only, boiler plus fuel system, central or decentralised systems	As for situation 2 but including the option of only converting the fuel supply and storage system of the existing heat plant
Implement (if option a or b chosen then long-term solution reverts to situation 2)	Evaluate options: technical feasibility; capital and operating cost; fuel availability	As for situation 2
	Select best option based on capital availability, security of supply, impact on operations	As for situation 2
	Implement	**Implement**

Many coal-fired boilers can be adapted to burn small to moderate proportions of biomass fuel in conjunction with reduced flow of coal fuel (co-firing). The proportion of biomass that can be co-fired will be different for each make of boiler and limits could arise due to mechanical or combustion performance constraints – bespoke advice should be sought on co-firing limitations, particularly for higher biomass fractions. There is currently no traditional co-firing in Southland. However, one sawmill is co-firing a small amount of coal with their waste sawdust (7:1 ratio) to improve fuel energy density.

Table 3 summarises the advantages and disadvantages of a coal and wood fired boiler heating system.

Heat specifiers

Heat specifiers are consultant engineers who design and develop the specifications for heating systems, and undertake heating system projects across the industrial and commercial sectors. Consultants develop technical specifications and can inform commercial evaluations to establish business cases. The evaluations may consider economic viability, system and project design (heat loads, fuel suppliers, plan design), and contracting.

Consultants are generally IPENZ registered. Fourteen technical consultants are promoted by Venture Southland and range from large consultancy firms, such as Opus, to smaller companies and individuals.

Table 3: *Pros and cons of coal and wood fired heating systems*

Fuel type	Advantages	Disadvantages
Coal Fired Boiler Heating System	• Low capital cost to replace when existing set up is a coal fired boiler • Low energy costs • Long economic life of 20 to 25 years on boiler when operating on high grade coal • Radiator heating is quiet and comfortable with long economic life	• High maintenance costs on boiler system • Staff required for daily cleaning • Staff require regular training to ensure economic operation and long life of the boiler • Dirty fuel contributes to air pollution and global warming • Shortage of high grade coal
Wood Fired Boiler Heating System	• Low energy cost (compared to LPG and diesel but not coal) • Sustainable fuel • Good economic life of 20 to 25 years depending on boiler type • Low maintenance costs • Clean burning • Carbon neutral so no carbon tax • Radiator heating is quiet and comfortable with long economic life	• High capital cost • A lot of space required for wood chip store • A lot of plant space required for boiler and buffer tank • Long lead-in time for boiler delivery

Equipment suppliers, installers and commissioners

Wood boilers are available locally in Southland, from six boiler suppliers.

There are several types of wood chip boilers available with varying combustion and feed mechanisms. Wood chip boilers use heat exchange surfaces to heat water and are a good option for hot water heating systems and for large users of hot water (e.g. hotels, prisons) or steam users (e.g. meat and dairy processors). There are also a range of wood pellet boilers available. Wood pellet boilers operate in a similar way to wood chip boilers but are designed to burn pellets efficiently.

Suppliers play a range of roles which can include:

- carrying out detailed system design
- selecting plant items (make and model)
- carrying out or subcontracting foundation design and structural design
- mobilising staff and transport to install and commission plant
- on-site assembly, installation and commissioning of plant
- training

Fuel suppliers

There are two wood fuel suppliers in Southland. The Niagara and Findlater sawmills supply dry timber processing residues from two sawmills. These suppliers provide a high quality fuel and have reasonable capacity to supply the market. Nature's Flame and Spark Energy also supply the region, although they are based outside Southland.

In Southland, more than one million tonnes of logs are harvested annually and this is projected to continue to increase to 1,550,000 tonnes in the next 30 years.[6] Almost half of this is exported.[7] The annual waste wood volume is currently 200,000 tonnes and will increase to 600,000 tonnes per annum over the next 30 years[8].

In boiler projects, the fuel supplier often takes responsibility to make minimum and maximum quantities of fuel available within a specified term, ensuring that delivered fuel remains within defined specifications. The supplier also maintains agreed stockpiles (or agreed alternative sources) to ensure continuity, and achieves "certified supplier" status under the Bioenergy Association of New Zealand accreditation scheme if required.

The fuel supplier's responsibilities will be specified in the fuel purchase agreement, but should include sourcing of "raw" fuel, fuel preparation, storage, insurance, quality control and delivery to the point of change-of-ownership, within the agreed quality specification. Delivered price should include all cost components up to the point of transfer of ownership.

