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The Secretary
Garnaut Climate Change Review Secretariat
Level 2, 1 Treasury Place
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Emailed

Dear Professor Garnaut

Submission to Garnaut Climate Change Review

The purpose of this Submission from Bioenergy Australia is to alert you to the status and significant role bioenergy could make towards the provision of base-load electricity generation and towards liquid transportation fuels in Australia in a future carbon constrained world. This submission builds on my contribution as an invited panellist at the Garnaut Review Forum on the role of innovation for low emission energy technologies, held in Brisbane on 10 December 2007.

In 2007 bioenergy is estimated to have provided 1,425 GWh of base-load electricity and 125 million litres of liquid transportation fuel in Australia. Sustainable production levels could be considerably greater and thus provide a significant contribution to Australia's energy requirements, whilst reducing both our greenhouse gas emissions and reliance upon imported petroleum products.

Some of the key points of this submission are:

- Bioenergy is currently a mature technology, with some 44 GW of installed bioelectricity capacity world-wide, providing mainly base-load dispatchable electricity.
- Bioenergy already provides approximately a quarter of the Renewable Energy Certificates under the current Mandatory Renewable Energy Target. Bioenergy can potentially provide considerably more renewable energy.
- Woody biomass can be grown in harmony with food crops. For instance huge areas of the WA wheat-sheep belt that is subject to dry land salinity, can be revegetated to provide biomass for energy and to simultaneously mitigate dry land salinity, while being integrated into the agricultural landscape.
- New technologies such as 'biomass integrated gasification combined cycle plants' and second generation biofuels are under development, which are aimed to increase energy conversion efficiencies and scale of deployment.
- Australia is not realising the full potential of bioenergy, due to a range of barriers covered in this submission.

Bioenergy Australia is a nation-wide government-industry alliance of some 63 organisations, established to foster biomass as a source of sustainable energy and for value-added bio-products such as biofuels. Its broad objectives are to:

- Promote an awareness and understanding of the economic, social and environmental attributes of sustainable energy from biomass.
- Broaden the market for biomass by enhancing opportunities, and by helping to reduce financial, regulatory, fuel supply, technical and institutional barriers to enable widespread adoption of biomass energy.
- Facilitate the development and deployment of biomass energy business opportunities and projects.

Bioenergy Australia is also the vehicle for Australia's participation in the International Energy Agency's Bioenergy program, an international collaborative RD&D agreement involving some 23 countries plus the European Commission. The Bioenergy Australia Manager represents Australia on the Executive Committee of IEA Bioenergy, which covers the broad spectrum of bioenergy, including bioelectricity. Bioenergy Australia acts as a forum for general and authoritative information dissemination on bioenergy, including drawing on international best practice experiences through its IEA Bioenergy participation.

Please note that this submission may not necessarily reflect the view of individual member organisations.

Biomass refers to organic matter, derived in recent times, directly or indirectly, from plants, as a result of the photosynthesis. It includes a wide variety of materials, from forestry and agricultural residues, to organic waste by-products from various industries, purpose grown energy crops, human sewage and animal manures, to woody weeds and municipal green waste. Bioenergy is the term used to describe energy and energy related products derived from biomass.

Bioenergy can be regarded as a form of solar energy, as photosynthesis combines atmospheric carbon dioxide with water in the presence of sunlight to form the biomass, while also producing oxygen.

The energy bound into the biomass can be recovered through the variety of bioenergy processes and technologies. During the energy recovery process, the carbon dioxide bound in the biomass is released to the atmosphere. Bioenergy is regarded as renewable, when the biomass resource consumed in the energy conversion process is replenished by the growth of an equivalent amount of biomass. Under the Kyoto Protocol bioenergy is regarded as carbon dioxide neutral.

Globally some 220 billion dry tonnes of biomass are produced through photosynthesis per year. The energy stored globally in biomass represents about 0.02% of solar energy incident on earth. This small portion of the absorbed energy is equivalent to approximately eight times the global anthropogenic primary energy consumption of around 400EJ/year. A study entitled, 'Biomass in the Energy Cycle' conducted for the former Energy Research and Development Corporation in1994 study identified some 54 million tonnes of broad acre agricultural residues across Australia that could be used for bioenergy. This would equate to some 5,400 MW of bioenergy capacity. In addition there are many other sources of biomass, such as a major component of urban wastes, sawmill residues, plantation thinnings, sewage and animal manures.

According to the International Energy Agency's data [1], renewable energy sources provide some 13.1% of the world's total primary energy supply. Of this, some 10.4 percentage points are from renewable combustibles and waste (i.e. biomass). In the OECD countries, renewable combustibles and waste provide 53.4% of the total renewable energy supply.

