BIOENERGY AUSTRALIA
FUEL | GAS | HEAT | POWER

Transitioning Australia's Liquid Fuel Sector: The Role of Renewable Fuels

This report was written by

Deloitte.

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Context and Objective

Assisting Australia in the transition to renewable fuels by highlighting key policies and fuels.

Report Context

Bioderived renewable fuels ("renewable fuels" for the purposes of this report) are produced by the chemical conversion of biomass from forestry, agriculture, wastes and other residues to low-carbon fuels. Renewable fuels can often serve as drop-in fuels within existing infrastructure. Renewable fuels provide the potential to decarbonise key sectors of the Australian economy which have been reliant on the use of liquid fossil fuels. This includes the transport, mining, construction and agriculture sectors amongst others.

In order to foster the development of a large-scale and sustainable renewable fuels industry within Australia, a supportive policy environment is needed from State, Territory and Federal Governments to reduce or remove key barriers to renewable fuels production and uptake.

Globally, liquid fuels accounted for 11.8 billion tCO^2e emitted in 2021.[1] Greater effort is required to increase renewable fuel uptake, with renewable fuels accounting for only 16% of global demand for liquid fuels.[2]

In addition to offering an immediate decarbonisation pathway, renewable fuels can act as a technology solution for long-term decarbonisation in several key sectors, such as in aviation and heavy transport whilst complementing industry wide hydrogen/hydrogen-derivatives and electrification initiatives.[3] Further to this, renewable fuels can serve as an industry growth bridge, whereby the growth in one industry can be leveraged in other industries where renewable fuels are a long-term solution. Renewable fuels can play a key role in decarbonising Australia in the long-term and in achieving the 2050 Net Zero target whilst stimulating significant economic growth.

Modelling performed within Australia's Bioenergy Roadmap has indicated that the development of a mature bioenergy sector over the next decade could add up to $10 billion in GDP per annum and deliver 26,200 new jobs.[4]

A thriving renewable fuels sector will deliver many benefits around regional development, improved waste management, export growth and the promotion of domestic fuel security.

Report Objectives

Deloitte has been engaged by Bioenergy Australia to **illustrate the role that renewable fuels can play in decarbonising the Australian economy** and explore key policy levers that would incentivise production and uptake of renewable fuels. This report will **provide an insight into actions that Australian governments could take** to progress the transition of renewable fuels domestically.

The report includes:

- **Fuel usage and renewable fuel sector overview: an overview of the Australian fuel market and the renewable fuel sector.**
- **Renewable fuels around the world: an overview of international policies and investments focused around renewable fuels.**
- **Policy lever assessment: an multi-criteria analysis of potential policy lever effectiveness in removing or reducing barriers to adoption of renewable fuels.**
- **Key policy levers for Australia: an overview of key policies that could be considered for adoption within the Australian market to assist in progressing renewable fuel uptake.**
- **Appendices**
  - **Feedstock overview**
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Executive Summary

Liquid fuels accounted for 45% of Australia's total energy use by industry, households and government in 2019/20. Renewable fuels offer a clear pathway both as a long-term decarbonisation solution and as a compatible bridging fuel to alternative technologies in the near term.

Without adequate government support, an Australian renewable fuels industry may fail to materialise

Although efforts are already underway to drive the uptake of renewable fuels through blending mandates and corporate announcements, industry engagement has illustrated that government support is vital for broader uptake.

Reliance on imported liquid fuels contributes to energy insecurity

Australia's dependence on imported fuel products has grown over the past two decades,[4] leaving Australia exposed to supply shocks and elevated international prices. A domestic renewable fuels industry would decouple Australia from this issue.

Greater GHG emissions

Without renewable fuels, the transport, mining, agriculture and construction sectors would continue to be dependent on incumbent fossil fuels, leading to continued GHG emissions. Renewable fuels are complimentary to other industry decarbonisation initiatives including electrification.

Domestic biomass feedstocks could be increasingly exported

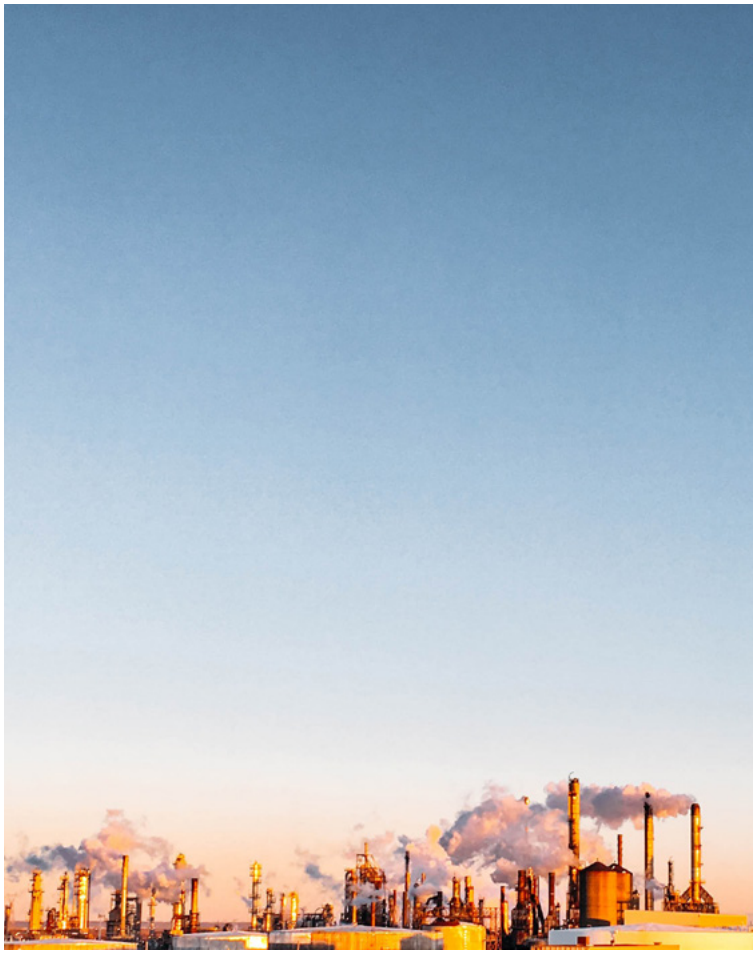
Inaction could result in Australia's high-quality renewable fuel feedstocks being exported to international markets that produce renewable fuels in countries with greater incentives and support, such as the US.

Consequential economic opportunity cost

As highlighted in Australia's Bioenergy Roadmap, the bioenergy sector as a whole has the potential to generate $10bn in additional GDP and 26,200 jobs by the 2030s,[4] thus an underdeveloped renewable fuel sector would lead to missed economic potential.

Health benefits of renewable fuels

Renewable fuels may lead to reduced pollution and broader community health benefits. According to a study from Clean Fuels Alliance America, replacing diesel fuel with biodiesel in Washington D.C. could reduce the symptoms of asthma and reduce sick days in addition to other health related benefits.[5]



Internationally, regions are moving quickly to capture the economic and decarbonisation benefits presented by renewable fuels, enacting measures to promote production and uptake.

Advanced International Policy Response

BRAZIL'S RENOVABIO PROGRAM

The RenovaBio Program introduces several mechanisms to drive uptake, including decarbonisation targets for fuel distributers based upon their market share. A compulsory target for fuel distributers in 2029 has been set at 10.2%.[6]

USA'S INFLATION REDUCTION ACT (IRA)

The IRA introduces an array of measures to stimulate the adoption of renewable fuels. The IRA includes the Biofuel Infrastructure and Agriculture Product Market Expansion Act and continues existing tax credit schemes.

EUROPEAN UNION'S RENEWABLE ENERGY DIRECTIVE (RED II)

The RED II has a target to reduce GHG emissions by 45% by 2030. The RED II sets an EU-wide renewable energy share target of 14% for the transportation sector to be achieved by 2030.

Australia

Currently, Australia has limited direct policies supporting renewable fuels at Federal Government level. This is potentially a missed opportunity for the adoption of renewable fuels.

Substitution of 6% of bioethanol and 2% of biodiesel within NSW, as well as 10% SAF, could contribute to significant liquid fuel replacement, stimulating growth of the industry in Australia.

Theoretical Australia wide adoption of renewable fuel policies*

If NSW replaced 6% of petrol consumption with bioethanol and 2% of diesel consumption for biodiesel as well as replacing 10% of aviation jet fuel with SAF, the following liquid fuel replacement and estimated emissions abatement could potentially be achieved:

Passenger Vehicle Fleet

- 900 ML of petrol and -130 ML of diesel, accounting for -3% of the passenger vehicle fleet emissions.

Heavy Vehicle Fleet

-130 ML of diesel accounting for -1.3% of the heavy vehicle fleet emissions.

Mining

-160 ML of diesel accounting for -2.8% of mining emissions.

Construction

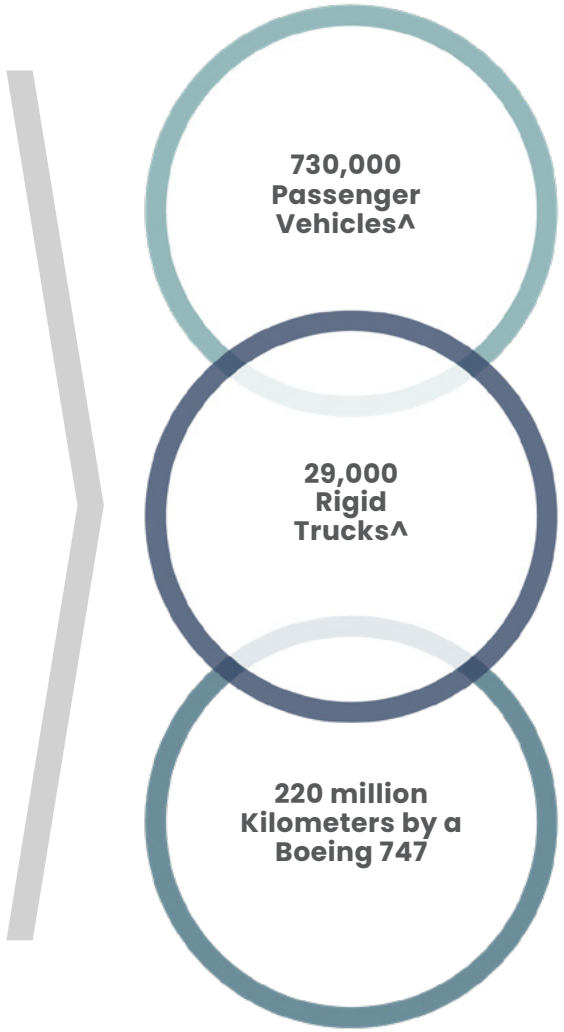
-65 ML of diesel accounting for -1.1% of construction emissions.

Agriculture, Forestry and Fishing

-49 ML of diesel accounting for -1.2% of agriculture, forestry and fishing emissions.

Aviation Transport

-740 ML of Jet A-1 accounting for -6.3% of aviation transport emissions.



Replacement of 6% of petrol with bioethanol could potentially result in the equivalent of -730,000 petrol passenger vehicles being removed from the road.

Replacement of 2% of diesel with biodiesel and/ or renewable diesel in the heavy vehicle sector could potentially result in the equivalent of -29,000 rigid trucks being removed from the road.

Replacement of 10% of Jet A-1 with SAF in aviation transport could potentially result in the equivalent of -220 million less kilometres per annum being flown by a Boeing 747.

Note: 6% bioethanol and 2% biodiesel rates were selected to represent realistic assumptions as set in in current NSW policies.

The 10% SAF assumption was selected as it resembles the Qantas SAF target.

Note: *This theoretical analysis does not consider the practical considerations around blending limits in sectors and is based on 2019/20 ABS data. Furthermore, the analysis excludes the effect of growth in demand by sector over time.

^ This includes benefits already realised from the NSW mandates.

Key opportunities and challenges to renewable fuel uptake.

Opportunities

There are a range of proven technologies that provide a pathway for the production of renewable liquid fuels as drop-in replacements for incumbent liquid fuels. Within the key transport and industrial sub-sectors listed to the right, there are a range of renewable fuels that can replace incumbent fossil fuels.

Renewable fuels would generate new skilled jobs (including within regional areas), significantly reduce emissions, divert waste from landfill, and enhance fuel security.[4]

Depending on fuel type, there are also several challenges…all of which can be overcome with a coordinated approach to industry development

Commercial readiness: the cost of producing renewable fuels currently exceeds the cost of production for traditional fossil fuels for most production pathways, resulting in higher prices for fuel users.

Willingness to pay: consumers are price sensitive, presently limiting broad adoption of renewable fuels. However, where there is a wholesale price advantage it should be passed onto end consumers.

Infrastructure compatibility: some existing fuel infrastructure and transport fleets have upper limits on the level of blended fuels which can be utilised without investments in upgrades.

Access to feedstock and availability: feedstocks are often dispersed, requiring the establishment of supply chains to facilitate utilisation for higher value uses. Access to cheaper feedstocks will lead to lower renewable fuel costs.

Subsidised fossil fuels: select conventional fossil fuels receive subsidies which distort market competition.

