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Australia

Biofuels Annual

2017

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Report Highlights:

The Australian biofuel industry and market remain small because mandates do not cover the entire country and remain modest compared to other countries with biofuel programs, and tax relief alone has not boosted biofuel use. With minimal mandate support, biodiesel production and imports have collapsed since 2014 due to lower world crude oil prices and high feedstock prices. Total biofuel production for 2017 is estimated at 290 million liters (ML), comprised of 250 million ML of fuel ethanol and a sharply reduced 40 million ML of biodiesel. Production of fuel ethanol has declined less (just over 15 percent since 2013) because of its value as an oxygenate in gasoline, and it is supported by a mandate in New South Wales (NSW) and a new 2017 mandate in Queensland. Second-generation biofuels, such as energy crops and algae-based fuels, have been successfully tested but are not yet commercially viable. However, the Queensland government has provided support for an advanced biofuels plant to produce fuel for military, aviation and marine applications.

Post:
Canberra

I EXECUTIVE SUMMARY

Australia is a major importer of crude oil and refined products for transport fuels; although overall it is a leading international exporter of energy. There has been a continued decline in domestic refining capacity for transport fuels and a significant rise in import dependence, with 85 per cent of refinery feedstock and 45 per cent of refined production consumption now met from imports. The Australian biofuel industry has significantly contracted in recent years due to lower world crude oil prices, high feedstock prices and a changing policy framework. Total production for 2018 is estimated by Post at 290 million liters (ML), comprised of 250 million ML of ethanol and 40 million ML of biodiesel.

Biofuel production is estimated to be unchanged from 2017, but is significantly below 2014 when it peaked at 400 ML and consumption approached 800 ML, including biofuel imports. Production of ethanol is relatively stable and is supported by a 6% mandate in NSW, while a 3% mandate in Queensland took force in 2017. The largest ethanol producer in Australia is Manildra, which manufactures ethanol from waste wheat and supplies the NSW market. Two smaller producers in Queensland manufacture ethanol from sorghum grain and sugar respectively. Imports of bioethanol from all sources appear to be uncompetitive with standard fuels under the current excise tax regime.

By contrast, production of biodiesel has collapsed due to high costs for feedstock (such as tallow) and low world oil prices. A surge in biodiesel imports occurred in 2013-15, building up stocks and keeping consumption higher than it would have been otherwise before the excise rebate scheme closed partly due to higher crude oil prices, which fell from mid-2014. Imports of biodiesel from all sources are subject to the full excise and appear to be uncompetitive with standard diesel imports.

These developments reduced the scale of the biodiesel market and the B2 mandate in NSW and related tax relief was insufficient to prevent firms leaving the industry. The largest biodiesel producer, Australian Renewable Fuels (ARF), closed in early 2016 although production capacity remains. Exports of tallow to Singapore for the manufacture of renewable diesel have increased significantly in recent years, reflecting reduced demand from biofuel refineries in Australia. Europe is the main destination for exports of Australian canola for use in the production of biofuels.

Second-generation biofuels such as energy crops and algae-based fuels have been successfully demonstrated but there is no commercial production and no subsidy scheme is offered for commercial sales. A significant research effort has been initiated by a number of research agencies in the development of first generation and second generation biofuels. The Queensland government has recently announced a number of programs aimed at making the state a center of bio-manufacturing and biofuels production. It also hopes to develop the commercial production of biofuels for military, maritime and aviation uses.

There are no comprehensive statistical series provided by industry or government that organize the picture on country-wide production, trade and sales of biofuel. This report builds annual supply/demand balances using available sources such as excise tax rebate statistics, industry statistics on plant capacity, and greenhouse gas emissions estimates by the Department of the Environment. Most biofuel plants have excess capacity and many have closed in recent years.

II POLICY AND PROGRAMS

International

Australia is a member of the Asia-Pacific Economic Cooperation (APEC) Energy Working Group which includes a biofuels task force. This is an international grouping of countries seeking to make biofuels a more viable and sustainable transport fuel. Other members of the taskforce are Brazil, Canada, Japan, New Zealand, Malaysia, Mexico, Singapore, Taiwan, Thailand, the United States and Vietnam. Bioenergy Australia is active in the International Energy Agency's Bioenergy group and Australia is participating in the development of ISO sustainability criteria for bioenergy.

Fuel Taxes – Excise and Import Duties

Biofuels are subsidized thru tax policy because they are taxed at far lower rates than their fossil fuel equivalents, but this support is scheduled to fall thru 2030. Imported fuel ethanol and biodiesel are taxed at the higher rates of fossil gasoline and diesel and thus disadvantaged over domestic biofuels.

Imports of petroleum products such as petrol and diesel attract a customs duty equivalent to the excise on domestically refined products. Domestic fuel ethanol and biodiesel are subject to lower rates, but the excise rates on these fuels are gradually increasing. The fuel excise tax is indexed to movements of the Consumer Price Index and is administered by the Australian Taxation Office (see table 1 below).

Table 1: Excise rates for fuel in Australia, 2017 (A\$/liter)

Tariff item	Description	From February 2017	From August 2017
10.1	Petroleum fuel	0.401	0.401
10.6	Diesel fuel	0.401	0.401
10.2	Fuel ethanol	0.026	0.053
10.2	Biodiesel	0.013	0.027

Note: The rate of duty for denatured ethanol for use as fuel in an internal combustion engine is worked out under [section 6H](#) of the *Excise Tariff Act 1921*. The rate of duty for biodiesel is worked out under [section 6J](#) of the *Excise Tariff Act 1921*. Source: Australian Taxation Office.

Under current arrangements, the rate of excise duty on locally produced fuel ethanol will gradually increase to one-third of the excise rate for petrol by 2030. Imported ethanol is subject to the full excise rate applying to petrol. The rate of excise on locally produced biodiesel will gradually increase to one half of the excise rate for diesel by 2030. Since mid-2015, imported biodiesel has been subject to the full rate of excise which applies to diesel. Prior to this, biodiesel imports received a full excise rebate to encourage the use of more environmentally friendly fuel.

Australian Fuel Standard for Biofuels

Federal government regulations apply to the quality of petrol and diesel fuel in Australia. The [Fuel Quality Standards Act 2000](#) provides a legislative framework for setting national fuel quality and fuel quality information standards. Fuel quality standards apply to petrol, diesel, biodiesel, autogas and ethanol E85. The standards aim to reduce the amount of toxic pollutants in vehicle emissions. A fuel quality information labelling standard covers Ethanol (in petrol) and Ethanol E85.

Under the fuel standard for E10, suppliers who supply petrol containing ethanol must comply with the Fuel Quality Information Standard (Ethanol) Determination 2003 (labelling standard). The [labelling standard](#) is in place

to inform consumers that the fuel they are purchasing contains ethanol. The Australian Government capped the level of ethanol that can be added to petrol at 10 percent in July 2003. This followed vehicle testing that suggested that petrol containing ethanol blends of 20 percent or more could cause engine problems in some older vehicles. A requirement to label ethanol blend petrol was introduced in 1 March 2004 and amended in January 2006 to simplify the labelling standard.

Under the [Fuel Quality for Ethanol-e85](#) (a fuel blend of 70–85 percent ethanol with the remainder petrol), the fuel may only be used in cars that have been specifically built or modified to use E85. These include flexible-fuel vehicles and V8 racing supercars. The [Fuel Quality Standard for Biodiesel](#) defines biodiesel as ‘a diesel fuel obtained by esterification of oil derived from plants or animals’.

