Brisbane Renewable Fuels Project

Market Context and Interim Report

Ampol Australia Petroleum Pty Ltd

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The views expressed herein are not necessarily the views of the Australian Government, and the Australian Government does not accept responsibility for any information or advice contained herein.

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ABBREVIATIONS

Term	Full name
AtJ	Alcohol-to-Jet
BRF	Brisbane Renewable Fuels
CI	Carbon intensity
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
FT	Fischer-Tropsch
GHG	Greenhouse gas
HEFA	Hydroprocessed Esters and Fatty Acids
ICAO	International Civil Aviation Organization
LCA	Life cycle assessment
LCLF	Low Carbon Liquid Fuels
PtL	Power-to-Liquid
RED II	Renewable Energy Directive
RD	Renewable diesel
SAF	Sustainable Aviation Fuel
UCO	Used cooking oil

1. Executive Summary

Ampol is exploring the development of a Low-Carbon Liquid Fuels (LCLF) plant at its Lytton refinery, known as Brisbane Renewable Fuels (BRF). The proposed plant will focus primarily on producing sustainable aviation fuel (SAF), with a smaller output of renewable diesel (RD), both derived from waste and purpose-grown renewable biomass sources such as used vegetable oil, animal fats (tallow), and oilseed crops. As drop-in alternatives to conventional fuels, SAF can help reduce hard-to-abate carbon emissions in aviation, while RD offers similar benefits across other transport sectors. With established aviation fuel and diesel markets nearby, BRF is well-positioned to supply its output locally. The hydroprocessed esters and fatty acids (HEFA) facility will have a SAF production capacity of at least 450ML per annum (~405ML SAF, ~45ML RD), representing approximately 4% of the national and 20% of Queensland's estimated 2024 aviation fuel market. Ampol's choice of technology and feedstocks enables domestic sourcing of production inputs, ensuring local supply security for these critical low-carbon fuels.

This report provides an assessment of the current market conditions for LCLFs, both domestically and internationally. Furthermore, the report provides a current status of the BRF Project as it progresses through design/engineering phases, into construction and operation. Key highlights from the report include:

- **Market Demand vs. Production Potential**: SAF production in 2024 was 1.25 billion litres globally, yet it only accounted for **0.3% of global jet fuel use**, highlighting significant growth potential. If Australia replaces **60% of aviation fuel with SAF by 2050**, demand could reach **9 billion litres annually**.
- **Feedstock Availability**: Australia has **sufficient feedstock potential to produce up to 14 billion litres of SAF by 2050**, valued at approximately **$19 billion**. However, most domestic feedstocks (e.g., **70% of canola, 80%+ of tallow, and used cooking oil**) are currently exported for refining overseas.
- **SAF Industry Growth**: Government policies and airline commitments (e.g., **Qantas' 10% SAF target by 2030**, equivalent to **600 million litres per year**) are driving demand. An **Australian SAF industry could create up to 15,600 jobs by 2050**.

Key Stats from the BRF Project

- Production Estimates:
    - **At least 405 million litres per annum (MLpa) of SAF** (90%)

  - **At least 45 MLpa of renewable diesel (RD)** (10%)
- Market Impact:
  - BRF's **SAF production will cover ~4% of 2024 national aviation fuel demand** and **~20% of Queensland's aviation fuel market**.
- Estimated Emission Reduction:
  - SAF is estimated to contribute **65% of aviation's required emissions reductions by 2050**.
  - RD and other LCLFs will reduce carbon emissions in hard-to-abate sectors like heavy transport and mining.
- Estimated Commissioning:
  - The BRF Facility is expected to be **operational by 2029**, subject to passing key project decision gates including Final Investment Decision (FID).

Key Lessons Learnt

- Need for Policy Support: **Strong government incentives and mandates are crucial to accelerating domestic SAF production**, as most Australian feedstocks are currently exported due to more favourable policies overseas.
- **Industry Collaboration Is Key**: Airline commitments (e.g., Qantas & Airbus' **$200 million SAF investment**) demonstrate the importance of early market development.
- **Feedstock Security Matters**: Despite abundant resources, **securing local feedstock supply chains** is vital to developing a sustainable domestic SAF industry.
- **Drop-in Fuels Are a Viable Decarbonisation Solution**: SAF and RD can integrate seamlessly with existing infrastructure, making them an immediate and practical alternative to fossil fuels.
- **Market Growth Potential**: SAF demand is set to rise significantly, and **early investment in local production will determine Australia's competitiveness in the global market**.

