Greenhouse gas emissions reduction using biomass energy for industrial and commercial heat

1. Introduction

Opportunities in the period out to 2025 (and beyond) for switching from fossil fuels to biomass[1], in particular wood fuel for heat supply for process heat have been assessed by the Bioenergy Association. Furthermore, the contribution this could make to greenhouse gas reduction by 2030, and subsequently to 2050 has been assessed. Three scenarios were developed to identify what would have to occur to get greater levels of greenhouse gas (GHG) reduction. This information sheet summarises the options and proposes policy requirements to achieve this.

Greenhouse gas emission reduction from the use of wood fuel for production of heat would lead to a significant reduction in the need for the Government to purchase international carbon units in order that New Zealand met its Paris Climate Change Targets. By 2050, under an accelerated scenario, 20PJ of coal could be replaced by biomass fuel resulting in a greenhouse gas emissions reduction of 1.8Mt CO_2 – e pa.

The saving is assessed to be an additional $1.1 million/year as a levelised average (assuming 46ktCO_2 eq are saved at $25/tonne over the 10 year time period out to 2030 for the Encouraged Growth scenario). By 2030 this will equate to a saving of around $11 million for the period to that year. The cost of achieving that saving while setting up a strong foundation for the future reductions is likely to be much smaller than the accumulated benefits.

The production and delivery of process heat from biomass fuel uses proven technologies and there are many facilities that demonstrate the ease of transitioning from use of coal to biomass fuel and the financial viability of the investments.

Targets:

Proposed targets for the substitution of coal with wood fuels (above 2017 levels) based on an Encouraged Growth scenario are:

2030 4 PJ/year
2040 11 PJ/year
2050 15 PJ/year

By 2050 this equates to:

- **Converting around 34MW/year of existing boiler plant to use wood fuels**
- **Adding around 90,000 tonnes of wood fuel/year**
- **1.3Mt/year CO_2 eq emissions being avoided**

Around $11 million in the period to 2030 of avoided cost - otherwise may need to purchase carbon credits (at an assumed a carbon price of $25/tonne CO_2 eq)

Incremental savings of $1.1 million/year over each of the 10 year period 2020 – 2030.

By 2050 under an Accelerated Scenario 20PJ of coal could be replaced resulting in 1.8Mt CO_2 - e pa.

[1] In Bioenergy Association documents the words biomass and wood are often used interchangeably because the greatest volume of biomass available for the production of heat is in the form of wood.

The main barriers to greater uptake of the use of wood energy are:

- The infrequent need to replace existing heat plant that is still serviceable using coal;
- the real and perceived cost of transition;
- the commercial availability of wood fuel for some applications compared to coal and natural gas;
- the cost and ease of other renewable alternatives (e.g. electricity);
- the location of the heat plant relative to fuel availability; and
- and inconsistent policy and price signals for public good externalities. Such externalities include greenhouse gas emissions, land use change and water quality.

The Emissions Trading Scheme (NZ ETS) will result in an increased value on carbon thus providing a market incentive to move from coal to wood fuel for heating but will not address other market failures and market development needs that are barriers to a greater use of wood fuel for heating. The impact of the NZ ETS will be slow coming so a faster replacement of fossil fuels for process heat will require specific programmes and policies to provide incentives to business.

The Bioenergy Association recommends that the focus for growing the transition from fossil fuels for process heat is on ensuring the availability of wood fuel with gradual growth in supply quantities driven by increasing demand from small and medium scale heat plant until sufficient fuel supply capacity is available for larger heat plant. **Encouragement of cofiring biomass and coal will allow some existing plant to start the transition.**

Biomass fuel supply will include plantation forestry harvest residues, agricultural and horticultural biomass and clean urban waste wood. This will enable the wood energy market to grow in an effective way and over time meet the levels and reliability of supply required for large heat plant to convert from coal, and then potentially natural gas, to wood fuels. With improvements in the perception of the long term availability of fuel the conversion of existing industrial and commercial heat plant to wood fuels is an action that can be taken now to start reducing GHG emissions.

Furthermore, the Bioenergy Association agrees that the Government and local authorities must show leadership and start to convert their existing heat plant facilities as set out in the New Zealand Energy Efficiency and Conservation Strategy (NZEECS)2 and confirmed as necessary by the Productivity Commission3.

There is potentially enough biomass available from plantation forestry to replace 60% of coal used in existing heat plant over the next 30 years. The remaining 40% can come from farm forestry; use of currently unused biomass eg straw; and electricity. There is adequate biomass fuel but the market is under-developed because the current demand for wood fuel is low. There are also enough suppliers with commercial and technical capability to expand supply if demand for wood fuel increases consistently and in an orderly manner.

[2] https://www.mbie.govt.nz/info-services/sectors-industries/energy/documents-image-library/NZEECS-2017-2022.pdf

[3] *Low-carbon economy*, The New Zealand Productivity Commission, 2018

In this context, the co-firing of larger coal plant with wood is a useful transitional approach as the co-firing percentage can be varied based on wood fuel availability, and gradually increased over time. In addition to this, for some sites with large coal fired heat plant facilities it may also be feasible to incrementally change heat plant facilities to use wood fuels (for example partial conversion or the introduction of wood fuel heat plant over a number of years).

The development of the local wood fuel supply market is a precursor for eventual large scale replacement of the coal fuels with wood fuels.

It is typically recognised that heat plants using wood fuels have higher initial capital costs and may incur additional costs with the purchase, handling and storage of biomass fuels compared to coal fired heat plants. Even so, wood energy can be the most economic option in many situations if total life cycle costs and other benefits are considered. Other significant non-energy benefits from switching from coal to wood fuel such as employment, regional growth, air quality etc. are a public good, which suggests that there is a role for Government in assisting industry sectors to transition from coal to locally sourced wood fuels.

Some low temperature heat applications could transition from fossil fuels to electricity using heat pump heaters. Medium temperature process heat can be supplied from electrode boilers. Electrode boilers are more compact than biomass fueled boilers and this is attractive on confined sites. They are also not complex technology and the fuel supply chain is simple. However the electricity is more expensive than biomass fuel. Electrical heat pumps have the potential to reduce the delivered heat costs below wood costs - but have limitations at medium to high temperatures. In addition, every $1m of heat pump capacity requires at least $3m of electricity generation and network investments. Some of these network upgrade costs are likely to be transferred to the heat user. Wood fuels are about halve the delivery cost of direct electrical heating and about half the total capital investment cost per MWh of heat delivered.

