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SUSTAINABILITY OF ENERGY SUPPLY AND RESOURCES IN NSW

Organisation: Bioenergy Australia

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BIOENERGY AUSTRALIA SUBMISSION

Inquiry into sustainability of energy supply and resources in NSW

September 2019

The purpose of this submission from Bioenergy Australia is to highlight how the development of a bioeconomy would result in a sustainable energy sector in NSW with significant economic and employment outcomes in regional areas.

About Bioenergy Australia

Bioenergy Australia is the National Industry association, committed to accelerating Australia's bio economy.

Our mission is to foster the bioenergy sector to generate jobs, secure investment, maximise the value of local resources, minimise waste and environmental impact, and develop and promote national bioenergy expertise into international markets.

Bioenergy Australia's objectives are to:

Advocate **-** With our members, we anticipate and develop leading positions on issues of concern to the advancement and growth of bioenergy in Australia.

Campaign **-** We raise the profile of the industry within the media and broader community to achieve a greater level of understanding about bioenergy and the vital role it must play to achieve carbon neutrality by 2050.

Inform **-** We publish reports, webinars and articles to help our members keep ahead of industry trends and opportunities. We also manage the Biomass Producer website, an AgriFutures Australia resource showcasing Australian bioenergy projects, expertise, and identifying opportunities for primary producers.

Connect **-** We facilitate knowledge exchange and networking for members through task-specific meetings, our Annual Conference, and Webinars. We link investors with emerging businesses; researchers with technology developers; government with innovators. We also administer Australia's participation in IEA Bioenergy. Our Industry groups bring together specialists in specific fields.

The capacity and economic opportunities of renewable energy.

The economic opportunities of renewable energy are widely demonstrated by the results achieved in the international scenario.

The International Renewable Energy Agency (IRENA) reviews renewable energy and jobs on an annual basis. Its latest review states that renewable energy employment worldwide has continued to grow since IRENA's first annual assessment in 2012. Global renewable energy employment reached 10.3 million jobs in 2017, an increase of 5.3% compared with the number reported in the previous year. The strongest expansion took place in the bioenergy and solar photovoltaic (PV) industries.

An increasing number of countries derive socio-economic benefits from renewable energy. Brazil, the United States, the European Union and SE Asian countries were among the largest employers.

The European solid biomass and wind power industries provide the most jobs, at about 389,000 and 344 000, respectively. Biomass use is receiving growing policy support, but half of Europe's jobs in this sector are in six countries: Germany, France, Spain, Italy, Poland and Finland.

A U.S. Department of Agriculture (USDA) report *An Economic Impact Analysis of the U.S. Bio-based Products Industry (2018)* analyses the economic impact of the biobased products industry on the U.S. economy. Results show that growing bioeconomy leads to higher revenues, more jobs, innovative partnerships, and key environmental benefits. The total contribution of the bio-based products industry to the U.S. economy in 2016 was $459 billion, a 17% increase from 2014, and it was employing 4.65 million workers an increase of more than 10% from 2014. This includes the 1.68 million people directly employed within the industry, plus 2.98 million employed in jobs supported by the industry. It was further estimated that each job in the bio-based industry supported 1.78 jobs in other sectors of the economy.

Socio-economic advantages are driven by a wide range of bioenergy technologies.

Biofuels

Globally, biofuels employment (at close to 2 million jobs) increased by 12%, as production of ethanol and biodiesel expanded in most of the major producers.

As an example, in Brazil, most renewables employment is in liquid biofuels and large hydropower. Total biofuel employment rose by 1% in 2017 to 593 400 jobs. Ethanol jobs declined due to the steady automation of feedstock supply and a decline of ethanol production (USDA-FAS, 2017c)14. While ethanol-related employment fell in Brazil, it was more than offset by gains in biodiesel jobs. IRENA estimates that Brazil employed 202,000 people in biodiesel in 2017, up more than 30, 000 from the previous year.

The report "An Economic Impact Analysis of the U.S. Bio-based Products Industry" commissioned by the U.S. Department of Agriculture's (USDA's) BioPreferred® Program in 2018, highlights that in the United States, the total contribution of the bio-based products industry to the U.S. economy in 2016 was $459 billion and it was employing 4.65 million workers. It was further estimated that each job in the bio-based industry supported 1.78 jobs in other sectors of the economy.

Waste to energy (WtE)

WtE facilities bring significant benefits in terms of employment and educational opportunities. According to the World Energy Council report "World Energy Resources - Waste to Energy", typical employment for a waste incineration plant of 50,000 tonnes per annum capacity would be 2 to 6 workers per shift. For a 24-hour operation, a typical plant would work on a three shifts system. For example, the WtE industry in the United States employed around 5,350 people nationwide in 2014, working at 85 specific sites. There were also additional 8,600 jobs created outside the sector. The jobs generated by the sector are usually well paid, stable and support the local economy.