Biomass can present itself in many forms, from relatively dry (e.g. rice husks) to very wet (sewage can contain 98 percent water). As such, appropriate technologies are required to convert the biomass to the desired end products. Converting the biomass can utilise a variety of paths and technologies. The primary conversion processes are via thermal, biochemical or mechanical/physical processing.

Figure 1 illustrates the range of energy processing paths for converting biomass to energy, chemical feedstocks and liquid biofuels. These are briefly explained below, coupled with providing examples of the commercial status of several bioenergy technologies.

Thermal (or thermo-chemical) energy conversion is generally applicable to drier biomass. The most familiar and commercially mature form of thermal energy conversion is combustion.

Combustion of biomass accounts for approximately 90 percent of the 44,000 MW of modern bioelectricity power plants world-wide, and is very similar to technology applied to solid fossil fuels such as brown coal. Excess air is applied for the combustion process to convert

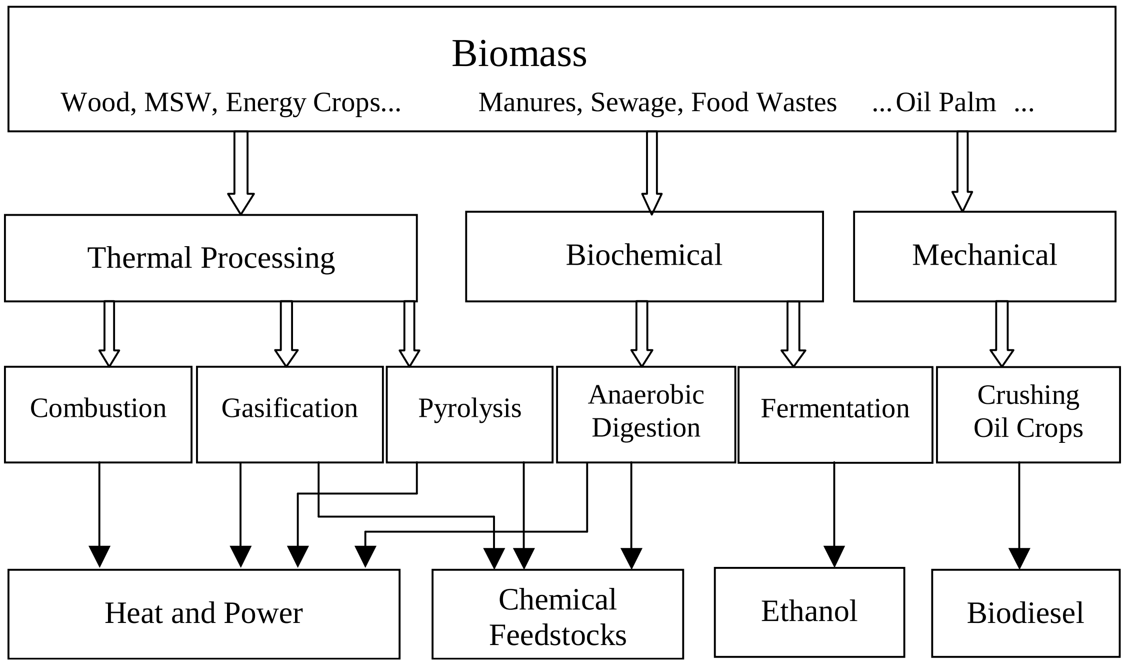


Figure 1: Bioenergy Conversion Routes

the biomass essentially to carbon dioxide and water vapour, liberating the stored energy in the biomass. Besides direct combustion, biomass can be co-combusted with coal in large utility boilers. Co-firing of biomass with coal is allowable under Australia's Mandatory Renewable Energy Target (MRET), and also under the NSW Greenhouse Gas Abatement Scheme, if the biomass source itself complies with the relevant Regulation administered by the Office of the Renewable Energy Regulator and under state legislation. Biomass co-combustion with coal is now well developed, with trials and commercial operation occurring in over 100 large power station units globally. Combustion technologies are mature technologies and have some advantages in terms of a low technological risk and cost.

Examples of biomass combustion plants are the bagasse fired plants in the sugar industry, where for instance the Pioneer Mill in Queensland has 68MW of electrical generation. Other examples are the Rocky Point Sugar Mill cogeneration plant of 30 MW electrical capacity, again in Queensland, and two 30MW scale plants currently being commissioned at the

Condong and Broadwater sugar mills on the NSW north coast. Co-firing has also been conducted at various Australian power stations, including at Liddell, Vales Point, Muja and Wallerawang power stations.

As an overseas example of a typical combustion bioenergy plant, Fig 2 shows an aerial photograph of the 36 MW Greyling Power Station in Michigan, USA. This plant operates on wood waste with steam conditions 510^{o}C and 8.8 MPa.

