Required Report: Required - Public Distribution **Date:** December 15, 2022

Report Number: AS2022-0029

Report Name: Biofuels Annual

Country: Australia

Post: Canberra

Report Category: Biofuels

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Report Highlights:

Ethanol consumption in Australia is forecast to remain stable in 2022 at only 1.1 percent of the gasoline pool, and biodiesel is forecast to increase moderately from very low levels but remain at less than 0.1 percent of the total diesel pool. Australia has very large feedstock (grains and molasses) supplies for bioethanol as well as robust supplies of feedstock (canola, tallow and used cooked oil) for biodiesel production. However, only a very small amount of these are used for domestic biofuels production. There is no federal government subsidy, tax credit or mandate supporting the production or use of biofuels. Only two states have biofuel programs with ethanol and biodiesel mandates, but these mandates are far from being reached. The federal government's introduction of new fuel standards for gasoline from January 1, 2022 has so far had no impact on the ethanol blend rate in Australia. Recent announcements may encourage increased production of sustainable aviation fuel in the coming years in Australia.

I. Executive Summary

Australia produces a vast supply of feedstock for bioethanol and biodiesel production. Despite this, biofuel production and consumption are very low and geographically limited and there is no trade. In fact, much of this feedstock is exported to the rest of the world for biofuel production. The national average blend rate for ethanol is among the very lowest, and after some initial progress, the biodiesel blend rate has retreated to near zero in recent years. There have been no new bioethanol facilities built in the last 10 years and no change in production capacity. Ethanol consumption and production has been low but relatively stable for many years leading up to 2020, but there has been some retreat in volumes due to the mothballing of a bioethanol production facility. Despite reduced domestic fuel usage since the start of the COVID-19 pandemic the blending rate has also declined. For biodiesel, the closure of multiple facilities in the early to mid-2010s and curtailment of imports after 2015 forced the modest national average blend rate to collapse with consumption and production falling sharply.

Australia has very large feedstock (grains and molasses) supplies for bioethanol as well as robust supplies of feedstock (canola, tallow and used cooked oil [UCO]) for biodiesel production. However, only a very small amount of this is used for domestic biofuels production. Canola is not even used domestically for biodiesel, but there are large exports to the EU for biodiesel production there. Australia also ships tallow and UCO overseas which is used to make biodiesel and renewable diesel. Rather than produce and use more biodiesel at home, Australian feedstocks are shipped overseas to support foreign biofuel programs. This is partially due to there being no national-level Australian biofuels program with nationwide goals and mandates, and little program support in the two states with programs.

Biofuels policy is driven by individual state governments, and there is no federal government subsidy, tax credit or mandate supporting the production or use of biofuels. Only two states have biofuel programs with ethanol and biodiesel mandates, but their goals are relatively modest and far from being reached. New fuel standards were implemented in Australia from January 1, 2022 reducing the gasoline pool maximum aromatics content from 42 percent to 35 percent. There was industry expectation that this may trigger increased consumption of ethanol in fuel blends as a means to meeting the new aromatics fuel standard. But, so far in 2022 there has been no change in the consumption of bioethanol.

Australia largely emerged from the impacts of COVID-19 in early 2022, and with this the gasoline and diesel pools have increased for the first eight months of 2022 and will likely result in a marginal rise for the full year. However, with essentially no increase in bioethanol consumption and a small increase for biodiesel anticipated for 2022, there is no material change in the biofuel blend rates.

II. Policy and Programs

Roadmaps and International Engagement

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 include 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.

Australia's first national bioenergy roadmap was released in November 2021 for the federal government via the Australian Renewable Energy Agency (ARENA). The primary purpose is to "enhance the growth of Australia's bioenergy sector and identify bioenergy's role in Australia's future energy mix and to help inform Australia's future policy and investment decisions."

The Queensland state government had taken an early lead by aiming to develop a competitive industrial biotechnology and bio products sector as part of its 10-year Biofutures Roadmap launched in 2017. The Queensland Biofutures Roadmap identified bioenergy as a priority industry to develop new markets for technology developers and agricultural producers. The state government has established an AU$5 million (US$3.75 million) Biofutures Industry Development Fund, an AU$5 million (US$3.75 million) Commercialization Fund, and an AU$4 million (US$3 million) Biofutures Acceleration Program. Potential feedstocks have been broadly defined, but the main sources are likely to be sugarcane and sorghum. Since launching a 10-year roadmap there have been a range of proposals supported by the funds.

The federal government provides some support to the biofuels industry via their own agencies, Australian Renewable Energy Agency (ARENA) and the Clean Energy Finance Corporation (CEFC). Bioenergy Australia is an industry body who facilitates stakeholders with R&D, production and supply channels.

Renewable Energy and Greenhouse Gas (GHG) Emissions

The newly elected federal government of Australia (May 2022) has committed to reduce economy-wide GHG emissions by 43 percent below 2005 levels by 2030 as part of the Paris Agreement under the United Nations Framework Convention on Climate Change. This is a substantially higher commitment than the previous government of 26-28 percent, although projections were tracking well ahead of their commitment. With the increased commitment by the federal government, more work will need to be done to achieve the target, and as yet no substantive initiatives have been announced. Australia's policy measures do not include targets specific for the transport sectors to meet the Green House Gas (GHG) reduction commitment in the form of Nationally Determined Contributions (NDC's) under the UNFCCC.