2. Market and Opportunity Overview

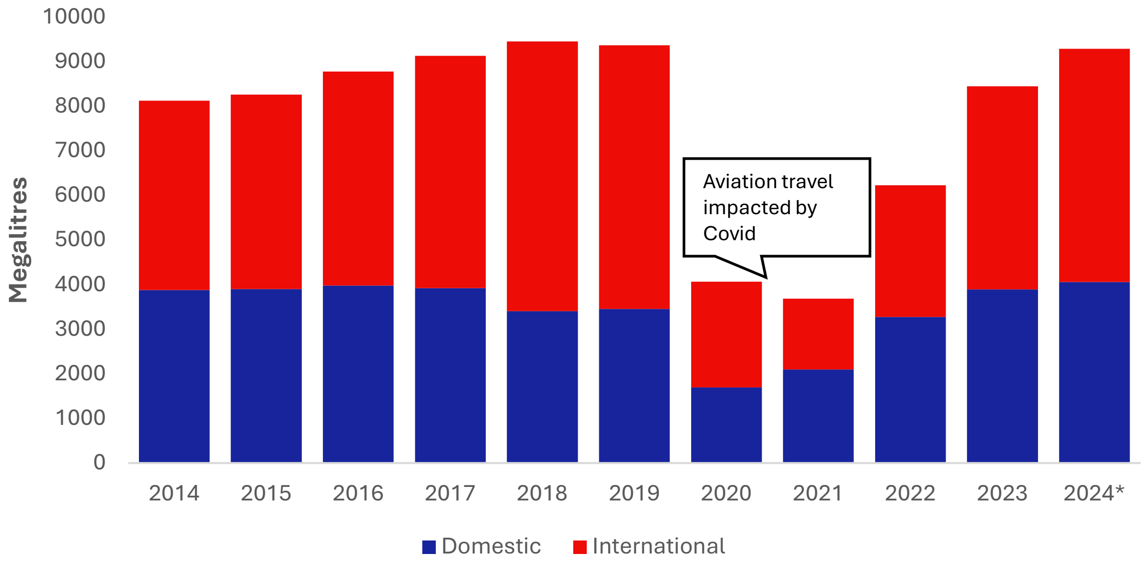
i. Aviation fuel market size

The aviation fuel market in Australia is determined by annual aviation fuel sales to airlines.

Aviation fuel sales

Approximately 8.4 billion litres of aviation fuel were sold in Australia per year over the past 10 years, with estimated sales for 2024 (based on Jan-Nov data) at 9.3 billion litres[1]. From 2014, the market increased by an average of 2.9% year on year, until 2020, when the impact of COVID-19 led to a 95% decrease in international and domestic passenger flights in the period from January to April 2020.[2] In 2024, Australia's domestic airline industry returned to more typical seasonal levels, with Australian Petroleum Statistics indicating a return to pre-COVID levels in that year.

Figure 1 Market Size of Aviation Fuel[7]



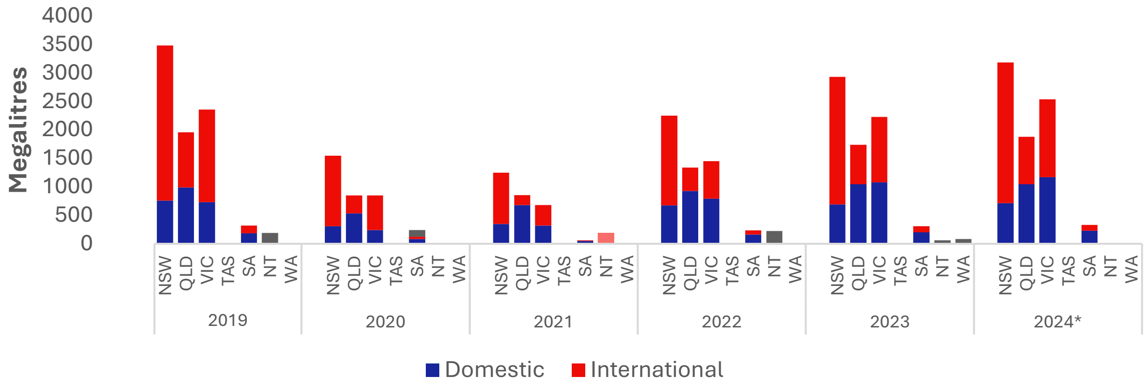
Notes: *Australian Petroleum Statistics 2024 contains data up to November 2024. Domestic and International figures are calculated based on the average sales from the provided 11 months of data.