Biomass types and characteristics

There are three main types of wood fuel – pellets, wood chip and hog fuel[9]. In Southland, wood chip is the main source of fuel, although pellets are used at two schools. The most appropriate fuel type for an organisation will depend on factors like location, energy requirements, existing wood burning technology and site characteristics (such as fuel storage capacity). The quality of the fuel is a key influencer of fuel supply decisions; the quality factors include moisture content, measurement, and variability (e.g. practical ranges, contaminants and effects).

Figure 2: *Simple supply chain for wood*

All of Southland's current chip supply for energy use is dry chip from existing by-product from sawmills. Outside of Southland, wood chip is also produced by using existing local low-value log products which are

[6] See www.woodenergysouth.co.nz/s/Southland-Wood-Residue-Supply-Assessment.pdf. (Table 2)
[7] See www.woodenergysouth.co.nz/s/Southland-Wood-Residue-Supply-Assessment.pdf. (p32)
[8] See www.woodenergysouth.co.nz/s/Southland-Wood-Residue-Supply-Assessment.pdf. (Figure 1)
[9] Hog fuel is wood residue and waste product that is processed through a chipper or mill and produces coarse chips and clumps normally used for fuel.

currently marketed and sold into alternative markets (exported or sent to a medium-density fibreboard plant) and from capturing wood residue from the forest site (e.g. green chip; see Figure 2).

In Southland, a functioning market for green chip from forest residues is yet to be developed and will be dependent on demand and price once larger industrials convert.

Because the market for wood fuel is small in Southland (due to low demand), there is a lack of price disclosure and signalling for forward contracts. Wood chip suppliers are also aware of the risk of losing their traditional customers in the wood processing sectors (medium-density fibreboard production) by supplying new customer segments who may compete with existing customers for supply. As demand for traditional wood products is sufficient, suppliers have little incentive to pursue interaction with groups who would potentially buy chips for wood fuel.

The Bioenergy Association of New Zealand provides a Wood Fuel Supplier Accreditation Scheme designed to give purchasers confidence in the quality and security of supply of biomass fuel.

Forest owners

Forest residues are leftover from harvesting for timber production or logs for export. Timber is higher value than wood fuel so forest owners are incentivised to reduce waste during harvest to maximise volume of timber and minimise waste which could be used as wood fuel. Forest owners are economically incentivised to sell off any residues that are leftover for wood fuel only if the price exceeds cost of recovery.

It is expensive to remove the residues from forests. Residues need to be extracted at the same time as logs are harvested to reduce handling costs.

An evaluation of EECA's previous wood energy programme noted that "the lack of demand for wood fuel is hindering forester (or wood supply contractor) willingness to invest recovering fibre from the forests".

2 Strategic fit

Table 4: *Strategic alignment of Wood Energy South*

NZEECS 2011-2016	Alignment
Target: "Utilise up to 9.5 PJ per year of energy from woody biomass or direct use geothermal additional to that used in 2005."	Wood Energy South encourages industrial heat users in Southland to switch from fossil fuels to woody biomass.
Business Growth Agenda	**Alignment**
"Increase productivity and reduce carbon emissions through new energy efficiency projects"	Wood Energy South aims to reduce carbon emissions associated with process heat in Southland.
"Ensure well-functioning markets, and identify and remove regulatory barriers to support renewable energy and reduce carbon emissions"	Wood Energy South aims to encourage the development and effective functioning of the wood energy market in Southland.

3 Role for government

3.1 Market failures and barriers

The role for government is based on the presence of market failures and market barriers. The primary failures and barriers preventing the uptake of further use of wood energy are:

- A lack of information and understanding
- A nascent and emerging market for wood fuel
- Unpriced externalities from the use of fossil-fuels.
  Affordability

3.1.1 Market failures

Lack of information and understanding

Where participants lack information and understanding, there is a role for government in ensuring that they have the information they need to make informed decisions, and to assist them more directly when they lack capacity to deal with that information. Heat specifiers and decision makers are not fully informed of the benefits of wood fuel over fossil fuels (coal, LPG or diesel). Energy users are unaware of the alternatives, and suppliers are sometimes unaware of the opportunity.