Biofuel Policy Framework and Mandates

Australia does not have any national mandate for bioethanol or biodiesel use and some analysts doubt that the federal government has the constitutional powers to impose such a mandate. There are, however, two state governments that have introduced mandates for the use of both biofuels, each state having different policies. But, given permitted exemptions, these mandates are more akin to aspirational targets which are falling well short of full implementation. These mandates are domestic supplier-based (rather than consumption-based), with exceptions provided for certain suppliers and fuel grades and as such do not guarantee a specific blend rate at the pump for the entire gasoline or diesel pools.

New South Wales Biofuels Policy

The New South Wales government introduced the Biofuels Act in 2007 to encourage broader use of ethanol and other biofuels in the state. The New South Wales government has applied multiple amendments to the Act. The amendment in 2016 sought to reduce the number of exemptions to encourage greater use of fuel ethanol, and the most recent amendments in 2021 had no impact on the strength or enforcement of the mandates. The New South Wales government has a legislated ethanol supply mandate of E6 across the gasoline pool for wholesale companies and a requirement for retailers with 20 or more outlets to offer ethanol blended products for sale. Under the amendment to the Biofuels Act, all fuel retailers that sell three or more types of gasoline and diesel and have sales above a certain threshold need to comply with the mandate.

The main objective of the policy is to support the development of a sustainable biofuels industry in New South Wales. 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 New South Wales on imported gasoline products; and (e) supporting regional development. The Biofuels Act is administered by the New South Wales Office of Fair Trading.

The New South Wales E6 mandate (with exemptions) requires that ethanol must represent six percent of the total volume of gasoline sold in the state. A B5 mandate also exists, which requires five percent of the total volume of diesel sold via major retail outlets to be biodiesel. With exemptions in play, however, actual percentage of bioethanol and biodiesel supplied in fuels in New South Wales in 2021 was 2.0 percent bioethanol and an estimated to be well below 0.1 percent for biodiesel.

Queensland Biofuels Policy

The Queensland state government has also introduced biofuel mandates to boost the biofuel and bio-manufacturing industry sector. In 2015, Queensland passed legislation that requires the fuel industry to meet targets for the sale of bio-based fuels. The mandate also sets minimum requirements for the sale of ethanol-blended regular unleaded gasoline and biodiesel blend by retailers and wholesalers. These mandates are independent of each other. Both schemes began in January 2017. The blend mandate for bioethanol across the gasoline pool was raised to four percent effective July 1, 2018. Similarly, the

biodiesel mandate was set at half of one percent across the biodiesel pool. An ethanol blend rate of 1.6 percent in Queensland was achieved in 2021, well short of the four percent mandate. Biodiesel use in 2021 is estimated at under 0.1 percent, also well below target.

Fuel Quality Standards (Petrol) Determination 2019 and Protection of Human Health

Australia implemented new fuel standards for petrol on January 1, 2022, known as the Fuel Quality Standards (Petrol) Determination 2019. The main thrust of the change is to bring the average aromatics content across all petrol grades in Australia down from 42 percent to 35 percent on a volume basis. Aromatics are used to boost octane which helps petrol combust more efficiently. The main aromatics in petrol are Benzine, Toluene, Ethyl Benzine and Xylenes, and all widely known or suspected of causing a range of human health issues including cancers. Reducing their content in petrol reduces human exposure to these toxic chemicals. Ethanol is a far safer source of octane than aromatics. Industry sources in Europe, North America and elsewhere all agree that ethanol is a superior octane enhancer to aromatics (highest octane rating of any component in gasoline and none of the health risks that aromatics have) and it has been widely used as a substitute for aromatics in the EU and the United States and other countries with fuel standards designed to lower their aromatic content.

Australia's public health protections as they pertain to petrol is substantially deficient compared the U.S., Europe and other developed countries. This legislative change has brought petrol in Australia to European standards already established more than 15 years ago (set in 2005) and in current U.S. standard provides considerably more protection now, set at a maximum 25 percent aromatics content.

Industry experts had calculated that for Australian petrol to meet the new standards in addition to the current 180 million liters (ML) consumed around a further 370 ML of ethanol could be required. If met from domestic sources this would approximately triple the current estimated fuel ethanol production in Australia. This would also equate to an average of over three percent ethanol content across all gasoline consumed in Australia but still well below current mandate levels of four and six percent in Queensland and New South Wales, respectively.

Financial Supports for Producers and Consumers

There is no direct subsidy support for producers or consumers to encourage greater use of biofuels in Australia. But there has been indirect support via establishing standards for fuel blends and programs to educate consumers in terms of bioethanol blend fuel products being safe for the majority of vehicles.

There are also a range of funding sources at federal and state government levels to support research and development through to the commercialization of new feedstock products and processes to produce biofuels. At the federal level, ARENA provides financial support across the entire innovation chain and CEFC invests in clean energy technology projects. State governments also have their own biofuels related funding programs as mentioned for Queensland.

Environmental Sustainability and Certification

No environmental sustainability or certification requirements have in the past been, or are currently, in place for the production of biofuels in Australia.

Excise (Sales) Taxes and Import Duties

Biofuels produced in Australia receive some tax relief with point-of-sale excise tax (retail sales tax) rates that are lower than those for fossil fuels, but the advantaged position is being reduced over time. Gasoline and diesel fuels attract an excise tax rate of AU$0.46 per liter (US$0.29 per liter) as shown in Table 1 below. This rate is reviewed biannually in line with the Consumer Price Index and administered by the Australian Taxation Office.