Biogas and Biomethane

Developing the biogas sector contributes to the development of local economies via several ways:

• Investment opportunity: the recently launched report "Biogas opportunities for Australia", prepared by ENEA consulting for Bioenergy Australia, found that biogas represented a multi-billion dollar investment opportunity for Australia, with the potential to offset natural gas use in transport and could be used for heat and/or electricity generation and injection into the existing gas network.

• Job creation: the development, construction and operation of biogas units result in direct and indirect job creation. According to the International Renewable Energy Agency (IRENA), the biogas sector represented about 333,000 jobs globally in 2016. China accounted for slightly less than half of these jobs, with 145,000 estimated direct and indirect jobs in the biogas industry. In the United States, the construction and operation of biogas plants in 2016 may have supported around 7,000 jobs according to the American Biogas Council.

• Local circular economies: by using waste locally produced as inputs and generating biogas and digestate as outputs, the overall biogas value chain is representative of the circular economy concept. Biogas and digestate can be used locally, as an energy source and an alternative fertiliser for agriculture, respectively. This has been demonstrated in a number of international case studies as discussed in the report by IEA Bioenergy Task 37, The role of anaerobic digestion and biogas in the circular economy.

• New source of income for farmers: the development of anaerobic digestion plants directly on farms offers new business opportunities and therefore potentially new sources of income for farmers. This was one of the drivers for the development of the biogas sector in France.

In addition, there is a significant opportunity to implement and apply proven technology to produce renewable methane from organic material, including waste, crop residues or even energy crops, and inject into the gas network to supply NSW gas consumers with reliable renewable gas produced within NSW.

Biomethane is a biogas that has been upgraded to be equivalent to Natural Gas. NSW has the opportunity to leverage decades of international development of the production and processing of biomethane from waste. In 2017 there were 540 operating biomethane plants in Europe producing 68 PJ/yr[1] which is equivalent to greater than 80% of entire NSW gas annual demand, with more countries such as Italy and France realising the opportunity this production is projected expand to produce 650 – 1371 PJ/yr (8 – 17x NSW Gas demand) by 2030[2]. A variety of methods of managing and

[1] **European Biogas Association.** *EBA Statistical Report 2018.* Brussels : Renewable Energy House, 2018

[2] **Stern, Jonathan.** *Narratives for Natural Gas in Decarbonising European Energy Markets.* The Oxford Institute for Energy Studies. 2019

encouraging the Biomethane market have been implemented across Europe, this provides a proven framework to shape the NSW Biomethane industry and spill over benefits including:

1. Established and modularised technology – technology has been implemented across a range of applications, has significantly reduced in cost and modularised to allow quick deployment.
2. Established regulations and incentives – incentives for Biomethane in Europe have varied from incentivising the end use in transport to a 'feed in' tariff to project support, as these have been in place for a number of years NSW can learn from these in crafting the industry.
3. Delivering positive externalities and capability – a Biomethane industry has developed in Germany for over a decade, while in France and Italy they have over the last few years implemented mechanisms to accelerate based on the advantages they see from Germany. The industry skills required to be developed and the benefits they provide has been well developed, as well as the experience in their rapid development.

Furthermore, NSW's significant energy renewable resources can be captured as hydrogen when there is excess capacity (balancing the grid) and specifically for hydrogen export. Hydrogen represents a significant opportunity that could be worth $1.7 billion and provide 2,800 jobs by 2030, as outlined by the Chief Scientist and supported by the COAG Energy Council. The gas network in the short term provides a support for projects by providing a supplementary sink and revenue stream and potentially in the long term as a low cost and high capacity route to the domestic and export market.

Production of pellets for energy

Pellets are a solid biomass fuel, mainly produced from wood residues but also from agricultural by-products such as straw. Pellets may be used for residential and industrial (power plants) energy generation purposes. The global industrial wood pellet market has grown dramatically in the last decade and is expected to grow significantly between the present and 2025. Between 2012 and 2017, the global wood pellet market has experienced growth rates averaging 10% annually, from about 19.5 million metric tonnes in 2012 to about 31.2 million metric tonnes in 2017. It has been estimated that the number of jobs generated from the wood biomass industry in the US is approximately 30,000 (USDA 2018). When the pellets are produced in the region that is using them, a significant number of jobs are created by the pellet fuel supply chain. For example, for a modestly sized pellet factory producing 125,000 tonnes/year of pellets, the combined number of direct, indirect and induced employment is in the order of 144 jobs.

Emerging trends in energy supply and exports, including investment and other financial arrangements.

<u>Being a key component of mitigation strategies, bioenergy is anticipated to expand substantially and a significant level of global investment is currently involved in the bioenergy sector.</u>

Over the period 2021 to 2030, the EU expects bioenergy projects to generate €58.7 billion per annum in economic activity and 550,000 direct and indirect jobs.

On a number of metrics, the development of the Australian bioenergy sector is substantially lagging other Organisation for Economic Co-operation and Development (OECD) and International Energy Agency (IEA) member countries. However, bioenergy presents a considerable opportunity for Australia to embrace. The Clean Energy Finance Corporation estimate a potential investment

opportunity of between $3.5 billion and $5 billion in energy from urbane waste, agricultural waste and forest residues.