Some existing fossil fueled heat plant could have the demand for coal reduced by efficiency improvements, cofiring or replacement by more efficient biomass heating. There is around $7bn of existing boiler assets that would need replacement but smarter use of biomass cofiring could reduce this capital burden on the heat sector by at least half.

This paper sets out what the Bioenergy Association's Wood Energy Interest Group[4] considers is achievable and summarises the advocated strategy and policy options for using wood energy to contribute to the reduction of New Zealand's greenhouse gases.

[4] The Wood Energy Interest Group is the operational arm of the Bioenergy Association responsible for developing policies and best practice standards, and hosting workshops, webinars and training courses aimed at ensuring that the wood energy sector is performing to best practice.

2. The heat sector

The industrial and commercial heat sector comprises of a total of 6800 MW of heat plant capacity and there are around 2200 plants across New Zealand spread across a range of sectors including dairy processing, wood processing, meat processing, other food processing, other manufacturing and hospitals (CRL Energy, 2014)[5]. In terms of current fuel types used for the industrial and commercial heat sector natural gas and coal make up over 60% of the total. Wood currently comprises of 20% of the total fuel with most of this being used by the wood processing sector. Across all heat plants, Government or local government owned facilities make up around 58% of all heat plants and of these only 7% are currently using wood fuels. Publicly owned heat plant make up 13% of the coal fired heat plant. The education and health sectors operate most of the coal heat plants.

For many heat users their current coal fired equipment has many years of serviceable life still available so for those owners it may be a number of years before they would even consider replacement unless a compelling driver occurs.

3. Target areas

Work undertaken by Waikato University has shown that the dairy and meat processing sectors are areas of priority with respect to reducing greenhouse gas emissions.

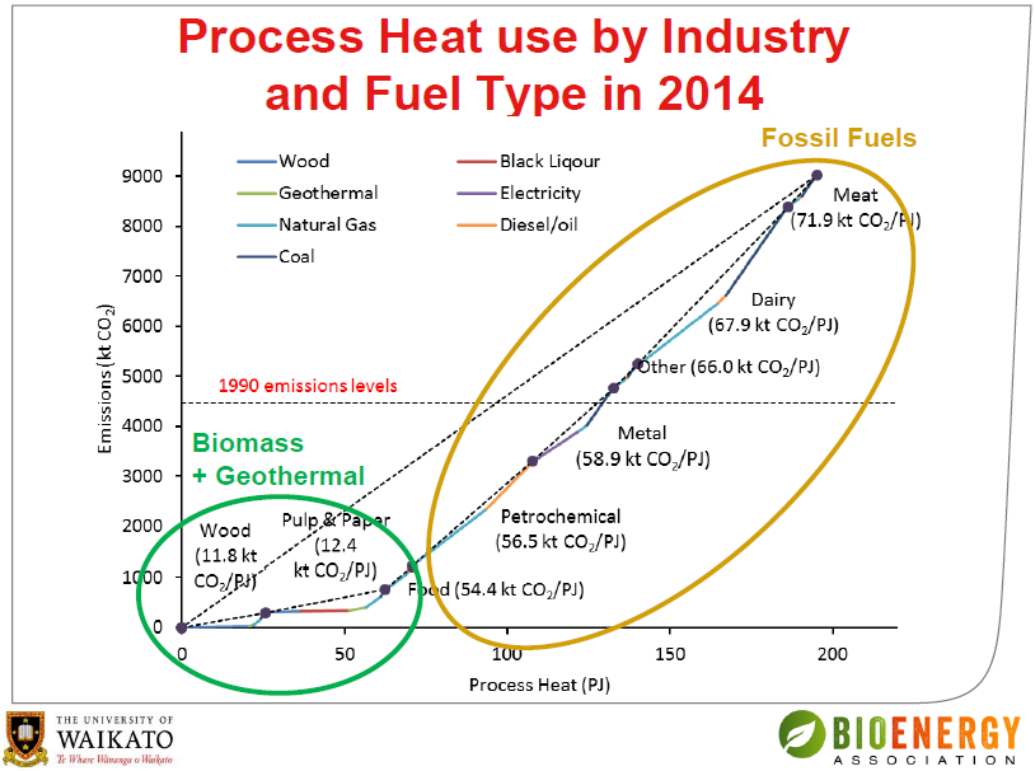

Figure 1: Greenhouse gas emissions intensity by sector

Reduction of greenhouse gas emissions and the move to using renewable energy in general is a public good as often there are minimal direct short term (i.e. 3 – 5-year timeframe) economic benefits for business to move

[5] CRL Energy, *2014 Heat plant in New Zealand*. CRL Energy Limited Report 14/11017.

from using fossil fuels to using low carbon options for heat. However when life cycle benefits and opportunities for 'shared value" arising from the use of wood fuel instead of fossil fuels are considered there are increasingly a number of business situations where a shift is economic and beneficial for business sustainability.

The 'other' sector (in Figure 1) which includes government owned facilities such as hospital, schools, correction facilities and community swimming pools is a component of the heat market where central and local government can provide leadership and install heat plant using renewable wood fuels. These are also facilities where the lifecycle economic benefits for Government as owner are greater than if the owners are in the private sector.

'Other' sector owned facilities are also ideal for assisting in creating economies of scale of fuel demand adequate to provide incentive for wood fuel suppliers to scale up their operations. This will assist in providing confidence to large heat user sectors (for example, dairy and meat processing) that the wood fuel suppliers can meet large demand for wood fuel on a sustained basis. Furthermore, that these fuels can be reliably delivered and consistently meet the relevant fuel specifications.

4. Scenarios for Wood Energy Expansion

Scenarios developed by the Bioenergy Association for growth in the production and utilization of wood energy to reduce greenhouse gas emissions are:

Scenario 1: Business as usual (BAU)

Conditions:

- Based on existing policies and market conditions. No policy changes and the refreshed NZEECS are not implemented.
- Uses existing combustion technologies and an extension of current trends.
- Assumes current ETS with the adoption of the 2 for 1 policy to ETS administration.
- Wood fuel heat plants continue to replace existing coal heat plants at the rate similar to current installation rates over the last 10 years through there is some increase as existing coal plant comes up for renewal/replacement or refit in the later years of the scenarios.

Scenario 2: Encouraged Growth

Conditions:

- Government adopts the draft refresh of the NZEECS by 2022 which signals that it wants to encourage short term domestic GHG reduction so as to minimise the need to purchase international greenhouse gas mitigation units and to create some more certainty in the investment market for renewable energy.
- That Government follows through with a plan of action and implements all tasks set out in the refreshed NZEECS adoption of a process heat programme..
- Government collaborates with forestry, waste and bioenergy sectors to implement the NZEECS and assists development and expansion of the wood fuel supply market.