NSW Government Biofuels Policy

The ethanol mandate in NSW is designed to encourage broader use of ethanol and other biofuels in the State. Most cars in NSW that use unleaded petroleum (ULP) can use 10 percent ethanol-blended fuel. The NSW government has a [legislated](#) ethanol supply mandate of E6 for wholesale companies and a requirement for retailers with 20 or more outlets to offer ethanol product for sale. Under the NSW [Biofuels Act 2007](#), a certain percentage of the total volume of petrol sold in NSW by volume fuel sellers is required to be ethanol and a certain percentage is required to be biodiesel.

The main objective of the Biofuels Act 2007 is to support the development of a sustainable biofuels industry in NSW. The Act has a number of secondary objectives, including (a) improving air quality; (b) addressing climate change by reducing greenhouse gas emissions; (c) providing consumers with cheaper fuel options; (d) reducing the reliance of NSW on imported petroleum products; and (e) supporting regional development. The *Biofuels Act* is administered by the NSW [Office of Fair Trading](#).

The NSW mandate (with exemptions) for ethanol is E6 requiring that ethanol must represent six percent of the total volume of petrol sold in NSW. A B2 mandate also exists, which requires two percent of the total volume of diesel sold to be biodiesel. A range of exemptions applied to petrol retailers which has lowered the effective mandate for ethanol below E6. The NSW government has sought to reduce the number of exemptions to the Biofuels Act to encourage greater use of fuel ethanol. Under an amendment to the Biofuels Act, all fuel retailers that sell three or more types of petrol and diesel and have sales above a certain threshold will need to comply with the ethanol mandate.

Queensland Government Biofuels Policy

The Queensland State government has introduced biofuel mandates to boost the biofuel and bio-manufacturing industry sector. The [legislation](#) passed in December 2015 requires the fuel industry to meet targets for the sale of biobased fuels, such as E10 and biobased diesel. The mandate sets minimum requirements for the sale of ethanol-blended regular unleaded petrol and biobased diesel. The biobased petrol mandate applies separately to the biobased diesel mandate. Both schemes began in January 2017. Details of the new requirements for fuel sellers are given [here](#).

Queensland Biofutures Roadmap

The Queensland State government is also pursuing the development of a competitive industrial biotechnology and bio products sector in its [Biofutures Roadmap](#). It has identified this sector as a priority industry to develop new markets for technology developers and agricultural producers. The state government has established an A\$5 million Biofutures Industry Development Fund, an A\$5 million Commercialisation Fund and an A\$4 million

Biofutures Acceleration Program. Potential feedstocks have been broadly defined to but the main sources are likely to be sugarcane and sorghum.

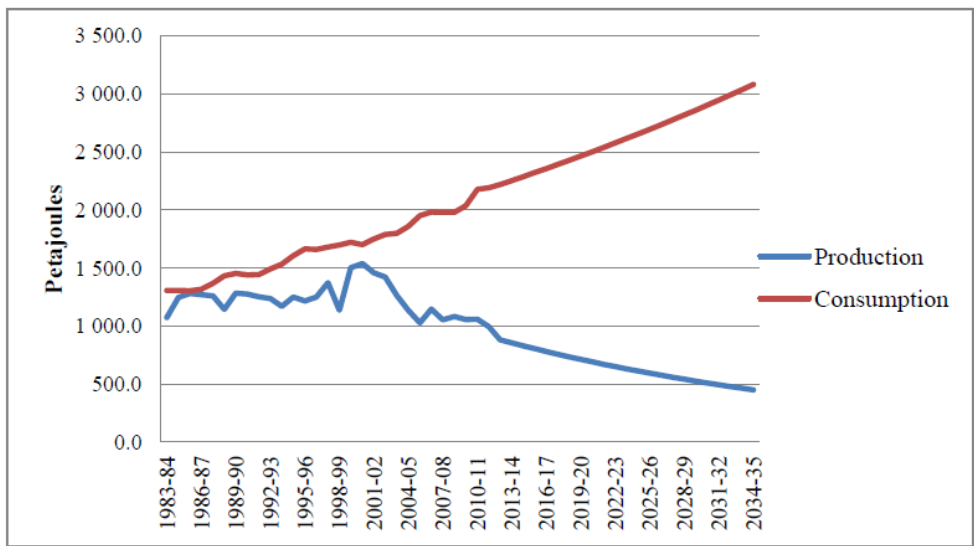
III FOSSIL FUELS, RENEWABLE ENERGY AND TRANSPORT FUELS

Overview

In 2016, Australian refineries refined 26 billion liters of refined products, with petrol and diesel accounting for approximately 80 percent of this production. Total demand for petroleum in Australia has been static over the last 15 year as vehicle fuel efficiency has improved. Use of regular unleaded petrol (ULP) has declined by more than 40 percent as consumers chose new vehicles that recommend the use of higher octane fuels or have moved to ethanol blend petrol. Other reasons include a decline in tariff and other barriers to motor vehicle imports into Australia, changing fuel efficiency regulations, lifestyle and consumption changes and greater fuel efficiency of the increasingly newer vehicle fleet.

Australian demand for ethanol blend petrol reached a peak of 16 percent of petrol use in 2010–11, largely as a consumer preference response to the ethanol fuel mandate in NSW, but has subsequently declined to less than 11 percent of total petrol use. A major reason appears to be consumer concerns over possible engine damage from the use of ethanol blended fuels which is supported by vehicle warranties on new cars which can be voided if the E10 fuel is used.

Chart 1: Australian oil production and consumption, 1983-2035



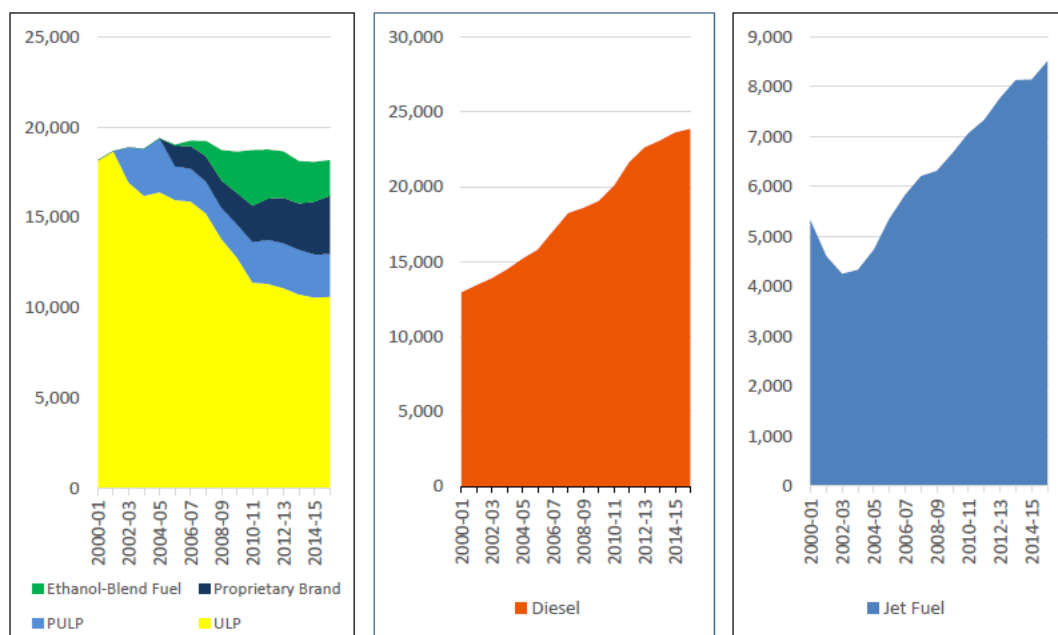
Source: Bureau of Resources and Energy Economics (BREE) and Department of Industry (2016, latest estimates available).