INDUSTRY	KEY INCUMBENT FUEL	REPLACEMENT RENEWABLE FUEL
Passenger Vehicle Fleet	Petrol	1G or 2G bioethanol
Mining	Diesel	Renewable diesel and biodiesel
Aviation Transport	Jet A-1	Sustainable aviation fuel
Heavy Fleet Vehicle	Diesel	Renewable diesel and biodiesel
Construction	Diesel	Renewable diesel and biodiesel
Agriculture, Forestry and Fishing	Diesel	Renewable diesel and biodiesel
Maritime	Fuel Oil	Renewable diesel and biodiesel
Rail Transport	Diesel	Renewable diesel and biodiesel

Through to 2050, Australia can reduce incumbent fuel usage by adopting renewable fuels as a short, medium and long-term solution within key liquid fuel demand sectors. These actions can be compatible with and complementary to other decarbonisation pathways.*

Sector	Renewable Fuel Application
Passenger Vehicle Fleet	1G and 2G Bioethanol, biodiesel and renewable diesel can be utilised as **short-to-medium term** technology bridging fuels to electric vehicles.
Heavy Vehicle Fleet	Biodiesel and renewable diesel can be utilised as a **long-term** solution, complementing electrification and hydrogen alternatives in the long-run.
Mining | Construction | Agriculture, Forestry and Fishing	Biodiesel and renewable diesel can be utilised as a **long-term** solution, complementing electrification and hydrogen alternatives in the long-run.
Aviation Transport	SAF can be utilised as a **long-term** solution, with hydrogen-derived fuels and electrification being adopted initially for short-haul flights.[7]
Maritime Transport	Biodiesel and renewable diesel can be utilised as a **long-term** solution, complementing hydrogen-derived fuels in the long-run.
Rail Transport	Biodiesel and renewable diesel can be utilised as a **long-term** solution, complementing electrification and hydrogen alternatives in the long-run.

* Timelines do not represent the scale of adoption and uptake

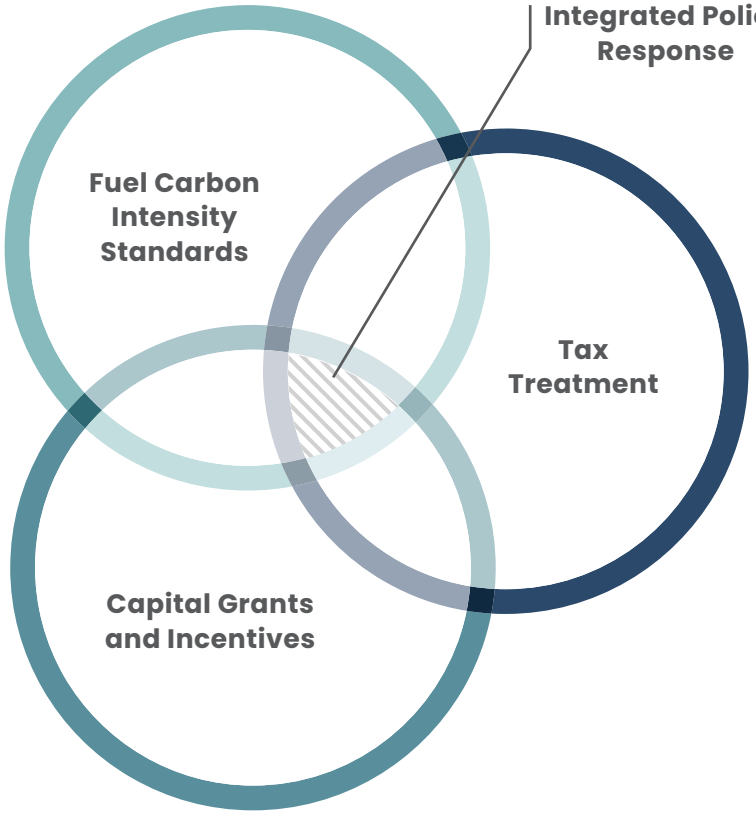
Short-listed policy levers have been assessed using a Multi Criteria Analysis (MCA), based upon, ease of implementation, adoption timeline, existing application and the end impact on renewable fuel production or consumption.

Policy Lever	Rank	Description
Taxation Treatment	**1**	**Taxation treatment is a significant policy lever to enable renewable fuel production and includes:** » **Maintaining and extending excise/fuel tax mechanism to support renewable fuels and enable growth of new renewable fuels (e.g. SAF and renewable diesel) in the market.** » **Implementation of tax credits for producers, blenders, fuel users and investors based upon uptake or avoided emissions.**
Fuel Carbon Intensity Standards	**2**	**A Fuel Carbon Intensity Standards policy lever is designed to:** » **Decrease the carbon intensity of Australia's transportation fuel pool and provide an increasing range of low-carbon and renewable alternatives. For Australia this could be represented as 10% Renewable Fuels by 2030.** » **The policy is implemented through a new low-carbon fuel emission crediting system and by developing flexible minimum volume production and/or carbon intensity of fuels.** » **Producers/refiners that exceed the minimum volume/carbon intensity are able to sell excess credits to producers/refiners that require credits to meet the minimum volume/carbon intensity. This policy can act as a national framework for the decarbonisation of liquid fuels.** **Note: The first low-carbon fuel standard mandate in the world was enacted by California in 2007,[8] similar legislation was approved in British Columbia in April 2008,[9] and by European Union in December 2008.[10]**
Capital Grants and Incentives	**3**	**Enabling partner and private partnerships through the provision of capital grants and incentives has been used internationally to support the growth of SAF, renewable diesel and biodiesel as it reduces the upfront investment cost and risk of renewable fuel projects and improve returns to investors. ARENA could be leveraged to support Renewable Fuels projects as part of its strategic priorities.**
Concessional Loans and Loan Guarantees	**4***	**Provision of low-interest or subordinated loans to facilitate access to private finance and reduce a project's cost of capital.**
Contracts for Difference (CfD)	**4***	**Government funding of the difference between the market price and a contracted price of renewable fuels so project developers are guaranteed a minimum price per unit of fuel produced.**

* Concessional loans/loan guarantees and Contracts for Difference achieved the same score

Effective Moderately Effective

Based upon the MCA in section 4, an integrated policy response, inclusive of adoption of fuel carbon intensity standards, tax treatment and capital grants and incentives would be expected to reduce barriers inhibiting the development of an Australian renewable fuels industry.



Fuel Carbon Intensity Standards

Enact an **Australian crediting system** based on **combined volume and carbon intensity crediting** to drive existing refiners to purchase renewable fuels from producers.

Develop flexible volume demands or carbon intensities to promote greater uptake in the short and longer term.

Tax Treatment

Create a **framework** such that there are **no excise implications** applicable to **future renewable fuel** production.

Assign **tax credits on a per litre basis** for **blending and production** of renewable fuels. Tax credits should be **variable** within a defined range depending upon **the emissions intensity** of each fuel type to incentivise maximum impact.

Capital Grants and Subsidies

Leverage **future fuels funding** infrastructure towards capital grant funding sources **targeted at new renewable fuels production capacity.**

Other Policy Levers For Longer-Term Consideration

Establishment of a renewable fuels **guarantee of origin scheme.**

Wind down **subsidies and rebates for fossil fuels** over the renewable fuels commercialisation timeframe to remove market distortions.

Establishment of a 2030 target for SAF uptake, transitioning ethanol production beyond 2030 to SAF production.

Establishment of **procurement targets** for **Government offtake** of renewable fuels, including for the Australian Defence Force.

Fuel Usage and Renewable Fuel Sector Overview

Australian Liquid Fuels Demand by Sector

Liquid fuels underpin several key sectors of the Australian economy, representing 45% of Australia's total energy used by industry, households and government in 2019/20.

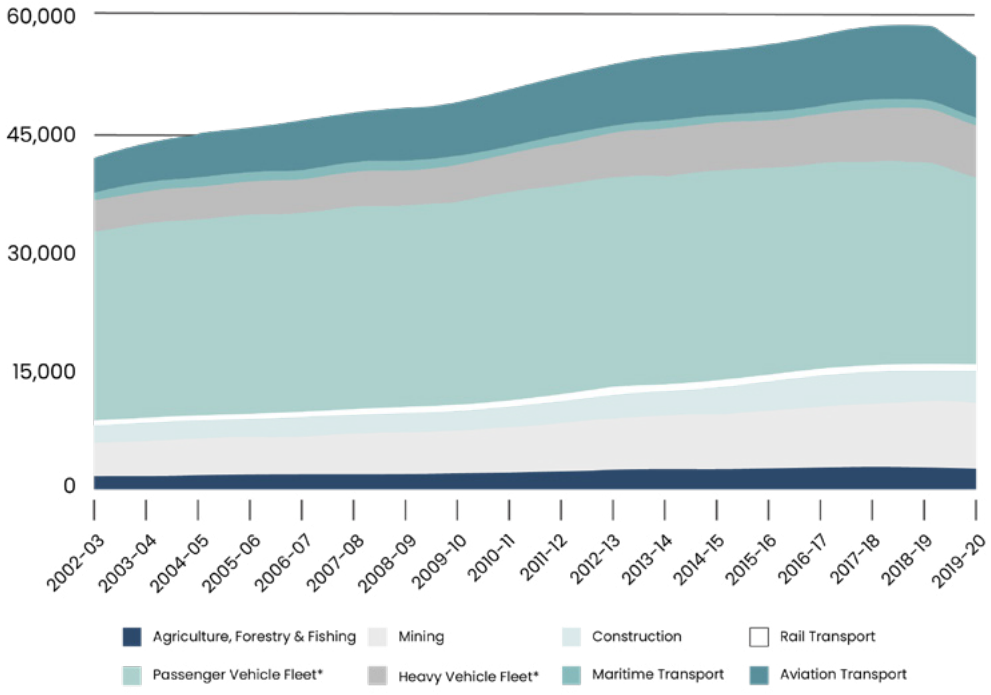
Australia's liquid fuel energy demand (Figure 1) has grown steadily since 2002/03 driven by demand in key sectors. Liquid fuel demand reached 54,000 ML in the 2019/20 financial year, representing 45% of Australia's energy consumption by industry, households and government in 2019/20. This has been driven primarily by demand growth in the mining, construction, aviation, passenger and heavy vehicle sectors. The 2019/20 financial year incorporates liquid fuel demand declines which emerged following the onset of COVID-19, with demand anticipated to having since recovered.

Decarbonisation of these sectors will be reliant upon a shifting portfolio of technologies including electrification and renewable fuels. Bio-derived renewable fuels are promising due to the high levels of technical readiness and the potential for significant low cost of production, combined with the compatibility with existing infrastructure.

Renewable fuels can therefore serve as a near term decarbonisation solution to these key sectors of the economy. Renewable fuels are a versatile decarbonisation solution that can drive emission reduction in sectors where other abatement options are not viable.

Without adequate government support during the commercial scale up, an Australian renewable fuels industry will fail to materialise. Although efforts are already underway in Australia to drive the uptake of renewable fuels through blending mandates, available grant funding and corporate announcements, industry engagement has illustrated that structural Government support and policy change is vital for broader uptake. Such policy environment will support Australia's 43% emissions reduction target by 2030.

Figure 1: Liquid fuel demand across eight key sectors of the Australian economy.[7,8]



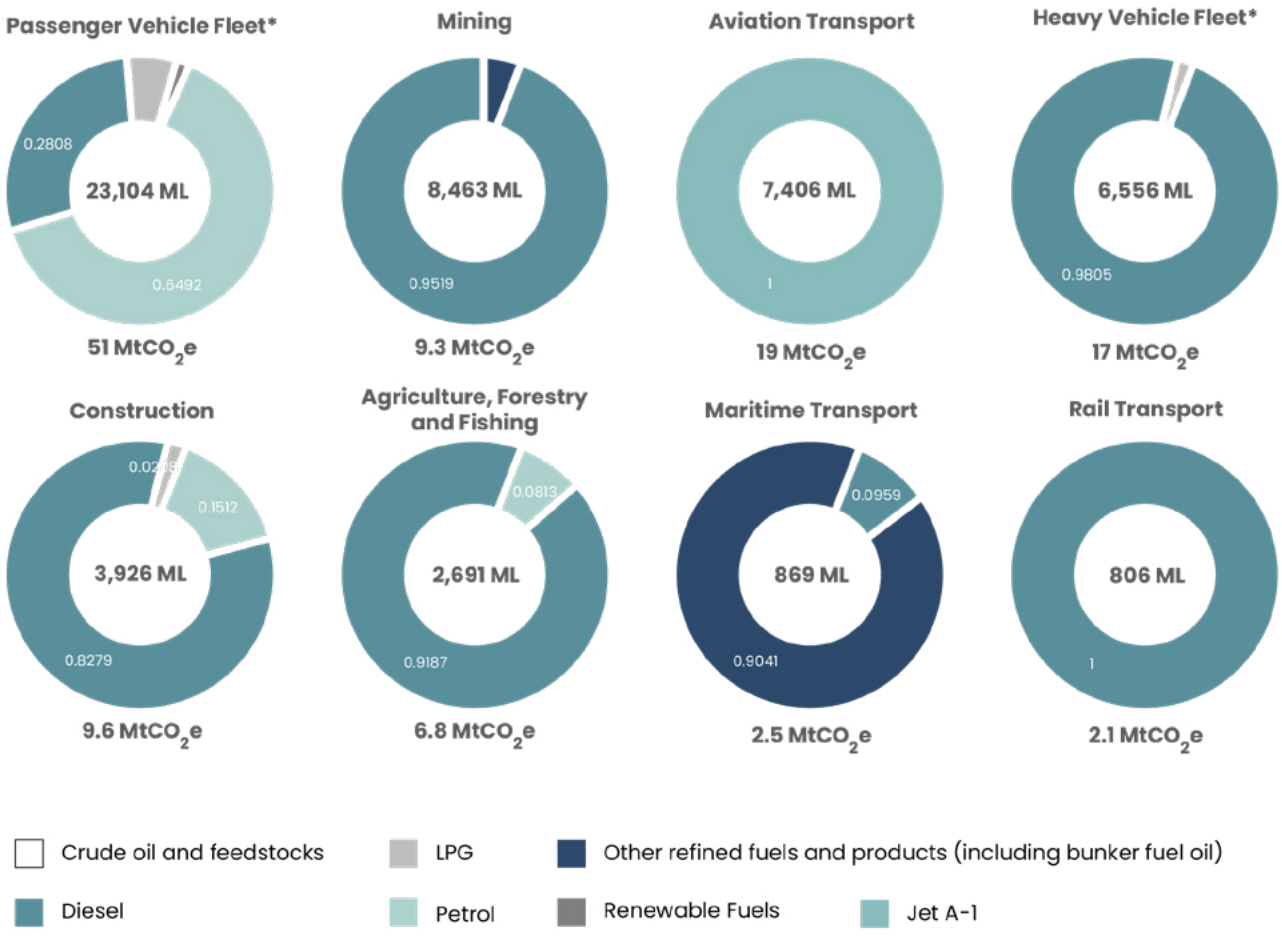
Notes: Liquid fuel demand is based upon conversion of ABS 2019/20 financial year Energy Accounts data. * The split between the Passenger Vehicle Fleet and Heavy Vehicle Fleet demand has been estimated based upon the total fuel consumption by vehicle type within the ABS Survey of Motor Vehicle Use for the 2019/20 financial year. The Passenger Vehicle Fleet was assumed to include passenger vehicles, motor cycles and light commercial vehicles. The Heavy Vehicle Fleet was assumed to include rigid trucks, articulated trucks, non-freight carrying trucks and buses.