The Cuijk Fluidised Bed Combustor (FBC) power plant in the Netherlands near the German border is a prime example of this technology. This 25 MW_e wood-chip plant has a steam temperature of 525 °C and a pressure of 10 MPa. This plant operates unattended at nights and over weekends. It is one of the world's first remote controlled, unattended biofuel-fired power plant in the world. Figure 3 provides an aerial view of the Cuijk FBC plant. The two round buildings with conical roofs in the foreground provide covered fuel storage. Fuel is supplied by road and by barge. The plant uses dry cooling to condense the steam, minimising water use.

Figure 2 : 36.2 MW Grayling Power Station in USA (photo NREL)

Figure 3: Aerial Photo of Cuijk 25 MW power plant (source Essent Energy)

One of the world’s largest biomass boiler is at the Alholmens Kraft Power Plant on the west coast of Finland. The boiler has a capacity of 550 MW_{th} and an electrical capacity of 240

MW_e. This sophisticated plant incorporates reheating of the steam with superheater steam conditions being 545°C and 16.5 MPa, with reheat steam conditions being 545°C and 16.5 MPa. This power plant is in part supplied by slash bundle (tree harvesting logging waste) biomass railed to the power plant. Figure 4 provides an aerial view of the plant, with the slash bundles at the bottom right of the photo.

Figure 4: Alholmens Kraft Bioenergy Plant in Finland

Figure 5 shows the turbine hall with the 240 MW steam turbo-generator.

Figure 5: Alholmens Kraft Turbine Hall Showing 240 MW Steam Turbo-Generator

A recent trend in some parts of the world is to use multifuel combustion energy plants, including use of biomass fuels. A prime example is the Avedore 2 Combined Heat and Power (CHP) plant located just outside of Copenhagen, Denmark. This power plant opened in mid 2002. It is has a multifuel capability, using both solid biofuels and natural gas. The biomass fuel consists of straw bales (200,000 tonnes per year) and wood pellets (300,000 tonnes per annum). The plant has an ultra super critical boiler with the steam conditions being 580-600°C and 300 bar (very similar to the Tarong North coal fired power station in Queensland). The overall plant efficiency is some 94% in combined heat and power mode. The pellets are manufactured at a nearby factory at Køge, mainly using imported logs and some pellets are also imported, mainly from Sweden. The Køge pellet plant consists of 18 pellets presses. The output of the CHP plant is 570 MW_e and 570 MW_{th}. The Avedore 2 unit is shown below (rear and to left) in Figure 6 adjacent to Unit 1 which is coal fired. During the design phase, Unit 2 was converted from coal firing to mainly biomass and natural gas. Biomass at times provides some 70 percent of the fuel energy of this Avedore power plant.

Figure 6: Avedore 2 Bioenergy Power Plant (taller unit)

Gasification uses a reduced amount of air or oxygen. In gasification combustible gases are liberated from the biomass, to produce a fuel or chemical feedstock. This gas is rich in carbon monoxide and hydrogen gases and can be used to fuel gas engines, gas turbines, or act as a chemical feedstock for the production of chemicals such as methanol or other synthetic fuels. The product gas is very similar to that produced from coal and reticulated around Australian cities before the advent of natural gas.

Biomass gasification is not as advanced as combustion technologies, but has been deployed to a limited extent in Australia. For instance Forestry Tasmania has had a small scale wood gasifier accredited by ORER operating in dual fuel mode with a diesel generator set. Overseas in the USA and Europe biomass gasification has reached commercial scale demonstration, with plants having operated in Burlington Vermont, USA, Gussing in Austria, Värnämo in Sweden. Biomass has also been co-gasified with coal at the flagship Buggenum gasifier in the Netherlands.

Biomass Integrated Gasification Combined Cycle (BIGCC) has been developed to maximise the energy conversion efficiency of biomass to electricity. In BIGCC gasified biomass powers a gas turbine, with the exhaust heat of the gas turbine raising steam to power a steam turbine. As such, electricity is provided by both the gas and steam turbines, resulting in overall higher thermal efficiency. In some instances heat is extracted from the BIGCC plant for district heating, raising the overall efficiency even further.

The world's first BIGCC demonstration plant was built in 1996 at Värnämo in Sweden by the Finnish engineering firm Ahlstrom and the Swedish utility Sydkraft. The plant used a pressurised version of Ahlstom's atmospheric pressure 'Pyroflow' circulating fluidised bed gasifier and supplied 6 MW of electricity and 9 MW of district heating. The air-blown gasifier operated at a temperature of 950-1000°C and 22 bar and incorporated a hot gas clean up system to remove tar and particulates. The gasifier was operated as a demonstration plant and clocked up some 8,500 hours gasifier operation and 3,600 hours BIGCC operation until the demonstration project was completed. Subsequently commercial considerations led to this plant being mothballed. This gasifier is now used for European Union research into producing liquid transportation fuels from gasified biomass. Figure 7 provides a schematic of the Värnämo BIGCC plant and Figure 8 provides an aerial photo of the plant.