Prior to July 1, 2015, biofuels did not attract an excise tax. From this date, on an annual basis the excise tax rate on domestically produced ethanol was scheduled to increase to reach a maximum of 32.8 percent of the gasoline fuel excise rate on July 1, 2020. For biodiesel, the excise rate is scheduled to annually increase before reaching a maximum of 50 percent of the diesel fuel excise rate on July 1, 2030. Currently the excise tax rate on bioethanol is AU$0.151 per liter (US$0.101 per liter) which is 32.8 percent of the gasoline fuel excise rate, and the biodiesel excise rate is AU$0.107 per liter (US$0.072 per liter) which equates to 23 percent of the diesel fuel excise rate.

For a six-month period starting March 30, 2022, in response to the rapid rise in world gasoline and diesel prices, the federal government provided consumers some relief from the high fuel prices by approximately halving the excise rates including for biofuels.

Table 1 - Excise rates for fuel in Australia, from Aug 2, 2021

Description	Excise Rate pre Aug 1, 2021	Excise Rate from Mar 30 to Sep 28, 2022	Excise Rate from Sep 29, 2022
Gasoline Fuel	AU$0.433/liter	AU$0.230/liter	AU$0.460/liter
Diesel fuel	AU$0.433/liter	AU$0.230/liter	AU$0.460/liter
Fuel Ethanol [a]	AU$0.142/liter	AU$0.075/liter	AU$0.151/liter
Biodiesel [a]	AU$0.087/liter	AU$0.054/liter	AU$0.107/liter

Source: Australian Taxation Office

Note: a = Excise calculated based on proportional product contents and their respective applicable rates

Imported fuel ethanol attracts a five percent import duty plus a customs duty rate equivalent to the excise (sales) rate applied to gasoline (see Table 2). Imported biodiesel attracts an import duty equivalent to the excise rate applied to diesel. Thus, the price competitiveness of imported biofuels are disadvantaged relative to biofuels produced domestically.

Table 2 – Australian Import Duties

HS Code	Product Description	Import Duties
2207.20.10	Ethanol for use as Fuel in Internal Combustion Engine	5%* and AU$0.460/liter
2207.10	Undenatured Ethanol	5%** and AU$94.41/liter
3826.00.10 & 2710.20.00	Biodiesel	AU$0.460/liter

Note: * & ** - 4% applies to Developing Countries. As per Australian Border Force - Chapter 22, 2207, Schedule 1, Part 4

There are no limitations on imports of biofuels into Australia, and they are permitted to meet supplier obligations under the New South Wales and Queensland mandates.

III. Fuel Ethanol

Ethanol production in Australia is primarily used as a renewable energy for passenger and commercial vehicles. It is also produced in Australia for alcoholic beverage, industrial chemical, and solvents including pharmaceutical and cosmetic purposes. Despite large feedstock availability, ethanol production remains small in Australia because there is no nationwide fuel ethanol program and the only two states with a fuel ethanol program have mandates which do not enforce higher blending. Over the last decade there has been no increase in fuel ethanol capacity or production. In fact, one of the three remaining ethanol producing facilities closed in February 2020 before reopening to support the surging demand for hand sanitizers at the time of the COVID-19 pandemic outbreak in Australia. This facility was subsequently mothballed in September 2020 and there are no indications that it will reopen in the short term.

Bioethanol fuel is produced by fermenting starch and sugars from a range of feedstocks such as wheat, sorghum, barley, and molasses. The most commonly available ethanol blend in Australia is E10, a 10-percent blend of ethanol with regular ultra-low sulfur petrol (ULP) (<95 RON). Ethanol blend fuels are also available to consumers Premium ULP (PULP) (95-97 and 98+ RON). Sales of gasoline and ethanol fuel blends for motor vehicle use in 2020 are shown in Table 3.

New South Wales and Queensland, the two states with mandates, have the highest consumption of ethanol blended fuel. Victoria is the only other state in Australia that sells ethanol blended fuel although it is a relatively small amount (just 0.6 percent of gasoline sales). The effective ethanol blend rate of gasoline sales in the states of New South Wales and Queensland is 2.0 percent and 1.6 percent, respectively. No other states consume ethanol and on a national level ethanol use is just 1.1 percent currently and has never been higher than an estimated 1.7 percent (2017).

Table 3 - Sales of gasoline and ethanol fuel for motor vehicle use in Australia, 2021

Fuel Use (Million Liters)						
Gasoline Type	**Premium (95-97 RON)**	**Premium (98+ RON)**	**Regular (<95 RON)**	**Ethanol Blended Fuel**	**TOTAL**	**Ethanol Content**
New South Wales	768.7	1,244.6	1,630.5	1,043.5	4,687.3	2.0%
Queensland	358.6	639.7	1,850.9	593.5	3,442.6	1.6%
Victoria	386.8	699.1	2,686.0	259.6	4031.6	0.6%
South Australia	90.9	145.3	827.7	0.0	1,063.9	0.0%
Western Australia	226.8	269.8	1,283.8	0.0	1,780.3	0.0%
Tasmania	48.8	0.0	310.7	0.0	359.4	0.0%
Northern Territory	25.7	0.0	110.2	0.0	136.0	0.0%
TOTALS	**1,906.4**	**2,998.3**	**8,699.5**	**1,896.9**	**15,500.8**	**1.1%**

Source: *Australian Petroleum Statistics, Commonwealth of Australia 2022*

Note: *The Australian Petroleum Statistic is actual consumption based on a range of gasoline types (RON contents) and differs from the International Energy Agency annual consumption which is adjusted to a standardized gasoline.*

Ethanol is blended with gasoline by the major petroleum companies using methods including “splash” or sequential blending, in tank blending and gantry side stream blending. Storing and blending ethanol with gasoline to produce E10 has involved additional investment in infrastructure at terminals and storage facilities of around US$30 million by the refinery sector which handles retail distribution. This investment was facilitated by the Biofuels Capital Grants Program to support new or expanded biofuel production capacity, which ended in 2010. Marketing campaigns to provide confidence to consumers that E10 vehicles are safe to use in modern vehicles, is the only other national government initiative to encourage greater consumption of bioethanol fuel. Most consumers have remained unconvinced.