- Local government responds to the NZEECS and provides leadership and demonstration of opportunities.
- Government contributes funding to achieve public good benefits.
- Assumes heat plant owners have no incentive to replace existing serviceable equipment before end of life.Carbon is priced at $25/tonne CO_2 eq (by 2020) and is increasing at a consistent rate of 2.5% per year.
- Differences from BAU:
  - Limited number of complementary measures as set out in refreshed NZEECS pursued and implemented.
  - Government requires evaluation of heat plant capital investment options to be on a total life cycle value instead of a least capital cost basis.
  - Central Government introduces policies to change Government procurement so that renewable energy and efficient energy use options must be considered when making investment decisions for heat plant and all additional benefits are included in the full life cycle analysis of options. Typically this full life cycle analysis will consider the next 30 years (i.e. out to 2047)
  - Government sets targets for the heat market to achieve specific reductions in GHG emissions and monitors progress to achieving the targets.
  - Government's project appraisal models use a projected higher CO_2 cost than the private sector may be exposed to under the ETS, in line with MBIE's "Medium" scenario of $25-50/tonne. (This approach/modeling is justifiable as it will be demonstrating that the Government is taking clear long term decisions that reflect the likely real price of carbon over the life of the assets.)
  - Local councils are required to introduce similar central Government procurement policies for their own purchasing or replacement of heat plant.
  - Government adopts a collaborative growth strategy with the wood energy sector based on reducing GHG emissions by using wood fuels instead of coal for industrial and commercial heat.
- Government procurement relies on the ETS as a surrogate for externalities – i.e. the new policies are complementary measures that significantly lift the use of renewable energy for GHG emission reduction.
- Medium to small sized plants are the initial focus for changing to wood fuels so as to grow the wood fuel supply market – but this changes with time to allow a shift to conversions for larger heat plants.
- Co-firing with coal and incremental replacement of heat plant using coal are accepted as a transition pathway and as a means of growing the wood fuel supply market and transitioning some serviceable coal plant to using biomass fuel. This is a means of overcoming the reality that much coal fired heat plant still has many years economic life that a business wants to make use of. .
- Wood fuel supply market growth is assisted by education and accreditation packages. (No constraint on fuel availability if the focus is on small/medium sized plants and given that around potentially 20 PJ of available wood fuel has been identified nationwide out to around 2035).
- New wood fueled plant is recognized as being more efficient than existing coal fired plant and operators opt for heat storage systems to achieve additional energy efficiency.
- Some conversions opt for replacement with electricity, in particular for low temperature hot water.

- Heat plant optimisation improves the efficiency of existing plant and reduces the need for some quantities of fuel.
- Air quality standards and regional consenting policies are improved and are not barriers to the use of wood fueled plant in any regions throughout New Zealand.

Scenario 3: Accelerated Growth (for GHG reduction, environmental and economic outcomes)

Conditions:

- The conditions of scenario 2 are achieved plus the following additional considerations.
- Government aims to maximize the opportunities for domestic greenhouse gas emission reduction to either markedly reduce or avoid the need to purchase international carbon trading units; and pursues the objectives of the Business Growth Agenda - "The Natural Resources stream of the Business Growth Agenda is focused on practical initiatives to improve land productivity and increase incomes while improving environmental outcomes."
- Government seriously considers and adopts in 2019 some complementary measures to the ETS and extends the NZEECS at the next review in 2022.
    - Accelerated depreciation for greenhouse gas emission reduction projects
    - Suspensory loans for greenhouse gas emission reduction projects.
- Government, forestry and wood processing sectors develop a collaborative approach to maximizing the value from forestry, its role in mitigating against reduced water quality and soil loss and significant additional tree planting occurs from 2018.
- Some farms adopt food plus fuel business philosophy. Those farms start offsetting their biological emissions by working collaboratively with wood fuel supply aggregators and other neighbouring farms to contract for supply of biomass for treatment into wood fuel and delivery to nearby biomass fueled heat plant.
- Carbon is priced at \$50/tonne CO_2 eq (2020) and it is increasing at a consistent rate of 5.0% each year.

Differences from scenario 2:

- The Government's project appraisal models use a projected CO_2 cost, in line with MBIE's "High" scenario of \$100/tonne.
- Additional low cost policies are introduced to address barriers specific across sectors and within a sector such as accelerated depreciation on capital expenditure and the introduction of suspensory loans to reduce the effect of current capital cost barriers.
- Government sets challenging targets for the heat market to achieve specific reductions in GHG emissions.
- Government does an annual cost-benefit of forward offshore purchase of GHG obligations compared to acquiring domestic mitigation through a capital fund which funds through suspensory loans the public good component of transitioning to wood fuel.
- The Government continues with capital grant schemes as part of regional development programmes similar to Southland's Wood Energy Programme.
- Government encourages additional domestic added value processing of wood with the consequence that greater volumes of high quality wood fuel become available.

- The Government, local authorities, and communities value the intangible benefits of wood energy (for example economic development, environmental improvements and energy resilience and security).
- Farm forestry is recognized as being a viable source of biomass fuel driven by environmental and commercial benefits for farm resilience.
- Government does not wait for new research to initiate strategies to reduce GHG emissions.

Note: Scenario 3 is based on economically rational decision making by investors and fuel suppliers. Greater amount of conversion could theoretically be achieved but this would require stronger Government intervention.

5. Scenarios for Using Wood Fuel for Heat

5.1 Substitution of coal with wood fuels

Focusing on the replacement of coal by wood fuels is a very cost effective way to reduce GHG emissions and achieve other Business Growth Agenda objectives. Furthermore, coal fired heat plants represents around 22% of the total nation-wide heat plant capacity, but around 30% of heat plant that potentially can be converted to wood fuel by 2050. Although natural gas represents 38% of the total heat plant capacity, it is generally regarded that conversions of heat plant fueled by natural gas to being fueled by wood fuel are going to be substantially more difficult to justify compared to conversion of coal fired units. Other fossil fuels such as diesel, LPG and Light Fuel Oil (LFO) represent less than 8% of the total heat plant capacity and are generally used for small scale heat plant. Many of these that are low temperature could possibly be converted to using electricity for heat. The Bioenergy Association scenarios focus on the conversion of existing coal heat plants to wood fuels as these are heat plants most likely to contribute to meaningful GHG emission reductions over the next 20 - 30 years.