Liquid fuels underpin several key sectors of the Australian economy, contributing significantly to Australia's emissions profile. Renewable fuels offer a decarbonisation pathway where other technologies may lack commercial readiness or are not viable.

Within Australia, liquid fuels contributed 117 $MtCO^2e$ across the considered sectors in 2019/20, equivalent to approximately 22% of Australia's 2020 emissions. The transport sector is the dominant user of liquid fuels within Australia, with the passenger vehicle fleet in particular contributing an estimated 51 $MtCO^2e$ to Australia's emissions and utilising over 43% of energy derived from liquid fuels within the sectors considered.

Further development of a domestic renewable fuels sector is also vital for Australia's decarbonisation ambitions and achieving domestic energy security. As highlighted in Australia's Bioenergy Roadmap,[4] Australia's dependence on imported fuel products has grown over the past two decades and increasing domestic production of renewable fuels is needed to ensure domestic energy security.

Government procurement of liquid fuels represents a relatively small but important portion of Australia's liquid fuel demand. For example, the Australian Defence Force (ADF) uses 300-320 ML of fuel per year, with 215 ML for aviation. Potentially procuring renewable fuels provides the ADF with the opportunity to establish foundational demand through government procurement.[13]



Notes: Based upon ABS 2019/20 financial year Energy Accounts.[11] *The split between Passenger Vehicle Fleet and Heavy Vehicle Fleet has been estimated based upon the total fuel consumption by vehicle within the ABS Survey of Motor Vehicle Use for the 2019/20 financial year.[12] The Passenger Vehicle Fleet was assumed to include passenger vehicles, motor cycles and light commercial vehicles. The Heavy Vehicle Fleet was assumed to include rigid trucks, articulated trucks, non-freight carrying trucks and buses.

Renewable Fuel Overview

Renewable fuels are at various stages of technical and commercial readiness in Australia, with infrastructure compatibility serving as a key benefit for adoption but also applying an upper bound on blending with existing fossil fuels.

Renewable Fuel	Replacement / Supplement	Technical Readiness Level[14]	Commercial Readiness[14]	Infrastructure Compatibility
Biodiesel	Diesel	8-9	6	» Refuelling station infrastructure is broadly considered compatible with biodiesel blends up to 20%.[15] » All vehicles which operate on diesel are compatible with biodiesel blends of B5, while some vehicles are compatible with biodiesel blends of B20.[16]
1G bioethanol	Petrol	8-9	6	» Bioethanol can be blended with petrol up to 10% (E10) for use in existing distribution infrastructure and light vehicles in Australia. Blending at higher rates requires minor vehicle modifications.[17,18] » There is growing evidence globally of compatibility of existing light vehicles with higher blend limits of E15 and even E20, with E15 blending permissible within the United States.[17]
2G bioethanol	Petrol	6-7	1	
Renewable Diesel	Diesel	4-8	1	» Renewable diesel is similarly compatible with existing refining and refuelling infrastructure, and is considered to have a comparative better compatibility than biodiesel which may aid increased volumetric blends.[19]
Sustainable Aviation Fuel (SAF)	Aviation Fuel	2-7	1	» SAF is broadly compatible with refining and distribution infrastructure, however, blend limits are in place depending on the production pathway (50%v/v for the Fischer Tropsch, HEFA and ATJ pathways).[20] » Aircraft tanks and engines require modification to operate on 100% SAF.[21]

The advantage of bio-derived renewable fuels

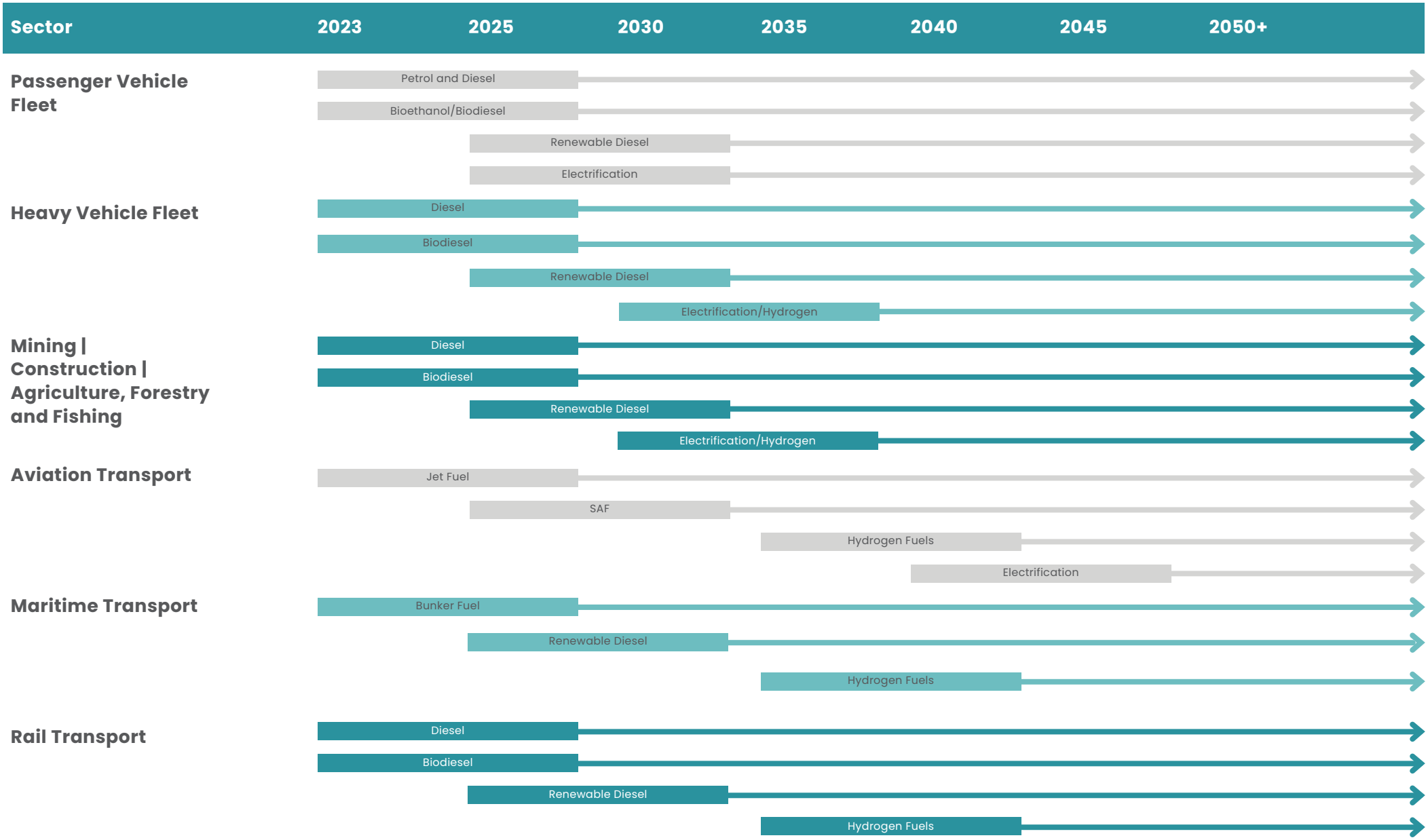
The comparatively high gravimetric and volumetric energy densities of bio-derived renewable fuels makes their use advantageous over other energy storage methods, such as hydrogen-derived fuels and battery storage (see table below). As such, the use of these fuels is more technically feasible in key applications such as aviation and maritime relative to alternative decarbonisation pathways where weight and volume considerations are of greater importance. Additionally, co-products such as DDG-S from ethanol fermentation can be used to produce animal feed while CO^2 from the same process can be repurposed for other uses.[22]

Fuel	Gravimetric Density (MJ/kg)
SAF[24]	46.3
Jet A-1[24]	43.3
Bunker C[24]	40.0
Biodiesel[25]	42.2
Methanol[24]	31.1
Ethanol[25]	19.9
Lithium Battery[23]	0.3-0.5

The Space for Renewable Fuels

Renewable fuels have a key role to play as both a long-term decarbonisation solution and as a bridging fuel to alternative low-carbon technologies across the sectors considered.

Sub-sector	Incumbent fuel	Replacement / Supplement	Application	Notes
Passenger Vehicle Fleet	Petrol and diesel	1G and 2G bioethanol, biodiesel and renewable diesel	Short-to-medium term technology bridging fuel to electric vehicles.	Improvement in the commercial viability of 2G bioethanol and renewable diesel production is necessary to drive down cost and promote uptake. Bioethanol production could be transitioned to renewable diesel and SAF production over time, as demand declines from the passenger vehicle fleet.
Heavy Vehicle Fleet	Diesel	Biodiesel and renewable diesel	Short to long-term solution complementing electrification and hydrogen alternatives in the long-run.	Biodiesel represents an immediate opportunity to contribute to reducing diesel GHG emissions. Improvement in the commercial viability of renewable diesel production is necessary to drive down cost and promote uptake.
Mining, Construction, Agriculture and Forestry and Fishing	Diesel	Biodiesel and renewable diesel	Long-term solution complementing electrification and hydrogen alternatives in the long-run.	Biodiesel represents an immediate decarbonisation alternative. Improvement in the commercial viability of renewable diesel production is necessary to drive down cost and promote uptake.
Aviation Transport	Jet A-1	SAF	Long-term solution complemented by hydrogen-derived fuels in the long-run.	Improvement in the commercial viability of SAF production is necessary to drive down cost and promote uptake.
Maritime Transport	Bunker Fuel Oil	Biodiesel and renewable diesel	Long-term solution complementing hydrogen-derivative fuels in the long-run.	Biodiesel represents an immediate decarbonisation alternative. Improvement in the commercial viability of renewable diesel production is necessary to drive down cost and promote uptake.
Rail Transport	Diesel	Biodiesel and renewable diesel	Long-term solution complementing hydrogen-derived fuels in the long-run.	Improvement in the commercial viability of renewable diesel production is necessary to drive down cost and promote uptake.



* Timelines do not represent the scale of adoption and uptake

Feedstock Overview

Australia has abundantly available feedstock for local renewable fuel production but faces challenges that could inhibit large-scale production of future fuels such as SAF and renewable diesel.

Feedstock driven processes

Renewable diesel and SAF are primarily produced via the hydro processed esters and fatty acids (HEFA) process or Fischer-Tropsch (FT) process, whilst the Alcohol to Jet (AtJ) process uses ethanol or butanol fuels to produce SAF, while biodiesel is currently primarily produced via transesterification. The feedstocks for each process can be seen in the table below. The distribution of feedstocks and cost of aggregation mean the choice of technology is driven by local feedstock availability. Currently the most commercially ready process for renewable diesel and SAF is the HEFA/HVO process which uses oil-based feedstocks, however, as technologies develop over time, other processes are expected to become increasingly competitive. For example, Power to Liquid (PtL) technology could become increasingly economic in Australia as Australia's advantage in green hydrogen production from renewable energy becomes more technically and economically viable. Once viable, PtL technology will be compatible with renewable fuel conversion pathways set out in this report.

A detailed breakdown of available state feedstocks and specific case studies on tallow and canola feedstocks can be found in **Appendix 1.**

Fuel	Process	Feedstocks
SAF, Biodiesel, Renewable Diesel	**HEFA/HVO**	**Fats and Oils (e.g. vegetable oils, oil crops, animal fats, used cooking oil)**
Biodiesel	**Transesterification**	**Fats and Oils (e.g. vegetable oils, oil crops, animal fats, used cooking oil)**
SAF, Biodiesel, Renewable Diesel	**FT**	**Waste, forestry residues, lignocellulosic biomass (e.g. crop residues(straw), wood processing residues, horticulture residue)**
Ethanol	**Fermentation**	**Sugar, starch**
SAF	**AtJ**	**Hydrolysed sugar, hydrolysed starch, hydrolysed polysaccharides from lignocellulosic biomass**

Feedstock supply chain and challenges

Agricultural feedstocks represent the largest source for renewable fuel production. While primary agricultural resources such as starch and sugar are abundantly available across Australia for use as a primary feedstock, other feedstocks need to be explored to fulfill the nation's demand for increased production of SAF and renewable diesel. Residues have technical and economic viability considerations stemming from collection issues as it is dispersed across the country and produces less fuel per tonne of feedstock. This feedstock has not previously been disposed of sustainably and Australian states, specifically Victoria are seeking to find alternative ways to utilise the millions of tonnes of wheat straw burnt each year. Farmers may require incentives to collect residues which would otherwise be left in-ground for nutrient cycling or sold for other power-generation purposes.

Forestry residues have similar issues with a lack of collection services to fully harness the energy potential from these feedstocks. Forestry products may also have social license issues as communities have concerns over deforestation for the production of renewable fuels.