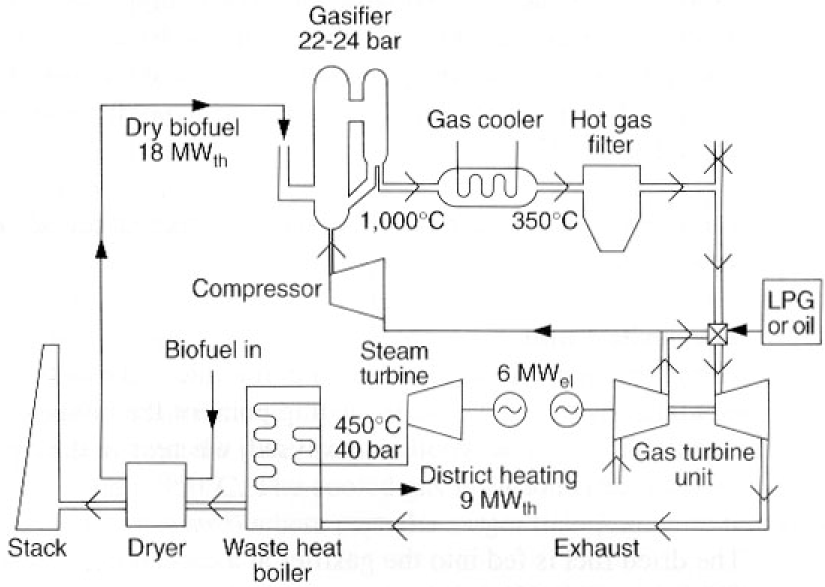


Figure 7 : Värnämo Schematic (sketch IEA)

Figure 8 : Värnämo BIGCC plant, Sweden

Pyrolysis of biomass takes two forms, slow pyrolysis as traditionally applied to charcoal making, or fast pyrolysis (flash pyrolysis), which mainly produces a combustible liquid fuel which can substitute for diesel or act as a chemical feedstock. Fast pyrolysis can convert up to 75% of the mass of the dry biomass to bio-oil. Pyrolysis occurs in the absence of oxygen under controlled conditions. Pyrolysis bio-oil is quite different to petroleum diesel, having a much higher specific gravity (1.2) and other physical and chemical properties. Bio-oil has approximately 60 percent the energy density of diesel on a volume for volume basis, and has been developed to the stage where commercial projects are beginning to emerge, after some 20 years of bio-oil development.

A leader in the pyrolysis bioenergy area has been Canadian company Dynamotive, who have built a 130 tonne/day biomass (input plant) in Ontario, Canada, where the bio-oil powers a 2.5 MW combustion turbine. Australian company, Renewable Oil Corporation has acquired a licence from Dynamotive and are working to develop projects in Australia to produce electricity from pyrolysis bio-oil.

Figure 9 shows the Dynamotive plant at West Lorne, Ontario, Canada, with the Orenda 2.5 MW combustion turbine in the foreground.

Figure 9: Dynamotive Plant in Canada (source: Dynamotive)

Biochemical conversion of biomass uses microbes to convert the biomass into energy related intermediate products such as methane rich biogas. A common example of biochemical conversion occurs in landfills, where anaerobic organisms convert garbage into a mixture of methane and carbon dioxide, in roughly equal proportions. Often this combustible gas is captured and used for producing electricity in gas engines or turbines driving alternators. Half the automotive gas used in Sweden is derived from biogas. Biogas can also be purified and injected into natural gas pipelines, and sold as a 'green' product.

Australia has in excess of 140 MW of landfill gas power generation, which is a prime example of this technology. The largest plants are in excess of 10 MW per installation. An example of this technology is at the Lucas Heights 2 landfill gas power plant, which has 11 MW capacity. EarthPower Technologies (part owned by Veolia) have acquired a biodigester near Parramatta, NSW where they produce 3 MW of renewable electricity, plus a fertiliser co-product from the digestate.

Mechanical means can also be applied to oil seeds to produce a biomass oil. This oil, (or for instance animal fat), can be further converted to biodiesel through an esterification process involving methanol or ethanol and a catalyst such as potassium hydroxide. Verve Energy in WA have trialed biodiesel from tallow as the fuel in a combustion turbine at Kalgoorlie, WA and have had a tender out to source 1 million litres of such fuel for electricity production. In addition, a byproduct of biodiesel production is glycerine. This has been co-fired with coal at a NSW power station.

Some aspect of bioenergy that are worthy of note are:

- Bioenergy has an advantage over other forms of renewable energy such as wind and direct solar energy. As the energy bound into the biomass provides inherent energy storage, bioelectricity can be dispatched, providing firm, base load capacity, unlike some other sources dispatched by nature. Additional energy storage is therefore not required for bioenergy. This allows excellent utilisation of the bioenergy plant's capacity. Many of the newer bioenergy plants have capacity factors in excess of 90 percent, on a par with coal fired units.