A nascent and emerging market for wood fuel

In markets that are small and still developing, there can be a role for government to coordinate between buyers and sellers until the market is of sufficient size to manage itself. Until that point you may find that, while the optimal state would include buyers and sellers entering the market, uncertainty over the timing prevent each from making initial moves. A low number of buyers prevent sellers from entering due to uncertainty of demand; buyers are reluctant to enter when only a few suppliers exist and supply is uncertain.

In these cases, there is a role for government in coordinating between buyers and sellers, informing each of the size of the market and providing venues and forums for each to connect. By lowering the transaction costs and providing information on where the buyers and sellers are, the government helps the market get over the initial hurdles of uncertainty and begin trading until it is of sufficient scale that the market will provide that information and certainty for itself.

Demand for wood fuel is characterised by immature supply chains and the perceived risk of insufficient amounts of fuel being available, and available at the right price. Without sufficient demand there is little incentive for the forestry sector to prepare wood fuel for sale. There is a lack of confidence in the technology and existence of a long term, sustainable, competitive supply chain. Given this, and the fact that there is long technology 'lock-in' due to asset lives of 30-40 years, there is a role for the Government to assist with information and coordination until a market develops.

Unpriced externalities

Wood fuel is more expensive than coal. One reason the price of coal is so low is that the market price for coal fails to capture all the externalities associated with its use – in particular, the costs associated with air pollution and resulting detriment to human health. Other environmental costs such as the costs of greenhouse gas emissions are priced into the cost of coal via the New Zealand Emissions Trading Scheme, however this price may not be sufficient to change behaviour. Optimally, these externalities can be included in the price through taxes or a market scheme. Where this is not practical, Government can have a role in regulating the effects or subsidising alternatives.

3.1.2 Market barriers

Affordability

A wood-fired heat plant has a higher initial capital cost than heat plant fuelled by coal, natural gas, LPG, diesel, fuel oil or electricity. As such renewable heat faces an initial capital expenditure hurdle, especially when the heat plant is competing for limited capital allocation.

3.2 Potential benefits

Table 5: *Public and private benefits expected from Wood Energy South*

Public benefits	Private benefits
• Avoided greenhouse gas emissions (primary) • Improved air quality	• Reduced maintenance costs • Lower fuel costs (LPG, diesel, electricity) • Improved health and safety

Avoided greenhouse gas emissions – primary public benefit

The burning of coal releases greenhouse gases, contributing to climate change.

Improved air quality – public benefit

Coal use is strongly associated with poor air quality. Environment Southland is developing measures to reduce air pollutants in the region. Poor air quality can cause respiratory conditions that require hospitalisation, which costs the public health system. This particularly affects the elderly and children.

Reduced maintenance costs – private benefit

Wood boilers require less maintenance than coal boilers. Further, corrosive emissions from coal boilers can reduce the life of surrounding roofing materials.

Lower fuel costs – private benefit

Where businesses are converting from LPG to wood, they will save money in the long-run through lower fuel costs. This benefit does not apply to conversions from coal.

Improved health and safety – private benefit

Coal ash is more difficult to handle than wood and can put workers' safety at risk with a higher likelihood of getting burned.

3.3 Potential costs

There are no logical private sector players who would be solving the problem, so crowding out is highly unlikely.

Lower fuel costs will accrue to only those businesses which switch from LPG, diesel or electricity to wood energy. The programme has the potential to increase fuel costs for businesses using coal-fired boilers, but this may be offset by unquantified benefits like reduced maintenance and improved health and safety. As a voluntary programme, as long as information is presented accurately, businesses can choose whether or not to trade-off different types of costs.

4 Intervention

4.1 Intervention logic

An intervention logic diagram is provided in Appendix One. It was developed during an internal programme review in late 2015.

4.2 Options

Options considered for the pilot at its inception were based around resource provision, rather than the intervention itself. The main alternative to WES would be business as usual. With the status quo, there is great uncertainty in the market and a low likelihood the nascent wood fuel market would mature in the immediate future.

The WES project was chosen after consideration of various options, including:

- the reason for using the cluster approach
- development of multi-site clusters (regions considered included Nelson/Marlborough, the Bay of Plenty and Southland)
- selection of a preferred site
- promoting supply and demand versus demand-only projects

Southland was chosen following a review of the heat demand, available fuel supply, and suitable project partners in the region. It has a high demand for heat for commercial premises such as schools, offices, rest homes, hospitals, and for industrial processes such as meat works, other factories and a growing dairy processing industry. Southland also has a significant forestry and wood processing industry, which generates an estimated 300,000 tonnes of wood waste a year that can be used for energy. The regional energy strategy also includes increased uptake of renewable energy as a key component.