Based on scenarios for converting existing coal fired heat plant[6] under the encouraged scenario (Scenario 2), which most closely aligns with the proposed strategies and policy intensions in the refresh of the National Energy Efficiency and Conservation Strategy, 2016 it is expected that up to 15 PJ/year of coal could be replaced by wood fuels by 2050 (Figure 2). If the Accelerated scenario was adopted then this can increase to around 20 PJ/year by 2050. If the Business as Usual scenario is adopted then the expected level of substitution at best would only be 7 PJ/year (this assumes that some existing heat plants change due to reaching replacement/or significant refurbishment due to age).

[6] Note there are no assumptions or consideration to totally new greenfields wood fuelled plant which would be additional to the analysis results in this document

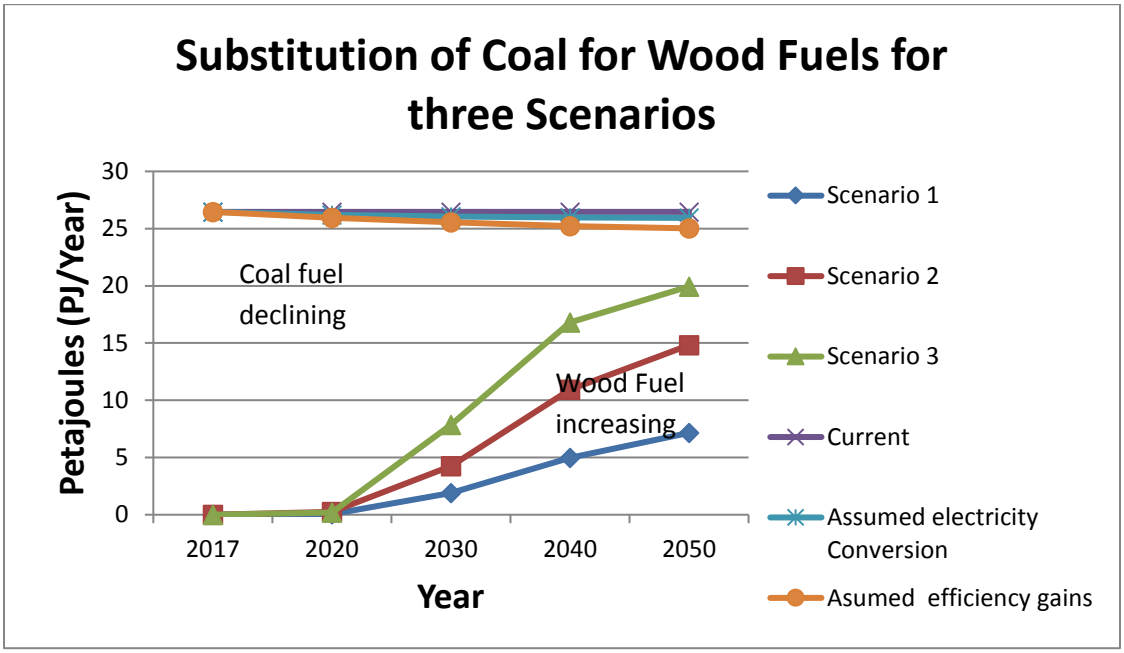

Figure 2: Scenarios for the substitution of coal by wood fuel

The three scenarios in Figure 2 are:

Scenario 1 - Business as Usual;
Scenario 2-Encouraged Growth (Implemented NZEECS); and
Scenario 3 - Accelerated Growth (maximising GHG reduction, environmental and economic outcomes).

Figure 2 includes the assumption that some low temperature heat plant may be converted to electricity and that there will also be some reduction of the use of coal due to heat plant efficiency gains for existing heat plants. Conversion to electricity was assumed to be around 1-2% over each decade period for low temperature heating of mainly small sized plant. Energy efficiency was assumed to vary between 1–3.5% over the analysis period. The current line represents the total amount of energy produced from existing coal fired heat plant in New Zealand currently. This analysis has assumed that there is no new plant built so if this were to occur it would be additional to the results shown in figure 2.

5.2 Targets

Establishing targets for the conversion of coal based heat plant to use wood as fuel will provide goals for development, implementation of policies and a framework for investment decisions across the industrial and commercial heat sectors.

As a result of the analysis results shown in figure 2, the Bioenergy Association recommends targets for the substitution of coal by wood fuels above 2017 levels as shown in Table 1. These targets are based on the encouraged growth Scenario (Scenario 2) which aligns with the intentions of the proposed refreshed NZEECS, 2016.

Table 1. Recommended targets above 2017 for the substitution of coal by wood fuel (PJ/Year).

Year (Decade)	Target substitution above 2017 (PJ/year)
2030	4
2040	11
2050	15

From a policy point of view and to maximise the amount of greenhouse gas emissions reduced by 2050 and to achieve net-zero emissions by that date it is recommended that scenario 3 should be pursued by Government as a minimum. Greater greenhouse gas emissions reduction beyond that of scenario 3 is possible but would require stronger Government intervention.

The sectors likely to contribute to achieving these targets are Meat Processing, Dairy and Hospitals (Figure 3). Though these sectors are not likely to start to contribute until after 2020 and with the most significant levels of coal substitution occurring in the decade from 2030 to 2040. The Government and local government sectors could contribute 0.1, 0.7, 0.6 and 1.2 PJ/year for period to 2020, and decades to 2030, 2040 and 2050, respectively. The Government and local government sectors comprise of correction and detention facilities, education (e.g. mostly schools), hospitals and local utility building facilities. The Government and local government sectors have been assumed to be taking leadership in the implementation of wood fuel heat plant (refer to Annex 4 for further information related to the role of the Government sector).

If the NZEECS is not implemented and the targets are not achieved the total growth in substitution of coal by wood fuel above 2017 levels will only be 2PJ (2030), 5PJ (2040) and 7PJ (2050) (i.e. less than 50% of a more proactive policy approach).