Australia’s supply of transport fuels is met by a mix of domestic and imported refined crude oil and other feedstock and finished product. In 2016, over 80 percent of the crude and other feedstock required for domestic refining was imported, with the balance being supplied from production in Australia. Around 40 to 45 percent of refined petroleum products are imported from overseas refineries. Since 2010, the number of Australian oil refineries declined from seven to five, with 35 million liters per day reduction in refinery capacity ([Energy White Paper 2015](#)).

Net imports from over 20 countries accounted for 53 percent of total consumption. Australian production of crude oil has been declining and 76 percent was exported in 2015–16 as these oils are largely unsuitable for local refineries. Over the past decade, consumption of petroleum products has increased by around 2 percent per year. Petrol, diesel and jet fuel use were 90 percent of total demand in 2016.

The Australian road transport fleet is generally reliant on petroleum based fuels such as petrol and diesel. Petrol is the dominant fuel in the light vehicle sector, although the share of diesel has increased. Diesel is the dominant fuel in the heavy vehicle sector. Petrol, diesel and aviation fuel are the dominant transport fuels, accounting for over 90 percent of transport energy use in 2015. The share of petrol in the transport fuel mix has decreased slowly over recent decades, outstripped by growth in diesel and aviation fuel. This reflects increased demand for diesel from mining activities and increased air transport activity.

Chart 2: Australian use of major petroleum products, 2001 to 2016 (million liters)



Note: PULP is premium unleaded petrol; ULP is unleaded petrol.

Source: Australian Institute of Petroleum.

Fuel Efficiency and Emissions

Australia has a range of policy measures to increase fuel efficiency in the vehicle fleet. Since 2004, the Australian Government has mandated fuel consumption labelling of all new vehicles up to 3.5 tonnes, to provide information to consumers on the relative performance of individual models. There are a range of voluntary measures in place to reduce vehicle CO₂ emissions and improve fuel efficiency. The Australian Government and the Federal Chamber of Automotive Industries (FCAI) agreed to a voluntary national average fuel consumption (NAFC) target for new passenger cars of 6.8 L/100km for petrol passenger cars. The Green Vehicle Guide (GVG) website provides model specific information to consumers on the emissions performance of all light vehicles produced since mid-2004.

Australia's national average carbon emissions from new passenger vehicles are comparatively high but are declining as the average age of vehicles in the national fleet falls. Some factors are a consumer preference for heavier vehicles and a lower proportion of diesel powered engines. According to a 2014 study by the National Transport Commission (NTC) the average annual carbon dioxide emissions ratings

of new passenger vehicles and light commercial vehicles was 192 grams per kilometer travelled, a 3.4 percent reduction from 2012 and is the third largest annual reduction since records started in 2002. In 2013, 2.2 percent of new cars sold in Australia were ‘green’ cars (compared with 1.2 percent in 2012). A ‘green’ car is a vehicle that does not exceed 120 g/km (NTC, 2014).

Table 2: Australian Fuel Use, historical, 2011 to 2016 (‘000 liters)

	2011	2012	2013	2014	2015	2016
Automotive Gasoline						
Unleaded gasoline	11,389	11,313	11,090	10,735	10,562	10,598
Premium unleaded	2,247	2,449	2,490	2,472	2,390	2,359
Proprietary brand	2,021	2,286	2,509	2,561	2,924	3,250
Ethanol-blended fuel	3,069	2,714	2,570	2,352	2,194	1,971
Total	18,725	18,762	18,659	18,120	18,070	18,178
Aviation fuel	7,068	7,336	7,773	8,168	8,143	8,511
Diesel Oil	20,061	21,643	22,631	23,081	23,619	23,866
Fuel Oil	757	942	717	811	791	862
Total petroleum products	52,410	54,040	55,252	55,173	55,159	55,440

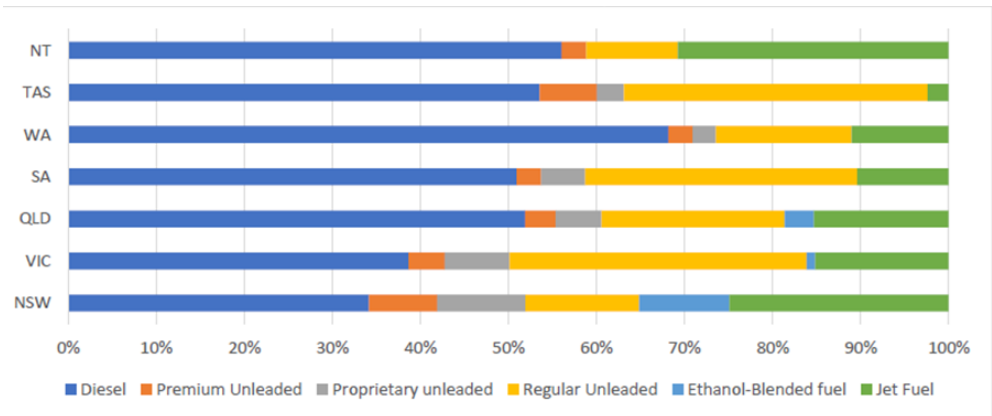
Source: Australian Petroleum Statistics.

Table 3: Australian Fuel Use Projections, 2017 to 2024 (ML)

Calendar Year	2017	2018	2019	2020	2021	2022	2023	2024
Gasoline Total	18.2	18.2	18.4	18.6	18.9	19.1	19.3	19.5
Diesel Total	24.0	24.0	24.2	24.4	24.6	24.8	25.0	25.2
On-road	7.7	7.9	8.1	8.3	8.6	8.8	9.0	9.2
Agriculture	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2
Construction/ mining	7.9	8.1	8.3	8.6	8.8	9.0	9.3	9.5
Shipping/rail	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0
Industry	1.3	1.4	1.4	1.4	1.5	1.5	1.5	1.6
Heating	na	na	na	na	na	na	na	na
Jet Fuel Total	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5
Total Fuel Markets	39.6	40.5	41.4	43.1	43.1	43.9	44.8	45.5