The status of and forecasts for energy and resource markets.

As part of the transition to a decarbonised energy sector, the global bio-economy is expected to grow significantly in the near future.

The International Energy Agency's (IEA) market analysis and forecast report has identified that globally bioenergy was the source of half of all renewable energy used in 2017 and it is forecast to see the biggest growth in renewable consumption over the period 2018 to 2023. Bioenergy – as solid, liquid or gaseous fuels – will account for 30% of the growth in renewable consumption in this period.

The world's bioeconomy currently consists of biofuels, biochemicals, biomass power, and bio-based products and sustainable bioenergy is expected to play a key role in the future low-carbon economy. In particular, with the decarbonisation of the energy sector, the growth of a global bioeconomy can contribute to an increased energy security and the achievement of ambitious emissions reduction targets. This is particularly relevant in sectors where there are limited options to reduce emissions. Key examples are aviation and marine.

As part of the global decarbonisation process, the international aviation industry has committed to reducing its greenhouse gas emissions. In 2009 the International Air Transport Association set the following ambitious targets of carbon neutral growth from 2020 and a 50 per cent reduction in net emissions by 2050 compared to 2005 levels. Unlike the land transport sector, airlines have limited options to materially reduce emissions other than through the use of aviation biofuels. Biofuels can decrease the carbon footprint of jet fuel by 80 per cent, based on full life cycle assessment. An overall reduction in CO2 emissions of 5 per cent can be expected if biofuel replaces 6 per cent of jet fuel by 2020. Therefore, the use of biofuels in the aviation sector is increasing rapidly. From one flight in 2008, the threshold of 100,000 flights has been passed in 2017. A number of airlines, including Cathay Pacific, FedEx Express, JetBlue, Lufthansa, Qantas, and United, have made investments by forward purchasing 1.5 billion gallons of Sustainable Aviation Fuel (SAF). Airports in Oslo, Stockholm, Brisbane and Los Angeles are currently mixing SAF with the general fuel supply.

The maritime industry is facing a similar transformation. LSF2020 refers to the new 'Low Sulphur Fuel' regulations, which will come into effect on 1 January 2020. These regulations are the biggest of a series of steps by the International Maritime Organisation to reduce marine pollution (MARPOL) in response to the threat of climate change. The LSF2020 emission regulations mean ships will have to significantly reduce emissions on the high seas as well as in coastal areas. Low sulphur fuels derived from biomass and wastes are an attractive solution to combat climate change and reduce emissions in the marine sector. A global transition towards biofuels in the shipping sector is underway and marine biofuels presents a large market opportunity. Today, marine fuel consumption is estimated to run at about 330 million metric tonnes each year, of which 80 percent to 85 percent is thought to be residual fuel oils. And, with the forecast growth in seaborne trade, that volume of consumption could double. Global demand for marine biofuels could reach more than 83 million metric tons a year, according to the "Paris Process On Mobility And Climate," a group that collaborates to create action on transport and climate change.

Alongside the transport sector, the gas network is also expected to be strongly supported by different forms of renewable energy and this will be particularly relevant for NSW. Currently, the State imports

approximately 97% of its gas from interstate and is subject to price volatility and supply shortages as a result of demand for LNG exports. However, there is a near term opportunity to complement existing gas supplies with renewable gas from biomethane. The benefits for NSW include:

- Creates a circular economy and retains value in NSW;
- Supports local jobs and investment particularly agricultural regions;
- Reduces greenhouse gas emissions on energy network by producing net carbon zero gas;
- Reduce greenhouse gas emissions of farming and food processing industries (destruction of methane and capture carbon dioxide);
- Reduces landfill and potential impact of contaminated ground water;
- Reduces particulate emissions (compared to waste-to-power);
- Captures nutrients (digestate) which can be used as fertilisers (offsetting high energy cost of synthetic fertilisers);

The advantage of utilising the NSW gas network is that this:

- Leverages the existing gas network infrastructure to reduce cost of development;
- Allows regional producers get immediate access to 1.4M customers across the state for their gas (and associated 'Green Gas' credits);
- Has a large storage potential that ensures that the energy can be used when it is needed rather than when it is produced;
- Reduces the energy lost in transmission compared to electricity;
- Is a dispatchable long term storage that enables variable renewable electricity;
- A support for variable renewable electricity, the hydrogen economy and export

Effects on regional communities, water security, the environment and public health.

Bioenergy Australia invites the Committee to consider the environmental, economic and social costs of burning coal and gas for electricity and how renewable energy can strengthen regional economies and improve water and air quality.

In particular, the development of a potential bioeconomy would deliver a wide range of economic, social and environmental benefits.

- **Employment and economic development of regional communities**

The bio-economy is built upon the use of sustainably derived, low-value feedstocks and wastes to produce high-value bioproducts including biofuels, biomaterials, biochemicals and bioplastics. The feedstock used for bioenergy-related processes is often available from rural activities, especially agriculture and it can be associated with existing or new manufacturing processes.