Domestic Consumption

Ethanol consumption in 2022 is forecast to be similar to the previous two years at 177 ML (see Table 4). Ethanol production is expected to remain unchanged, and the small variance in consumption is due to small changes in exports. Despite the big rise in gasoline prices in 2022, overall gasoline consumption is forecast to increase moderately to 16,160 ML from 15,921 ML the previous year. However, this still remains nine percent below the pre-pandemic level of 2019.

Australian demand for ethanol blended in gasoline grew from 2006 to 2010, reaching equivalent to 1.6 percent of national gasoline consumption, due to a mandate introduced in New South Wales a few years earlier. Fuel ethanol use has seen small variations since then and has basically plateaued, but has fallen off since 2020 due to reduced domestic production after a production facility was mothballed. Even with a decline in gasoline use since the start of the COVID-19 pandemic, the decline in fuel ethanol production and consumption has led to a decline in the blend rate of fuel ethanol to 1.1 percent since 2020.

As previously noted, new fuel standards implemented from January 1, 2022, that reduces the gasoline pool maximum aromatics content in petrol have not impacted ethanol use.

Industry sources indicate that consumers real or perceived view is that the E10 blended fuel efficiency is lower than that of regular ULP and the price differential between the two fuels is not sufficient to provide any advantage to the use of E10. In addition, some consumers fear the possibility that ethanol blended fuel cause damage to their vehicle's engine. New South Wales and Queensland state governments have implemented marketing campaigns and web sites clearly outline that E10 fuel was safe and would not cause damage to most vehicles and enabling consumers to check if their own vehicles are suited to E10 fuel.

Other contributors to the modest but general decline in ethanol use in Australia is, first, the overall decline in gasoline consumption of 17 percent from the most recent peak in 2017 to 2021. This decline has been exacerbated by a large fall in gasoline use in 2020 due to lockdowns associated with the COVID-19 pandemic which only partially recovered in 2021. Second, there has been a trend, particularly in New South Wales, for motorists to prefer PULP instead of regular ULP and E10 blended fuel at a rate well above the national average. Premium fuels in New South Wales represent 43 percent of total gasoline demand. New South Wales ethanol use reached a peak in 2010/11 as some ULP pumps were forced to be removed to increase ethanol blended fuel use. Since then, ULP and E10 consumption has declined as consumers particularly in New South Wales have continued to prefer PULP.

An Australian government report produced by the Department of Infrastructure, Transport, Cities and Regional Development released in August 2019 studied EV uptake in 22 countries and analyzed the impediments to uptake and forecast uptake of EVs. The report identified that since 2010 the uptake of EVs in Australia has increased from zero to only one-third of one percent of vehicle sales in 2018. This uptake in Australia is very low relative to all countries that encourage vehicle fleet transitions, such as US (2.6 percent), China (4 percent), Canada (5.4 percent), Sweden (10.3 percent) and the standout Norway at 49 percent. EV sales in Australia have increased to 3.4 percent for the January to September period of 2022 broadly in line with the reports forecast.

The same report indicated that the vehicle price had a far greater influence than future gasoline prices in consumers deciding if they would purchase an EV. Industry reports that in Australia there is a large gap in the price of EVs compared to internal combustion engine (ICE) vehicles, the choice of available EVs is small and wait times are very long. Industry analysts indicate that vehicle manufacturers plan their builds and allocate vehicle supply to various parts of the world years in advance. As part of their allocation process, they take into account the gap in vehicle price (with available incentives) between EVs and ICEs which is largely driven by the degree of government subsidies offered for EVs. Some also argue that Australia is somewhat of a dumping ground for ICE vehicles that do not meet the higher fuel standards in other parts of the world such as the EU and United Sates. These groups argue that if Australia had similar fuel standards there would be less ICE vehicles allocated to Australia and as a

result manufacturers would have greater certainty of higher EV sales if Australia. Also true, EV model offerings of virtually all car manufacturers worldwide are now greatly accelerating and EV technologies and design are advancing. Regardless of EV support policies currently in place, there is an expectation that manufacturers must greatly expand EV offerings to remain globally competitive and support consumers shift their preference away from ICE technology.

So, in Australia with relatively low subsidies for EVs in the past (although this is improving), EV allocations are low and new model choices are more limited. However, according to the Global Wealth Report 2022 by Credit Suisse, Australia ranked first in the world based on median wealth per adult in 2021. With this, many Australians in the market for a new vehicle are perhaps prepared to pay a greater premium for EVs than other parts of the world. Not surprisingly the demand for EVs in Australia far exceeds supply, so the growth in EVs could be greater if not for the lack of supply to Australia, in part caused by faltering global supply chains.

At the current policy settings, in conjunction with the forecast decline in battery prices, which is expected to bring down the gap in price between EVs and ICEs, the Australian Government report forecasts that the share of EV sales will improve to eight percent by 2025 and 27 percent by 2030. Some industry experts suggest that EV sales in Australia is likely to reach 50 percent by 2030. If forecasts of this nature prove correct there will be major disruptions to gasoline consumption in Australia.

The trending decline in gasoline consumption, increasing preference for PULP, and increasing EV sales will continue to limit expansion potential for ethanol. However, given that ethanol content of overall gasoline consumption in Australia is merely 1.1 percent, it is unlikely that the volume of ethanol consumption is likely to decline substantially in the next decade. Despite mandates in New South Wales and Queensland (albeit not strongly enforced), the bioenergy roadmap released in November 2021, and new fuel standards from January 1, 2022 - all encouragement for increased ethanol use in fuel - the outcomes do not reflect any improvement.