Waste (Municipal solid waste(MSW), commercial and industrial, construction and demolition) is also a viable feedstock across Australia. There are fewer competing industries for waste, which is also typically in consistent supply, particularly in urban areas where waste is already collected and aggregated. However, many high potential landfills have already implemented biogas projects while other landfills are too widely dispersed across the country, adding difficulty for potential aggregation. Furthermore, it is expected that MSW production will increase to 9 million tonnes per annum in 2030, up from 6.5 million tonnes per annum in 2010.[26]

Fats and Oils such as animal fats, specifically tallow, are produced abundantly in Australia but are exported to other countries and have competing uses. In Australia, for example, most tallow is used in the production of animal or aquaculture feed and petfood.

Feedstock Exports

The exports of Australian feedstock to other countries is potentially impacting on Australia's ability to produce SAF, renewable diesel and biodiesel domestically. Australia supplies feedstocks for renewable fuel production in other countries as evidenced by the export of tallow to Singapore for SAF and renewable diesel production. Case studies outlining the export of tallow and canola for international renewable fuel production are provided in Appendix 1.

Risks of Inaction

Australia is exposed to environmental, economic and energy security risks if government choose not to intervene and promote the renewable fuel industry.

- **Without adequate government support, an Australian renewable fuels industry may fail to materialise. Although efforts are already underway in Australia to drive the uptake of renewable fuels through blending mandates and corporate announcements, industry engagement has illustrated that government support for various elements of the renewable fuel value chain is vital for broader uptake. For example, a lack of necessary infrastructure within the renewable fuel supply chain will lead to an absence of a domestic renewable industry and would significantly slow the uptake of renewable fuels. Additionally, a lack of revenue support mechanisms within Australia has led to higher production costs as compared to the US and Europe.**
- **Reliance on imported liquid fuels contributes to energy insecurity. Australia's dependence on imported fuel products has grown over the past two decades[1] and increasing domestic production of renewable fuels is needed to build domestic energy security. Relying on imported fuels could not only have detrimental effects to the local economy but also increase political risk.**
- **Greater GHG emissions. Without renewable fuels, the transport, mining, agriculture and construction sectors would continue to be dependent on incumbent fossil fuels in the short to medium term. Although certain sectors such as passenger vehicles have a decarbonisation pathway through electrification, aviation transport and other sectors would take longer to decarbonise.**
- **Domestic biomass feedstocks could be increasingly exported. Australia already produces high quality biomass feedstocks, much of which is already exported. Without a domestic renewable fuels industry to capture these feedstocks, international fuel producers would potentially increase the import volumes. Additionally, greater incentives and support in other countries such as the US IRA, could further drive the export of Australia's feedstocks in the long-term.**
- **Consequential economic opportunity cost. As highlighted in Australia's Bioenergy Roadmap, the bioenergy sector as a whole has the potential to produce $10b in extra GDP and 26,200 jobs by the 2030s,[4] thus an underdeveloped sector in the future will provide an opportunity to international refiners to export fuels such as SAF to Australia and act as a supplier to the Australian domestic market. Domestic airlines and the ADF would in effect have to purchase fuels at a higher cost to meet their emission requirements.**
- **Health benefits of renewable fuels. Renewable fuels could lead to reduced pollution and broader community health benefits. According to a study from Clean Fuels Alliance America, replacing diesel fuel with biodiesel in Washington D.C. could reduce the symptoms of asthma, reduce sick days, cancer cases, and could result in US$7.5 billion in avoided health costs annually.[5]**

Renewable Fuels Around the Globe

Global State of Play Overview

Production and trade of renewable fuels is returning to near-2019 levels after a decline from the COVID-19 pandemic. Increased investment and the release of new policies has the potential to drive further increases in renewable fuel production.

Key Policies

New and existing policies will expand renewable fuel production and demand. In August 2022, the United States approved the Inflation Reduction Act (IRA) which includes incentives for biodiesel, renewable diesel, sustainable aviation fuel and advanced fuels production as well as support for renewable fuels infrastructure.[27] In addition, Canada (Clean Fuel Standard), Brazil (RenovaBio), Europe (new targets under Fit for 55), India (higher ethanol blending) and the United States (California and Oregon low carbon fuel standards (LCFS) and other states considering LCFSs) continue to support expanded renewable fuel uptake in the coming years.[28] However, higher oil prices and weaker GDP are slowing growth in 2022.

Renewable Fuel Production

Biodiesel and ethanol are the leading renewable fuels in production. These fuels are produced primarily by the United States, EU and Brazil. In 2021, US ethanol production totalled about 57 billion litres and combined biodiesel/renewable diesel production exceeded 9.5 billion litres.[29] In Brazil, ethanol and biodiesel production for 2022 is estimated at 31.66 billion litres and 6.37 billion litres respectively.[30] Figure 3.1 below shows the estimated production of biodiesel and ethanol in Europe in 2021.

Trade

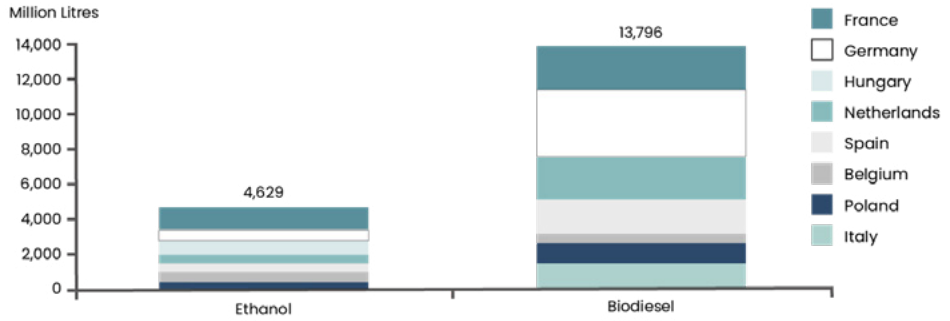
Key primary feedstock trade includes soybean oil, canola oil, palm oil and tallow. Soybean trade is dominated by China with the majority of imports from the US, Brazil and Argentina. Canola oil is mainly exported by Canada, with half of the world's canola seed exports originating from Canada.[28] As major producers, Indonesia and Malaysia produce over 300 Mt of palm oil annually and export the bulk of their production.[32] Australia also exports a majority of its tallow with 70% of Australia's tallow exported in 2020, 288 kt destined for Singapore.[32] This is a result of Australia's large herd and tallow production line but a small domestic market for renewable fuels. Canola oil in Australia is similarly exported in bulk, with over 80% of domestic production attributed to exports in 2021/2022.[33]

Investment

Global investment in liquid renewable fuels more than doubled in 2021, reaching approximately US$8 billion.[28] Two-thirds of this growth was in biodiesel due to the rising investment in HVO renewable diesel, although ethanol investment has also nearly doubled. The United States and Brazil each contributed approximately 30% to global investment in 2021.[28] The planned expansion of capacity at HVO renewable diesel and biojet kerosene projects, such as Neste's US$1.98 billion investment in Rotterdam, is likely to create further supply in the near term.[34]

A detailed overview on countries insights can be found in **Appendix 2.**

Figure 3.1: Breakdown of ethanol and biodiesel* production in Europe in 2021 (ML)



*Biodiesel fuels include both EU27 FAME and EU27 HDRD Production

Key Policy Lever Assessment Methodology

A MCA was used to assess the different policy levers with reference to international case studies.

Assessing Key Policy Levers

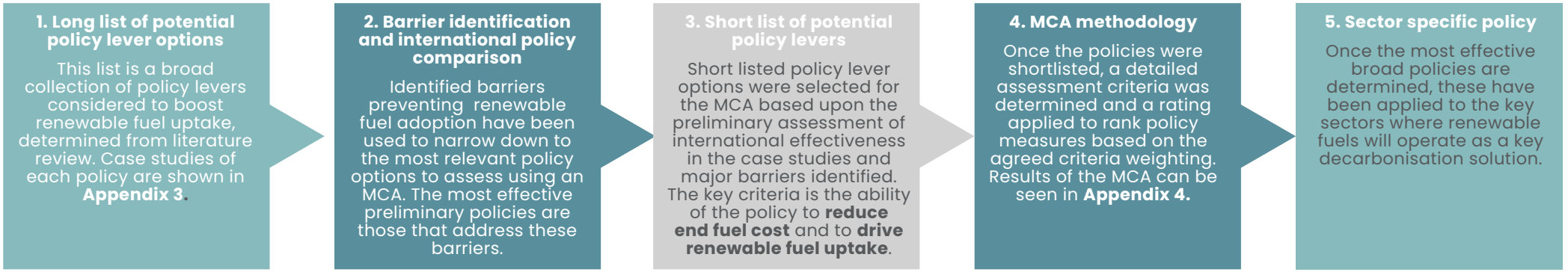
Eight broad policy levers have been considered as a part of this analysis to identify effective mechanisms which can be leveraged to stimulate the development of an Australian renewable fuels industry.

The policy levers considered include:

- **Tax Treatment**
- **Fuel Carbon Intensity Standards**
- **Concessional Loans / Loan Guarantees**
- **Contracts for Difference**
- **Waste Levies / Bans**
- **Capital Grants and Incentives**
- **Strategies and Roadmaps**

Policies were shortlisted by excluding those which did not pass preliminary screening based upon the high-level ability of a policy to directly reduce end-use fuel cost or drive fuel uptake. The ranked policies have been assessed based upon their **ease of implementation, adoption timeline, existing application and the end impact on renewable fuel production or consumption**, with rankings according to effectiveness, moderate effectiveness and less effectiveness. Throughout this, consideration for Australia's emissions reduction target of 43% on 2005 levels by 2030 drove outcomes.

MCA Methodology



Assessment Criteria

The MCA was assessed across 6 criteria, accounting for the ease of implementation, potential timeline, existing support mechanisms and the level of actual reduction in traditional fuel consumption from the implementation of the policy. A description for assessment of each detailed criteria can be seen below:

Assessment Criteria	Detailed Criteria	Less Effective	Moderately Effective	Effective
Ease of implementation	Criterion 1: Degree of support across communities/ consumers and industry.	Mixed or complete lack of support from communities and industry	Moderate degree of support from communities and industry	Strong degree of support from communities and industry
	Criterion 2: Simplicity of policy adoption by consumer and industry.	Very difficult or difficult to adopt policy	Moderately difficult to adopt policy	Easy to adopt policy
Potential timeline	Criterion 3: Time period for policy implementation at state, territory and federal government level.	Policy can be implemented in the long-term (>2030)	Policy can be implemented in the medium-term (2025-2030)	Policy can be implemented in the short-term (by 2025)
	Criterion 4: Time period for renewable fuel production uplift.	Production uplift can be implemented in the long-term (>2030)	Production uplift can be implemented in the medium-term (2025-2030)	Production uplift can be implemented in the short-term (by 2025)
Existing strategic support / support mechanisms	Criterion 5: Presence of similar support mechanisms	Alternative support in place and effective	Moderately effective alternative support in place	Little to no alternative support in place
Level of actual reduction in traditional fuel consumption or increase in renewable fuel production	Criterion 6:Approximate impact on fuel uptake and/or production	Indistinct/ indistinguishable impact on fuel production and/or uptake	Low or moderate impact on production and/or fuel uptake (% of target fuel)	High impact upon fuel production and/or uptake (% of target fuel)

Notes: Weightings of assessment criteria were determined in consultation with Bioenergy Australia.

Key Policy Lever Assessment

Short-listed policy levers have been assessed using the MCA, based upon, ease of implementation, adoption timeline, existing application and the end impact on renewable fuel production or consumption. .

Summary

After assessing the policies using case studies and further analysis, the policies were classified as follows:

Policy Lever	Rank	Description
Taxation Treatment	**1**	**Taxation treatment is a significant policy lever to enable renewable fuel production and includes:** » **Maintaining and extending excise/fuel tax mechanism to support renewable fuels and enable growth of new renewable fuels (e.g. SAF and renewable diesel) in the market.** » **Implementation of tax credits for producers, blenders, fuel users and investors based upon uptake or avoided emissions.**
Fuel Carbon Intensity Standards	**2**	**A Fuel Carbon Intensity Standards policy lever is designed to:** » **Decrease the carbon intensity of Australia's transportation fuel pool and provide an increasing range of low-carbon and renewable alternatives. For Australia this could be represented as 10% Renewable Fuels by 2030.** » **The policy is implemented through a new low-carbon fuel emission crediting system and by developing flexible minimum volume production and/or carbon intensity of fuels.** » **Producers/refiners that exceed the minimum volume/carbon intensity are able to sell excess credits to producers/refiners that require credits to meet the minimum volume/carbon intensity. This policy can act as a national framework for the decarbonisation of liquid fuels.** **Note: The first low-carbon fuel standard mandate in the world was enacted by California in 2007,[8] similar legislation was approved in British Columbia in April 2008,[9] and by European Union in December 2008.[10]**
Capital Grants and Incentives	**3**	**Enabling partner and private partnerships through the provision of capital grants and incentives has been used internationally to support the growth of SAF, renewable diesel and biodiesel as it reduces the upfront investment cost and risk of renewable fuel projects and improve returns to investors. ARENA could be leveraged to support Renewable Fuels projects as part of its strategic priorities.**
Concessional Loans and Loan Guarantees	**4***	**Provision of low-interest or subordinated loans to facilitate access to private finance and reduce a project's cost of capital.**
Contracts for Difference (CfD)	**4***	**Government funding of the difference between the market price and a contracted price of renewable fuels so project developers are guaranteed a minimum price per unit of fuel produced.**

* Concessional loans/loan guarantees and Contracts for Difference achieved the same score