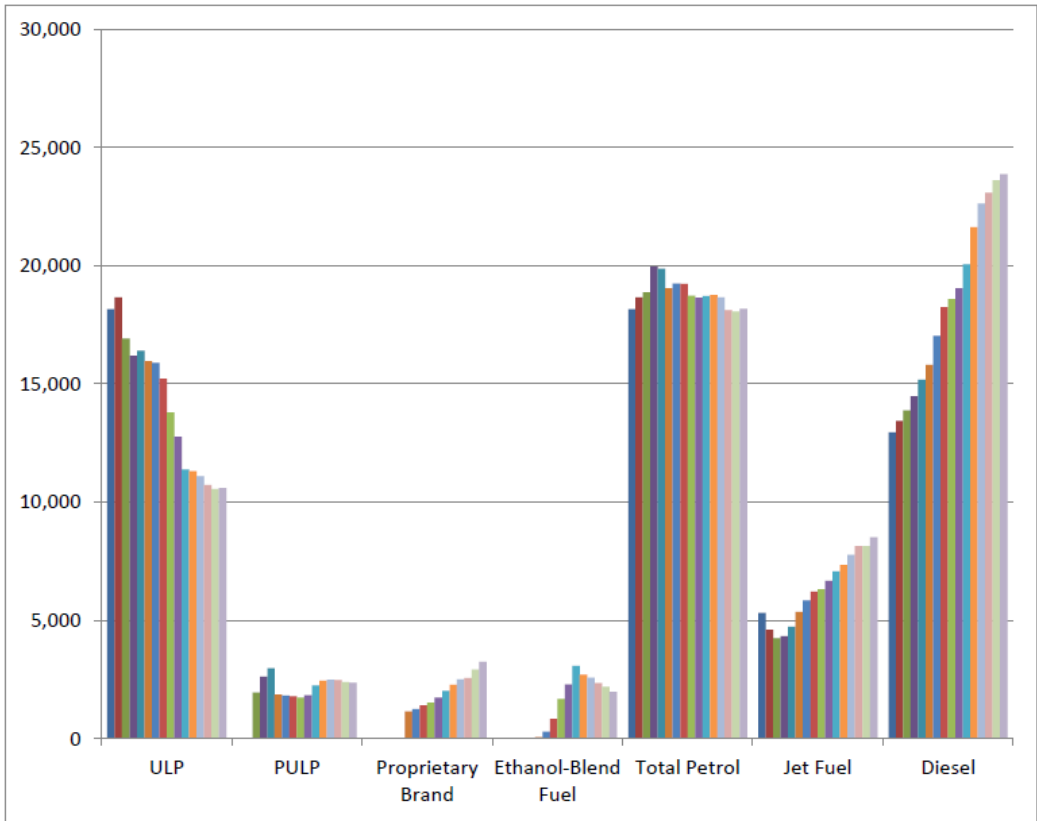
Sources: Department of Industry (2016, latest estimate), Australian Energy Statistics, Australian Petroleum Statistics and Post estimates.

Chart 3: Australian demand for petroleum products by State, 2015-16



Source: Australian Institute of Petroleum.

Chart 4: Australian demand for petroleum products, 2001 to 2016



Note: ULP is unleaded petroleum and PULP is premium unleaded petroleum.

Source: Australian Institute of Petroleum.

RENEWABLE ENERGY IN AUSTRALIA

Coal remained the second largest primary fuel consumed in 2014–15, accounting for 32 percent of energy consumption. After five years in a row of decline, coal consumption rose by 3 percent in 2014–15, underpinned by increased black and brown coal use in the electricity generation. Despite this increase, Australia's coal consumption remains around 20 percent lower in 2014–15 than its peak in 2008–09, when its share of the energy mix was more than 40 percent. Natural gas accounted for 24 percent of energy consumption in 2014–15. Gas consumption rose by 1 percent in that year, supported by increased gas-fired electricity generation in Queensland.

Renewable energy sources accounted for the remaining 6 percent of total energy consumption in 2014–15, comprising mainly biomass, followed by hydro and wind energy. Renewable energy accounted for 14 percent in Australia's electricity generation in 2014–15. Renewables generation declined by 7 percent in 2014–15, driven by hydro generation, which declined by 27 percent. This is mainly attributable to lower water levels in hydro dams, particularly in Tasmania.

In 2014–15 renewable energy consumption rose by 2 percent, with growth in bagasse, wind and solar outweighing the significant fall in hydro. Wind energy continued to be a significant driver of growth in renewables, increasing by 12 percent in 2014–15 as additional capacity came online in several states. Solar PV and biogas use also grew strongly in 2014–15, by 23 and 17 percent, respectively.

Table 4: Australian renewable energy production by fuel type, 2014-15

Source	Renewable energy production (PJ)	Share (%)	2014-15	Average annual growth, 2006-2015 (%)
Biomass	186.7	54.4	6.8	-1.2
Wood, wood waste	81.7	23.8	-2.1	-2.1
Bagasse	102.9	30.0	14.0	-0.6
Biogas	19.1	5.6	17.0	9.9
Biofuels	11.4	3.3	-12.1	23.7
Ethanol	6.7	2.0	-22.7	na
Biodiesel	4.7	1.4	9.7	na
Hydro	48.8	14.1	-27.0	-1.9
Wind	41.3	12.0	11.8	23.5
Solar PV	21.5	6.3	22.9	59.3
Solar hot water	14.8	4.3	12.2	22.3
Total	343.3	100.0	1.6	2.1

Source: Department of Industry and Science (2016), *Australian Energy Statistics*, Canberra.

Renewable energy sources accounted for 6 percent of Australian energy consumption in 2014/15, comprising mainly biomass, followed by hydro and wind energy. The transport sector represented 27 percent of Australian energy consumption, with road transport taking up three quarters of this sector and air transport accounting for 20 percent. Renewable energy production in Australia reached 343 petajoules in 2014/15 (the latest available year) and represented around 2 percent of total energy production, which is dominated by coal, gas and oil production.

In December 2014, the Australian government commenced a review of Australia's emission reduction targets, emissions trading and post-Paris Climate Accord action by the Climate Change Authority. In June 2017, the Minister for the Environment and Energy announced the Government is considering the recommendations of the Review in the context of a wider review of climate policies and emissions reduction targets. The outcome of the review process has not yet been announced. It appears unlikely that policies affecting the biofuels sector will be changed significantly under the review process.

Under current policies, there is a national target for 20 percent of Australia's electricity to be sourced from renewable energy sources by 2020. The primary mechanism for achieving this target is the Renewable Energy Target (RET) which requires 33,000 GWh per year of renewable energy by 2020, when 24 percent of electricity generation is expected to be sourced from renewable sources (see [link](#)).

Table 5: Australian renewable energy consumption by fuel type, 2014

Source	Energy consumption (PJ)	Share (%)	Change since 2013 (%)	Average annual growth, 2005-2014 (%)
Biomass	183	53.0	-1.1	-1.4
Woodwaste	93	26.9	3.1	-0.9
Bagasse	90	26.1	-5.1	-2.0
Biogas	16	4.7	17.0	9.1
Biofuels	12	3.6	2.6	24.3
Ethanol	7	2.1	-12.1	-
Biodiesel	5	1.5	33.5	-
Hydro	66	19.2	0.8	1.9
Wind	37	10.7	28.8	31.3
Solar PV	18	5.1		58.3
Solar hot water	13	3.8		19.7
Total	346	100.0	4.0	2.4

Source: Department of Industry and Science (2015), *Australian Energy Statistics*, Canberra.

The Renewable Energy Target (RET) operates through the creation and surrender of Renewable Energy Certificates, each certificate being for one MWh of compliant renewable energy. Under the scheme, energy retailers and large energy users must purchase a proportion of their energy requirements from renewable energy sources. In 2015, the RET was amended to reinstate biomass from native forest wood waste as an eligible source of renewable energy. The RET is administered by the Federal Government's Office of the Clean Energy Regulator.

In 2014, renewable energy accounted for two percent of total energy production. Over the year, the share of renewables in electricity generation increased to almost 15 percent, up from 8 percent a decade previously. Hydro was the largest contributor to renewable generation, accounting for around half of total renewable generation. The shares of wind and solar electricity generation have continued to grow and accounted for 4 percent and 2 percent respectively of total electricity generation in Australia. Wind generation in South Australia accounted for over 30 percent of the total fuel mix in that State.

Renewable energy consumption in 2014 rose by four percent, with growth in all renewable energy sources except bagasse and ethanol. Wind energy continued to be a significant driver of growth in renewables as additional capacity came online in several states. Solar PV and biogas use also grew strongly in 2014.