With a technologically advanced agricultural sector and a large amount of biomass available, the bio-economy represents a significant jobs and economic growth opportunity for regional Australia in different sectors.

Biofuels

The QUT report "Biofuels to bioproducts: a growth industry for Australia" showed an increased use of 10 per cent ethanol-blended petrol (E10) in Australia could create 2080 direct jobs and up to 6570 indirect jobs and has the potential to attract A$1.56 billion of investment and generate more than A$1.1 billion of additional revenue per year in regional communities.

In Australia, wheat starch, molasses and sorghum are used for bioethanol production, with facilities located in the regional communities of Nowra in New South Wales and Dalby and Sarina in Queensland. Manildra's facility in Nowra offers 350 jobs on the entire manufacturing site, while Wilmar's bioethanol distillery in Sarina directly employs 80 people in the bioethanol production process and a further 80 people in the distribution and sales of biofertilizer.

Locally-produced biodiesel can also support regional Australia by boosting national fuel security and offering employment opportunities. As an example, Just Biodiesel, in partnership with Refuelling Solutions, has reopened the Barnawartha plant after its closure in 2016, to produce biodiesel, a renewable, clean-burning diesel replacement that will reduce Australia's dependence on foreign petroleum, with the added benefit of creating jobs and improving the environment. The facility has re-employed 11 of the original staff and is on track to add a further 5 jobs. Through the support from many local suppliers, substantial economic benefits will be achieved for the region.

Waste to energy (WtE)

The conversion of residual wastes into energy delivers economic benefit to resources that would generally be considered as end-of-life products.

WtE technologies are therefore an attractive option to treat non-recyclable waste streams not only due to the challenges associated with landfill availability and related greenhouse gas emissions, but also their potential contribution to sustainable baseload power generation, heat recovery, metals and aggregates recycling, as well as regional development and jobs.

The potential utilization of a broad range of waste streams provides the opportunity to create new industries. For instance, technologies are constantly under development to optimise the conversion of waste into biofuels. In addition, new employment opportunities arise from growing and harvesting biomass, transport, handling, and through procurement, construction, operation and maintenance of bioenergy plants.

Some examples of employment opportunities of Australian WtE projects are listed below.

- Australian Paper is working with Suez on the construction of the first Victorian energy-from-waste project at the Latrobe Valley mill, east of Melbourne. A recent economic impact study from Western Research Institute has confirmed that the WtE facility would support an average of 1,046 Victorian jobs pa during the three-year construction period and more than 900 when operational.
- The construction of the Kwinana waste to energy plant, Australia's first large-scale project of its kind, has commenced and it is expected to be open by the end of 2021. More than 800 jobs will be created during construction and 60 positions once operational.
- World-leading German waste-to-energy company REMONDIS has announced plans to build a WtE facility in Swanbank, south of Ipswich. This project could create up to 200 jobs during construction and some 70 jobs during operations.

Biogas and Biomethane

International demand for gas exports from eastern Australia is continuing to put pressure on local gas supply and prices. Locally produced biomethane injected into the local distribution network can improve domestic supply whilst providing net zero carbon energy for gas consumers.

According to the Deloitte report "Decarbonising Australia's gas distribution networks", biogas is currently the cheapest option for decarbonisation of energy provided by gas networks. Enough biogas potential exists to meet all residential and commercial gas demand on the East Coast. The cheapest form of biogas feedstock (urban waste, livestock residue and food waste), is currently sufficient to meet around 14% of energy used from gas.

By using waste locally produced, the biogas industry supports local economies and regional communities, creating jobs, and offering new income sources, particularly for farmers.

The biogas plant itself is not labour intensive, but it can create new business opportunities in rural areas which otherwise suffer from depopulation. Through collaboration with different farms, the biogas plant can create different job opportunities along the process chain, such as raw material cultivation and collection. By increasing local energy production, income stays in the local area instead of going to global energy markets.

Biogas can be used directly onsite for local heat production via a boiler, but it can also be converted into electricity and heat by a combined heat and power (CHP) unit. The electricity produced can be used onsite or exported to the electricity grid. The heat can be used in local industrial processes or by specific customers (e.g. greenhouses) if they are close to the plant.

As previously mentioned, biogas can further be converted into biomethane via upgrading technologies.

Biogas and Biomethane enable economic development through energy export, develop transferable skills and reduce their reliance on fertiliser. This has been demonstrated in Europe where Biomethane has created long term sustainable jobs and businesses. This is because a significant portion of the employment and economic activity generated as part of a bioenergy sector remains in the regional communities, the feedstock (fuel) is created by local farmers, it is transported by local people and the plants are operated in the communities. In fact, 4.2 jobs ongoing direct and 2.1 ongoing indirect jobs are estimated to be created per MWe of capacity[3] and a majority of the construction costs are labour and local equipment (such as biodigester, civil and piping). In comparison a typical solar farm requires minimal operations staff, such as the 56 MW Moree Solar Farm requires 5 employees to operate (0.09 direct ongoing jobs per MWe of capacity)[4] and a majority of its construction costs are imported solar panels (60%)[5].