Effective

Moderately Effective

	EFFECTIVE	EFFECTIVE
	Taxation Treatment	**Fuel Standards**
	Criteria 1 2 3 4 5 6 Assessment 3 3 3 3 2 3	Criteria 1 2 3 4 5 6 Assessment 3 2 2 3 3 3
Ease of Implementation	Lowering of fuel excise rates for blended renewable fuels would contribute to broad community and industry support from key players. Similarly, renewable fuel tax credits have received broad community and industry support in the US. The policy has minimal direct negative effects on industry or consumers and has made renewable fuel prices more competitive, particularly with the greater support given to SAF.	Although fuel standards are likely to receive resistance from the oil and gas sector,[35] consumers would be relatively unaffected by such standards. A fuel standard credit system would receive resistance from incumbents as the failure to meet renewable fuel volume production requirements or carbon intensity reductions will necessitate the purchase of fuel credits. The ideal implementation of the policy would involve combining both volume and carbon intensity based systems to ensure fuel producers meet volume demand and also produce fuel sustainably.[36]
Adoption Timeline	In Australia, the rate of fuel excise is adjusted in February and August each year in line with inflation and GST. Adjustment to excise rates is a likely first step to increase the competitiveness of renewable fuels, being relatively simple to implement with the bi-annual changes. Tax credit generation, however, could be implemented but would require greater time to pass through the legislative processes and industry and community consultation. The policy itself would have an immediate impact, attracting new investment and lowering production cost.	Although the RFS system (volume-based system) showed volatile credit prices in the first few years of the program, the system has provided substantial growth in ethanol and biodiesel uptake over the long-term.[36] A carbon-based system such as the RenovaBio program in Brazil or the LCFS system in California has shown an arguably greater success than RFS and should thus be implemented in parallel.
Existing Application	Renewable fuels produced in Australia receive some tax relief with point-of-sale excise tax (retail sales tax) rates which are lower than those for fossil fuels.[35] However, the excise rates would require further reduction to generate a sufficient impact to the industry. A tax credit scheme has yet to be implemented within Australia.	Australia does not have renewable fuel credit schemes such as the RFS or LCFS systems.
Impact on Renewable Fuel Production or Consumption	Tax credits are likely to lead to a large uptake of renewable fuels. The uptake effect from tax crediting systems in the US, while inexact, has led to a large uptake of renewable fuels with an increase of 4 billion to 17 billion gallons of ethanol and 100 million gallons to 2 billion gallons of biodiesel.[36] Similarly, adjustments to the fuel excise rates, by improving the competitiveness of renewable fuel blends would contribute to greater renewable fuel uptake.	The introduction of fuel standards will likely drive greater production of renewable fuels. In the US, LCFS has resulted in carbon emission abatement of more than 30 Mt from 2010 – 2020 while the RFS (with tax credits) has resulted in an uptake increase from 4 billion to 17 billion gallons of ethanol and from 100 million gallons to 2 billion gallons of biodiesel.[36] In Brazil, the RenovaBio program avoided 24.4 Mt of greenhouse gases in 2021 from the trading of 24.4 million decarbonisation credits.[37]

	EFFECTIVE	MODERATELY EFFECTIVE
	Capital Grants and Incentives	**Concessional Loans and Loan Guarantees**
	Criteria 1 2 3 4 5 6 Assessment 3 3 3 3 1 3	Criteria 1 2 3 4 5 6 Assessment 3 3 3 2 1 2
Ease of Implementation	Capital grants and incentives for assisting in project capital expenditure and commercialisation are broadly supported by communities and industry, particularly for developing new industries. They are relatively simple to implement for developers, with delays only emerging from the need to meet grant criteria and approval processes. The community broadly supports grants targeted at projects which economically support communities, contribute to job creation and foster nascent industries.	Existing soft loan initiatives at the Federal and State level illustrate the broad support for concessional loans as a policy mechanism. Concessional loans are supported by renewable fuel producers as they reduce the cost of capital. They are also supported by communities as they are seen as promoting projects which are economically beneficial and allow for nascent industries which otherwise wouldn't exist to form whilst recouping the initial investment over time. Concessional loans are simple to implement by industry, however, approval can take time, particularly in meeting criteria such as comparable contributions of finance by industry.
Adoption Timeline	Capital grants are simpler to implement for Government relative to other policy mechanisms, owing to the fiscal discretion available to State and Federal Governments. Capital grants aid industry, in particular producers, to reach financial close on projects, accelerating decision making and project construction as well as assisting with reaching commercial readiness.	Offering a loan as opposed to a grant has greater political acceptance and shorter timelines for adoption. Concessional loans can help expedite the capital raising process, particularly in risky infant industries. However, often these projects still require a degree of equity investment and, as such, do not fully address the capital raising challenge.
Existing Application	Renewable fuel projects are eligible for grant funding through various Commonwealth and State Government programs. However, a significant acceleration of deployment in Renewable Fuel projects will require dedicated government programs.	Concessional loans are available from State and Federal Governments.[38] It is clear that either the scale, conditions or other applicability of these measures have been ineffective in stimulating industry development, particularly at this scale of development.
Impact on Renewable Fuel Production or Consumption	Capital grants drive fuel production by progressing the development of facilities which may not be economically viable and contributing to lower fuel cost.	Although concessional loans and loan guarantees would not have as large of an effect as capital grants, these could become moderately effective levers in funding projects by improving the business case for renewable fuel producers, helping projects reach financial close.

	MODERATELY EFFECTIVE
	Contracts for Difference (CfD)
	Criteria 1 2 3 4 5 6 **Assessment** 2 1 1 3 3 3
Ease of Implementation	A CfD renewable fuel policy has yet to be implemented globally. The UK Government has shown interest in a CfD policy, particularly for SAF where it is seen as necessary to enable the greater uptake.[39] Industry and consumers are supportive as it would ensure price stability and reduce volatility, assisting price setting for producers such that projects hit benchmark returns. However, the exact mechanism of the policy requires further development and consultation.
Adoption Timeline	As further development is required, the policy would not be implemented for several years. The mechanism however has been effective in the UK electricity market and would likely have a positive impact on the renewable fuel industry.
Existing Application	CfD have significant potential as well but have not been implemented within renewable fuels as of yet.
Impact on Renewable Fuel Production or Consumption	The first use of a CfD policy to support sustainable projects was the low-carbon electricity CfD policy implemented in the UK in 2014. This mechanism has been particularly effective in terms of its impact on offshore wind with 13 GW of projects in the four rounds carried out to date and with prices falling from US$164.59/MWh to US$46.61/MWh.[39] The policy was especially useful in alleviating concerns over price volatility, which would be specifically relevant to the SAF industry.

Key Australian Policy Levers – Taxation Treatment

While Australia has implemented a reduction in tax excise rates for renewable fuels, further fuel excise tax reductions and the implementation of tax credits will support the cost-competitiveness of renewable fuels as the sector commercialises.

Potential Australian Policy Response:

- **Create a framework such that there are no excise implications in anticipation of future renewable fuel production.**
- **Assign tax credits on a per litre basis for blenders and renewable fuel producers applicable to the recipient's total tax liability. Tax credits should be variable within a defined range depending upon the emissions reduction effect.**

The Taxation Treatment of renewable fuels can serve as either a demand-side or supply-side measure. Tax incentives can be implemented to improve the competitiveness of renewable fuels and reduce supply-side costs. This can be achieved through either reducing the excise tax on renewable fuels further or through the generation of tax credits through investment, production, blending, or use.

Australia has a reduced renewable fuel excise tax for bioethanol and biodiesel. However, this is insufficient for further industry growth. Australia currently has a reduced excise tax for renewable fuels utilised for road transport (primarily 1G ethanol and biodiesel) relative to fossil fuels as shown opposite.[40] These rates alone, however, are insufficient to further grow the renewable fuels industry and fail to recognise the emissions reduction benefit of varied renewable fuels. To promote the use of more sustainable renewable fuels and improve their competitiveness against fossil fuels, frameworks could be created such that there are no excise implications in anticipation of future renewable fuel production (2G bioethanol and renewable diesel).

Within the aviation industry, Australia has no distinguished fuel excise rate for SAF. Current excise rates consider kerosene for use as fuel in aircraft, providing no specialised rate for SAF. The opportunity exists to recognise SAF as a new fuel type and create a framework such that there are no excise implications for SAF production pathways.

Tax credits applicable to the total tax liability of the target supply chain player can be implemented to encourage renewable fuel adoption. In the US, credit-per-gallon base amounts are US$0.20 (non-aviation fuel) and US$0.35 (aviation fuel). The credit amount can increase to US$1.00 per gallon (non-aviation fuel) and US$1.75 per gallon (aviation fuel) if wage, apprenticeship, and emission reduction requirements are met.[41] If the emission reduction of a renewable fuel exceeds a specific percentage (50% in the US), a greater tax incentive can be provided.[42] Application of a tax credit scheme within Australia would yield greater encouragement to not only produce a higher volume of renewable fuels but to also source the feedstocks sustainably and reduce other areas of emissions along the supply chain. To be eligible for the additional tax incentive, a lifecycle assessment would need to be conducted for the eligible renewable fuels to understand the total emission reductions, promoting greater transparency.[42]

Tax rebates in off-road heavy vehicles. Lowering tax excise rates would have little effect in the mining, agriculture, and construction industry due to the existing tax rebates for off-road diesel use. These rebates largely act as fossil fuel subsidies and would thus need to be gradually lowered in alignment with industry stakeholders to provide financial incentive to renewable fuels.

Renewable Fuel	Australian Fuel Excise Rate (AU$/litre)[40]
Ethanol	0.151
Biodiesel	0.107
Gasoline (other than aircraft)	0.46
Kerosene (for use as fuel in aircraft)	0.03556
Diesel	0.46
Fuel Oil	0.46

Key Australian Policy Levers – Fuel Standards

Fuel carbon intensity standard credit systems are necessary in advancing Australia's renewable fuel industry.

Potential Australian Policy Response:

- **Enact a new fuel standard crediting system to drive existing refiners to purchase renewable fuels from producers.**
- **Develop flexible volume demands or carbon intensities.**

Fuel standards (inclusive of volume blend requirements and emissions reduction requirements) are a legislative measure which can drive fuel uptake across sectors. A fuel standard policy can refer to the implementation of:

1. A fuel standard credit system, generating credits for greater carbon emission abatement and volume production:

- **The use of fuel standards such as the RFS/LCFS systems used in the US can be applied in Australia and targeted to specific sectors.** For example, the LCFS system is applied to only transport fuels in California.[43] Targeting a specific sector would eventually allow for greater growth in other sectors as well, due to the higher demand for renewable fuels, development of key infrastructure, and the lower production cost from economies of scale.

2. Flexible renewable fuel volume demands or carbon intensities:

- **Fuel producers need to meet their renewable fuel volume obligations by either producing the required volumes or by buying credits.** In California, providers of renewable fuels used in transportation generate credits by obtaining a certified carbon intensity reduction and reporting transaction quantities on a quarterly basis. Credits are then calculated relative to the flexible annual carbon intensity benchmark with fuels above the benchmark generating credits and fuels below it, at a deficit.[43] Similarly, a volume-based system such as RFS, requires fuel producers to meet their renewable volume obligation (RVO) with parties exceeding the RVO receiving extra credits which can then be sold to parties that have a deficit.

Guarantee of Origin (GO) scheme can be paired with a fuel standard policy.

Although a renewable fuel GO is yet to be implemented globally, this mechanism would enable greater transparency, monitoring and verification of renewable fuels. Certificates would also provide additional information on the overall sustainability of the renewable fuel to customers.

» **The combination of both a volume-based and carbon intensity crediting system is the ideal method in implementing this policy.** While a volume-based system will deliver greater renewable fuel production, a carbon intensity system will ensure that production methods prioritising sustainable feedstocks are rewarded. Fuels made from low or negative emitting feedstocks such as palm oil will benefit less from higher carbon prices, but those with a higher emissions saving relative to conventional fuels will benefit more. Additionally, the volume of renewable fuel production and carbon abatement can be set per year to ensure the industry maintains its steady growth.

Key Australian Policy Levers – Capital Grants and Incentives and Other Measures

New and existing ARENA capital grants should be directed towards renewable fuel producers to drive production for immediate supply-side stimulation.

Potential Australian Policy Response:

» **Leverage future fuels funding infrastructure to invest grant funding to target new renewable fuels production capacity.**

Capital grants and incentives are supply-side measures best targeted at feedstock production and collection as well as renewable fuel production. Currently, the high capital and operating costs associated with renewable fuels production (in particular 2G bioethanol, renewable diesel and SAF) are inhibiting demand, due to the lower willingness to pay. Capital grants offer a mechanism by which to reduce upfront cost and risk of projects, simultaneously reducing the end fuel cost.

Capital grants are best targeted at supply chain components where learnings over time through project delivery are anticipated to drive down the cost of fuel production. In particular, this is required to ensure cost reductions from key production pathways. Furthermore, novel and efficient mechanisms of feedstock collection and distribution are required to drive down feedstock costs and improve process efficiencies, with feedstocks representing a significant input cost.

The nature of the dispersion of feedstock resources across Australia requires investment across all production processes. This is because all methods will serve as a part of a diversified portfolio of renewable fuels production pathways to service Australian and, potentially, global demand.

Capital grant programs are currently available under ARENAs Future Fuels Fund but there has been limited funding to date for renewable fuels projects. It is clear that to unlock this opportunity, capital grants are required to be implemented in conjunction with other policy levers targeted at the demand-side.

Other Policy Levers For Longer-Term Consideration

» **Establishment of a renewable fuels Guarantee of Origin scheme.** Although a renewable fuel GO is yet to be implemented globally, this mechanism would enable greater transparency, monitoring, and verification of renewable fuels. Certificates would also provide additional information on the overall sustainability of the renewable fuel to customers. A Guarantee of Origin (GO) scheme can be paired with a fuel standard policy to work in tandem.

» **Gradually reduce Government financial assistance for fossil fuels in the long-term to remove market distortions.** This includes decreasing existing fossil fuel subsidies such as off-road fuel tax credits used in heavy vehicles off public roads. Reducing government financial assistance for fossil fuels over the long-run would improve the competitive landscape for renewable fuels entering the market.

