Secretariat:
[redacted]

11 January 2017

The Research Director
Agriculture and Environment Committee
Parliament House
Brisbane Queensland 4000

**Emailed** (aec@parliament.qld.gov.au)

Dear Research Director

**Submission regarding the use of bioenergy technologies for weed control**

This submission from Bioenergy Australia is in response to the Agriculture and Environmental Committee's call for submissions relating to the Inquiry into the impacts of invasive weeds and their control in Queensland.

The purpose of this submission is to alert the Committee that such weeds are a compliant form of fuel for bioelectricity power plants under the Federal Government's Renewable Energy Target. The Committee should also be cognisant that the Queensland Government, through the Department of State Development has initiated a Biofutures program, which will require a variety of biomass feedstocks for developing future biobased industries. In this context, biomass from weeds should be recognised as one possible control technology in the Committee's deliberations. Several biomass sources, including weeds could provide the feedstocks for a variety of applications, such as heat, cooling, electricity, liquid and solid fuels plus bio-production.

Generally bioenergy can provide dispatchable and base-load power and contribute to transportation fuels. Bioenergy can provide for domestic energy security, job creation and economic development, mainly in rural and regional areas, skills' capacity building and providing various environmental benefits, most notably mitigating carbon dioxide emissions and land-care.

**Bioenergy Australia** is a nation-wide government-industry-research alliance of more than fifty 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 biomass as a sustainable resource for the production of energy and related bio-products
- Broaden the market for biomass across the supply chain by addressing economic, financial, social, economic, technical, regulatory and institutional barriers, to enable widespread adoption of biomass energy and bio-based products.
- Facilitate the development and deployment of biomass energy business opportunities and projects through the provision of information.
- Broaden the support base for Bioenergy Australia to ensure its continued role in promoting sustainable biomass energy in Australia.

Bioenergy Australia is also the vehicle for Australia's participation in the International Energy Agency's Bioenergy program (www.ieabioenergy.com), an international collaborative RD&D (research, development and demonstration) 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 and biofuels. 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 does not necessarily reflect the view of individual member organisations.

**Biomass and Bioenergy**

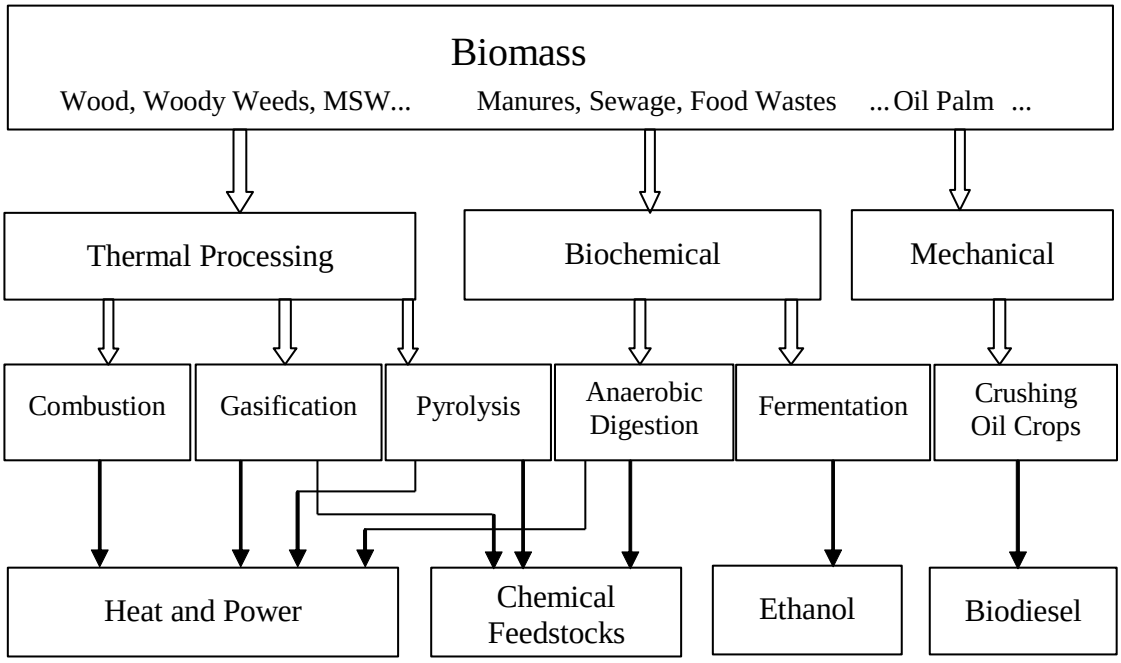
Biomass refers to organic matter, derived in recent times, directly or indirectly, from plants, as a result of the photosynthesis. It includes a wide variety of materials, including woody weeds. Bioenergy is the term used to describe energy and energy related products derived from biomass.