4.3 Investment objectives

Expected outcomes of the programme include sustainable growth in the wood fuel supply chain, development of a functioning wood supply cluster and improved understanding of the benefits of wood energy. The programme's targets are:

- a 0.15 PJ increase in annual wood fuel energy use in Southland
- 8,000 tonnes per annum of national CO_2 savings.

4.4 Potential impact

By reaching its targets, WES would result in:

- 0.15 PJ of end-use boiler capacity switching from fossil to wood fuels, resulting in 195,000 tonnes of CO_2 (lifetime) avoided
- a functioning wood energy cluster in Southland encompassing additional supply and demand market participants
- advice on heat provided by specifiers active in the Southland market including accurate information on wood energy as an option

- heating systems that comply with the requirements of the planned Environment Southland Air Plan (note that coverage of industrial and commercial emissions under the Regional Air Plan 2016 will be reviewed in the future)
- a net present value of $10.07m and benefit-cost ratio of 3:1 for New Zealand[10]

4.5 Market readiness

As boilers are long-lived assets, there are a limited number of opportunities for conversion in the short run. Only two to five boilers over 100KW are due for replacement each year.

Coal is the predominant fuel in Southland. There is little awareness of wood energy in the market, but future changes to local air quality restrictions is putting pressure on firms to consider alternatives to fossil fuels. Previous resource studies identified availability of wood fuel in the Southland region, but these need to be updated with the latest information and costs.

No issues with the availability of wood boilers with both New Zealand-built and imported European plant readily available for installation.

At the beginning of the programme, Venture Southland identified themselves as a willing business partner. They identified having the capability to drive the initiative, provide local insight, contacts, and credibility to the programme. This shows the market is taking steps to mature the local wood fuel market, and accelerate the diffusion of wood fuel boilers.

4.6 Risks

At the outset of the programme, EECA identified the following potential risks to the programme.

Table 6: Potential risks and mitigations for Wood Energy South

Risk	Probability	Impact	Mitigation
Venture Southland does not get engagement with the local business community.	Low	High	EECA will support Venture Southland's communications strategy and exploit existing EECA relationships in the region.
Consultants provide incorrect advice to heat plant users.	Medium	High	A consultant competency and accreditation scheme will be developed.
Not enough sites elect to switch to wood fuels.	Low	High	Active promotion of the grant offering.
A functioning cluster does not result from the programme.	Medium	Medium	Prioritise projects that support multiple users and suppliers being established.
There is insufficient supply in the region.	Low	Medium	Encourage other suppliers to start operating in the region.
Projects are a threat to health and safety.	Low	High	EECA will make it a contractual requirement that the recipients of grants implement and manage the Demonstration Project with all due care and skill and to a professional standard. This includes compliance with the *Health and Safety at Work Act 2015*; specifically, that the business ensure, so far as is reasonably practicable, the health and safety of workers

[10] Assuming a boiler life of 23 years, a 50% utilisation factor, and a mix of conversions from coal, diesel and LPG.

			and others affected by the business or undertaking.
Projects have negative environmental impacts	Low	High	EECA will make it a contractual requirement that the recipients of grants implement and manage the Project with all due care to avoid, limit, or mitigate negative environmental impact(s), including taking all necessary steps to comply with the *Resource Management Act 1991* (RMA), relevant regional policy statements and plans, and district plans (as defined in the RMA).

Following the commencement of WES, additional risks were identified, including:

- Fewer conversion opportunities than originally assumed.
- Slower pathway than originally anticipated for Southland's air quality review – the proposed regional air plan stage 2 will begin once the National Environmental Standard for Air Quality (NESAQ) has been reviewed[11].
- Insufficient capital funding allocated to the project: if conversions accelerated the WES project would not be able to meet demand for capital. (To date this has not been an issue.)

4.7 Interdependencies

Within EECA, WES complements the Top 200 business programme. EECA Account Managers under the Top 200 programme promote wood energy to their customers in the region and provide a link between the WES project and businesses. In addition, the programme fits with energy (process heat) audits to ensure right-sizing of replacement heat plant.

WES also relates to initiatives within the Southland region. The air quality standards under development by Environment Southland were expected to facilitate decisions to convert to wood boilers. The standards development has been delayed and this may have impacted on conversion numbers to date.