» **Establishment of procurement targets for State and Federal government offtake of renewable fuels, including for the Australian Defence Force.** The scale of State and Federal governments as fossil fuel offtakers make government procurement a promising method to create the foundation of the industry through commitment to a base load for its own liquid fuel demand. In particular, procurement of renewable fuels for vehicle fleets and the Australian Defence Force are promising pathways.

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Glossary

Term	Acronym	Definition
Hydroprocessed esters and fatty acids / Hydrotreated Vegetable Oil	HEFA/HVO	The HEFA process is a commercially mature process, using fatty feedstocks to produce renewable fuels. A key end price driver for this process is the raw and processed feedstock price. Current feedstock prices are expensive in comparison to other incumbent non-renewable fuels due to the limited availability of the feedstock.
Fischer-Tropsch	FT	The FT process is an emerging method for the production of renewable fuels. Feedstocks for the process can be derived from any high carbon-content material, with hydrogen ideally present to improve the process efficiency. In current deployments natural gas and coal serve as the primary feedstocks for the process. The cost of the FT process is primarily driven by the upfront capital cost which serves as the predominant barrier to investment, however, over time these costs are anticipated to decline.
Fermentation	Fermentation	Ethanol production via fermentation is a well-established process in the industry. Sugar/starch crops are milled and fermented into ethanol with co-products of distiller grains and carbon dioxide. The cost of ethanol is driven by the feedstock cost of sugar crops and the capital cost of ethanol production facilities.
Alcohol-to-Jet	AtJ	The AtJ process is another emerging method in producing SAF. In this process, alcohols such as ethanol and butanol sourced from fermented biomass are converted to jet fuel. Similar to fermentation, the cost of the AtJ process is driven by the high upfront capital cost of production facilities as well as the feedstock price, largely contributed by the collection and transport of biomass to production facilities.
Power to Liquid	PtL	PtL is a synthetically produced liquid hydrocarbon. In this process, green hydrogen is produced using the electrolysis of water from renewable electricity before being synthesised with carbon feedstocks via processes such as FT to generate liquid hydrocarbons. Similar to other synthesis processes, PtL production results in a mix of gasoline, kerosene, diesel, and other fuel products.

Appendix 1
Feedstock Overview

The total theoretical feedstock potential across Australia amounts to nearly 2,400 PJ in available energy per annum.

The theoretical resource potential was represented in total tonnages available per annum. As materials have different energy densities (e.g. 1 tonne of oil crops provides 5 times more energy than 1 tonne of sugar crop), these tonnage values have been converted to potential energy through multiplying each resource's tonnage (tonnes p.a.) by the resource's calorific value (GJ/tonne) to find the resource's energy potential (GJ p.a.).

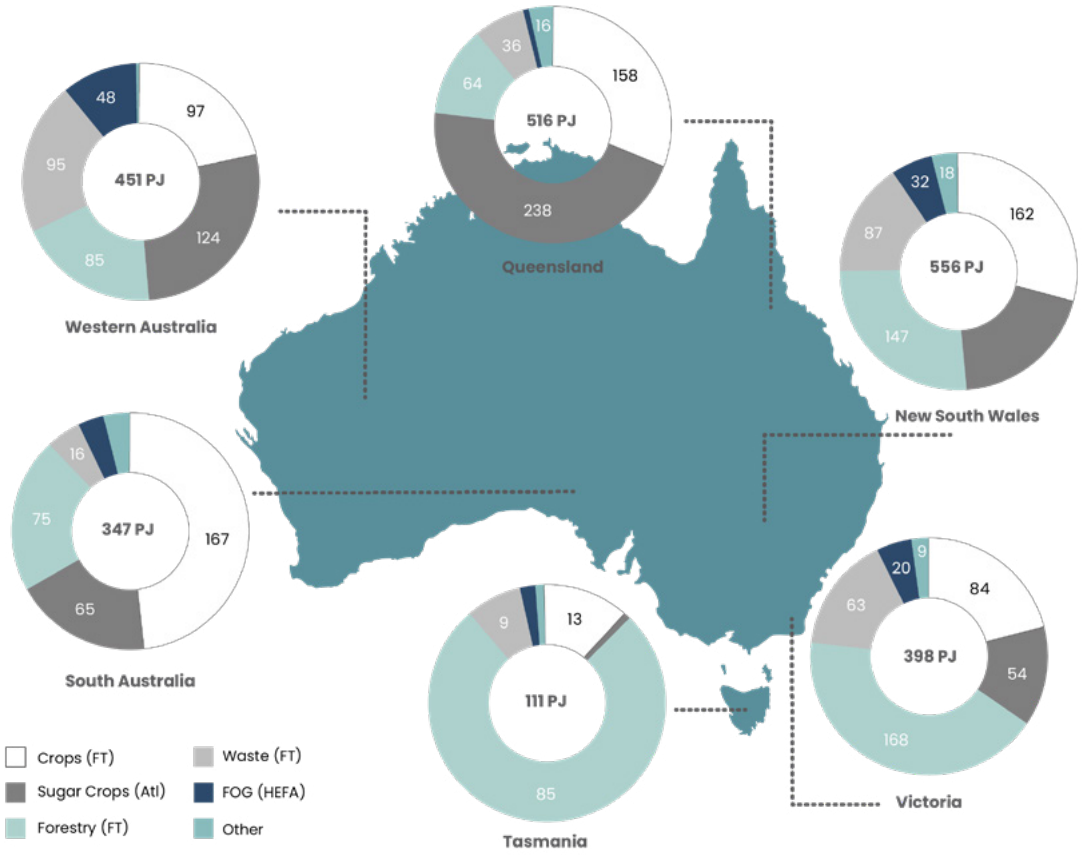
Notable resources (by energy potential) across Australia include sugarcane in Queensland (205.7 PJ); crops (~145 PJ) in New South Wales, Queensland and South Australia; as well as softwood forestry products in NSW (104.5 PJ).

In the short-term, crops present the greatest opportunity as there are limited competing uses and fewer socio-economic and environmental-sustainability obstacles than primary resources such as agricultural and forestry products.

Note: The data provided is sourced from the Australian Biomass for Bioenergy Assessment (ABBA) dataset and ABARES crop datasets. The theoretical data, as shown above does represent the actual available feedstocks for biofuel production as the waste and forestry data from the ABBA dataset is based on calculation estimates while crops in the ABARES datasets have alternatives use cases (e.g. food).

*Crops consists of crop residues, horticulture residues and non-food crop products.

Theoretical resource potential per Australian state (PJ per annum)



Tallow Case Study

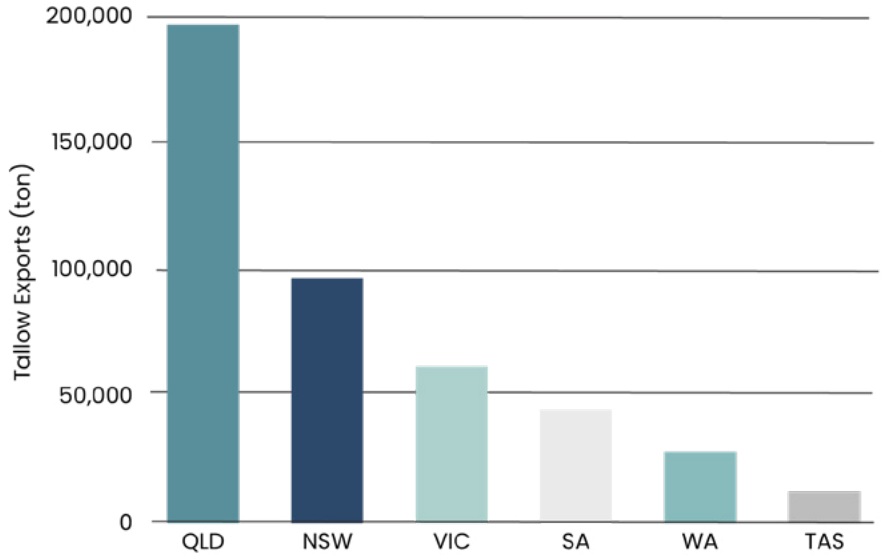
Tallow was historically used in a number of food, cleaning, and cosmetic products. Now its use in biodiesel is more prominent.

Tallow is a by-product of the meat processing industry. It is primarily produced from rendered bovine tissue (beef), but can contain other animal fat as well. Because tallow is derived from advanced beef processing systems, tallow is produced in commercial quantities in only a small number of countries. Brazil, Australia and the US are major tallow producers, collectively accounting for around two-thirds of global tallow supply. There are around 70 renderers in Australia, and 5 major players in the Australian tallow market.

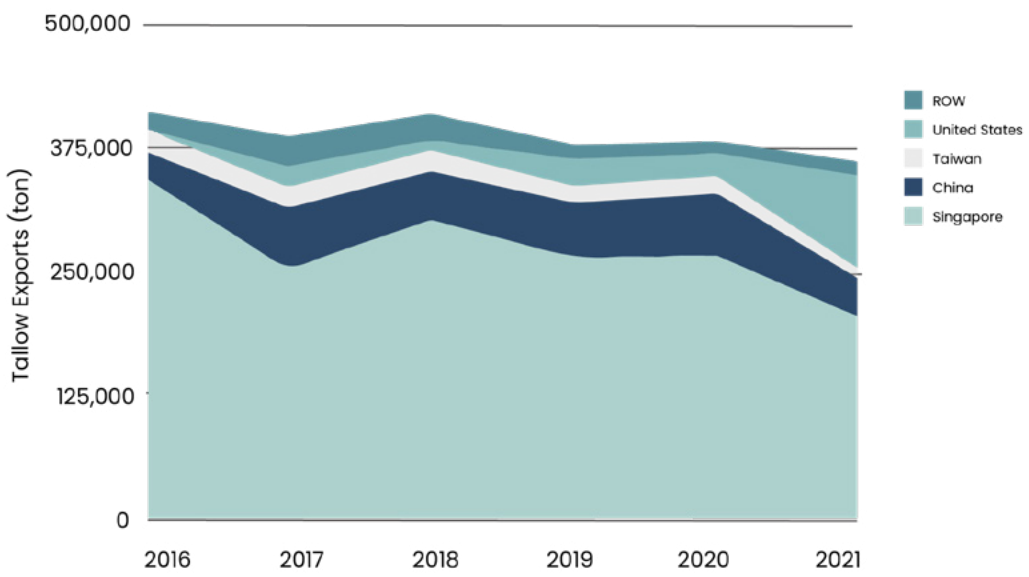
Tallow is predominantly thought of as an input into biodiesel, but the commodity has a wide variety of end markets. In Australia, for example, most tallow is used in the production of animal or aquaculture feed, petfood, intensive animal production, edible applications, and for chemical and industrial applications with only approximately 15% of tallow being used in biodiesel production.[44] This in contrast with countries such as the United States for example where approximately 10% of inedible tallow was used in livestock feed in 2011, and around 55% in biodiesel.

Reflecting the limited growth in global production, global tallow use is estimated to have not materially changed in aggregate over the past two decades. It is likely though that there has been a steady shift in demand from end markets as a result of government policies promoting domestic biodiesel industries. This is reflected in Australian exports of tallow to markets such as Singapore, which has policies in place to support biodiesel production. As seen in the charts below, states such as NSW and Qld are large producers and exporters of tallow, primarily exporting in bulk to Singapore for renewable fuel production.

Annual tallow exports by state of production as of January 2022*



Australian tallow export volumes by destination, annual 2018 to 2021*



* Data is sourced from Deloitte internal knowledge

Canola Case Study

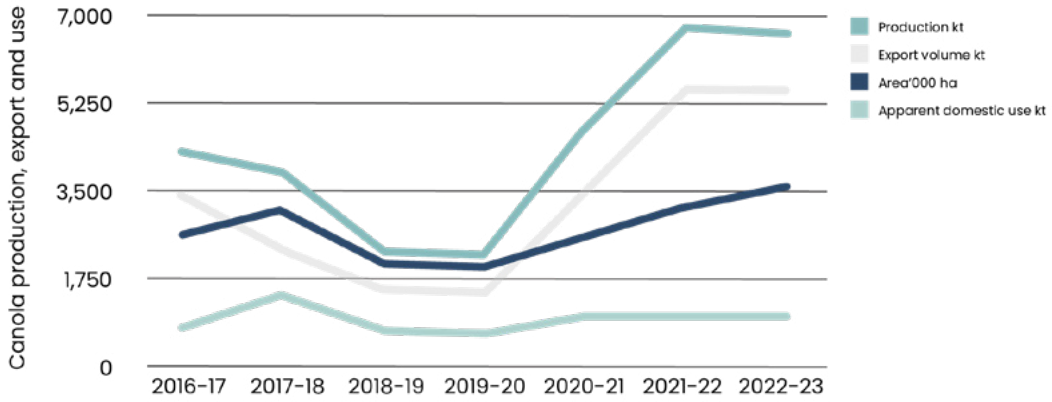
Canola production and export has increased over the recent few years and has an opportunity to play a greater role in the uptake of renewable fuels as a critical feedstock.

Australia is one of the world's few exporters able to supply bulk shipments of non-GM canola to international markets for use across a variety of industries. Oil can be extracted from canola to be used in a range of products including margarines, shortening, and cooking oils.[45] Within the context of the bioenergy industry, canola oil can be used to produce renewable fuels with its excellent performance under cold conditions providing an advantage over alternative vegetable oils.[45] Canola meal, the main by-product of crushed canola, is used as a high-protein feed for intensive livestock, mainly in the pig, poultry and dairy industries.