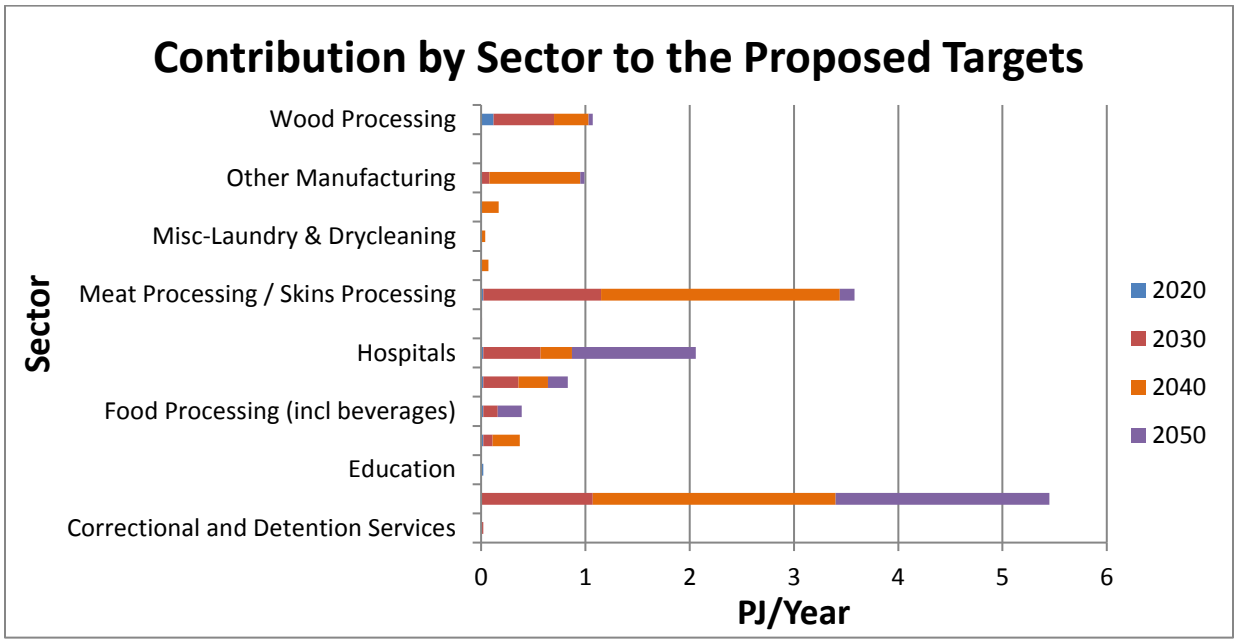

Figure 3. The contribution of each sector to the substitution of coal by wood fuels for the Encouraged Growth Scenario (Scenario 2).

Fossil fueled heat plant less than 0.5MW in size that are able to be converted to renewable energy are likely to become fueled by either electricity or wood pellets. The wood pellet production capacity is adequate to meet likely demand for pellet fuel.

Heat plant in the 0.5 - 2 MW range provide much of the shift to wood fuels over the initial transition period and as the capacity for wood fuel supply improves then this leads to greater opportunity to convert heat plants of 2-10MW. This then leads to more use of wood fuels by heat plant over the 10MW size range. Heat plants over 10 MW include those from the meat processing and dairy sectors. For these facilities it has been assumed that the full heat capacity is not taken up by wood fuels in the short term due to constraints in the wood fuel supply and cofiring with coal is likely as a transition to greater use of wood fuel over the next 30 years.

Table 2. The contribution of each heat plant size category for each decade for the Encouraged Scenario (Scenario 2 (PJ/year).

Heat Plant Size	2020	2030	2040	2050	Total
< 0.1	0	0	0	0	0
0.1-0.5	0	0.02	0	0	0.02
0.5 - 2	0.08	0.33	0.16	0.01	0.58
2 -10.	0.16	1.29	2.3	0.72	4.47
>10	0.01	2.36	4.48	3.15	10
Total	0.25	4	6.94	3.88	15.07

5.3 Projected Wood Fuel Demand

The wood fuel demand required to achieve the proposed targets is 780k tonnes per year by 2030, 2 million tonnes by 2040 and 3.3 million tonnes by 2050 for the Encouraged Scenario (Scenario 2). For Scenario 3 the total wood fuel demand increases to 3.5 million tonnes by 2050. Current wood fuel forecasts indicate that there is around 2 million tonnes of wood fuel currently available out to 2040 but additional sources of wood fuel will be required to reach the higher demand levels by 2050 for Scenario's 2 and 3. This is considered achievable with more planting by the forest sector provided planting is able to be harvested. (Planting of native trees which can not be harvested may lock up land suitable for revenue earning).

In addition the increased demand for wood fuel will provide an incentive for some farms located near heat plant to expand from being solely food producers to food plus fuel producers. Farm forestry is already firmly established throughout New Zealand and the drivers of having biological emissions offsets, reduced nutrient runoff into waterways and biomass fuel from shelterbelts, woodlots and riparian planting will improve farm business resilience.

There are also quantities of agricultural waste such as corn stover, straw etc which can be pelletised and used as biomass fuel. In many countries such as China these sources of biomass are more common than wood fuel.

The scope for cofiring biomass fuel with coal can be broadened by torrifying the biomass so that it more closely resembles coal. This can improve combustion but in addition because torrified wood pellets are not hydroscopic the need, and thus cost, for dry transport and storage is reduced.

Cofiring high grade fuel (pellets) with low grade hog fuel is also a method for being able to combust cheaper low grade fuels which would otherwise be left in the forest or dumped to landfill.

While greater quantities of biomass suitable for processing into fuel can be recovered from plantation forests there will need to be a commercial driver for forest owners and contractors for this to occur. This is likely to come about once the size of the biomass demand becomes big enough.

The sale of biomass fuel is in its infancy as until recently biomass fueled heat plant was fueled from material sourced on-site eg sawmills. As heat plant owners without direct access to biomass fuel eg hospitals, schools have transitioned from fossil fuels the market has required third party fuel suppliers to become established. Expansion in the demand for biomass fuel will require expansion of these suppliers. It is a specialist business as the suppliers aggregate biomass from a wide range of sources and treat it to become specification compliant fuel. Growth in the fuel supply market will need to be orderly if it is to avoid the often boom / bust outcomes that industries which grow to fast can experience.

The analysis of biomass fuel availability shows that there would be adequate quantities to convert 100% of fossil fueled heat plant by 2050 but each of the fuel supply initiatives outlined above would have to be progressed and this will require Government R & D assistance and leadership.