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.

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 examples of the commercial status of several bioenergy technologies.

Figure 1: Bioenergy Conversion Routes



**Thermal** (or thermo-chemical) energy conversion is generally applicable to drier biomass, such as wood and agricultural wastes. The most familiar and commercially mature form of thermal energy conversion is combustion.

**Combustion** of biomass accounts for approximately 90 percent of the 102,000 MW of modern bioelectricity power plants world-wide, and is very similar to technology applied to solid fossil fuels such as coal. Excess air is applied for the combustion process to convert 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 utility boilers. Co-firing of biomass with coal is allowable under Australia's Renewable Energy Target (RET), if the biomass source itself complies with the relevant Regulation administered by the Office of the Clean Energy Regulator. 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. Co-firing has also been conducted at various Australian power stations, such as Liddell, Vales Point, Wallerawang, Muja power stations.

**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 mature 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 the Clean Energy Regulator fuelling a compression ignition engine. Overseas in the USA and Europe biomass gasification has reached commercial scale demonstration, with plants having operated in Gussing in Austria, Värnämo in Sweden. These biomass gasifiers are similar in many respects to gasifiers already used commercially in the coal industry.

Gasified biomass can be upgraded and converted to a synthetic natural gas, which can be injected into pipelines for use with fossil derived natural gas. The City of Sydney has adopted this concept in its Renewable Energy Master Plan (together with biologically derived natural gas).

**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 a number of commercial plants have operated for many years in North America. Several groups are now commercialising technology to upgrade the pyrolysis oil to "drop in" transport fuels. The world's largest pyrolysis fuels plant recently began operation in the USA.

**Biochemical** conversion of biomass uses microbes to convert the biomass into energy related intermediate products such as methane or ethanol. 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. This technology is attuned to wet wastes. Biogas can be purified with the methane injected into conventional gas infrastructure. For instance the UK's Renewable Heat Obligation allows for such us of biogas.

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 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 and soil erosion. Tree crops can provide the multiple benefit of providing landscape solutions in degraded landscapes as well as providing fuel for bioenergy. The Australian Conservation Foundation (ACF) produced a report 'Fuelling Landscape Repair' noting the merit of planting trees to rehabilitate land, and also providing an energy feedstock.
- 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 [1] indicates an employment level of some 180-500 person-years/TWh of fuel energy.

**Biofuels**

The present generation of Australian biofuels are largely based on ethanol and biodiesel, which provide less than one percent of current fuel requirements in Australia. In January 2017 the Queensland Government introduced a state biofuels mandate requiring 3% ethanol in regular unleaded petrol and 0.5% biodiesel in petroleum diesel. In Australia ethanol is currently produced from starch wastes, molasses and sorghum grain, while biodiesel is mainly produced from waste vegetable oil, tallow and some virgin plant oils.

New technologies for producing biofuels are being developed world wide based on lignocellulosic feedstocks. In addition to drop-in hydrocarbon fuels from fast pyrolysis (mentioned above), technologies now being operated or built at commercial scale include:

- Straw and wood to ethanol via fermentation, for example the plant illustrated in Figure 2, operated by Beta Renewables at Crescentino in Italy:

Figure 2: Beta Renewables Ethanol Plant in Crescentino, Italy

- Wood waste to ethanol via gasification, for example the plant illustrated in Figure 3, operated by Ineos Bio in Florida, USA.