Agriculture is the fourth most energy-intensive industry in Australia, behind manufacturing, transport and mining and accounts for nearly four percent of industry energy usage. On farms, energy is consumed as general electricity for lighting and appliances, fuel for machinery, vehicles and freight costs; and for heating and cooling, especially in the dairy, horticulture, piggeries and poultry sectors.

The Clean Energy Finance Agency (CEFC) has provided co-financing for agribusinesses for a range of bioenergy projects from on-site generation using biogas, solar PV and cogeneration to new refrigeration units and other equipment upgrades. These investments allow farmers and food producers to generate energy on-site and reduce their energy bills.

Table 6: Australian electricity generation by fuel type, 2014

Source	Electricity generation (GWh)	Share (%)	Change since 2013 (%)	Average annual growth, 2005- 2014 (%)
<i>Fossil fuels</i>	211,255	85.1	-2.4	0.2
Black coal	105,772	42.6	-5.1	-2.1
Brown coal	46,076	18.6	-3.1	-1.6
Gas	54,394	21.9	6.5	9.6
Oil	5,012	2.0	12.3	6.5
<i>Renewables</i>	37,042	14.9	11.6	6.8
Hydro	18,421	7.4	0.8	1.9
Wind	10,252	4.1	28.8	31.3
Solar PV	4,858	2.0	27.0	58.3
Bioenergy	3,511	1.4	11.4	-1.0
Geothermal	0.5	0.0	0.0	0.0
<i>Total</i>	248,297	100.0	-0.6	0.9

Source: Department of Industry and Science (2015), *Australian Energy Statistics*, Canberra.

One example of renewable energy generation in the Australian sugar industry is Queensland-based Tully Sugar which produces its own power by operating its steam boilers with renewable biomass generated from the fiber that remains after juice is extracted from sugar cane. The company then exports unused green power into the Queensland electricity grid. Similarly, Mackay Sugar has a A\$120 million co-generation plant that processes waste from its sugar milling operations to sell renewable energy back into the national electricity grid. At full capacity the company can produce enough renewable energy to power about 30 percent of the needs of the Queensland town of Mackay.

The poultry and pig industries in Australia feature a range of biomass power generation schemes. Chicken farms have installed anaerobic digesters and generators to meet non-peak power requirements using chicken manure and other waste. A number of pig farms use biogas capture and heat generation to generate energy.

IV FUEL ETHANOL

Overview

Fuel ethanol is used as a renewable transport fuel produced by fermenting starch and sugars from a range of feedstocks such as wheat, sorghum and molasses. The most commonly available ethanol blend in Australia is E10, a 10 percent blend of ethanol with unleaded petrol (ULP). Ethanol blend fuels are also available using premium unleaded petrol (PULP).

Table 7: Sales of gasoline and ethanol fuel for motor vehicle use in Australia, 2015 (million ML)

State	Premium unleaded	Proprietary brand	Regular unleaded	Ethanol blended	Total
NSW	1,162	1,274	1,650	1,727	5,812
Victoria	414	683	3,585	90	4,773
Queensland	405	561	2,510	377	3,852
South Australia	87	151	1,027	-	1,265
Western Australia	254	233	1,434	-	1,921
Tasmania	49	22	283	-	353
Northern Territory	19	-	75	-	94
Australia	2,390	2,924	10,564	2,194	18,070
Share (%)	13.2	16.2	58.5	12.1	100.0

Source: Department of the Environment and Energy, *Australian Petroleum Statistics*, see: [link](#). Post notes that a break-down of national sales of gasoline and ethanol fuel by state is not available for more recent years.

Ethanol is blended with petrol to make commercial products by the major petroleum companies using a range of methods including ‘splash’ or sequential blending, in tank blending and gantry side stream blending. The process of storing and blending ethanol with petroleum to make E10 (10 percent ethanol; 90 percent petroleum) has involved additional investment in infrastructure at terminals and storage facilities of around A\$40 million by the refinery sector which handles retail distribution of ethanol fuels in Australia. This investment was facilitated by the Biofuels Capital Grants Program to support new or expanded biofuel production capacity, which ended in 2010.

Production

The ethanol industry in Australia has three established producers in NSW and Queensland, with an installed production capacity of 440 million liters (ML). The largest ethanol producer in NSW uses wheat starch and has the capacity to manufacture around 300 million liters of ethanol. Queensland has two ethanol plants, one operated by United Petroleum at Dalby and a smaller facility operated by Wilmar at Sarina. The Dalby biorefinery is located in the sorghum growing region in the Darling Downs and normally buys around 200,000 MT of sorghum grain a year from local growers, which can produce 80 million liters of fuel-grade ethanol (one MT of sorghum grain can produce around 400 liters of ethanol). At full capacity, the biorefinery also produces 830,000 MT of wet distillers’ grain which is used for animal feed supplements, mainly in the dairy and cattle feedlot industries. In mid-2017, the Dalby ethanol bio refinery announced a US\$20 million investment to boost production capacity by 24 million litres to 100 million liters a year.

The Sarina biorefinery is operated by the Singapore company Wilmar and produces fuel ethanol from sugar. It has the capacity to manufacture around 60 million liters of ethanol annually. The Queensland plants have been

operating below capacity. However, the Queensland State government expects that demand for fuel grade ethanol will increase by 75 million ML after the introduction of the mandate in 2017 and then will further increase to 100 million ML by 2018. The [Liquid Fuel Supply Act 1984](#) requires the Queensland fuel industry to meet targets for the sale of biobased fuels.

A number of domestic fuel-grade ethanol plants are proposed. These include:

- A North Queensland Bio-Energy (NQBE) proposal envisages the construction of a US\$400 million sugar ethanol and power generation facility in Ingham, North Queensland to produce over 90 million liters of ethanol annually.
- A NSW proposal for an ethanol plant at Deniliquin, NSW to produce up to 115 million liters of fuel grade ethanol annually using low grade wheat.
- A Bioenergy plant to produce ethanol from a variety of sources. The Australian Renewable Energy Agency (ARENA) has provided funding for Renewable Developments Australia to develop a plant for a US\$600 million renewable bio-energy plant to produce 350 million liters of fuel grade ethanol from sugar cane and sorghum; and
- A Queensland Austcane Energy proposal is for a US\$180 million sugar cane ethanol plant to produce 100 million liters per year of fuel-grade ethanol annually.

Consumption

In 2015, fuel ethanol produced in two states supplied around one percent of the total road transport fuel market in Australia. The predominant petrol-ethanol blend (E10) is sold in NSW and Queensland. Ethanol use has been declining in recent years in Australia due partly to the lower availability of E10 pumps and a consumer preference for regular unleaded over E10. The lack of a significant price differential between E10 and regular petrol has reportedly contributed to the decline in ethanol sales.

There has been some consumer resistance to biofuels and there is a trend for NSW motorists to prefer premium unleaded petrol (PULP) use instead of E10 blended fuel at a rate well above the national average. Premium fuels in NSW represent almost 45 percent of total petrol demand. NSW ethanol use reached a peak of just over E4 in 2010-11 largely due to the forced removal of ULP at many sites, but since then average blending has fallen to just over E2 as consumers find new ways to buy PULP.

In Queensland, the biobased petrol mandate requires that 3 percent of the total volume of regular unleaded petrol sales and ethanol blended fuel sales by liable retailers must be biobased petrol (ethanol). If three out of every ten liters of regular petrol sold by a petrol station is E10 which contains 10 percent ethanol, that station would have met the mandate. The ethanol mandate will increase to 4 percent from 1 July 2018. The Queensland government has released an information campaign to support the biofuels mandate on the [E10 OK](#) website. The Queensland Government vehicle fleet is giving priority to using E10 where practical to do so, as outlined in its [retail fuel purchases policy](#).