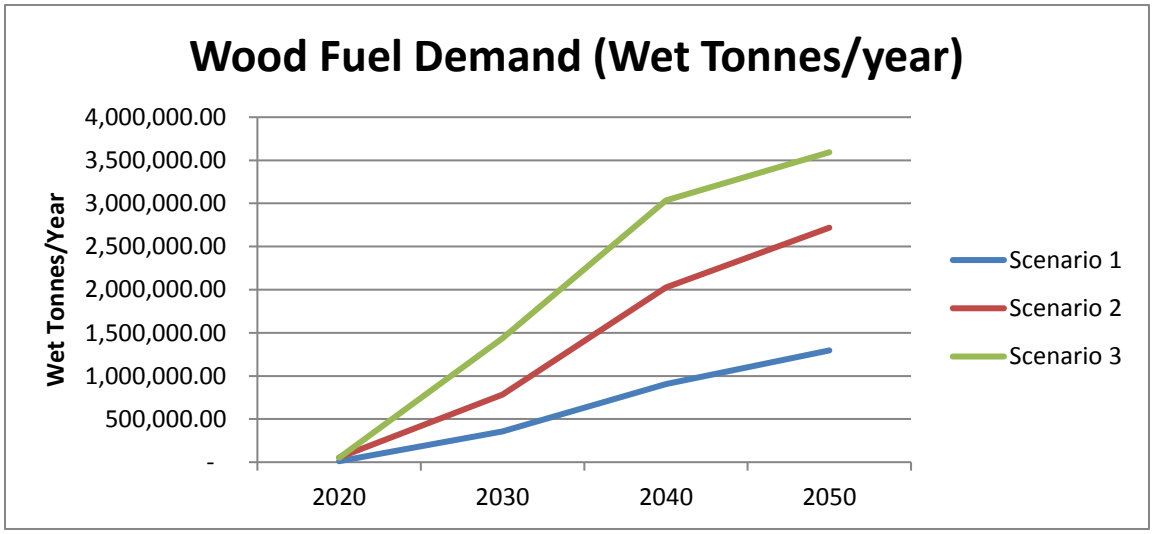

Figure 4. Wood fuel demand for each scenario out to 2050 (wet tonnes/year).

Note: The assumptions used to determine the wood fuel demand are based on a sector specific load factor, 75% efficiency and a wood fuel calorific value of 7.5 GJ/ tonne wet fuel.

5.4 Projected GHG emission reductions

The greenhouse gas emissions reductions projected to rise above 2017 levels from the substitution of coal by wood fuels are 1 MT CO_2 eq by 2040 for Scenario 2, and this increases to 1.3 Mt CO_2 eq by 2050. For Scenario 3, the GHG emission reductions would increase by 50% by 2040 to 1.5 MT CO_2 eq (Figure 5).

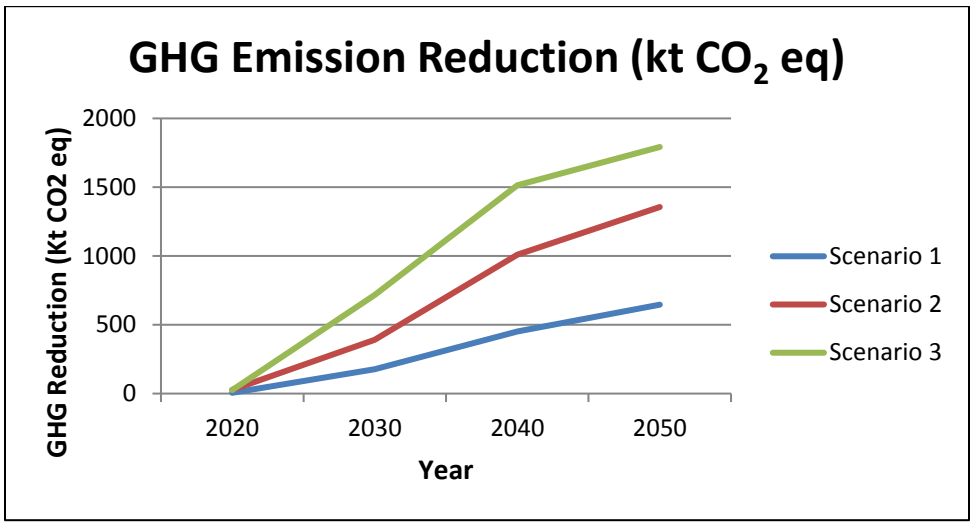

Figure 5. Greenhouse Gas emission reductions for the three scenarios (kt CO_2 eq).

5.5 Wider benefits of conversion to wood fuel

The additional benefits arising from the proposed GHG reduction measures for the industrial and commercial heat sector are significant:

- Multiple national and local benefits – and not just the supply of energy:
  - National and regional economic growth (new factories, local jobs, etc);
  - Business growth and financial resilience (cost effective renewable energy);
  - Environmental: reduced emissions to air, waste reduction, and improved water quality due to land use change from pasture to forest and other crops;
  - Clean, green, low carbon economy supporting 'green' products in international markets.
- Additional value for forest & land owners:
  - 10-15% of forestry fibre can be wasted (so a major opportunity, especially for Iwi as emerging forest owners);
  - Opportunity for farms to produce food plus fuel;
  - Opportunities for farms to offset biological emissions;
  - Improve farm business resilience.
- Economic growth from world leading fibre-growing conditions:
  - Enhanced opportunities for bio-oil, bio-chemicals, bio-plastics etc (“Bio-materials”);
  - The possible development of bioenergy centres where wood fuels, bio-oil, biogas and liquid fuel systems are integrated and supplying multiple services and benefits.
  - Co-products with traditional farming contributing extra revenue streams for farmers.
- However market failure means most benefits are not currently being realised:
  - A “Rational Choice” for a company is not the same as a rational choice for New Zealand;
  - Energy users don’t care about non-cost benefits (jobs, energy diversity etc);

- Selling logs to Asia minimises economic benefits, and exports employment opportunities;
- Increased added value processing of wood within New Zealand produces economic value for NZ through the creation of jobs and higher value export products, plus high quality wood fuel for heat.

6. Barriers

The fact that the primary benefits of transition from using fossil fuels to using renewable fuels, to produce heat energy and thus reduce greenhouse gas emissions, is a public good makes it difficult for private sector heat plant owners to justify making the change. However industry has shown by recent decisions to move from using fossil fuels to using wood fuel that the private benefits in niche applications can justify the move. The encouragement policies in the NZEECS refresh will be enough to shift a number of other potential substitution projects over the line and to get them committed to by the private sector.

Trading in wood fuel is new and still not often undertaken so the wood fuel supply sector can be said to be still in its infancy. Until recently heat plant owners using wood fuel have generally been able to supply the fuel from their own wood processing operations. With the entry of heat plant owners who have to purchase wood fuel there is all the elements of market development that have to be established e.g. standards, contracting best practice, perceptions of future fuel availability and market price knowledge.