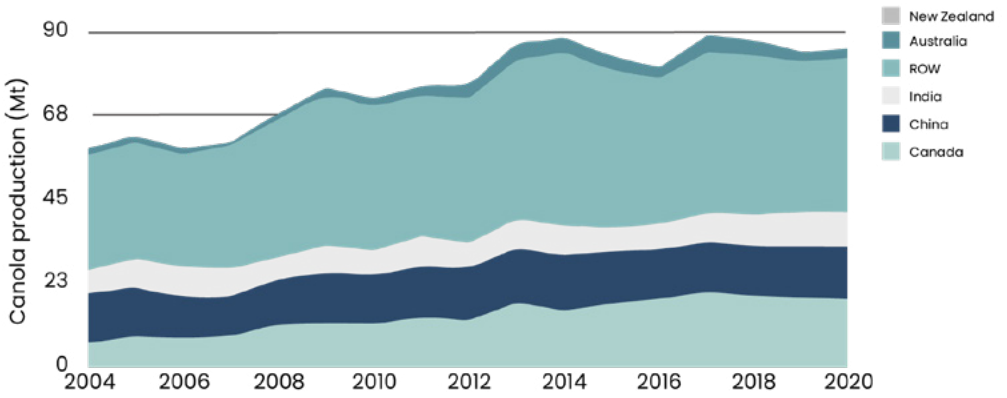
Australia has a moderate-sized canola sector with production reaching a record 6,352 kt or $5.8 billion worth in 2021-22. Canola is primarily grown in Western Australia, NSW, Victoria and South Australia with Queensland and Tasmania yielding smaller amounts. Despite producing lower volumes of canola seed in comparison to countries such as Canada and China as seen in the chart below, Australia remains one of the largest exporters of canola. Geographically, Australia is well placed to supply the export markets of Asia with high-quality canola for oil and meal production in addition to importers of Australian canola having access to both conventional and GM product. The Australian Canola industry has seen large increases in canola export over recent years, increasing export supply from 3.4 Mt in 2020-2021 to over 5.5 Mt in 2021-2022 with exports to Europe, China, Japan, and other international markets annually.[46]

Global demand for canola is expected to increase over the next year due to rising demand for protein meal particularly in China, higher demand for cooking oil, and due to the increase in biodiesel production. In the European Union, rising energy prices are expected to increase the cost of using diesel in the production of biodiesel, driving demand for vegetable oil as a substitute.[47]

Australian canola production, export and use[33]*

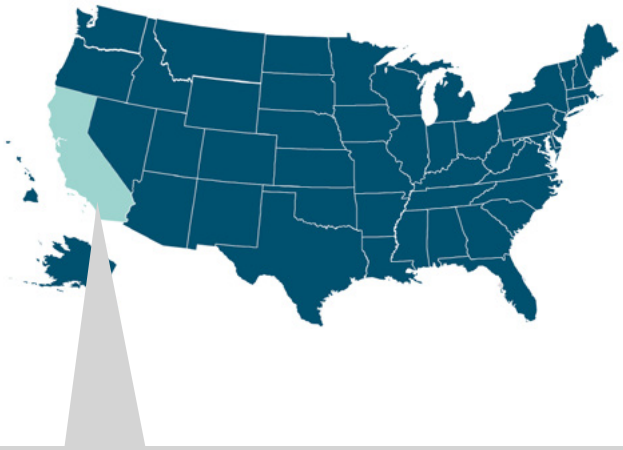


Annual global canola seed production[47]



*2022-2023 Canola production, export and use data is forecasted

Appendix 2
Country Insights
USA



California

California has additional renewable fuels policy beyond those established by the Federal Government, leading the United States. The Low Carbon Fuel Standard (LCFS) establishes an annually declining allowable carbon intensity factor for fuels.[50] Use of low-carbon fuels below the established intensity factor generates credits based upon the use of renewable fuels including ethanol, biodiesel, renewable diesel and alternative jet fuel. The Californian Carbon Allowances (CCA) program also has a carbon-emissions cap-and-trade program which allow for tradeable carbon credits.[51]

With the passage of the Inflation Reduction Act, the United States became a world leader in providing government support to foster renewable fuels adoption.

US Federal Government Action

Within the US, historical adoption of renewable fuels has been driven by the Renewable Fuel Standard, with a required blend into transport fuel of 36 billion gallons in 2022, dominated by the uptake of conventional and cellulosic ethanol.[48] Currently in the US, every gallon of fuel contains a minimum of 10 % renewable fuels which provides fuel to approximately 250 million cars.

The US Inflation Reduction Act (IRA) introduces an array of measures to stimulate the adoption of renewable fuels. Key measures include:[41]

- **Biodiesel Tax Credits: tax credits from US$1.25 - US$1.75 per gallon incentivising the adoption of biodiesel, renewable diesel and alternative fuels, inclusive of second-generation biofuels.**
- **Aviation Fuel Tax Credits: tax credits of US$1.25 - US$1.75 per gallon incentivising the adoption of sustainable aviation fuels. For every percentage of lifecycle emissions reduction below 50%, an additional US$0.01 per gallon is added to the base US$1.25 tax credit.**
- **Clean Fuels Production Tax Credits: tax credit of US$0.2 - US$1 per gallon for clean fuels production.**
- **Biofuels Production Grants: US$500 million fund available for biofuel infrastructure and agriculture product market expansion.**
- **Low-Emission Aviation Grants: US$297 million fund available for alternative fuels and low-emission technology within the aviation sector.**
- **Biofuels Investments: US$15 million as a part of the Clean Air Act.**

The US Federal **Renewable Fuel Standard** requires fuel refiners, blenders, and importers to sell a specified volume of renewable fuels, ramping over time, generating Renewable Identification Numbers (RINs) which can be traded. Volume requirements are regulated by the Environmental Protection Agency, which establishes volume requirements for obligated entities, based upon a percentage of product sales.

US SAF Grand Challenge allots US$4.3 billion in funding to support the development of SAF projects and for fuel producers.[49]

European Union

The European Union is implementing initiatives to legalise the increase in renewable fuel use across member states.

In 2022, the EU consumption of biodiesel and renewable diesel is expected to be 17.61 billion litres, similar to the consumption of 17.611 billion litres in 2021.[60]

As a result of risk indirect land use change (ILUC) rules, palm oil not allowed as a feedstock.

The top consumers in the EU of biodiesel and renewable diesel in 2022 are:[60]

1. France at 3.42 billion litres
2. Spain at 1.94 billion litres
3. Sweden at 1.73 billion litres
4. Italy at 1.38 billion litres
5. Poland at 1.1 billion litres
6. Belgium at 740 million litres

European Union (EU)

Within the EU, fossil fuels are the primary source of fuel in the aviation and maritime sector. However, recently the EU have shifted its focus from fossil fuels to renewable fuels in order to achieve a reduction in greenhouse gas emissions and be climate neutral EU by 2050.

The **EU Fit-for-55** is a set of proposals and updates to EU legislation with the aim of reducing EU emissions by at least 55% by 2030.[52] They have focused on a few key initiatives including:

- **ReFuelEU aviation: the first blending obligation for SAF commencing in 2025. EU airports will be required to provide aviation fuel containing 2% SAF by 2025, growing to 5% by 2030, 32% by 2040 and 63% by 2050. It should be noted power-to-liquid (PtL) synthetic SAF is mandated to comprise 0.7% by 2030, 8% by 2040 and 28% by 2050.[53]**
- **FuelEU maritime: to promote the use of green fuels by the maritime industry with the aim of reducing GHG intensity. The targeted reduction is up to 70% by 2025.[54]**
- **EU energy taxation directive: sets minimum excise duty rates for the taxation of energy products including aviation fuels. Sustainable and alternative fuels have a 0% tax rate to support the transition.[55]**
- **Renewable energy directive: provides a legal framework for the development of renewable energy in the transport sector and had the aim to reduce greenhouse gas emissions by 55% by 2030.[56] However, it has recently been revised (RED II), with the introduction of REPowerEU Plan, to increase the target from 40% to 45% by 2030. The adoption is expected to be finalised by end 2022.[57]**
- **REPowerEU Plan: to domestically generate renewable energy and reducing the need for EU energy imports.[58]**

In June 2022, the European Council entered into negotiations with the European Parliament, known as 'trilogues', in order to adopt the approach to the aviation and maritime initiatives and to legalise it under EU legislations.[59]

Brazil

In 2021, renewable fuels represented 25 % of transport fuels in Brazil and are expected to continue increasing: [62]

- Bioethanol, is the primary renewable fuel used, representing an average of 49% of gasoline and ethanol use, on an energy basis.
- Biodiesel consumption is continuing to grow - to replace diesel in heavy duty vehicles. In 2019, biodiesel represented 9.6% of diesel consumption, on an energy basis.

Currently, 46% of Brazil's total energy supply is made up of renewables with 70% of the supply from biomass. [62]

Brazil has implemented the RenovaBio Program to aid in the decarbonisation of renewable fuels plants.

Brazil has implemented a national biofuels policy known as the **RenovaBio Program**, formalised in 2017. The program aims to support annual carbon intensity reductions in fuels over a 10 year period to support the country's target to reduce their GHG emission by 37% and 43% by 2025 and 2030, respectively.

The renewable fuels included in the program are: [61]

- **ethanol**
- **biodiesel**
- **biomethane**
- **biokerosene**
- **second-generation ethanol.**

The program allows for the trade of decarbonisation credits (CBios), to provide an additional revenue stream for producers. The policy is mandatory for fuel distributers which are required to achieve individually set decarbonisation targets based upon market share. The compulsory target for fuel distributers in 2029 has been set at 10.2 %.[6]

Through to 2020, Brazil has developed **241 renewable fuel plants** which are certified through the RenovaBio Program. The majority of these plants are bioethanol plants, with only 22 biodiesel plants.[6]

The implementation of the RenovaBio Program has created jobs and increased income for the local farming community through renewable fuels production. It is estimated 1.5 million direct and indirect jobs have been created in ethanol production. [62]

Canada

Canada produces a significant amount of ethanol, fulfilling an estimated 61% of the domestic demand for the past eight years with US ethanol supplying the remaining requirement. Canadian ethanol plants produced 1.7 billion litres in 2020 while ethanol fuel consumption was recorded at 2.7 billion litres.[67]

Incentivized by the value of US RINs attached to every gallon of biodiesel that meets mandates under the US RFS and the US biodiesel blenders credit of USD 1 per gallon, Canada continues to export a significant proportion of domestically produced biodiesel to the United States.[67]

Canada is pursuing policy measures which mandate the use of renewable fuels across key sectors of their economy.

The Canadian **Clean Fuel Regulations** require liquid fossil fuel suppliers to reduce the carbon intensity of their gasoline and diesel fuels by approximately 15% below 2016 levels by 2030.63 This GHG emissions reduction requirement will grow from a 3.5 gCO^2e/MJ reduction in 2023 to 14 gCO2e/MJ in 2030. Regulated parties must create or buy credits to comply with reduction requirements.

Other jurisdictional clean fuel standards include:[63]

- **Alberta: 5% renewable alcohol in gasoline and 2% renewable diesel in diesel.**
- **Manitoba: 10% ethanol mandate in gasoline and 5% biodiesel mandate in on- and off-road diesel.**
- **Ontario: 10% renewable content blending in gasoline from 2020, growing to 15% by 2030 and blending of 4% renewable diesel.**
- **Sakatchewan: 7.5% ethanol blend mandate and 2% renewable diesel content.**
- **British Columbia: 5% ethanol content in gasoline and 4% in diesel fuel.**
- **Quebec: 10% low-carbon fuel in gasoline by 2023, growing to 15% by 2030. 3% low-carbon fuel content in diesel, growing to 10% by 2030.**

The Canadian Government has also developed a CAD 1.5 billion **Clean Fuels Fund** to support low-carbon fuels production, inclusive of renewable fuels.[64]

Further to this, Canada has implemented a **pollution pricing system**, comprised of a regulatory charge on fossil fuels and an Output-Based Pricing System (OBPS) for industries. The fuel charge rates vary by jurisdiction with rates reflecting a CAD 50 per tonne of CO^2e in 2022.[65] The OBPS puts a price on emissions for facilities which emit 50,000 tonnes per annum, setting an emissions limit for each facility, requiring facilities to provide compensation for excess emissions.[66]

Other Country Insights

Countries differ globally in the aggressiveness of their policy response to promote the adoption of renewable fuels, with sustainability and broader societal concerns emerging.

Germany

- **As a country within the European Union, Germany is required to adhere to the policies previously outlined.**
- **Germany is pursuing synthetic SAF (PtL) production alongside biological SAF production, seeking to promote the development of both industries. A PtL production target of 2% by 2030 represents a subset of the broader 5% target under EU regulation, 1.3% greater relative to the EU regulation PtL target of 0.7%.[68]**

Sweden

- **As a country within the European Union, Sweden is required to adhere to the policies outlined previously.**
- **Sweden is planning to place an emissions reduction obligation on fuel suppliers to reduce emissions by 28% from petrol and 66% from diesel by 2030 through the blending of renewable fuels.[69]**
- **Sweden has also introduced a SAF mandate, commencing in 2021 at 0.8% of fuel sold, growing to 27% by 2030.[70]**

United Kingdom

- **The Renewable Transport Fuel Obligation (RTFO) in the UK requires fuel suppliers supplying greater than 450,000 litres per annum to supply a percentage of fuels derived from renewable and sustainable sources. The percentage of renewable fuels grows annually and fuel suppliers can meet their obligation beyond using renewable fuels by redeeming Renewable Transport Fuel Certificates.**
- **In the UK, every litre of fuel has a minimum requirement to contain 10 percent of renewable fuels[71] and are now seeking to implement a SAF mandate to comprise 10% of jet fuel by 2030 (approximately 1.5 billion litres).[72] The mandate would work as a greenhouse gas emission reduction scheme, as opposed to a fuel volume scheme, with tradeable certificates. It is anticipated to begin to apply to jet fuel suppliers by 2025, with fuels required to reduce emissions by at least 50% relative to conventional jet fuel. It should be noted that SAF produced via the HEFA pathway will be capped.**

New Zealand

- **New Zealand has enacted the Sustainable Biofuels Obligation which obligates fuel suppliers to reduce the emissions intensity of their fuel supply by an increasing percentage each year from 2023. By 2025 the legislated target has been set for 3.5% GHG reduction, whilst a provisional 2030 target of 5% has been established.[73]**

Australia

In comparison to countries such as the US, UK and Canada, Australia has limited renewable fuel policies and requires more initiatives to upstart the industry.