Rather than extracting value from organic wastes in the form of energy the digestion process increases the value of the waste when it is processed because the digestion of crop residues and farm wastes makes the nutrients more available to plants. This has the following benefits:

[3] **DKM Economic Consultants.** *The Economic Benefits from the Development of BioEnergy in Ireland to meet 2020 targets.* 2012.

[4] **ARENA.** Moree Solar Farm. *ARENA.* [Online] August 15, 2019. [Cited: August 27, 2019.] https://arena.gov.au/projects/moree-solar-farm/.

[5] **The Australian PV Association.** *Modelling of Large-Scale PV Systems in Australia.* 2011.

1. Enhancing availability of nutrients – resulting in a strong increase in crop growth[6]
2. Offsetting industrial fertilisers – reducing demand for imports and limiting soil and water pollution[7]
3. Capturing carbon and energy – that would normally be released in the field
4. Enhance water security – capturing and utilising wastewater

Biogas and Biomethane production primarily utilises waste. Nevertheless, if energy crops that are currently used for bioethanol are used to produce BioLNG they actually produce 3 – 4 times more transportation fuel per area[8] significantly improving the utilisation of land.

With regards to the renewable electricity sector, there are currently significant network constraints to the growth of the industry, the requirements for development of projects, especially in remote parts of the grid, are increasing and existing projects are being curtailed. There are significant opportunities for the growth in variable renewable electricity in regional areas, however in order to take advantage of these opportunities it must be balanced with stable and long term dispatchable storage which is provided by the existing gas network.

Furthermore, NSW significant energy renewable resources can be captured as hydrogen when there is excess capacity (balancing the grid) and specifically for hydrogen export. Hydrogen represents a significant opportunity that could be worth $1.7 billion and provide 2,800 jobs by 2030, as outlined by the Chief Scientist and supported by the COAG Energy Council. The gas network in the short term provides a support for projects by providing a supplementary sink and revenue stream and potentially in the long term as a low cost and high capacity route to the domestic and export market.

Production of pellets for energy

Production of pellets for energy generation represents a significant opportunity for regional Australia. Pellets may be used to produce much needed dispatchable power in Australia as we gradually transition from coal-fired generation. Production of pellets results in long-term jobs for the regions, as the production and supply of biomass to processing facilities takes place all year round. There are substantial volumes of biomass currently under-utilised and which would be suitable feedstock for pellet production (the AREMI national map provides more information on the availability of biomass across key regions nationally). There are a range of opportunities for job creation along the biomass supply chain, including the ability to grow biomass crops in marginal, unproductive land in farms or land in need of rehabilitation as a result of extractive activities such as mining.

As an example, one medium sized pellet mill with a production capacity of 100,000 Tonnes p.a. works 7600 hours p.a., involving about 20 FTE employees. In addition, extra employment is required in the construction on the plant for the prior 12 months. Upstream jobs involved in the harvesting and downstream jobs involved in the transport and distribution logistics for the route to market for pellets also create additional jobs. A very high percentage of this labour is locally sourced providing a solid stimulus for regional areas.

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[6] *Effects of anaerobic digestion on digestate nutrient availability and crop growth: A review.* **Möller, Kurt and Müller, Torsten.** s.l. : Wiley, 2012, Engineering in Life Sciences.

[7] **Eyl-Massega, Marc-Antoine and Mathieu, Carole.** *Biogas and Biomethane in Europe.* Centre for Energy. 2019.

[8] **Bauer, Wolfgang. 2015.** *Comparison of Bio-Ethanol and Biogas: Net Energy Ratio, Total Yield, and Greenhouse Gas Emissions.* Michigan State University, 2015. 6th World Congress on Biofuels and Bioenergy.

- **Energy, fuel and clean water security**

NSW Treasurer Dominic Perrottet has recently warned energy security is one of the biggest challenges facing the economy and called on the federal government to settle on policies that give certainty to investors in the electricity sector. NSW is vulnerable to changes in global coal markets as our overseas customers make shifts in their energy systems towards renewable energy. The most recent forecast from the Office of the Chief Economist shows likely declines in coal imports in our three biggest coal customers: Japan, South Korea and China. Four of NSW's five coal fired power stations are also expected to close in the next 17 years. That doesn't leave NSW communities that are heavily reliant on coal exports of coal-fired power stations much time to diversify and prepare, so alternative sources of energy are essential.

Biomass can be converted into cost effective dispatchable energy with low greenhouse gas emissions. Bioenergy is typically sourced from agricultural, forestry, industrial or municipal waste streams, turning a waste into a commodity. Bioenergy is already making a substantial contribution to supplying global energy demand, and can make an even larger contribution, providing greenhouse gas savings and other environmental benefits, as well as contributing to energy security, improving trade balances, providing opportunities for social and economic development in rural communities, and helping with the management of wastes, so improving resource management. Estimates indicate that bioenergy could sustainably contribute between 25% and 33% to the future global primary energy supply (up to 250 EJ) in2050. It is the only renewable source that can replace fossil fuels in all energy markets. There is huge potential for bioenergy in Australia for heat, cooling and electric power generation to supply industry and communities with renewable energy that supports the community and the economy whilst reducing greenhouse gas emissions.