The Bioenergy Association recognises that there are a range of potential customers for wood fuel. These are summarised in Appendix 1.

Heat plant are significant capital investments and can have economic lives of around 30 years so replacing heat plant equipment is not undertaken very often. When it is done the decisions are often based on a 15-30 year time frame risk analysis. The consequence is that the decision making time frame for potential substitution is long term. There is also a lot of work required from identification of a need and commissioning of any new plant. This can often be over a period of 5-10 years. As a consequence the substitution projections in Scenarios 2 and 3 are skewed towards the latter decades as policy changes and consequential behaviour changes by investors also take a number of years to achieve.

Access to capital for investment in new heat plant is a significant barrier. Policies to assist this will improve investment.

However, it is expected that having a predictable and secure supply of wood fuel will be the main barrier to address (See section 4.3 above).

7. Key Drivers

- Public support statements from Government/Ministers will encourage new thinking by forest and wood products sector, farmers and investors.
- Farmers being assisted to take up the opportunities for being producers of food plus fuel:
    - Identifying and demonstrating the financial and environmental benefits for farm resilience
    - Establishing regional hubs for aggregating biomass from a number of neighbouring farms.

- The switch from fossil fuels to use of wood fuel provides significant public benefits with regard to climate change and transitioning to a low carbon future.
- Adoption of policies for government and local body procurement of wood fuel heat plant would:
    - Move government agency decision making from short term least capital cost focus to lifecycle analysis resulting in fit for purpose decision making which is based on long term outcomes;
    - Provide economies of scale for the wood fuel supply market to grow;
    - Demonstrate that the Government is serious about addressing climate change;
    - Provide demonstration to private sector heat plant owners of the ease and low risk of switching from coal to wood fuel.
- Assisting coal fired heat plant owners cofire biomass fuel
    - R&D and demonstration of cofiring biomass and coal in existing equipment
    - R&D into torrifaction of biomass to produce fuel
- The efficiency of the wood fuel supply market would be improved by;
    - Increased demand for wood fuel from a greater number of heat plant owners.
    - Bioenergy Association and EECA collaborating to quantify the economic, environmental and social benefits of wood fuels compared to fossil fuels through full life cycle assessments.
    - Increased domestic processing from the forestry and wood products sectors which will increase the availability of wood residues and quality of wood fuel supplies.
- Greater assistance provided by the establishment of funding mechanisms to support the transition to renewable energy:
    - Accelerated depreciation;
    - Reinstate, and ideally boost, the EECA wood energy programme;
    - Suspensory loans.

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Annex 1: Wood Fuel User Categories

Market drivers	Categories	Fuel source	User	Focus
Direct Heat from biomass	(Domestic) Micro heat plant <0.1MWt	Purchase firewood and pellet fuel	Private	• Air quality regulations • Installation standards, consenting • Installer accreditation • Generic marketing
	(School scale) Very small 0.1-0.5MW	Purchase pellet fuel and chip	Government, schools and rest homes etc	• Link to Ministry of Education • Information on options • Conversion vs new
	Small heat plant 0.5-2MWt	Purchase pellet fuel and chip	Government facilities	• Work with Ministry of Health and l advisers • Air quality regulations
	(Commercial scale) Medium heat plant 2-10MWt	Own woodfuel	Wood processors	• Support owner/operators • Air quality regulations
		Purchase solid biofuel (chip and pellet fuel)	Govt facilities	• Work with Ministry of health, Corrections • Air quality regulations
			Food processing	• Support owner/operators • Air quality regulations • Link to waste to energy opportunities
			Horticulture	• Promotion of applications in horticultural magazines • Air quality regulations • Contribution to plant growth
	(industrial scale) Large heat plant 10<	Own woodfuel	Wood processors	• Support owner/operators • Air quality regulations
		Purchase solid biofuel (chip and pellet fuel). Torrified biomass	Food processing	• Develop wood fuel supply market through focus on medium scale heat plant so that adequate availability of fuel • Support coal/wood fuel mix • Air quality regulations.

Annex 2: Proposed complementary measures

Government has established the Emissions Trading Scheme to assist in transitioning from high carbon fuels to low carbon fuels. However to meet the Paris greenhouse gas emission reduction targets without any other initiatives other than the ETS it is likely to require New Zealand to purchase international greenhouse gas reduction units. Bioenergy Association analysis shows that because of the high value of the public good benefits of switching from use of fossil fuels to wood fuels for heating it would be more cost effective for the Government to introduce some light handed complementary measures to assist Crown agencies and businesses to switch. This leadership would provide encouragement for private sector heat facility owners to also consider transitioning to wood fuels.

Under the "Encouraged Growth scenario (scenario 2) the following complementary measures would encourage transition from coal to wood fuel and thus achieve significant GHG reductions from public sector, and industrial heat applications.

1. **Government and Bioenergy Association agree targets for switching the use of wood fuels for coal by 2030, 2040 and 2050**.
    - The objective is to encourage the use of wood fuel for producing heat and to reduce the amount of coal used.
    - Government signals to local government and industry that it will encourage the use of biomass as fuel.
    - Government adopts a collaborative growth strategy with the wood energy sector based on reducing GHG emissions by using wood fuels to substitute for coal.
    - The Bioenergy Association and Government agree specific targets for the use of biomass as fuel in public sector facilities, food processing, and wood processing sectors by 2030,2040 and 2050 and for all heat plant by 2040.
    - EECA and Bioenergy Association, under a Collaboration Agreement, agree on a strategy and action plan including: target regions and sectors; promotion; education and information programme; value proposition information; collection and dissemination of demonstration project information.
    - MBIE to extend the existing mechanism for the collection of data relating to the use for biomass for heat and to provide annual reporting on biomass use for heating by region.
    - EECA continue with capital support schemes as part of regional development programmes similar to the Wood Energy South in the Waikato and Otago/Canterbury regions.
    - Government to review the present use of the landfill Waste Disposal Levy and the criteria for grant allocations from the Waste Minimisation Fund, so as to include use of biomass and wood residues as a fuel for heat plant.
    - Address air emission rule barriers to the consenting of heat plant.
    - The Bioenergy Association will assist to achieve the targets by:
        - Establishing a working group with EECA to develop a work programme for switching in each target sector and region.
        - Preparation and promotion of the value of using accredited wood fuel suppliers and registered wood energy advisers.
        - Collating and publishing useful information from any demonstration facilities into a Technical Guide.
        - Collating technical information from case studies and publishing.

- Hosting regional meetings to assist heat users and their advisers to be up-to date with switching opportunities and practises.