- Besides greenhouse gas abatement, a benefit of bioenergy that is of considerable interest in Australia is the combating of dryland salinity (e.g. in the Murray Darling Basin and in the WA wheatbelt). In Western Australia some 1.8 Mha of land is affected or is at high risk from dryland salinity. One way of addressing rising water tables and resulting dryland salinity, is through the planting of oil mallee eucalypts. Their deep roots act as water pumps, lowering water tables and mitigating the problem. To date some 30 million oil mallees have been planted for this primary purpose in WA, and also for the provision of biomass for energy and other prospective value-added products. As such, tree crops can provide the dual function of providing landscape solutions in degraded landscapes as well as providing fuel for bioenergy.

  Verve Energy in conjunction with Enecon Pty Ltd and the Oil Mallee Company recently completed trials of an Integrated Wood Processing plant at Narrogin, WA. This 1 MW demonstration pilot plant produced renewable bioelectricity, activated carbon and eucalyptus oil (as an industrial solvent). Verve is now seeking joint venture partners to further develop this technology, including for dispatchable electricity. This type of technology could be applied in similar situations in the Murray Darling Basin.
- There are employment opportunities from the ongoing requirement to source and provide fuel for the life of a bioenergy project (a 30 MW bioelectricity plant would require close to 300,000 tonnes of biomass per year). An assessment by IEA Bioenergy [2] indicates an employment level of some 180-500 person-years/TWh of fuel energy.
- Bioenergy is providing approximately 25% of surrendered Renewable Energy Certificates (RECs) under the MRET scheme. However, the proposed termination of MRET in 2020 by the former Coalition Government and the oversupply of RECs from early response to the scheme, saw the REC price slump from highs of approximately $40 to well under $20. This caused many bioenergy projects to stall. The price has now again risen to above $40 in more recent times. MRET remains a significant driver for bioenergy investment.

Greenhouse Gas Balances of Bioenergy Systems

Life cycle analysis applies a methodical ‘cradle-to-grave’ assessment of a technology, within pre-defined system boundaries to assess the particular technology’s use of resources for its manufacture, use and eventual decommissioning. This assessment is generally applied to inputs as well as outputs associated with the technology. Of particular interest for various energy technologies are the life cycle emissions of ‘carbon dioxide equivalent’ gases.

Table 1 shows the results from a UK Department of Trade and Industry study [3], partially based on an IEA study, comparing the life cycle emissions of carbon dioxide for various conventional and renewable energy technologies. On a life cycle basis, greenhouse gas emissions of bioenergy systems are project specific, but typically in the range 4-50 grams CO_2 equivalent/kWh. The high level for municipal solid waste incineration is largely a result of the high fossil fuel content of unsegregated wastes. By comparison, photovoltaic technology is reported at over 150 grams CO_2 equivalent/kWh.

Table 1: Life Cycle Carbon Dioxide Equivalent Emissions for various technologies (g/kWh) (adapted from [3]).

Technology	**g/kWh CO_2**
Brown Coal: Current Practice	1100-1300
Bituminous Coal: Best Practice	955
Gas: Combined cycle	446
Diesel: Embedded	772

Onshore wind	9
Hydro - existing large	32
Hydro – small-scale	5
Decentralised photovoltaic (PV)- retrofit	160
Decentralised PV – new houses	178
Decentralised PV – new commercial	154
Bioenergy Technologies	
Bioenergy – poultry litter - gasification	8
Bioenergy – poultry litter – steam cycle	10
Bioenergy – straw – steam cycle	13
Bioenergy –straw - pyrolysis	11
Bioenergy – energy crops - gasification	14
Bioenergy – Forestry residues – steam cycle	29
Bioenergy – Forestry residues - gasification	24
Bioenergy – animal slurry – anaerobic digestion	31
Landfill gas	49
Sewage gas	4

Figure 10 and 11 illustrate how an energy plantation harvested on a 20 year cycle can displace fossil fuel over a period of 100 years. The figures illustrate the carbon accumulation in the trees, forest floor litter and in the soil and the displacement effect of biomass used in place of fossil fuel. Figure 10 relates to a coupe scale, while Figure 11 reflects the aggregation of several coupes on the same time scale. Use of trees for biosequestration alone would result in the accumulated carbon plateauing when the trees mature, as opposed to the bioenergy option which results in ongoing and increasing carbon displacement.