[1] Australian Petroleum Statistics 2024, https://www.energy.gov.au/publications/australian-petroleum-statistics-2024
[2] https://www.anao.gov.au/work/performance-audit/covid-19-support-to-the-aviation-sector

Current aviation fuel market in Australia

Of the estimated 9 billion litres of aviation turbine fuel in 2024[3]approximately 43% (3.7 billion litres) was attributed to domestic flights. Domestic demand is concentrated and primarily driven by major airlines such as Qantas Group (comprising Qantas and Jetstar) with approximately 62% of market share, and Virgin Australia with approximately 31% of market share. [4]

Figure 2 Market size of Aviation fuel by state[5]



Notes: *Australian Petroleum Statistics 2024 contains data up to November 2024. Domestic and International figures are calculated based on the average sales from the provided 11 months of data. ~Total are volumes provided without allocation to domestic or international flights.

NSW, VIC and QLD make up the majority of the Australian aviation fuel market, with approximately 35% (3.2BLpa), 30% (2.5BLpa) and 20% (1.9BLpa) of market share respectively.[6]

Australia's national aviation fuel demand is projected to increase significantly by 2050, driven by factors such as new airport developments, expansions of existing facilities, and population growth. Specifically, forecasts indicate a 75% increase in Australian jet fuel demand by 2050[6].

The opening of Western Sydney International (WSI) Airport in 2026 is expected to contribute notably to this growth. Projections suggest that WSI's jet fuel demand will reach approximately 570 million litres per annum by 2031 and exceed 2.5 billion litres per annum by 2050[7].

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[3] Jan – Nov 2024 statistics retrieved from https://www.energy.gov.au/publications/australian-petroleum-statistics-2024 Dec 2024 estimated based on average monthly sale figures
[4] https://www.accc.gov.au/system/files/domestic-airline-competition-in-australia-may-2024-report.pdf
[5] Australian Petroleum Statistics 2024, https://www.energy.gov.au/publications/australian-petroleum-statistics-2024
[6] Sustainable Aviation Fuel State of Play 2024, https://www.boeing.com.au/content/dam/boeing/en-au/pdf/boeing-and-csiro-saf-state-of-play-report-2024.pdf
[7] Review of Aviation Fuel Supply Options 2023, https://wsiairport.com.au/sites/default/files/2023-05/WSI%20Review%20of%20Aviation%20Fuel%20Supply%20Options%202023.pdf

ii. LCLF demand

This report focuses on advanced LCLFs, specifically SAF and RD, which are proposed to be produced at the BRF facility. SAF and RD offer a mid-term solution for reducing carbon emissions in industries that are considered hard-to-abate, challenging to electrify, and require alternative approaches to decarbonization. As drop-in fuels, they can seamlessly replace conventional aviation fuel and diesel without requiring modifications to existing aircraft, vehicles, or fuel supply chains. Additionally, SAF and RD play a critical role in helping Australia meet its greenhouse gas emissions targets, enhance energy security, and support economic growth.[8]

Australia's LCLF industry is rapidly gaining momentum, particularly in advanced biofuels such as SAF and RD. Recognizing their strategic importance, the Australian Government has identified LCLF as a priority under its *Future Made in Australia* agenda. This initiative aims to foster the growth of new industries by leveraging Australia's comparative advantages, strengthening domestic capabilities, and advancing sectors critical to the nation's economic and environmental interests.[9]

Global LCLF demand

The global demand for LCLF is experiencing rapid growth, driven by increasing pressure to reduce carbon emissions, reduce carbon emissions in hard-to-abate sectors such as transportation, and achieve emission reduction and net-zero commitments.

This growth has generally been underpinned by government policy in various jurisdictions to stimulate the production and uptake of these fuels in order to establish an industry today that can grow over the long term alongside increasing efforts to reduce emissions. Hard-to-abate sectors such as transportation will continue to drive long-term global growth in demand for LCLF, pushing diversification in feedstock production and manufacturing technology.