4.8 Resource allocation

WES operates with the following resourcing:

- 2.2 FTE in 2015/16
- Spend to date: $1.7 million over two years (including staff salaries)

[11] The current dates set for Gore and Invercargill to reach their PM10 targets under the NESAQ (1 Sep 2016 and 1 Sep 2020 respectively) are unlikely to be met.

5 Performance

5.1 Effectiveness

WES has yet to meet its objectives (as of November 2016). Only 0.006 PJ of the 0.15 PJ target of wood energy conversion has occurred (Table 7). This is because the bulk of converters under the programme to date are schools – relatively small energy consumers, compared with industrial plants in the region.

Table 7: *Progress against targets*

Programme end target	Progress to date
0.15 PJ increase in wood energy use in Southland	0.006PJ (4% of target)
8000 tonnes CO_2-e pa reduction	530 tonnes CO_2-e pa reduction (7% of target)

Of the nine sites in various stages of converting boilers to wood energy, all but s 9(2)(b)(ii) are opportunities for less than 250 tonnes CO_2-e saving per year. If all of the prospects other than s 9(2)(b)(ii) switched to wood energy, the total carbon saving would still be less than 1,900 tonnes per year, or one quarter of EECA's target for the programme.

On the other hand, s 9(2)(b)(ii) the potential to save more than 14,000 tonnes of CO_2-e per year, and 0.2 PJ per year, more than EECA's total target.

s 9(2)(b)(ii) still considering whether to switch to wood fuel, and these decisions, particularly s 9(2)(b)(ii), will determine whether the programme exceeds its targets or fails to meet them.

The wood industry has grown in Southland in recent years. There are now two woodchip suppliers, woodchip boilers are being supplied locally, and, since July 2014, five conversions have occurred, two are in the process of converting, and four sites are considering options for conversion (either through formal feasibility studies or desktop technical studies/advice).

Awareness of benefits of fuel-switching has also increased. Several sites are considering wood energy as a direct result of WES and the quality of advice is good. The Wood energy advisory group and the production of the specifiers guide support more accurate information to the sector.

Developing a sustainable wood energy supply chain is known to be a long-term objective. This is supported by the evaluation of the programme that was the predecessor of Wood Energy South which suggested that it would take 10-15 years to really get the industry well-developed.[12] While they were talking on a national scale it is logical to assume that it may take up to 5-10 years to achieve a successful wood energy cluster in Southland.

5.2 Achieved benefits

To date the programme has nine sites in various stages of converting boilers to wood energy (see Appendix Two). These sites include six schools, Environment Southland, and Slinkskins (lamb and calf skin tanning). Given Southland has 381MW of heat plant capacity, the possible conversion of s 9(2)(b)(ii) to wood fuel would represent a huge success for the programme, should s 9(2)(b)(ii) decide to proceed.

[12] Sinclair Knight Merz Evaluation of Wood Energy Programme 2007/08 –2010/11.

Several small wood energy conversions are commissioned or in progress but large scale conversions will be required to achieve the programme's targets in the project timeframe. To date, WES has brought about over 530 tonnes of annual carbon savings, converting over 0.006 PJ per year of industrial heat to wood energy, and ensured that s 9(2)(b)(ii) are engaging with suitably qualified consulting companies.

5.3 Value-for-money

A cost-benefit analysis was conducted to assess the quantifiable outcomes of EECA's expenditure from programme inception through to the end of the 2015/16 financial year. The results are summarised in Table 8 and details and assumptions are outlined in Appendix Three.

Table 8: *Cost-benefit analysis results for Wood Energy South from 2014/15 to date.*

Metric	Description	Value	Comment
Net present value		-$2M	If 'pipeline'[13] projects are included this improves to $13m.
Benefit-cost ratio	PV all benefits/PV all costs	0.19:1	If 'pipeline' projects are included this improves to 2.17.
ROI Government	PV public (government) benefits/PV public (government) costs	0.07:1	If 'pipeline' projects are included this improves to 1.99.

5.4 Programme future

WES will continue to run until June 2017. Beyond then, EECA will consider looking outside the Southland region, and whether some extension or monitoring in Southland continues. Before then, WES will continue to promote the uptake of wood fuel boilers, and increase EECA account management involvement with key businesses.

6 Lead organisation

The *Energy Efficiency and Conservation Act 2000* clearly gives EECA the mandate to promote renewable energy and undertake demonstration projects making EECA the logical central government agency to lead. Additionally EECA has previous experience with wood energy promotion.