In addition, biomass offers significant opportunities to deal with our national fuel security. International Energy Agency mandates that countries hold at least 90 days' supply of liquid fuel reserves. However, according to the latest Department of Energy figures, Australia sits well below this, with 22 days' worth of petrol, 17 days of diesel and 27 days of total petroleum products. Biofuels reduce dependence on foreign oil by producing a reliable source of domestic energy securing Australia's energy independence. As an example, the substitution of 10% of Australia's petrol consumption with domestically produced bioethanol would result in a reduction of our reliance on imported fuels by up to 18% and an improvement of Australia's balance of trade by about A$1 billion annually. In addition, oil discovery is in decline and the world has reached the point at which new drilling has failed to increase the maximum level of extraction. Renewable fuels such as biodiesel can solve many of the concerns that are raised by suggestions of "peak oil", a term used to express when the maximum level of oil can be extracted from the earth.

Bioenergy can also play a key role in securing clean and uncontaminated water streams by utilising waste otherwise dumped in landfills. The primary environmental problem arising because of landfills is groundwater contamination from leaches. There are several hazardous wastes that find way into the landfills and once they are there, the inevitable is the natural deterioration of ground water. The toxic products in the landfills range from industrial solvents to household cleaners. Besides the chemicals from household and industrial products, electronic wastes contain lead, mercury and cadmium. A huge percentage of these landfill toxins infiltrate the soil to reach the fresh water waterways, which eventually end up in the domestic water and sadly enough, the foods that we consume. The pollution can also adversely harm animal and plant life. Therefore, the diversion of waste residues from landfill to bioenergy facilities significantly reduces water contamination and improves clean water security.

- **Environmental and health benefits**

Coal mining and burning are two of the chief causes of poor air quality in NSW, which is causing significant health issues. Annual emissions from NSW coal exports, when burnt in overseas power stations, are approximately triple our annual domestic greenhouse emissions. This gives New South Wales a global role to play in tackling climate change.

By alleviating demand for petroleum-based products, the sustainable management of biomass and conversion to bioenergy supports a transition to a low-carbon economy through a reduction in greenhouse gas emissions and results in a range of positive environmental and health impacts.

Biofuels

The replacement of traditional fossil fuels with biofuels in the transport sector provides significant environmental and health benefits.

As described in the QUT report Biofuels to bioproducts: a growth industry for Australia, blending bioethanol or biodiesel with transportation fuels leads to a reduction in greenhouse gas emissions (see table 1).

Fuel type	*Australian consumption (ML)	Average CO_2 emissions factor (kg of CO_2qe/L)	*Total CO_2 emissions (Mt of CO_2eq/y)	Average CO_2 emissions factor with 10% ethanol / biodiesel (kg of CO_2eq/L)	*Total CO_2 emissions with 10% ethanol / biodiesel (Mt of CO_2eq/y)	Total reduction in CO_2 emissions (Mt of CO_2eq/y)
Petrol	18,240	2.35	43.0	2.09	40.4	2.6
Diesel	26,539	2.72	72.2	2.43	65.9	6.3

Table 1. Conventional transportation fuels greenhouse gas (CO2eq) emissions and potential emission reductions with biofuel blends.

The full implementation of an Australia wide E10 and B10 mandate would correspond to a reduction of, respectively, approximately 2.6 million tonnes and 6.3 million tonnes of greenhouse gas emissions per year.

From a health perspective, ethanol-blended petrol reduces emissions of harmful carcinogenic substances, such as benzene and 1,3-butadiene and polycyclic aromatic hydrocarbons, by between 30 per cent and 70 per cent; and ultrafine particulates (<1µm) by up to 90 per cent.

A study undertaken at the Ford Australia node of the Advanced Centre for Automotive Research and Testing concluded that hydrocarbons, NOx, CO2 and particulate matter emissions from E10 petrol were, respectively, 15 per cent, 18 per cent, 5 per cent and 26 per cent lower compared to unleaded petrol (see table 2).

Fuel type	Hydrocarbons (mg/km)	CO (mg/km)	NO_x (mg/km)	CO_2 (g/km)	Particulate Number (#)
ULP	27.67	260.37	19.19	234.18	1.39 E+11
E10	23.44	259.98	15.78	223.34	1.03 E+11
Average emissions reduction	15%	0%	18%	5%	26%

Table 2. Cumulative emissions from a vehicle running on ULP and E10.

The beneficial health and health care cost impacts of using ethanol-blended petrol have been principally attributed to reduced particulate emissions from ethanol-blended fuels reducing mortality and morbidity associated with lung cancer, cardiopulmonary disease, chronic obstructive pulmonary disease, asthma and cardiovascular disease

The opportunity of reducing air pollution in the transport sector is particularly relevant in marine and aviation, due to the strict international emission reduction targets.