Production

In 2022, Australian production for bioethanol used as fuel is forecast to remain stable at 175 ML. There are only two significant producers of fuel ethanol in Australia, and this is essentially a byproduct of higher value non-fuel ethanol production.

Manildra is the largest ethanol producer with a capacity of over 300 ML and is located in New South Wales. Manildra processes wheat starch through an integrated process which separates the gluten and processes the remaining starch into a range of food and industrial-grade starches, glucose syrups, and ethanol products. Waste from this process is then used to make stock feed products. Along with fuel ethanol the plant produces higher value-added ethanol products including beverage, pharmaceuticals, cosmetics and industrial products.

Queensland has one active ethanol plant in Sarina owned and operated by Wilmar Australia, part of the Singapore-based company, Wilmar International. The facility generates fuel ethanol from molasses, a by-product of sugar production. It has the capacity to manufacture around 60 ML of ethanol annually. Wilmar has a further processing facility in Melbourne for the production of a range of higher value ethanol products including alcohol, industrial grade products including sanitizers and cleaning products, pharmaceuticals and cosmetics.

Table 4 – Australian Bio Ethanol Statistics 2012 to 2020 and forecast 2021

Ethanol Used as Fuel and Other Industrial Chemicals (Million Liters)										
Calendar Year	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022f**
Beginning Stocks	0	0	0	0	0	0	0	0	0	0
Fuel Begin Stocks	0	0	0	0	0	0	0	0	0	0
Production										
Fuel Production	251	231	217	242	317	273	239	175	175	175
Imports										
Fuel Imports	0	0	0	0	0	0	0	0	0	0
Exports										
Fuel Exports	0	0	0	0	0	0	0	0	0	0
Consumption										
Fuel Consumption	251	231	217	242	317	273	239	175	175	175
Ending Stocks										
Fuel Ending Stocks										
Refineries Producing Fuel Ethanol (Million Liters)										
Number of Refineries	3	3	3	3	3	3	3	3	3	2
Nameplate Capacity	440	440	440	440	440	440	440	440	440	440
Capacity Use (%)	57.0%	52.5%	49.3%	55.0%	72.0%	62.0%	54.3%	39.8%	39.8%	39.8%
Co-product Production (1,000 MT)										
DDG	172	156	144	164	224	189	164	110	115	115
Feedstock Use for Fuel Ethanol (1,000 MT)										
Wheat	397	346	310	374	565	453	374	211	369	369
Sorghum	151	151	151	151	151	151	140	140	0	0
Molasses	122	122	122	122	122	122	110	130	122	122
Market Penetration (Million Liters)										
Fuel Ethanol Use	251	231	217	242	317	273	239	175	175	175
Gasoline Pool 1/	18,889	18,594	18,509	18,750	19,112	18,521	17,841	15,546	15,921	16,160
Blend Rate (%)	1.3%	1.2%	1.2%	1.3%	1.7%	1.5%	1.3%	1.1%	1.1%	1.1%

Note: 1/ Includes all biocomponents (biofuels) like ethanol and ETBE as well as MTBE if used. f = forecast
Source: Australian Bureau of Statistics (for trade data), Gasoline Pools are from the International Energy Agency, Forecasts are from FAS/Canberra.

A second plant in Queensland owned by United Petroleum at Dalby, which had been producing ethanol from starch-based feedstock, closed its operations in September 2020. The Dalby bio-refinery is located in a sorghum growing region in the Darling Downs and had processed up to 200,000 metric tons (MT) of sorghum grain a year from local growers, which could produce as much as 80 ML of fuel-grade ethanol. At full capacity, the biorefinery also produces 830,000 MT of wet distillers-grain and in its last

year installed equipment to produce dried distillers-grain, which is used for animal feed supplements, mainly in the dairy and cattle feedlot industries.

Australia has ample starch-based feedstock for ethanol production. Wheat demand for fuel ethanol production in 2022 is forecast to be around 369,000 MT which is only 1.1 percent of the 2021 record production season of 36.3 (million metric tons) MMT. Similarly, sorghum demand from the Dalby facility while operational has equated to around 13 percent of the past 10-year production average. The Wilmar sugar cane mill in Sarina is one of 24 mills and the only mill in Australia that produces bioethanol. The entire sugar cane intake at this mill equates to only 3.9 percent of total sugar cane production nationally, and only part of the molasses produced at Sarina is used for ethanol. Feedstock availability is far from a limiting factor to ethanol production in Australia.

Trade

Imports and exports of denatured fuel ethanol for Australia are forecast remain at zero. Australia does export some denatured bioethanol for other industrial uses.

IV. Biodiesel

Over the last decade, biodiesel production and use in Australia rose but then collapsed in 2016. In 2019 and 2020 there was a small uptick in production supported by the reopening of a significant production facility. However, this facility has ceased production from mid-2021 due to their primary feedstock (tallow) more than doubling in price from their contracted supply price which expired in 2021.

Biodiesel is produced from renewable plant or animal lipids (fats and oils) through a process called transesterification. The feedstocks used in Australia are tallow and used cooking oil. Biodiesel could be produced from canola, of which there is a large supply. However, opportunity cost of canola is too high and the cost of production is too high relative to the cost of fossil diesel fuel and uneconomic in the Australian market.

B5 biodiesel fuel 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 labelled, and there is an Australian fuel standard for pure unblended biodiesel (B100).