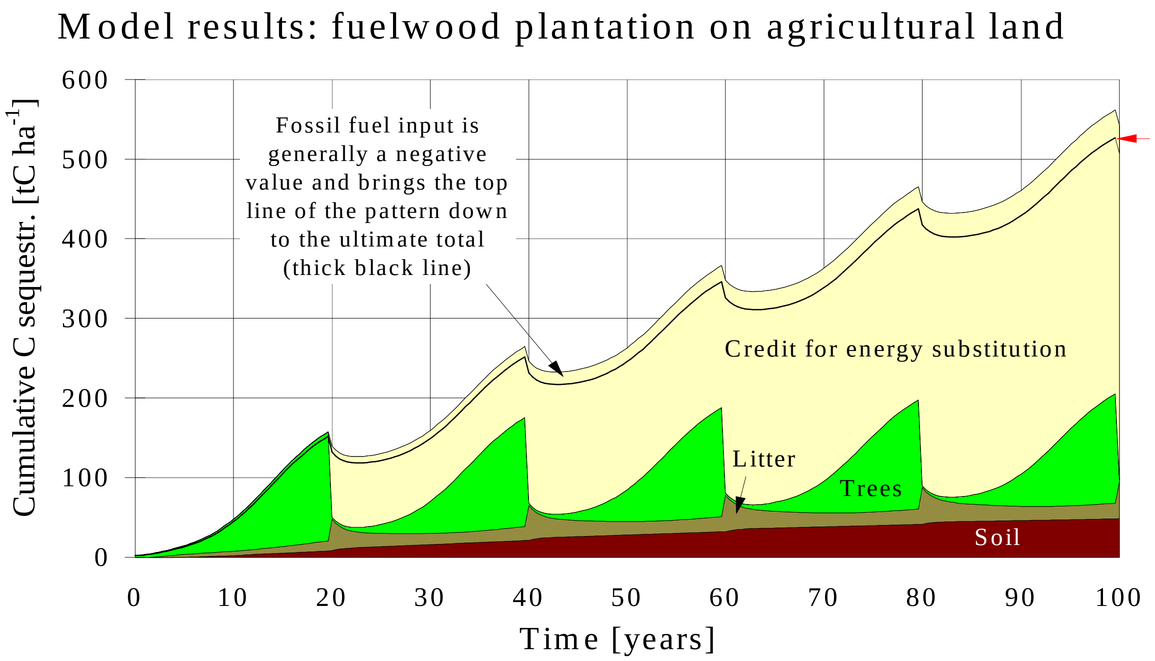


Figure 10: Fossil Fuel Substitution by Biomass – Plantation Coupe Scale (source IEA Bioenergy)

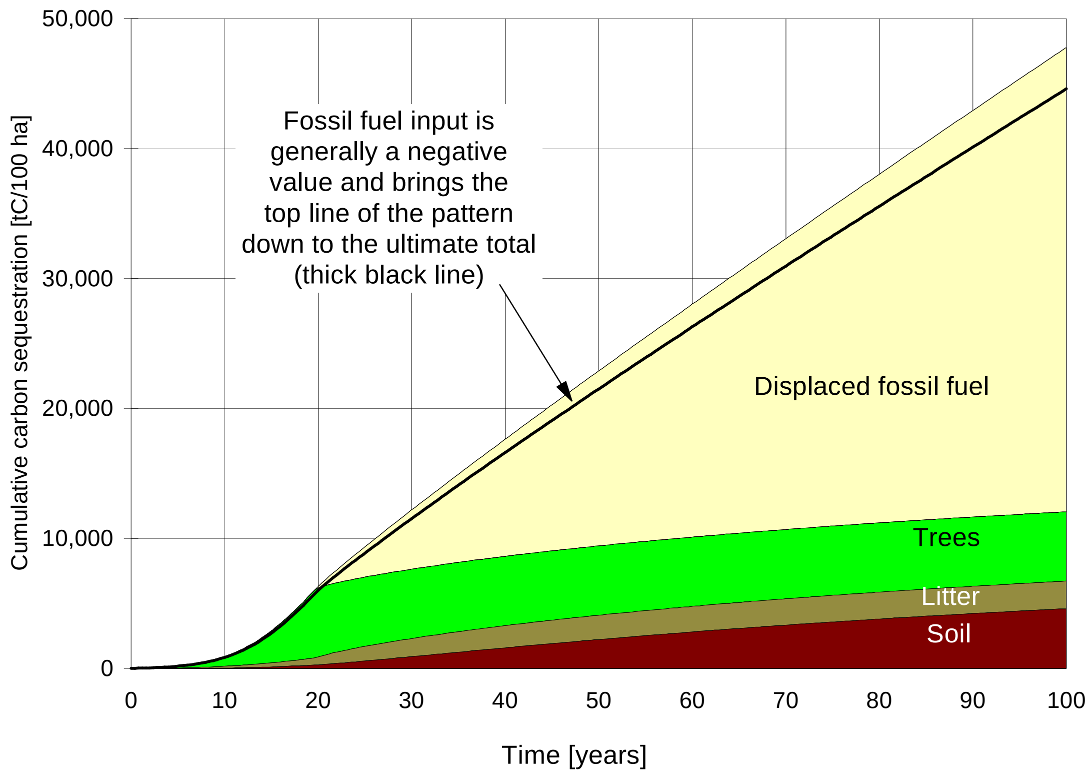


Figure 11: Fossil Fuel Substitution by Biomass – Plantation Scale (source IEA Bioenergy)