2. **Central Government introduces procurement policies so that waste to energy or other renewable energy options must be considered when making capital investment decisions and all costs and benefits are included in a full life cycle analysis of options and reasons provided for not adopting a renewable energy solution.**
   - Central Government introduces policies to change Government procurement policies so that renewable energy and efficient energy use options must be considered when making investment decisions and all additional benefits are included in a full life cycle analysis of options.
   - Government's project appraisal model uses a CO_2 cost profile assumption published by EECA from time to time. This profile takes account of assumed movement over time as a result of the ETS (This approach/modelling will also demonstrate that the Government is taking clear long term decisions that reflect the likely real price of carbon over the life of the heat plant (i.e. 20 years plus).
   - Local councils are required to introduce procurement policies similar to those adopted by central Government.

3. **EECA extends the repayment period for Crown Loans**
   - Extend the period of Crown Loans for biomass energy facilities beyond the current 5 years to better reflect the economic lifecycle costs and benefits of a wood fuel heat facility.

Under the Accelerated Growth Scenario (scenario 3) the following complementary measures would encourage transition from coal to wood fuel and provide significant further GHG reductions from public sector and industrial heat applications.

1. **The complementary measures in Encourage Growth Scenario (scenario 2), but with a higher projected price of carbon for heat plant modelling for all Government facilities.**

2. **Government introduces policies to allow for accelerated depreciation of renewable energy, waste to energy and energy efficiency capital investments.**
   - Renewable energy and energy efficiency equipment is more capital intensive but often has lower on-going operating costs than alternatives.
   - Access to capital is a major barrier to investment in renewable energy and energy efficiency solutions. Allowance of accelerated depreciation is fiscally neutral to Government except for timing. However accelerated depreciation can provide a significant assistance to plant investors.

3. **Assist farms become suppliers of biomass fuel**
   - R & D of pelletisation of agricultural residual biomass eg corn stover, straw etc for use as fuel
   - R & D and demonstration on growing and extraction of biomass from shelterbelts, riparian planting, woodlots and erosion control for delivery as a fuel.

4. **Assist cofiring of existing coal plant as a transition**
   - R & D into cofiring biomass fuel with coal as a transition pathway
   - Provide guidance on the cofiring of high quality biomass fuel eg pellets with low quality hog fuel
   - R & D of torrifaction of biomass to make a fuel suitable for use in existing coal fired combustion plant

5. **Government establishes a GHG Reduction Fund to provide suspensory or low interest loans or similar for renewable energy and energy efficiency capital investments.**
    - Many renewable energy projects may be potentially financially attractive but access to capital is a major barrier. Because the most significant benefits of transitioning from fossil to biomass fuels are public goods having provision for suspensory loans which are paid back out of operating profits once the project is operational can assist potential projects get underway.
    - Suspensory loans from central government, or restructured rates schemes at city council level could assist the uptake of this low emission technology.
    - Government does an annual cost-benefit of forward offshore purchase of GHG obligations versus acquiring domestic mitigation through a capital fund which funds the public good component of transitioning from coal to wood fuel.
        -

6. **Support for domestic added value processing of wood**
    - Assist the forestry and wood products sector realise efficiency gains, therefore value. Government encourages additional domestic added value processing of wood with the consequence that greater volumes of high quality wood fuel become available.

Annex 3: Assumptions

The assumptions for the wood energy GHG reduction scenarios are:

Note these assumptions are reflected in the number of existing plants that are currently coal fueled and which are converted to wood derived fuels.

Business as Usual: Scenario 1
• Over the period 2017 - 2050 around 0.21PJ/year of new substitution of wood fuel for coal is occurring. This requires around 35-40,000 tonnes/ year of wet wood fuel to come on stream. This is driven by the requirements to meet the Paris agreement but with minimal intervention by the Government and the price of carbon remains at around current levels (i.e. less than $20 per tonnes CO2 eq.
• No new (greenfields) heat plant uses coal.

Encouraged Growth: Scenario 2	**Accelerated Growth: Scenario 3**
• Wood fuels includes all form of fuels derived from wood and herbaceous materials and may include wood residues, torrefied wood, Miscanthus, bio-oil, pellets and producer gas. Wood residues and other fibrous materials are expected to be the main fuel supplies.	• As for Scenario 2
• A total of 372 heat plant conversions from coal fuels to wood occur over the period 2016 - 2050.	• A total of 372 heat plant conversions from coal fuels to wood occur over the period 2016 - 2050.
• Over the 33 years being considered for the different scenarios all the current coal fired heat plant will be renewed and a selection of the smaller heat plant will be converted to electricity (low temperature hot water systems).	•
• Some of the larger heat plants (in particular for the diary and meat processing sectors) start to transition to wood fuels using a range of strategies which will include the adoption of co-firing coal and wood fuels and incremental conversion of the different heat plant on site.	• As for scenario 2, but there is an acceleration of the use of wood fuels by the diary and meat processing sectors.
• Coal co-firing is being used at appropriate sites	• As for scenario 2
• All sectors are encouraged to switch to wood fuels - but there is an emphasis on the Government facilities which tend to have smaller capacity heat plants.	• The dairy, education, meat and wood sectors are the main sectors to take advantage of the depreciation regime for the period 2020 – 2040. Larger plants are able to come online due to improved security of wood fuel supply.
• Emission factors for GHG emissions of different fuels derived from Ministry of the Environment voluntary reporting guidelines	• The emission factors as for scenario 2.
• That the heat plant providers are not constrained in the supply of heat plant (i.e. there is spare capacity in the heat plant delivery and installation supply chain). Wood fuel can be supplied effectively where it is required.	• As for scenario 2.
• By initially focusing on the small plants and developing the wood fuel market (where wood fuels can be delivered more cost effectively) then this encourages an increase in the larger non Government related boilers to be converted to wood fuel.	
• The conversion to wood fueled heat plant reduces after 2040 because the ‘easy’ to convert plants are reduced.	
• Electricity and geothermal heat were not included in this analysis.	

Annex 4. Comparison between the contributions of Government owned heat plant and privately-owned heat plant to energy arising from the use of wood fuels.

The Government commercial heat sector is expected to provide leadership and be an 'early adopter' of wood fuel heat plant. By the Government sector taking such a leadership role, then this will encourage the wood fuel supply sector to develop and provide more commercial security for the private sector to move from coal to wood fuels. The figure below indicates that by the Government encouraging the use of wood fuels then this will facilitate significant growth in the use of wood fuel derived energy in the private sector.