Today, limited volumes of biodiesel are sold via wholesalers to the retail network. For several years prior to 2016, when biodiesel production and consumption levels were higher, a large proportion of biodiesel (both domestic production and imports), was sold in bulk to mining and transport companies on long-term contracts. The majority of this was in the long-haul trucking industry. After the demise of half the biodiesel plants and three-fourths of production capacity, long-term bulk contracts ended.

U.S. and European diesel engine manufacturer warranties for engines typically allow biodiesel blends up to 20 percent with conventional diesel (B20) provided that the resultant blend meets the diesel standard. Scania trucks have five of their engines approved to run on B100 in Australia. Other diesel engine manufacturers are typically certified for fuels up to B5 in Australia.

Domestic Consumption

Biodiesel consumption in Australia is forecast to increase moderately to 15 ML in 2022, from 10 ML in 2021. The forecast consumption level is in line with 2016 to 2018. The increase in consumption in 2019 and 2020 was associated with an increase in supply from a plant that recommenced production in mid-2019 but has been mothballed in November 2021. Consumption of biodiesel in Australia is geographically limited and is very when the average national blend rate is calculated, estimated at under one tenth of one percent of overall diesel use.

Due to the fact that B5 diesel blends meet diesel standards and, the volume of diesel blend sold in each state is not recorded in the Australian Petroleum Statistics, it is not possible to provide an accurate assessment of the biodiesel consumption in the two mandated states. However, in 2021 the combined diesel consumption in New South Wales and Queensland was 48 percent of national consumption. If all of the biodiesel produced is consumed in these two states, which is largely considered to be the case, then the average blend rate across both reaches 0.07 percent in 2021 (0.12 percent of on-road sector consumption). On a national basis biodiesel consumption in 2021 was 0.03 percent of the total diesel pool. Consumption has fallen well short of the two percent mandated target in New South Wales and half of one percent in Queensland and is expected to remain the case for 2022 and the foreseeable future.

As part of Australia's transition to net zero emissions by 2050, the federal government has supported the establishment of major hydrogen projects in each state and territory (other than the Australian Capital Territory). Some industry experts indicate that Australia has established itself as the world leader in the development of a hydrogen fuel industry. A project in Victoria in January 2022 in a world first has produced hydrogen, liquefied it, transferred it to a purpose-built ship, and transported the fuel to Japan. Although at this point the hydrogen is generated from brown coal, a further phase of the project is to establish a carbon capture and storage capability. The first critical piece of the project was to develop the infrastructure to produce and transport the fuel to international destinations at a commercial scale. Other projects involve the use of renewable energy to produce hydrogen and are expected to commercialize in the coming years. With scale and technology improvements the federal government had set a target of producing hydrogen fuel for AU$2.00 per liter (US$1.34 per liter) by 2030.

Hydrogen is considered to be the most likely option to decarbonize the heavy vehicle industry in Australia. There are currently three hydrogen refueling stations in Australia and the states of Western Australia, Victoria, New South Wales and Queensland have major plans to support the establishment of many more hydrogen refueling stations along the major highways to encourage the heavy transport sector to transition to hydrogen or hydrogen-electric powered heavy vehicles. Hydrogen-electric

powered trucks and buses are available in Australia. Also, the University of New South Wales has announced that they have designed a direct injection system that can be retrofitted to existing diesel engines that enables them to use as little as 10 percent diesel and the balance hydrogen and anticipate that it will be commercialized within 24 months.

If the development of large-scale hydrogen fuel production technology continues to develop at pace it is conceivable that the cost of the fuel could become competitive with other fuels and readily available in Australia. If so, it is likely that in the coming years diesel consumption in Australia would decline substantially.

The low consumption levels are largely driven by the absence of strictly enforced mandates which results in low domestic production and negligible imports. As shown in Table 5, both biodiesel production and imports were significantly higher from 2012 to 2015 compared to the period from 2016 to 2021. With the strong federal and state government support towards establishing a renewable hydrogen fuel industry in Australia as a means to decarbonizing the heavy transport sector, there is little impetus to grow biodiesel production in Australia.

Production

Biodiesel production is forecast to decline in 2022 to 15 ML from 25 ML in 2021, falling to levels near the three years from 2016 to 2019 when production ranged from 15 ML to 13 ML (see Table 5). The decrease from 130 ML in 2015 to 15 ML in 2016 is largely due to one producer with three production facilities being placed into receivership and shutting down production in early 2016. One of the three sites has subsequently been recommissioned and production recommenced in mid-2019, only to cease once again in mid-2021 and be mothballed in November 2021. This site is largely responsible for the small resurgence in biodiesel production approximately doubling from 2018 to 2019 and 2020.

Of the two operating biodiesel producing facilities in Australia, the primary feedstock for the larger producer is tallow. The cooking oil is primarily used to blend with tallow during cooler months to lower the cloud point and minimize the risk of engine damage when operating temperatures are lower. The other producer primarily uses used cooking oil for biodiesel production.

The forecast tallow consumption for biodiesel production in 2022 is 7,000 MT (see Table 5). With a very large beef and sheep industry this a small fraction of the overall amount of tallow produced in Australia.

According to a Meat and Livestock Australia report on ‘Biodiesel Additive’ published in July 2011 at that point there was over 600,000 MT of tallow produced annually in Australia. The beef cattle industry is by far the largest producer of tallow in Australia and the production of meat in 2021 was around 15 percent lower than for 2011, so tallow production is estimated to be around 510,000 MT for 2021.