Industry Status

Table 2 lists operating renewable electricity projects in Australia at 31 December 2005, while Table 3 lists the capacities of projects under construction [4]. As of 31 December 2005 there were a total of 96 bioenergy projects in Australia with a combined capacity of 646 MW. In addition 144 MW of bioenergy capacity was under construction, consisting of 86 MW bagasse, 34 MW landfill gas, 13 MW wood waste and 11 MW from other sources. It is believed that the Clean Energy Council has more up to date information on bioenergy and other renewable energy plants in a more up to date plant register.

Table 2: Operating Bioenergy Projects

Biomass Source	**Number of Projects**	**Capacity (MW)**
Bagasse	28	406.3
Paper Industry Wastes	3	76.5
Crop Wastes	1	1.5
Food Anaerobic Digestion	2	4,1
Landfill Gas	49	130.1
Municipal Solid Waste	1	1.4
Sewage Gas	10	17.9
Wood Waste	2	8.5
Total	96	646.2

Table 3: Bioenergy Plants Under Construction

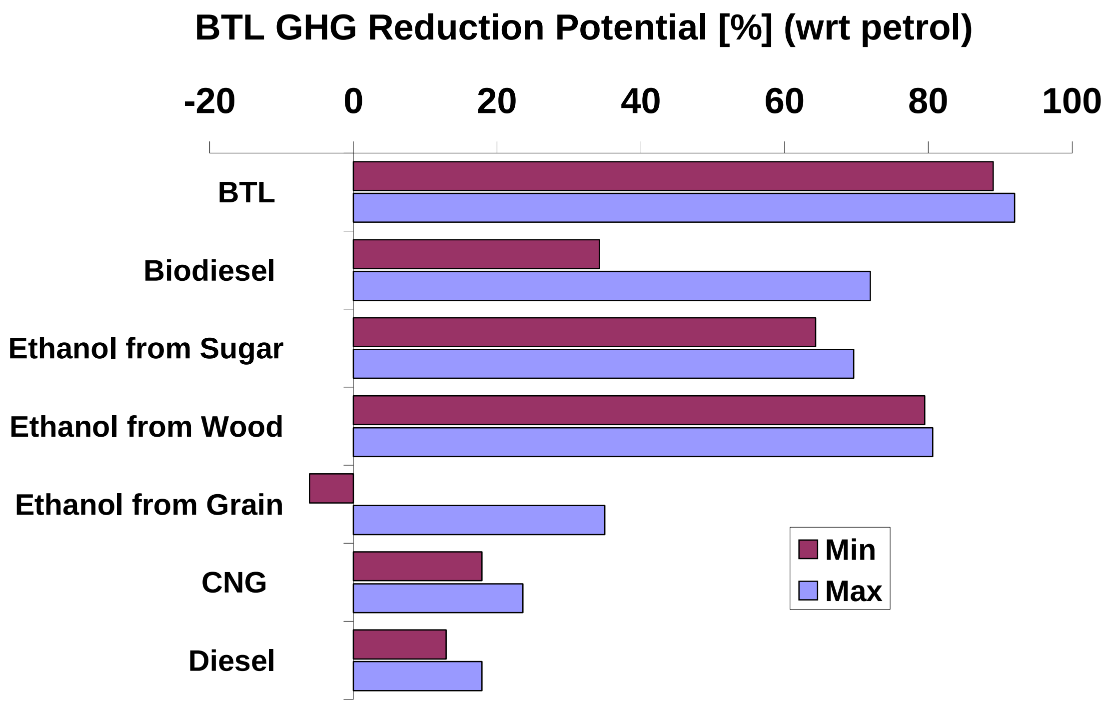
Biomass Source	Number of Projects	Capacity (MW)
Bagasse/Wood	3	85.5
Energy Crops	2	1.1
Landfill Gas	8	33.8
Sewage Gas	2	10.8
Wood Waste	1	13.5
Total	16	144.7

The former NSW Sustainable Energy Development Authority (SEDA) produced a commissioned report "NSW Bioenergy Handbook" [5] which included a review of the potential of bioenergy in NSW for electricity generation. This authoritative report indicated that the then generating capacity could be expanded from 89.5 MW to 1,577 MW, without considering the use of native forestry logging residues for bioenergy(which are outlawed in NSW, but otherwise permitted under MRET). This report gives approximate costs for bioenergy at various scales. The report indicates for a bioenergy plant based on the conventional steam cycle, that the approximate capital cost would be $1,400-$1,600 per kW of installed electrical capacity. The report quotes a guide cost of 10c/kWh for a plant with a gross electrical output of 30 MW.