National Renewable Fuel Related Policies and Initiatives

There are a lack of significant (or direct policies) supporting renewable fuels in Australia at a federal level. However, wider policies supporting renewable energy penetration and emissions reduction can support renewable fuel development, as seen below:

- **Emission Reduction Fund (ERF):[74] A voluntary scheme that provides incentives for the adoption of new practices and technologies to reduce carbon emissions. Participants can earn Australian carbon credit units (ACCUs) for emissions reductions, currently priced at $37 per tonne of CO^2 abated.**
- **National Greenhouse and Energy Reporting (NGER) Scheme:[75] National framework for reporting and disseminating company information about GHG emissions. The Safeguard Mechanism is a component of NGERs and complements it by sending a signal to businesses to avoid increases in emissions beyond BAU levels. It obligates Australia's largest GHG emitters to keep net emissions below their emissions limit (or baseline). It only applies to facilities with direct scope 1 emissions of >100,000 t CO^2-e/year.**
- **ARENA Bioenergy Funding Boost:[76] ARENA has already committed $131 million to 38 bioenergy-related projects in Australia and will be committing an extra $33 million to kickstart the bioenergy industry, co-funding research development and deployment of advanced sustainable aviation and marine renewable fuels.**
- **Clean Energy Finance Corporation (CEFC): Although the CEFC has yet to fund a renewable fuel project, it recognises the potential within the renewable fuel industry, with a report on Biofuels and transport: An Australian opportunity. Additionally, the CEFC has funded waste to energy projects.**
- **Biodiesel import duties:[40] Renewable fuels 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.**

Other State Implemented Policies and Initiatives

Besides Queensland, the NSW government has also implemented renewable fuels mandates (Biofuels Act). The main objective of the policy is to support the development of a renewable fuels industry in NSW. The current blending rate mandate is set at 6% for ethanol and 5% for biodiesel.

Queensland

The Queensland State Government released their Biofutures Roadmap and Action Plan in 2016[77]. The document outlines a vision for a $1 billion sustainable and export-oriented industrial biotechnology and bioproducts sector. At $5m each, separate funds have been established for the Biofutures Industry Development Fund, Commercialisation Fund, and Waste to Biofutures Fund in addition to a $4m Biofutures Acceleration Program. The state government has also introduced renewable fuel mandates to boost the renewable fuel and biomanufacturing industry sector. The biodiesel blend mandate was set at 0.5% while the ethanol blend rate was set at 4%.

Appendix 3
Policy Lever Case Studies

Direct financing and fuel standards are a simplistic approach to renewable fuel funding and have been used in other countries globally, particularly in the US and EU.

Policy Levers	Description	Case Studies
Fuel Carbon Intensity Standards	» Implementation of new low-carbon fuel emission crediting to set flexible minimum volumes and/or carbon intensity of fuels. » Producers/refiners that exceed the minimum volume/carbon intensity are able to sell excess credits to producers/refiners that require credits to meet the minimum volume/carbon intensity. This policy can act as a national framework for the decarbonisation of liquid fuels.	EU - Renewable Energy Directive (RED) II.[78] The overall EU target for Renewable Energy Sources consumption by 2030 has been raised to 32%. RED II sets an EU-wide renewable energy share target of 14% for the transportation sector to be achieved by 2030, with binding targets for advanced biofuels of 3.5% by 2030. GHG emission savings from renewable fuels produced in installations starting operation from 1 Jan 2021 shall be at least 65%. USA - RINS.[79] The EPA uses Renewable Identification Numbers (RINs) to track renewable transportation fuels. The RIN system allows the EPA to monitor compliance with the Renewable Fuel Standard (RFS), a federal program that requires transportation fuels sold in the United States to contain minimum volumes of renewable fuels. California, USA - LCFS[80] The state uses a low carbon fuel standard (LCFS) to provide further focus on carbon emission reduction. The LCFS standards are expressed in terms of the "carbon intensity" (CI) of gasoline and diesel fuel and their respective substitutes.
Capital Grant and Incentives	» Capital grants reduce the risk and upfront investment cost of renewable fuel projects and improve returns to investors. » Governments may choose to run competitive tenders and award funding to most attractive projects. » Typically applied to small-scale projects or projects in demonstration phase.	USA - Biofuel Infrastructure and Agriculture Product Market Expansion (part of Inflation Reduction Act): [40] US$500 million fund available for biofuel infrastructure through to 2031 and agriculture product market expansion. The grant is aimed at increasing the sale and use of agricultural commodity-based fuels. This funding will allow USA to provide additional grants for infrastructure improvements related to blending, storing, supplying and distributing biofuels.

Taxation Treatment	» **Tax incentives, credits and exemptions can reduce the cost of renewable fuel projects.** » **Governments may choose to reduce tax rates or waive certain taxes for equipment that are inputs to renewable fuel projects.** » **Governments may also provide credits or exemptions to offset energy production taxes.** » **Alternatively, a carbon tax can promote investment in low emissions technology.**	**USA - Biodiesel Tax Credits(part of Inflation Reduction Act):[40] Tax credits from US$1.00 - US$1.75 per gallon incentivising the adoption of biodiesel, renewable diesel and alternative fuels, inclusive of second-generation biofuels. Fuel must meet certain emissions standards. Credit-per-gallon base amounts are $0.20 (non-aviation fuel) and $0.35 (aviation fuel). Increases in credit amount to $1.00 per gallon (non-aviation fuel) and $1.75 per gallon (aviation fuel) if wage and apprenticeship requirements are met. Under the credit, the lower a fuel's carbon intensity score, the higher the potential credit.**
Soft loan/loan guarantee	» **Governments may provide low-interest or subordinated loans to facilitate access to private finance and reduce the cost of capital.**	**USA - Advanced Biofuel Production Grants and Loan Guarantees:[81] The Biorefinery Assistance Program (Section 9003) provides loan guarantees for the development, construction, and retrofitting of commercial-scale biorefineries that produce advanced biofuels. The maximum loan guarantee is $250 million and the maximum grant funding is 50% of project costs.**

Other levers also exist but have not been widely implemented yet.

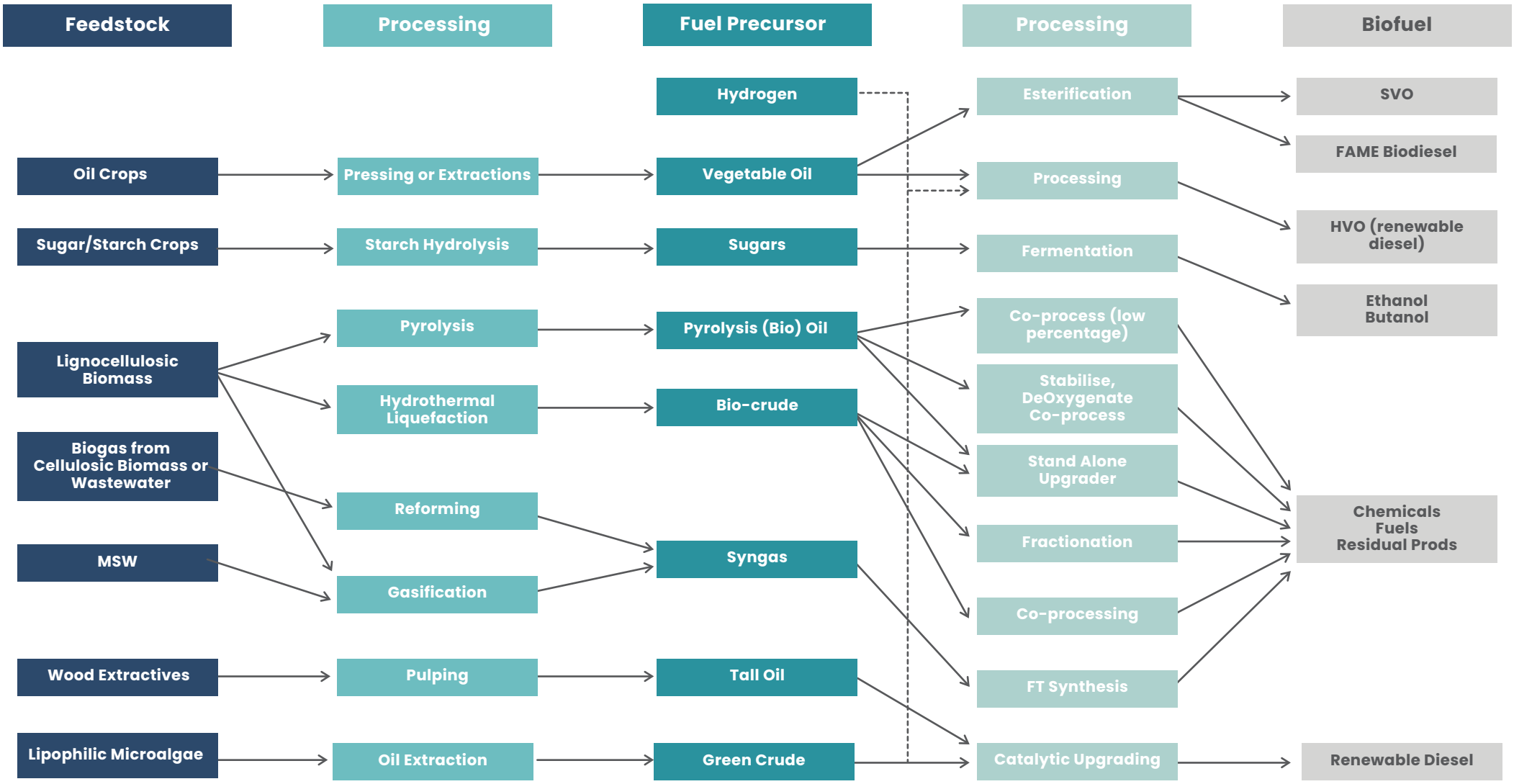
Policy Levers	Description	Case Studies
Contracts for Difference	» Governments fund the difference between the market price and contract price so that renewable fuel project developers are guaranteed a minimum price per unit of renewable fuel produced. » The contract price (or 'strike price') reflects the cost of investing in a particular technology and is usually established through a reverse auction mechanism.	No case study available. CfD policies for electricity generation exist, specifically in the UK.[82] In this policy, CfDs incentivise investment in renewable energy by providing developers of projects with high upfront costs and long lifetimes with direct protection from volatile wholesale prices, and they protect consumers from paying increased support costs when electricity prices are high. Similarly, CfDs can be applied to pay the difference between market value of renewable fuels and an agreed strike-price.[83] Government can set a strike price (i.e., price floor) guaranteed via contract for a set period of time, during which the government would pay the difference between the market value of a finished fuel and the agreed upon strike price. The strike price would be determined for a given project through a competitive reverse auction, wherein interested producers of ultra low-carbon fuels bid to secure the lowest strike price they would be willing to support. A CfD policy for SAF is currently under development and may be formally proposed in the UK in the future.
Waste levies/Bans	» Levies for waste disposal can incentivise alternative utilisation of waste, including as a potential feedstock for renewable fuel production. » Jurisdictions may choose to ban organic waste disposal in landfill.	NSW, SA, WA, Qld and Victoria have existing waste levies. NSW has the highest levies with a metropolitan levy rate of AUD 143.60 per tonne and AUD 82.70 as their regional levy rate.[84] UK - Landfill tax.[85] The tax is set at a rate of AUD 180.26 per tonne with a steady increase over recent years. Tax exemptions are set for certain waste streams such as hazardous waste, biofuels or animal-by-products among others.
Strategy/Roadmap	» Establishing a strategic direction for renewable fuels industry including technology roadmaps. Accompanied by an action plan for policy implementation and R and D.	Australia has launched a Bioenergy Roadmap. The report sets out a vision for a sustainable bioenergy industry that delivers lower emissions, regional growth, energy resilience and waste management benefits for Australia. A more specific renewable fuel strategy or roadmap could also be developed. This could provide further clarity into the level of contribution into the renewable fuel industry and provide a pathway into achieving Australia's renewable fuel ambitions.

Appendix 4
Multi-Criteria Analysis (MCA) Results

Objectives And Criteria	Weight	Taxation Treatment	Fuel Carbon Intensity Standards	Capital Grants and Incentives	Soft loan/loan guarantee	Contract for difference
Ease of implementation	**30%**	**90**	**75**	**90**	**90**	**45**
Criterion 1: Degree of support across communities/ consumer and industry.	15%	3	3	3	3	2
Criterion 2: Simplicity of policy adoption by consumer and industry.	15%	3	2	3	3	1
Potential timeline	**30%**	**90**	**75**	**90**	**75**	**60**
Criterion 3: Time period for policy implementation at state, territory and federal government level.	15%	3	2	3	3	1
Criterion 4: Time period for renewable fuel production uplift.	15%	3	3	3	2	3
Existing strategic support / support mechanisms	**20%**	**40**	**60**	**20**	**20**	**60**
Criterion 5: Presence of similar support mechanisms	20%	2	3	1	1	3
Level of actual reduction in traditional fuel consumption or increase in renewable fuel production	**20%**	**60**	**60**	**60**	**40**	**60**
Criterion 6:Approximate impact on fuel uptake and production	20%	3	3	3	2	3
Total	**100%**	**280**	**270**	**260**	**225**	**225**

Notes: Weightings of assessment criteria were determined in consultation with Bioenergy Australia. The colour scale reflects the relative contribution of each assessment criteria to the end score, highlighting a strong contribution in green, moderate contribution in yellow and a low contribution in red.

Appendix 5
Technology Pathways



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This report was written by

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