Table 5 – Australian Biodiesel Statistics 2012 to 2021 and forecast 2022

Biodiesel (Million Liters)										
Calendar Year	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022f**
Beginning Stocks	0	0	0	0	0	0	0	0	0	0
Production	114	150	130	15	13	13	28	27	25	15
Imports	118	371	159	1	1	0	0	0	0	0
Exports	11	3	0	5	0	0	2	9	15	0
Consumption	221	517	289	11	14	13	26	18	10	15
Ending Stocks	0	0	0	0	0	0	0	0	0	0
Production Capacity (Million Liters)										
Number of Biorefineries	6	7	6	5	3	2	2	3	3	3
Nameplate Capacity	297	312	212	197	50	50	50	107	107	107
Capacity Use (%)	38.4%	48.1%	61.3%	7.6%	26.0%	26.0%	56.0%	25.2%	23.4%	14.0%
Feedstock Use (1,000 MT)										
Tallow	77	101	87	3	2	2	14	17	16	7
Used cooking oil	32	42	38	11	10	10	12	9	8	8
Market Penetration (Million Liters)										
Biodiesel, on-road use	221	517	289	11	14	13	26	18	10	15
Diesel Pool, on-road use 1/	12,858	13,178	13,828	13,723	15,245	16,084	16,389	15,983	16,788	17,000
Blend Rate (%)	1.7%	3.9%	2.1%	0.1%	0.1%	0.1%	0.2%	0.1%	0.1%	0.1%
Diesel Pool, total 1/	24,850	25,343	26,269	25,957	28,720	29,859	30,192	29,877	31,382	31,800

Note 1/ Fuel pools are defined as fossil fuels plus all "bio-components" (biofuels) blended with fossil diesel. f = forecast

Source: Australian Bureau of Statistics (for trade data), Diesel Pool, total 1/ is from the International energy Agency, Forecasts are from FAS/Canberra. Diesel Pool, on road use 1/ is calculated by FAS/Canberra from Department of Industry, Science, Energy and Resources, Australian Energy Statistics, Table F, September 2020,

Trade

The forecast for biodiesel exports in 2022 is a drop to zero after the one biodiesel producer that targeted part of its production for exports had ceased production in 2021. The facility which recommenced production in mid-2019 had focused on the export market in Europe and other markets to diversify their risk. This explains the slight resurgence of exports in 2020 and 2021 before the facility ceased production in mid-2021. The other two production facilities focus their supply to the domestic market in the mandated states.

Australia has consistently exported over 390,000 MT tallow over the last five years (see Table 6) and is set to do so again in 2022. Much of this has been sourced for biodiesel production. Up until 2021, Finnish company Neste Oil, a global leader in hydrogenation derived renewable diesel (HDRD) production, is considered to be the major buyer to support its production facilities in Singapore, Netherlands and Finland. However, there has been a big shift in the destination of tallow exports so far in 2022 with the United States becoming the major destination.

Table 6 – Australian Bovine Tallow Exports 2017 to 2021 and Jan to Sep 2022

Bovine Tallow Exports ('000 MT)						
Country	**2017**	**2018**	**2019**	**2020**	**2021**	**2022 Jan to Sep**
Singapore	269	313	280	286	224	123
United States	23	11	29	25	102	173
China	64	51	59	66	40	11
Other	66	66	33	54	25	42
TOTALS	**421**	**441**	**401**	**431**	**391**	**348**

Note: Data is for HS Code 150210
Source: Australian Bureau of Statistics.

Industry also reports that the competition and price of used cooking oil in Australia is very strong due to export demand for use in biodiesel production.

Around two-thirds of Australia's canola oilseed exports are to the EU, largely for biodiesel production. In 2021, 2.54 million metric tons (MMT) of canola was exported to the EU, enough to produce up to 3,150 ML of biodiesel. Industry sources indicate that the cost of canola is uneconomic for the production of biodiesel in Australia. In January to September 2022 canola exports to the EU have already increased by 13 percent from the same period in the previous year, reaching 2.87 MMT to date.

V. Advanced Biofuels

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), Moring oleifera (Western Australia) and algae (Queensland, South Australia, Victoria). The Australian Renewable Energy Agency has provided funding to projects developing advanced biofuel production technologies. None have reached commercialization stage.

Sustainable Aviation Fuel (SAF)

Fuel costs are a large part of airline operating expenses. Nevertheless, the global airline industry (including Australian carriers) has set its sights on supporting the commercialization of SAF which is expected to contribute more to lowering future GHG emissions (especially on long-haul routes) than any other factors including ongoing airplane technology development. Although, there have been some early initiatives with the likes of Qantas operating the first commercial SAF flight in 2012 and Virgin Australia running a two-year trial from October 2017 using SAF, progress has been slow and there has been no documented take off (as yet) of commercial off-take sales as seen in Europe or the United States.

Qantas, Australia's largest domestic and international carrier, has made a series of announcements over recent years. One which is currently active is the sourcing of SAF from London's Heathrow Airport reportedly accounting for around 15 percent of its fuel requirement for its flights out of London. A further initiative includes an agreement for around 20 ML of SAF from Los Angeles and San Francisco airports reportedly due to begin in the coming months. In June 2021 the company announced that it will invest AU$50m (US$33 M) towards the development of SAF supply in Australia. Its goal was to have four to six domestic suppliers by 2025. In June 2022 Qantas and Airbus announced a partnership investing up to AU$287m (US$189m) for locally developed and produced SAF and feedstock initiatives.