In January 2020, the marine industry will undergo one of its greatest changes in recent times with the limit for sulphur in fuel oil used on board ships reducing from the current 3.5% to 0.50% m/m (mass by mass) when operating outside designated emission control areas. This is as a consequence of changes to the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI that come into effect on Jan 1 2020. These regulations have seen a progressive reduction globally in emissions of SOx, NOx and particulate matter and the introduction of emission control areas (ECAs) to reduce emissions of those air pollutants further in designated sea areas. This will significantly reduce the amount of sulphur oxides emanating from ships and should have major health and environmental benefits for the world, particularly for populations living close to ports and coasts. With very low sulphur levels and low CO2 emissions, fuels derived from biomass and wastes represents therefore the best option to meet the International Maritime Organization (IMO) requirements.

The aviation industry is facing a similar transformation. At a global level, the aviation industry has committed to reducing its greenhouse gas emissions and has set a target of carbon neutral growth from 2020. To achieve the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) targets, all sustainable fuels will need to be assessed against a robust and consistent Lifecycle analysis (LCA) framework. Unlike the land transport sector, airlines have limited options to materially reduce emissions other than through the use of aviation biofuels, therefore bio-based aviation fuels can significantly contribute to a significant decrease in global CO2 emissions. Worldwide in 2015, 781 million tonnes of CO2 were produced from flights. Biofuels can decrease the carbon footprint of jet fuel by 80 per cent, based on full life cycle assessment. An overall reduction in CO2 emissions of 5 per cent can be expected if biofuel replaces 6 per cent of jet fuel by 2020.

Biofuels represents therefore a real opportunity to reduce emissions in the transport industry, but significant environmental benefits can also be achieved in other sectors. For instance, there is huge potential for bioenergy in Australia for heating, cooling and electric power generation to supply industry and communities with renewable energy that supports the community and the economy whilst reducing greenhouse gas emissions.

Waste to energy (WtE)

Studies have shown that the increased deployment of WtE compared to landfill can reduce greenhouse gas emissions. This is because when residual organic material is placed into a landfill, bacteria breaks it down to produce a gas called methane. Some of this methane can be captured in well-operated landfills however, it is often difficult to fully contain. Any methane that is released into the environment is 25 times more potent than carbon dioxide and therefore, reducing methane emissions from landfill is one of the focus areas for meeting our international commitments to reduce greenhouse gases.

An example of this greenhouse gas benefit is demonstrated by the Kwinana WtE project in WA. It has been calculated for this project that there will be an estimated 400,000-tonne reduction of greenhouse gas per year simply by diverting the waste from landfill and offsetting other fossil fuel energy generation.

Biogas and Biomethane

Biogas production and utilisation can contribute to Australia's national greenhouse gas (GHG) emission reduction target by providing a renewable energy source and capturing emissions from animal waste storage and landfill sites. These emissions would otherwise be released into the atmosphere.

In 2015 under the Paris Agreement, the Australian Government committed to reduce emissions by 26-28 per cent from 2005 levels by 2030. According to CEFC's 2015 report The Australian bioenergy and energy from waste market, the investment opportunity to 2020 for new bioenergy and energy from waste projects was estimated to avoid more than 9 million tonnes of CO2e emission Australia wide, each year between 2015 and 2020.

The biogas sector's contribution to the reduction of GHG emissions is made through three main pathways:

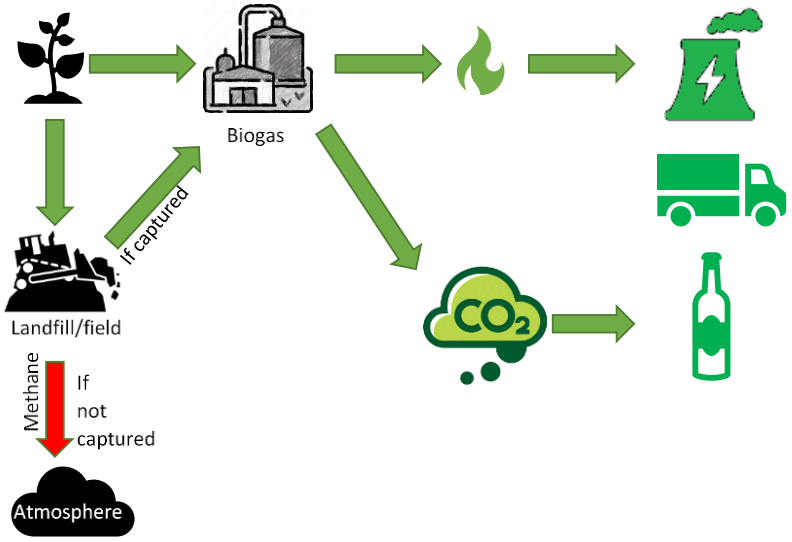
1. Replacement of fossil fuels: the reduction of carbon dioxide emissions is realised when biogas replaces fossil fuels for energy purpose. The combustion of fossil fuels releases carbon accumulated over millions of years. In contrast, the combustion of biogas is considered as carbon neutral, due to the shorter lifecycle of the biomass used.