The Australian Institute of Petroleum has estimated that the share of vehicles for which fuel ethanol is an unsuitable fuel was 11 percent in NSW and noted that some applications such as marine and small engines are reportedly not able to use ethanol blends. However, the share of vehicles for which biofuel is reportedly an unsuitable fuel will decline over time as the national vehicle fleet is replaced. The NSW and Queensland governments have undertaken a number of marketing campaigns to improve consumer understanding of fuel ethanol use in vehicles. A key problem for the biofuels industry is that most vehicles that can use ethanol blended

fuel are only warranted for blends up to 10 percent, while some warranties can be voided if ethanol is used as a fuel.

The Queensland government has pushed for higher sales of fuel ethanol under its mandate, which began in January 2017. It reported in mid-2017 that fuel ethanol sales had increased by 40 percent in the first three months of the state government mandate and that an additional wholesale and retail network of over 150 additional fuel sites had been upgraded to sell E10 fuel by mid-2017.

A further source of demand could come from the aviation industry in Australia. The global airline industry is under pressure to take voluntary initiatives to lower carbon emissions or eventually face regulations imposed on it. Virtually all jet fuel is currently imported. The industry has sought expressions of interest for supplies of locally produced, aviation bio-based, drop-in jet fuel. This aims to reduce emissions and lower the industries vulnerability to volatile oil prices. The major airlines Virgin Airlines and Air New Zealand have also developed a clear strategy to use biofuels for aviation fuel in the future.

Trade

Fuel ethanol imports are subject to both a general tariff of 5 percent and the customs equivalent full excise on mid-energy fossil fuels of A\$0.401 per liter. These measures have made fuel ethanol imports generally uncompetitive with domestic ethanol (see fuel taxes section).

Table 8: The Australian Ethanol Industry (ML)

Ethanol Used as Fuel (Million Liters)										
Calendar Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Beginning Stocks	na	na	na	na	na	na	na	na	na	na
Production	203	275	319	347	306	260	250	250	250	250
Imports	21	38	40	14	8	6	6	5	5	5
Exports	8	6	3	31	37	5	22	20	20	20
Consumption	216	307	356	330	277	261	234	235	235	235
Ending Stocks	na	na	na	na	na	na	na	na	na	na
Fuel Balance Check	0	0	0	0	0	0	0	0	0	0
Production Capacity (Million Liters)										
Number of Refineries	4	4	3	3	3	3	3	3	3	3
Nameplate Capacity	456	440	440	440	440	440	440	440	440	440
Capacity Use (%)	45%	63%	73%	79%	70%	59%	57%	57%	57%	57%
Co-product Production (1,000 MT)										
Bagasse	30	50	60	65	60	50	50	50	50	50
DDG	134	193	223	214	203	187	182	182	182	182
Feedstock Use (1,000 MT)										
Wheat	306	486	564	540	512	468	460	460	460	460
Sorghum	122	130	148	143	135	130	120	120	120	120
Molasses	96	99	117	112	106	91	90	90	90	90
Market Penetration (Million Liters)										
Fuel Ethanol	216	307	356	330	277	261	234	235	235	235
Gasoline	19,503	18,198	18,725	18,762	18,659	18,120	18,070	18,178	18,000	18,200
Avg National Blend Rate (%)	1.1%	1.7%	1.9%	1.8%	1.5%	1.4%	1.3%	1.3%	1.3%	1.3%

Note (a): Estimates for DDG co-production assume that DDGs from both wheat and sorghum and using the same yield as DDGs from corn (1 MT of corn = 0.313 MT of DDG). Source: Department of Industry, BREE and Post estimates.

V BIODIESEL AND RENEWABLE DIESEL

Overview

Biodiesel is produced from renewable plant or animal lipids (fats and oils) through a process called transesterification. The feedstocks used in Australia are animal fats (namely tallow) or used cooking oil (recycled yellow grease). Renewable diesel is a product derived from the same feedstock used in biodiesel but is chemically equivalent to and fully substitutable with petroleum-derived diesel. The only type of renewable diesel currently commercially available at large scale is typically called hydrotreated or hydrogenated vegetable oil (HVO). There is no commercial production of this biofuel in Australia. However, Australia has imported and consumed small volumes from a plant in Singapore in 2013 and perhaps more recently, although a full accounting of past volumes traded is not possible because no trade code exists specific to this product. Australia does export tallow to Singapore which is used to produce HVO.

B5 is the most common blend used in Australia, and is considered under fuel standards to be identical with fossil diesel fuel and is sold unlabeled. The B20 biodiesel blend is generally sold for commercial operations and is labeled. Biodiesel has slightly lower energy content than conventional diesel although this is not significant when operating vehicles on biodiesel blends up to B20. There is an Australian fuel standard for unblended biodiesel (B100).

Most diesel fuel in Australia is sold in bulk to commercial/industrial customers such as mining and transport companies on long-term contracts. Only a quarter of the diesel fuel used in Australia is sold through retail outlets. Of this 80 percent is bought by the long-haul trucking industry with only a small proportion sold to private customers. Diesel engine manufacturer warranties for engines typically allow biodiesel blends up to 5 percent with conventional diesel (B5) provided that the resultant blend meets the diesel standard. Some manufacturers have engines which are certified for fuels above B5 but there are only a limited number of such engines in use in Australia. Biodiesel blends up to B100 are typically used in fleet operations, such as local council trucks.

Production

Post estimates Australian production of biodiesel at only 40 million ML in 2017 and 2018 due to the closure of most of the industry in response to continued unfavorable conditions of limited mandate support, low international oil prices, high feedstock prices, and insufficient tax relief to offset high feedstock prices to bridge the gap between fossil diesel prices and biodiesel. In early 2016, Australian Renewable Fuels, the largest biodiesel producer closed. Post has maintained current capacity at 400 million liters in the biodiesel supply/demand balance because the plants are only shuttered and could be reopened under a new buyer and under more favorable economic conditions or policy framework. Australia does not produce renewable diesel.

Trade

Biodiesel exports, which were always small, have ceased with the sharp decline in production. Imported biodiesel is uncompetitive with regular diesel under the new excise and import duty arrangements (see policy section), and have dropped significantly from recent years and were negligible in 2016 and expected to remain so in 2017 and 2018. Australia has imported renewable diesel from Singapore, and the first known shipments totaling 21.4 ML occurred in 2013, but later shipments (if any) are unknown and most of the trade coming from Singapore is likely biodiesel and may be transshipped (originate) from Malaysia and/or Indonesia. Australia is a significant exporter of tallow to Singapore, where it is used in the production of renewable diesel (see Chart 5).

Table 9: Selected biodiesel production facilities in Australia (ML), 2017

Biodiesel plant	Location	Capacity	Feedstock	Production start
Australian Renewable Fuels (ARF) Largs Bay	South Australia	45	Tallow, used cooking oil	2006 (closed 2016)
Australian Renewable Fuels (ARF) Picton	Western Australia	45	Tallow, used cooking oil	2006 (closed 2016)
Biodiesel Industries Australia (BIA)	New South Wales	20	Used cooking oil, vegetable oil	2003
Australian Renewable Fuels (ARF) Barnawartha	Victoria	60	Tallow, used cooking oil	2006 (closed 2016)
Ecotech Biodiesel	Queensland	30	Tallow, used cooking oil	2006
Smorgon Fuels Biomax Plant	Victoria	100	Tallow, Canola oil and Juncea oil	2005 (now closed)
Macquarie Oil	Tasmania	15	Poppy oil, waste vegetable oil	2008
Territory Biofuels	Northern Territory	140	Palm oil, Tallow, used cooking oil	closed in 2009

Note: Details of production by plant are not available.