The biggest recent announcement in April 2022 by Oceania Biofuels who intends to invest AU$500m into constructing Australia's first refinery for SAF and renewable diesel in Gladstone, Queensland. It plans to use locally sourced waste and sustainable feedstocks including tallow, UCO and canola to produce 350 ML annually of sustainable fuels for aircraft and vehicles. Plant construction is scheduled to begin in early 2023 and be completed in late 2024 with production commencing in early 2025. There are reports of multiple other organizations at various stages of considering establishing facilities to produce SAF in Australia.

Advanced Pilot Biofuel Plants in Queensland

In March 2016, Southern Oil Refining company, an oil recycling company, committed to build an AU$16 million biofuel pilot plant in Australia. The facility, called the Northern Oil Advanced Biofuels Pilot Plant, has now been built in Gladstone, Queensland and produces biodiesel derived from sugarcane bagasse. The pilot plant is operational and in conjunction with its research laboratory is undertaking a range of projects exploring alternate feedstock options. There are plans to eventually expand the plant into an AU$150 million commercial scale refinery with a capacity of 200 ML of advanced biofuel a year. The Queensland State and federal governments have provided grants supporting this initiative. At this point there is no commercialized biofuel production from this facility, nor any announcements of any progress towards its goals.

Mercurius Australia the parent company of which is Mercurius Biorefining based in the United States is exploring the use of bagasse as a feedstock initially for the production of a product able to be blended with aviation fuel. A key advantage of bagasse as a feedstock is that it is a byproduct of sugar cane processing and is aggregated at the sugar mill. The business has established a pilot plant at Mackay Sugar's Racecourse mill in Mackay, Queensland where it is reported to be trialing their patented REACH^{TM} technology, a 'liquid phase catalytic' method of turning bagasse into fuel. It differs from the typical 'biochemical' (fermentation of sugar into ethanol) and 'thermochemical' (feedstock is heated and gasified and molecular structure altered to fuel) methods. It is reported that the company has received financial support for the project from the Queensland government.

VI. Notes on Statistical Data

There are no comprehensive statistical series provided by industry or government for biofuel production, consumption, trade, and stocks in Australia.

Bioethanol consumption is derived from Australian Petroleum Statistics, August 2022, Commonwealth of Australia 2022. The report provides monthly statistics of gasoline, diesel and jet fuel consumption by state. Gasoline consumption data includes the volume of ethanol blended gasoline consumed. For the purpose of this report, it is assumed that all ethanol blended gasoline is E10 which is sold throughout the retail network. Using this data, along with industry sources involved in the bioethanol industry and import and export data from Trade Data Monitor, a service of IHS Markit which sources directly from the Australian Bureau of Statistics, the annual production of bioethanol is determined and presented in Table 4.

Biodiesel production from 2016 to 2021 in Table 5 is based on advice from biodiesel producers. Production data from 2013 to 2015 is unchanged from the 2019 FAS Canberra Biofuel Annual report. In conjunction with import and export data, biodiesel consumption is derived as presented in Table 5.

The industry supply chain for gasoline and diesel involves a short time frame from production to sale, being a matter of weeks. Since both bioethanol used as fuel additive and biodiesel are sold as blended products it is assumed that beginning and ending stocks each year are zero.

Import and Export Data for biofuels in Tables 4 & 5 are sourced from the Australian Bureau of Statistics based on the following HS Codes;

- HS220720 Fuel Ethanol
- HS382600 Biodiesel

Co-product production data for distillers grains, which are reported in dry form (DDGs) in Table 4 is calculated using the following conversion rates:

- Wheat 1 MT = 313kg DDG
- Sorghum 1 MT = 313kg DDG
- Barley 1 MT = 313kg DDG

Feedstock use for the production of bioethanol in Table 4 is calculated using the following conversion rates;

- Wheat 1 MT = 393 liters ethanol
- Sorghum 1 MT = 430 liters ethanol
- Molasses 1 MT = 246 liters ethanol
- Barley 1 MT = 241 liters ethanol

Feedstock use for the production of biodiesel in Tables 5 is calculated using the following conversion rates;

- Tallow 1 MT = 1,043 liters ethanol
- Used Cooking Oil 1 MT = 1,043 liters ethanol

There is no industry data providing a breakdown of annual diesel consumption by sector as presented in Table 3. This data is estimated based on the following data and calculations:

- Source data is from the Department of the Environment and Energy, Australian Energy Statistics, Table F, September 2022
    - The table provides sector-by-sector diesel consumption in petajoules on an annual basis from July to June starting from 2012/13 through to 2020/21
- The data was converted to an annual calendar year basis by taking 50 percent of the energy use in 2012/13 and 50 percent from 2013/14 and adding the two together to produce the 2013 energy consumption of diesel for each industry sector. This method was applied to produce annual results from 2013 to 2020 on a calendar year basis.
- The data was then converted from petajoules to ML by applying a conversion of 38 megajoules per liter.
- The proportion of diesel consumption for each sector in each calendar year was applied to the annual diesel consumption data from the International Energy Agency (IEA) Gasoline, Diesel & Kerosene Demand, OilMktRpt, June 2022.
- The diesel consumption calculated from energy data and converted to a calendar year basis from Department of the Environment and Energy, Australian Energy Statistics, Table F, September 2022 was compared to the diesel consumption data from the IEA report (referred to above) with the following variances;

Year	2013	2014	2015	2016	2017	2018	2019	2020
Variance	0.68%	-1.28%	-0.89%	-5.34%	-0.62%	-0.71%	0.16%	-1.78%

- The industry sector diesel consumption for 2021 and 2022 is based on the same calculated proportional industry sector usage as 2020. These proportions are applied to the diesel consumption data for Australia for 2021 and 2022 from the IEA report and the FAS/Canberra forecast for 2022.

Attachments:

No Attachments