The only other candidate for leading this work is Venture Southland. Venture Southland has led the programme on the ground, with support from EECA as programme partner. Local wood cluster development benefits from a local champion connected to a local network of wood suppliers, heat users, and the wood energy support industry (boiler suppliers, boiler maintenance specialists and consultants). However, Venture Southland is restricted to Southland and does not have the depth of experience or resources to take on a larger role.

[13] 'Pipeline' projects are those that are in the process of considering switching but are not confirmed.

7 Conclusions

As a pilot, the direct engagement aspects of the Wood Energy South programme proved to be sound, however the cluster development (or supply chain development) aspects need to be better understood before further replication. It was optimistic to attempt to develop a cluster in three years – creating a cluster is difficult, and each needs to be suited to the particular market.

There is a strong role for government to address multiple failures – information, nascent market and unpriced externalities. The programme also has strong alignment with the proposed NZEECS priorities.

More analysis is required on the economic potential of private sector boiler switching in New Zealand, and a better understanding of the drivers and decision factors involved in this.

An insight from the pilot was that a higher rate of return on public investment would be achieved if large clients were targeted for switching and a supply chain cluster was then developed around this large client.

The pilot confirmed and expanded upon EECA's understanding of the barriers to wood fuel use. Wood fuel does not work out economically at an organisational level in Southland. Where wood fuel is currently being considered there are usually drivers beyond the strictly economic (e.g. corporate social responsibility, impending air quality standards).