Figure 3: Wood Waste to Ethanol via Gasification

- MSW to ethanol via gasification, for example the plant illustrated in Figure 4, being built by Enerkem in Alberta, Canada

Figure 4: Enerkem MSW to Ethanol Plant in Alberta Canada

Other groups such as Gevo, Byogy and Swedish Biofuels are developing technologies to convert ethanol to hydrocarbons that may be blended seamlessly with petrol, diesel and jet fuel.

These commercial technologies have been developed by international groups with significant engineering capability and the ability to license their technologies into Australia. At the pre-commercial level, exciting and innovative work is underway in Australia on new technologies, such as using hot, compressed water to convert biomass to a bio-crude feed for oil refineries (by Licella in NSW). Woody weeds could provide feedstock for the above mentioned technologies.

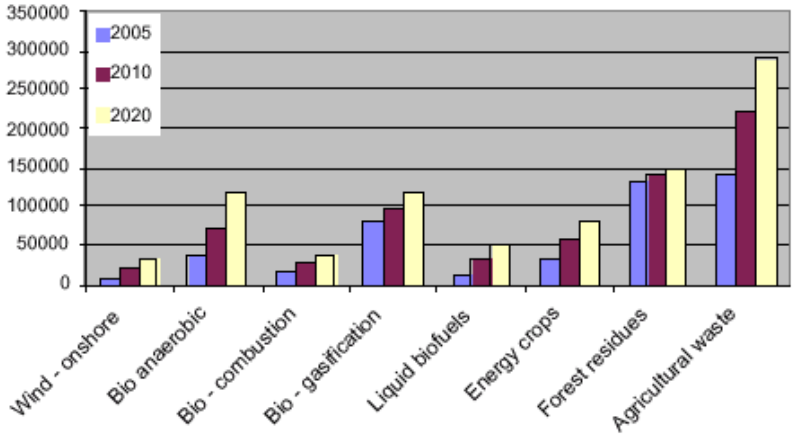
**Bioenergy Australia** is the vehicle for Australia's participation in the International Energy Agency's Bioenergy Program (www.ieabioenergy.com). It is currently participating in five Tasks:
Task 37 *Energy from Biogas*
Task 38 *Climate Change Effects of Biomass and Bioenergy Systems*
Task 39 *Commercialisation of Conventional and Advanced Liquid Biofuels from Biomass*
Task 42 *Biorefining in a Future Bioeconomy*
Task 43 *Biomass Feedstocks for Energy Markets*.

Such participation is exposing Members of Bioenergy Australia to the latest international developments in bioenergy and contributes to the development of alternatives to fossil fuels.

An opportunity is to use invasive weeds such as *Mimosa pigra* and *Vachellia nilotica*, prevalent in Northern Australia, for fuel and feedstocks. Such industries, besides contributing to our future fuel mix and energy security, would stimulate rural economies and provide permanent jobs through the production of the biomass and the supply logistics.

**Job Creation**

Bioenergy is known to have impressive economic multipliers, translating into employment opportunities, especially in rural and regional areas. Figure 5 from a European Union study shows the impressive job creation potential of bioenergy.



Projected employment in the EU for biomass technologies. Wind is included for comparison.
Source: EU Altener Report: Impact of RES on Employment, 2000.

Figure 5: Employment from Bioenergy Technologies

**Conclusion**

The bioenergy opportunity has not been realised to in Australia to the same extent as in North America and Europe. Various studies have shown that bioenergy could provide a substantial proportion of Australia's stationary and liquid fuels needs. This submission has been provided to bring to the Agriculture and Environment Committee's attention what has and is being achieved overseas in this area, and what could be achieved in Australia, using feedstocks including woody weeds.

Thank you for the opportunity of providing this submission. I would be most pleased to provide follow-up information and assistance to the Committee. This would hopefully lead to bioenergy opportunities contributing more substantially to the generation mix and future fuel supplies in Queensland, together with the jobs and sustainable economic development that are unique to this well-established form of renewable energy.

Yours Sincerely

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Dr Stephen Schuck
Bioenergy Australia Manager

References:

[1] 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.