In a study conducted by ENEA Consulting and Quantis in 2015, the replacement of natural gas by biomethane in France resulted in the reduction of GHG emissions by 54 gCO2e for each MJ that was produced, injected into the gas grid and consumed. This amount translates to more than 85 per cent emissions reduction from the consumption of natural gas, which has the emission factor of approximately 63.1 gCO2e per MJ (LHV) in France.

2. Capture of methane emissions from landfills: new landfill sites start to release methane after five years, reaching a peak emission in about 20 years, and continue to discharge gas over the course of following decades. Thus, capturing exiting methane from landfills to utilise for energy production contributes to GHG emission reduction.

3. Capture of methane emissions from animal waste and meat processing waste water storage lagoons: open storage of slurry and lack of manure treatment results in methane emissions being released into the atmosphere. By using them as a feedstock for biogas production, methane emissions are avoided or at least reduced.

When biogas is captured it can be upgraded to biomethane, which involves the removal of CO2 (~38%) (and other contaminants). This CO2 can be utilised for industrial purposes, fed into greenhouses to enhance plant growth or potentially stored to make Biomethane carbon negative. The Biomethane can then injected be into the gas grid to offset existing gas use for any number of applications including heating, electricity production, transport (CNG) or industrial purposes. A certification or Guarantee of Origin system is being developed, similar to GreenPower for electricity, that will allow any of the customers for these applications to access carbon neutral gas.



• Biomethane for grid injection: as biomethane has similar characteristics to natural gas, its injection into the gas grid does not require any adaptation of the existing infrastructure (neither the gas grid nor customer equipment connected to it). The Gas Vision 2050 report reflects the ambitions of the key organisations representing Australia's gas sector on accelerating the decarbonisation of the gas sector beyond 2050. Biogas production is identified as one of the primary technologies for achieving this using existing infrastructure.

• Biomethane for vehicle fuel: biomethane produced from biogas upgrading plants can be further compressed or liquefied to be used as fuel for vehicles, mostly cars, buses and trucks of various sizes. It therefore offers a new opportunity to decarbonise the transport sector while promoting new uses for gas. This opportunity has already been recognised by a number of pioneering providers of commercial vehicles developing alternative solutions for vehicle fuels. As an example, Scania, a Swedish manufacturer of commercial heavy vehicles, has offered 95 biomethane buses to the Kalmar county public transport in 2017, as part of a longer-term service contract targeting the distribution of more than 500 vehicles. In Australia, Scania has signed memoranda of understanding with different biofuel providers as well as the NGV Group. This has the potential of opening up future opportunities for fuelling its current fleet of gas buses and future gas vehicles with biomethane in NSW an in Australia.

Opportunities to support sustainable economic development in regional and other communities likely to be affected by changing energy and resource markets, including the role of government policies.

Around the world, government policies have been instrumental in supporting the development of sustainable bio-economies. In particular, they are playing a key role in securing feedstock supply, infrastructure and logistics; promoting access to technology and early-stage investment support; and improving demand. Local strategies have been developed to provide stable political environments and guidance for investors and other relevant stakeholders in the bio-economy.

There are certainly opportunities to diversify regional economies in NSW using the skills and assets the region already possesses, such as strengths in the agriculture, wine-tourism and manufacturing industries, as well as skilled machinery operators, drivers, technicians and trade workers.

As with any emerging sector, government support plays an important role in removing barriers, setting targets and accelerating the development of the industry.

Following the direction of the Federal Government, the NSW should collaborate with other States and Territories to grow the Australian bio-economy through:

• establishing a uniformed national vision for the bio sector in Australia, with a corresponding set of policy objectives and targets informed by cost benefit analyses;
• developing a roadmap to achieve the vision, including recommended policy levers for all levels of government to implement; and
• monitoring performance of achieving the roadmap through regular reporting.

In particular, the NSW Government can play an important role in supporting the development of the renewable gas industry, including but not limited to:

- Supporting regional biomethane feasibility and feedstock studies;
- NSW Government offtake of net carbon zero green gas, any gas demand connected to the distribution network (e.g. CNG, hospitals, etc)
- Land, zoning, approval support for biomethane projects;
- Incentives and support for initial projects;
- In-kind assistance to identify and reduce regulatory barriers;
- EPA endorsement and sanction of process; and
- Assistance and support for the certification and treatment of grid injected biomethane

In summary

As part of the transition to a global low-carbon economy, the role of renewables in the energy system keeps expanding in order to replace fossil-based energy sources.

Australia is also involved in this transition, and the NSW Government needs a plan to diversify and prepare for a future beyond coal. This involves preparing the community and economy for structural adjustment and considering renewable energy options to replace fossil-based fuels.

In this context, Bioenergy Australia highlights NSW's potential for growth in bioenergy production and use and the related economic, social and environmental opportunities.

Thank you for the opportunity to provide this submission.

Yours sincerely

Shahana McKenzie, CEO Bioenergy Australia