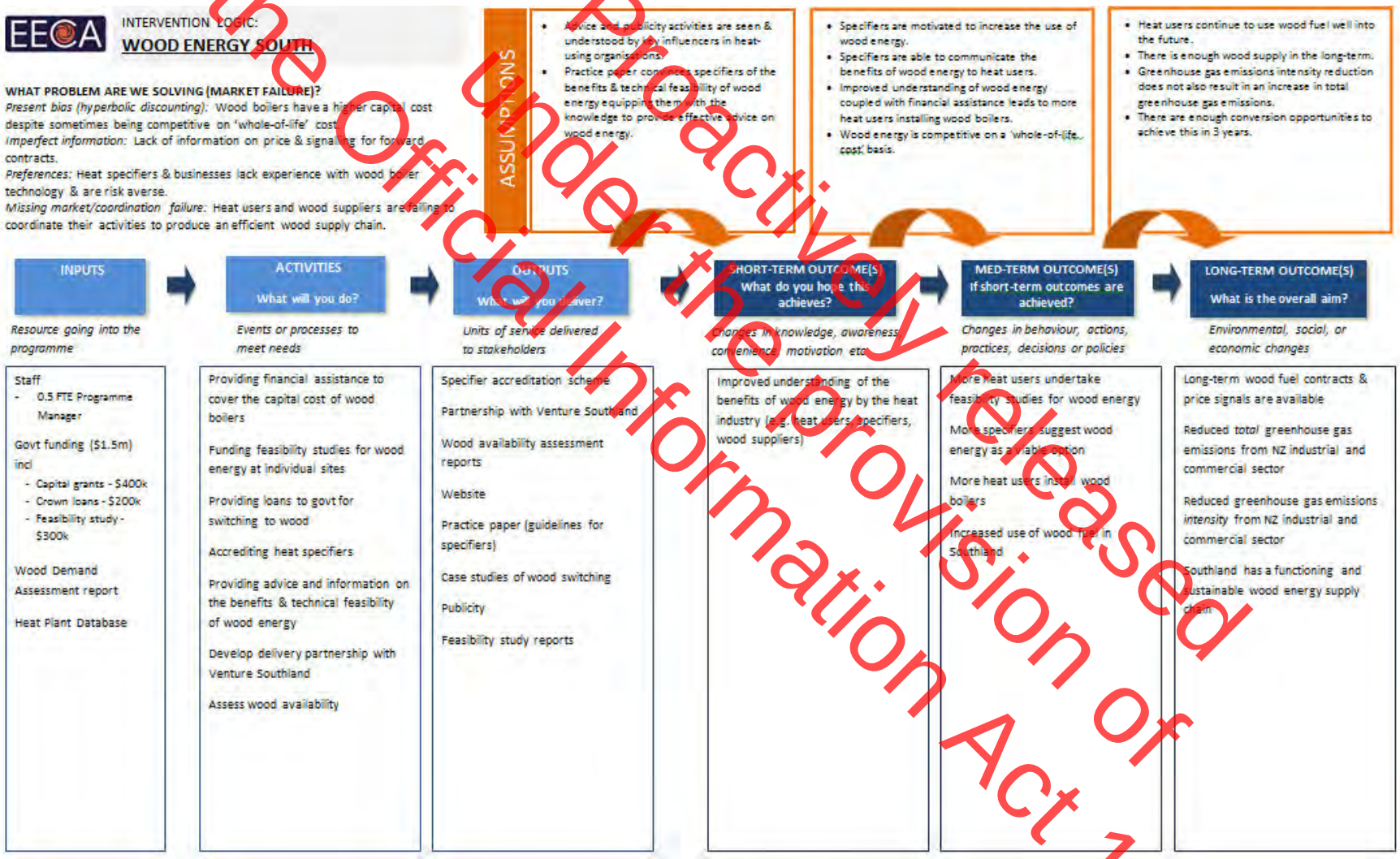
8 Recommendations

Utilise MBIE and EECA's analysis of opportunities for private sector boiler switching (in particular, evidence of public benefits and market readiness), and then consider the opportunities for further development around potential large clients.

EECA should establish whether there are sufficient benefits and willingness to justify programme intervention in terms of switching government boilers, and what lessons from this pilot can be picked up in the refocused business programmes.

9 Appendices

9.1 Appendix One – Intervention logic



9.2 Appendix Two – Boiler Conversion Carbon Savings Tracker

	Slinkskins Thornbury	Environment Southland	Takitimu School	Waihopai School	West Gore School	Makarewa School	s 9(2)(b)(ii)	s 9(2)(b)(ii)	s 9(2)(b)(ii)
Status	Commissioned mid-2014	Commissioned late 2014	Commissioned mid 2015	Commissioned mid 2015	Commissioned December 2015	Boiler installation underway			
Boiler size (kw)	350	150	200	220	200	200			
Original fuel	LPG	Coal	Coal	Coal	Coal	Coal			
Usage (kwh)	882,000	147,000	144,000	158,400	144,000	144,000			
Carbon saved (t/year)	211	53	52	57	52	52			

9.3 Appendix Three - Cost Benefit Analysis

This review cost-benefit analysis assesses the quantifiable outcomes of EECA's expenditure from programme inception through to the end of the 2015/16 financial year. General assumptions applied in the analytical framework used in this review:

- EECA costs include all direct internal costs and payments and grants to service providers and client companies. General EECA overheads have not been included.
- All third party capital and operating costs, whether actual or estimated, are included. Estimated/budget costs and benefits are used in the absence of actual measured benefits. Source, granularity and attributed confidence of this data are noted.
- Only expenditure to year end 2015/16 is included, anticipated subsequent payments are omitted.
- Future benefits (e.g. energy savings) accruing from EECA expenditure to year end 2015/16 are included. Benefits from future expenditure omitted.
- Comment is made on the likely additionality of the EECA programmes.
- Cash flows are expressed in NZ$2016 discounted at the default Treasury rate of 7%.

Specific inputs used in the review of the Wood Energy South Programme:

- EECA direct costs of running the programme, part-payment of feasibility studies and some contribution to the capital cost of new wood-fired boilers[14]. These are treated as public costs and are taken from EECA's internal records.
- Third party costs are the remainder of the additional capital costs of wood-fired boilers and any additional operating costs. The additional capital and operating costs have been estimated from proposals provided by boiler suppliers and generic cost data supplied by EFI and should be considered indicative only. These are designated private costs.
- Fuel consumption costs are reduced but, as a fuel substitution programme, the energy content of the wood fuel effectively offsets that contained in the fossil fuel being replaced. Fuel consumption for the respective fuels has been estimated by EECA and service providers for each of the projects under consideration based on the size and efficiencies of the boilers. Reductions in relative fuel costs are a private benefit.
- Carbon dioxide emissions are reduced by replacing fossil fuels with wood. This is a public benefit.
- The programme to date includes seven boiler replacement projects which either have a completed or committed status. Six of these plants are coal-fired and one LPG-fired, although total fuel consumption is evenly split between the two fuels because of the relative size and utilisation of the boilers. s 9(2)(b)(ii)
- Fuel savings arising from the programme are assumed to continue for twenty three years, a typical life of a boiler (although some can remain operational for significantly longer, but relative savings may degrade in the longer term as boiler performance declines).
- MBIE's price monitors have been used for deriving economic prices for fuels. Market prices have been used for fuels not included in the monitors and all future prices are maintained at the 2016

[14] The programme supports the installation of wood-fired boilers as an alternative to clients continuing to use existing fuel types at the time of replacing existing boilers. No conversions of existing boilers to wood-firing are included in the programme. Wood-fired boilers and their associated storage and feed systems are generally more expensive than alternative fuel counterparts, resulting in higher capital costs for wood-fired boiler installations.

level. Carbon dioxide prices are set at the average value of an NZU in each year of the programme and valued at $25 per tonne thereafter.