Source: Biofuels Association of Australia and Post estimates.

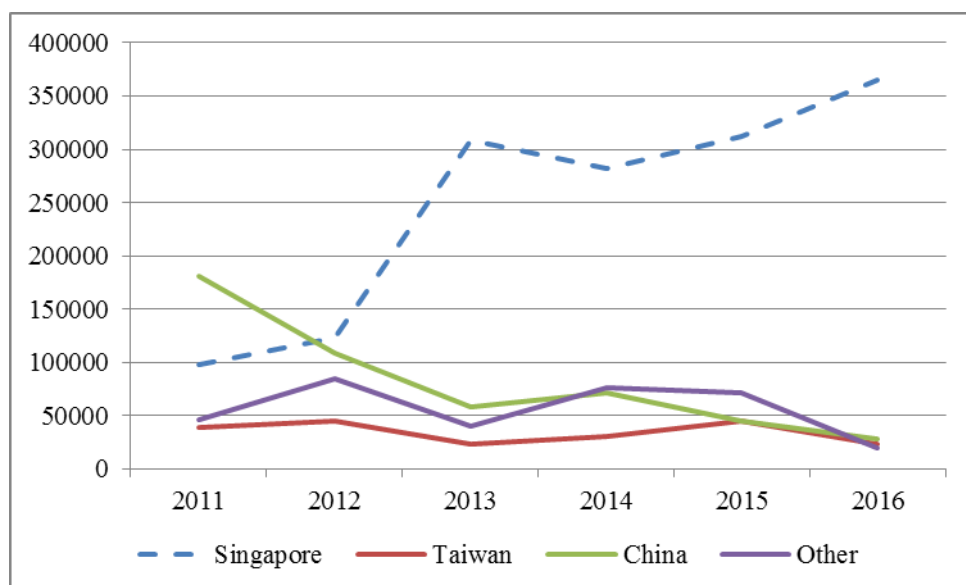
In 2011, Australia imposed anti-dumping and countervailing duties on imports of biodiesel from the United States. The duties were imposed mainly due to the U.S. federal tax credit of US\$1/gallon. In April 2016, the Australian government announced the termination of its antidumping measure applying to biodiesel imported from the United States (see [link](#)), however US shipments have not resumed.

Table 10: Australian imports of biodiesel by country, 2010-2016 ('000 liters)

Country	2012	2013	2014	2015	2016
Singapore*	858	39,741	209,583	139,355	0
Argentina	0	28,604	32,189	4,748	0
Indonesia	15,488	28,339	116,956	6,084	686
United States	0	11,352	0	1,105	1
Canada	5,018	5,482	1,057	0	0
Other	46	4,185	10,980	8,128	82
Total	21,410	117,703	370,765	159,420	769

Note: (a) Biodiesel and mixtures thereof, not containing less than 70 percent by weight of petroleum oils or oils obtained from bituminous materials (Tariff code: 382600). *Includes 21.4 ML of renewable diesel in 2013, and possibly some in following years. Source: Global Trade Atlas.

Chart 5: Australian exports of tallow, 2011-2016 (MT)



Note: Tariff code: 1502.

Source: Global Trade Atlas.

Table 11: The Australian Biodiesel Industry, 2009-2018

Biodiesel (Million Liters)										
Calendar Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Beginning Stocks	0	0	0	0	0	0	0	0	0	0
Production	85	85	90	114	114	150	130	100	40	40
Imports*	11	9	25	21	118	371	159	1	0	0
Exports	0	0	0	10	20	20	10	0	0	0
Consumption*	96	94	115	125	212	501	279	101	40	40
Ending Stocks	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
Production Capacity (Million Liters)										
Number of Biorefineries	8	6	6	7	7	8	8	5	3	3
Nameplate Capacity	380	380	380	400	400	400	400	400	400	400
Capacity Use (%)	22.4%	22.4%	23.7%	28.5%	28.5%	37.5%	32.5%	25.0%	10.0%	10.0%
Feedstock Use for Fuel (1,000 MT)										
Tallow	42	42	40	65	65	60	50	46	16	16
Used cooking oil	39	39	45	45	45	85	75	50	22	22
Market Penetration (Million Liters)										
Biodiesel	96	94	115	125	212	501	279	101	40	40
Diesel	19,500	20,000	20,061	21,643	22,631	23,081	23,619	23,866	24,000	24,000
Blend Rate (%)	0.5%	0.5%	0.6%	0.6%	0.9%	2.2%	1.2%	0.4%	0.2%	0.2%

Note: (a) Production statistics for biodiesel were revised using National Greenhouse and Energy Reporting Scheme data which captures more production than the Production Grants Scheme (excise rebates); (b): A small volume of renewable diesel (HVO type) was reportedly imported and consumed in 2013; (c) Nameplate capacity refers to the intended full load production output of all facilities after accounting for repairs and maintenance, and includes all facilities in full operation as well as partially idled or shutdown but not dismantled.

Source: Post estimates based on information from industry and government contacts.

VI ADVANCED BIOFUELS

Overview

There is no commonly agreed upon set of criteria used to define advanced biofuels. In this report, second generation or advanced biofuels include cellulosic ethanol, butanol, methanol, and dimethyl ether (DME), Fischer-Tropsch diesel or hydro-treated lipids (HVO), other drop-in fuels, and biofuels made from algae. Second generation biofuels are commonly agreed to be biofuels not made using the traditional, long-standing processes of sugar and starch fermentation (ethanol) and esterification whereby glycerin is separated from plant and animal lipids (biodiesel).

There have been a number of research and trial projects in Australia on second generation and advanced biofuels using non-traditional feedstocks including lignocellulosic feedstocks. The Oil Mallee project for example used Mallee eucalypts to produce eucalyptus oil, activated carbon (biochar), and bioenergy in a one kW integrated wood processing demonstration plant. Other feedstocks under development have included Indian mustard seeds (Western Australia), *Pongamia pinnata* trees (Queensland, Western Australia), *Moringa oleifera* (Western Australia) and algae (Queensland, South Australia, Victoria). The Australian Renewable Energy Agency provided funding to projects developing advanced biofuel technologies.

Biofuel and Sustainable Aviation Fuel (SAF)

Traditional aviation fuel accounts for around 30 percent of the operating costs of the major airlines in Australia and this share has increased significantly over the last decade. The airline industry has encouraged the development and use of biofuel as a sustainable aviation fuel (SAF) to reduce greenhouse gas emissions and lower dependence on volatile oil prices and build supply of competitively-priced biofuels. A 2011 study by the Commonwealth Scientific and Industrial Organisation (CSIRO), supported by Boeing, Airbus, Qantas and Virgin, found that a sustainable aviation fuels industry could be developed and would decrease greenhouse gases by almost 20 percent in the aviation sector. In 2012, Qantas operated Australia's first commercial SAF flight from Sydney to Adelaide with a 50 percent blend of SAF with traditional jet fuel in one engine.