Your attention is also drawn to a major publication from the Federal Government's Rural Industries Research and Development Corporation entitled 'Biomass Energy Production in Australia – status, costs and opportunities for major technologies, which would provide the Secretariat with added information of the prospects for bioenergy in Australia.

Liquid Biofuels

Bioenergy Australia is a participant in the International Energy Agency's Bioenergy program and participates in Task 39 *Commercialising First and Second Generation Biofuels from Biomass*. There is currently much focus world-wide on establishing biofuels technologies that would not compete with food or fodder for resources. Promising technologies are ligno-cellulosic ethanol and also Biomass to Liquids (BTL) technologies which use thermal processing (gasification of the biomass and synthesis of mainly carbon monoxide and hydrogen into synfuels). Figure 12 below illustrates the very significant greenhouse gas reduction potential of BTL and other fuel technologies with respect to petrol. Figure 12 summarises a range of studies for each generic technology or fuel. It illustrates that BTL and ethanol from wood are front runners for potential greenhouse gas mitigation.



Source: JRC/EURCAR/CONCAWE, Well-to-Wheels Report Jan 2004

Figure 12: Comparison of Various Biofuels for Greenhouse Gas Reduction.

Overcoming Barriers to the Uptake of Bioenergy in Australia

As noted above, biomass provides over 10 percent of the World's total primary energy supplies, and modern bioelectricity plants provide some 44 GW of global capacity; the same scale as Australia's total coal fired power industry. In the lead up to the establishment of the MRET scheme in 2001, the Reading Report, commissioned by the Federal Government surmised that biomass would provide close to half the total MRET target. In fact to date bioenergy has only provided about one quarter of the total surrendered RECs. There are several reasons for the under performance of biomass which are brought to the Garnaut Review's attention:

- The regulatory framework and resulting market have not provided sufficient certainty and market incentive for several mooted bioenergy projects. Bioenergy plants are capital intensive and the previous 'cliff' at 2020 for MRET has stalled projects. This market uncertainty has been reflected in volatile REC prices, which at their low points stalled several projects.
- The investment cycle for bioenergy plants is around 25 years. This does not necessarily match biomass resources cycles, such as forest residue off-take agreements which tend to be on shorter time frames.
- MRET has imposed onerous chain of custody requirements on biomass. This has mainly occurred due to concerns about the use of native forestry biomass. RECs are differentiated by their source under MRET, with some bioenergy RECs having a lower value. It is surmised that this discount could transfer into the Emission Trading Scheme. As such, not every tonne of CO2 equivalents would have the same value.
- Renewable Energy Certificates are denominated in terms of energy. As such, little credit is provided for the firm power capacity and dispatchability that bioenergy power plants can provide. This value is not reflected in MRET or the evolving emission only trading

schemes. It should be noted that a typical large scale bioenergy plant can have a capacity factor of over 90 percent, while a wind farm is likely to be below 40 percent.

- For bioelectricity, typically some 50-60 percent of the cost of producing the energy is attributed to the cost of the fuel. In Britain, an Energy Crops grant Scheme was set up to provide government support for the establishment of energy crops to support the British Renewable Obligation Certificate scheme. No similar support is available in Australia.
- Regarding 'Co-ordinated international public good research' and the role of government, Bioenergy Australia has for the past decade participated in the International Energy Agency's Bioenergy program, which is an RD&D program involving some 23 countries plus the European Commission. Most countries are directly funded to participate by their national energy authorities or by Government Departments. For instance the USA is represented by the Department of Energy, Canada by the Department of Natural Resources, Sweden by the Swedish National Energy Administration. The vehicle for Australia's participation has been Bioenergy Australia. Consequently Australia has been limited in the Tasks in which it has been able to participate. Government may well have a role in providing greater funding contributions to enable greater levels of participation in IEA Bioenergy and access and participation in bioenergy research.

Thank you for the opportunity of providing this submission. I would be most pleased to provide follow-up information and assistance. This would hopefully lead to bioenergy opportunities contributing significant capacity to the generation mix in Australia in the near future.

Yours Sincerely

Dr Stephen Schuck
Bioenergy Australia Manager

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[2] Danielsson, Bengt-Olaf. Employment Effects of Wood Fuel Harvesting, page 142 of IEA Bioenergy, *Forest Management for Bioenergy*, The Finnish Forest Research Institute, Vantaa, 1997.

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[5] *NSW Bioenergy Handbook*, Department of Energy, Utilities and Sustainability, 2004.