Costs and benefits for the two cases are summarised in the table below.

	2014	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
CO2 Reduction tpa							
Completed and Committed Projects Only	0	0	367	367	436	436	436
"Pipeline" Projects Included	0	0	367	367	13305	13305	13305
Expenditure $ million (nominal dollars)							
EECA							
Completed and Committed Projects Only	0.000	-0.820	-0.844	0.000	0.000	0.000	0.000
"Pipeline" Projects Included	0.000	-0.820	-0.844	0.000	0.000	0.000	0.000
Third Parties							
Completed and Committed Projects Only	0.000	-0.462	-0.011	-0.101	-0.013	-0.013	-0.013
"Pipeline" Projects Included	0.000	-0.462	-0.011	-7.184	-0.213	-0.213	-0.213
Value of Energy Saved $ million (nominal dollars)							
Completed and Committed Projects Only	0.000	0.000	0.025	0.029	0.029	0.029	0.029
"Pipeline" Projects Included	0.000	0.000	0.025	0.029	1.978	1.978	1.978
Value of Emissions Reduction $ million (nominal dollars)							
Completed and Committed Projects Only	0.000	0.000	0.004	0.006	0.011	0.011	0.011
"Pipeline" Projects Included	0.000	0.000	0.004	0.006	0.324	0.324	0.324

Key conclusions to draw under these assumptions:

- The net present value of the programme to date is in the order of -$2.0 million based on the committed and completed projects to date. s 9(2)(b)(ii)
- Benefits fall principally to the private sector through fuel cost savings, most significantly through the substitution of wood for LPG. Public benefits are driven by the near-effective elimination of carbon dioxide emissions through the switch to wood fuels.
- Public benefit to public cost ratio is highly dependent on the inclusion of the "pipeline" projects. The ratio resulting from their inclusion may be overstated, as further public expenditure may be necessary before they become reality, although this would have to be well in excess of current levels of EECA programme costs for this ratio to approach unity.
- Similarly, the leverage of private expenditure from public costs is highly dependent on the inclusion of these projects and any future public expenditure necessary to secure them.

Present Values (Based on $2016 Cash Flows)		*PV $million*	
		Committed/Completed	Plus "Pipeline"
EECA Costs	*Public*	*-1.723*	*-1.723*
Third Party Costs	*Private*	*-0.734*	*-9.457*
Energy Saved	*Private*	*0.349*	*20.874*
CO2 Reduction	*Public*	*0.120*	*3.423*
Net Present Value		*-1.988*	*13.117*
Ratios			
All Benefits/All Costs		*0.19*	*2.17*
Public Benefits/Public Costs		*0.07*	*1.99*
Public Benefits/Private Benefits		*0.35*	*0.16*
Private Costs/Public Costs.		*0.43*	*5.49*

This analysis has quantified greenhouse gas emission reductions and reduced fuel consumption by client companies. There are expected to be benefits that have been unquantified and the scale is unknown. These include improved energy security, increased productivity and competitiveness.

s 9(2)(b)(ii)

There are no measured energy savings from the programme and records of client companies' costs are limited to proposals for the installations of wood-fired boilers. Nevertheless some of the outcome metrics can stand up to a reasonable level of scrutiny:

- The projects relate to specific boiler installations where fuel consumptions and associated reductions in carbon emissions can be well defined. This adds a relatively high level of granularity to the analysis and provides a good degree of confidence in the relation between public benefits and public costs.
- The net benefits of the existing seven projects are probably understated as public investment was made into projects which will only attain commitment from client companies after the 2015/16 year. However, the inclusion of the "pipeline" probably overcompensates for this shortfall.
- Client company net costs of switching to wood are based on generic costs of wood- and fossil-fuel fired boilers. Metrics containing measures of private costs should be treated as indicative only.