The [Roadmap Report](#) found that by 2020 a 5 percent bio-derived jet fuel share could be possible in Australia and New Zealand, expanding to 40 percent by 2050. Ongoing research aims to develop competitive 'drop-in' advanced biojet fuels compatible with existing engines, infrastructure and existing supply chains. The industry has recognized that biofuels represent an important opportunity to reduce aviation emissions, but the price of aviation biofuels has not yet become commercially viable, especially in a period of low international oil prices.

In April 2016, Virgin Australia and Air New Zealand issued a 'request for tender' for a ten-year supply of 200 million liters of biojet fuel from 2020, equivalent to around five percent of their projected fuel consumption. The request for tender was partly in response to the Australian government's [emissions reduction fund safeguard mechanism](#), which requires the largest emitters, including airlines, to keep emissions within baseline levels from 1 July 2016. In addition, the International Air Transport Association (IATA) has set targets for an annual average increase in fuel efficiency each year from 2009 to 2020 of 1.5 percent carbon-neutral growth from 2020 and a reduction in emissions of 50 percent of the 2005 figure by 2050.

Advanced Biofuel Plant in Queensland

In March 2016, Southern Oil Refining company, an oil recycling company, committed to build a A\$16 million biofuel pilot plant in Australia. The facility is called the Northern Oil Advanced Biofuels Pilot Plant and has now been built in Gladstone, Queensland with biodiesel produced from sugarcane bagasse. The pilot plant is expected to be operational later in 2017 and will aim to produce fuel within three years for use in field trials by the US and Australian navies. There are plans to eventually expand the plant into an A\$150 million commercial-scale refinery with a capacity of 200 million liters of advanced biofuel a year. The Queensland State government has provided a grant to cover part of the cost of the plant.

U.S.-Australia Cooperation on Biofuels

Under a 2012 U.S.-Australia *Statement of Cooperation for the Research and Use of Alternative Fuels*, Australia and the United States agreed to exchange information about policies, programs, projects, research results and publications, and to conduct joint studies in areas such as fuel sources and environmental impacts.

The Great Green Fleet initiative of the U.S. Department of the Navy and the U.S. Department of Agriculture aims to make alternative fuel blends a regular part of the military's bulk operational fuel supply. In 2012, the Secretary of the U.S. Navy established a goal that by 2020, half of the Department of Navy's energy would come from alternative energy sources. One goal of this policy is to demonstrate the viability of advanced alternative fuels as a substitute for petroleum and to increase energy security.

In May 2014, the Royal Australian Navy (RAN) confirmed plans to transform its existing fleet of naval vessels and aircraft into bio-fuel capable by 2020. This decision is in line with the US Navy's plans to convert its own fleet using at least a 50-50 fuel blend. Australia has also been offered access to the alternative fuel technology, which is currently being developed by the US military. In total, the RAN is planning to make fifty vessels and aircraft compatible with alternative fuels. In June 2017, discussions were held in Queensland with the procurement branch of the US Navy and management of the Gladstone biofuels pilot plant to see if fuel produced by the plant would be compatible with needs of the US naval fleet and navy ships visiting the port.

VII BIOMASS FOR HEAT AND POWER

Bioenergy is derived from biomass to generate electricity and heat, or to produce liquid fuels for transport. Biomass is any organic matter of recently living plant or animal origin. It is available in many forms such as agricultural products, forestry products, municipal and other waste. Traditionally, woody biomass has been used for bioenergy; however more recent technologies have expanded the potential resources to include agricultural residues, oil seeds and algae. Bioenergy currently accounts for nearly 1 percent of Australia's electricity production, and 7 percent of renewable electricity production.

While overall energy generation and fuel use is dominated by fossil fuels, especially coal, petroleum and gas, bioenergy is one of the largest contributors to Australia's renewable energy production. Energy from biomass is derived from five separate energy sources: garbage, wood, waste, landfill gases, and alcohol fuels. Most biomass uses incineration to generate power. Biomass generally includes plant or animal matter used for the production of fibres or chemicals, and may also include biodegradable wastes that can be burnt as fuel. Biomass can be converted to energy in many different ways, including direct combustion, gasification, combined heat and power (CHP), anaerobic digestion and aerobic digestion.

In 2015, bioenergy accounted for around one percent of Australia's electricity production and seven percent of renewable electricity production. Biofuels accounted for around one percent of Australia's fuel consumption. The bioenergy industry uses a range of biomass resources including: bagasse, which remains after sugar has been extracted from sugarcane; landfill gas, wood waste and black liquor, energy crops, agricultural products and municipal solid waste. In 2015, there were around 400 accredited renewable energy power stations with 140 accredited bioenergy power stations.

Australia's sugar industry produces considerable renewable energy (electricity and steam) from bagasse, which is the leading source of renewable electricity generation. A number of agencies in Australia are currently researching whether sugarcane trash and bagasse can be converted to biogas and upgraded to biomethane for use in sugarcane farming and transportation. Solids from biogas production could then be converted via hydrothermal liquefaction to biofuels and chemicals.

Wood energy is derived both from the direct use of harvested wood as a fuel and from wood waste streams. The largest source of energy from wood is pulping liquor or 'black liquor' which is a waste product from the industrial processes of the pulp, paper and paperboard industry. Australia burns an estimated five million tonnes of firewood per year. A range of woody biomass is currently commercially used to generate power. These are typically densely planted, high yielding varieties of poplar, willow and eucalyptus that regenerate quickly after harvesting via coppicing (shoots from the stumps of trees).

The heat component of industrial cogeneration (such as alongside sugar mills) and dedicated industrial thermal energy are not supported by a specific mandatory target or Renewable Energy Certificates (RECs) in Australia. Residues from forests and wood processing and organic waste streams are relatively untapped resources for heat and power generation in Australia. Wood residues include primary waste from forestry such as cleared bark and sawn branches as well as pulp logs. Secondary residues from sawmills include chips, sawdust and shavings. These residues are generally abundant in the southern and eastern coasts, and in south western WA, with supply being available year round. There have been a number of proposals to use wood waste for biofuels, although none are yet commercially viable.

VIII NOTES ON STATISTICAL DATA

Post notes that there are no comprehensive statistical series provided by industry or government that organize the picture on country-wide biofuel production, consumption, trade and stocks. This report builds annual supply/demand balances using available sources such as excise rebate statistics, industry statistics on plant capacity and greenhouse gas emissions estimates by the Department of the Environment.

Details of Australian government policies on renewable energy and biofuels were sourced from the Department of Industry, the Australian Taxation Office and The Australian Renewable Energy Agency (ARENA). Australian Budget papers and explanatory memoranda provided details of actual legislation that affects the biofuel industry and expected changes to this legislative and regulatory framework.

Data on the production of biofuels in Australia was estimated by Post based on information from a range of sources, including from the Department of Industry and the Australian Taxation Office. Until 2014, the excise rebate provided an estimate of production which has been since supplemented by data from the Australian National Greenhouse and Energy Reporting Scheme and the Biofuels Association of Australia. There are a number of reports on possible production of advanced biofuels in Australia including the recent Qantas/Shell (2013) report and the CSIRO (2011) and LEK Advanced Biofuels Study (2011).

Trade statistics were sourced from the Australian Bureau of Statistics through the online Global Trade Atlas, a product of IHS Market. Statistics on energy use in Australia were sourced from a variety of sources including the Bureau of Resources and Energy Economics (BREE)'s 2015 report on Australian energy statistics. Reports by the NSW and Queensland governments on biofuels and by the Australian Competition and Consumer Commission on its monitoring of the Australian petroleum industry were also reviewed.