Australian LCLF demand

Liquid fuels account for approximately 40% of Australia's total energy demand, with the transport industry accounting for 70% of Australia's refined liquid fuel demand.[10] As a result, Australia's demand for LCLF is projected to grow, driven by the need to reduce carbon emissions in hard-to-abate sectors such as medium-long distance aviation, heavy road and domestic maritime transport, mining, agriculture and construction where

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[8] https://www.dcceew.gov.au/climate-change/publications/australias-emissions-projections-2023#:~:text=As%20reflected%20in%20Australia's%20Nationally,emissions%20budget%20from%202021%2D2030.

[9] https://www.infrastructure.gov.au/sites/default/files/documents/low-carbon-liquid-fuels-consultation-paper.pdf

[10] Australian Energy Update 2024 https://www.energy.gov.au/sites/default/files/2024-08/australian_energy_update_2024.pdf

electrification, and in some cases renewable hydrogen, cannot be used due to energy and technology requirements.

These sectors (excluding international aviation) are expected to account for nearly 20% of Australia's emissions by 2030 and will likely continue relying on liquid fuels, particularly aviation fuel and diesel, through 2050. With the majority of Australia's aviation market concentrated on the east coast, BRF production outputs have a strategic advantage due to their geographical proximity, presenting potential priority placement opportunities[11].

SAF and RD are currently the most viable approach to abatement in the aviation industry and some heavy transport applications respectively, where performance requirements are high and few alternative commercially viable emissions abatement options are likely to emerge in the medium term over the next 15 years.[12]

Australia has significant potential to expand its LCLF industry and capability due to its abundant agricultural resources, existing farming practices, waste feedstocks, and access to renewable energy.

A domestic LCLF industry will be key to reducing carbon emissions from Australia's liquid fuel demand, whilst supporting industry growth and job creation, particularly in regional areas, while increasing Australia's energy security. The proposed BRF would support Australia to develop a domestic LCLF industry, with a capacity to produce at least 405 ML of SAF and 45 ML of RD per year by 2029.[13]

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[11] Jan – Nov 2024 statistics retrieved from https://www.energy.gov.au/publications/australian-petroleum-statistics-2024 Dec 2024 estimated based on average monthly sale figures

[12] https://www.infrastructure.gov.au/sites/default/files/documents/low-carbon-liquid-fuels-consultation-paper.pdf

[13] https://arena.gov.au/projects/ampol-brisbane-renewable-fuels-pre-feed-study/

iii. SAF and domestic opportunity

SAF provides a significant opportunity for Australia to lower emissions of the aviation industry, which currently contributes approximately 2.5% of global emissions.[14] As a 'drop-in' solution, SAF can be blended with traditional fuel and used in service immediately without significant alterations to existing engines and supporting refuelling infrastructure. On a global scale, the International Air Transport Association (IATA) estimates SAF could contribute around 65% of the emissions reduction required by aviation to reach net zero in 2050.[15]

Global trends

SAF is becoming increasingly important in meeting goals to lower carbon emissions and the market is expected to see substantial growth over the next 25 years as countries strive to reach 2030 and 2050 ambitions. In 2024, 1.25 billion litres of SAF were produced and 160 SAF projects could be online before 2030[16]. Despite an increase in global uptake, SAF production only represented 0.3% of global jet fuel use in 2024[17], highlighting the magnitude of potential future SAF demand in the long term and the associated pipeline of production opportunities.

Domestic opportunity

Momentum for a domestic SAF industry has grown significantly in the past year, supported by Federal Government measures to progress development in LCLF production and further industry investments.

Demand for SAF

Demand for SAF is being driven by voluntary commitments from major domestic airlines such as Qantas, which has pledged to using 10% SAF in its overall fuel mix by 2030 (approximately 600 million litres of unblended SAF per year) and around 60% by 2050[18] , and Virgin Australia's announcement of its net zero goals by 2050. Additionally, several industry initiatives are also helping to advance the SAF industry, including the agreement between Qantas and Airbus to invest up to US$200 million to accelerate the establishment of an Australian SAF industry and Virgin Australia's successful SAF trial supplied by Ampol through Brisbane Airport's jet fuel supply infrastructure.

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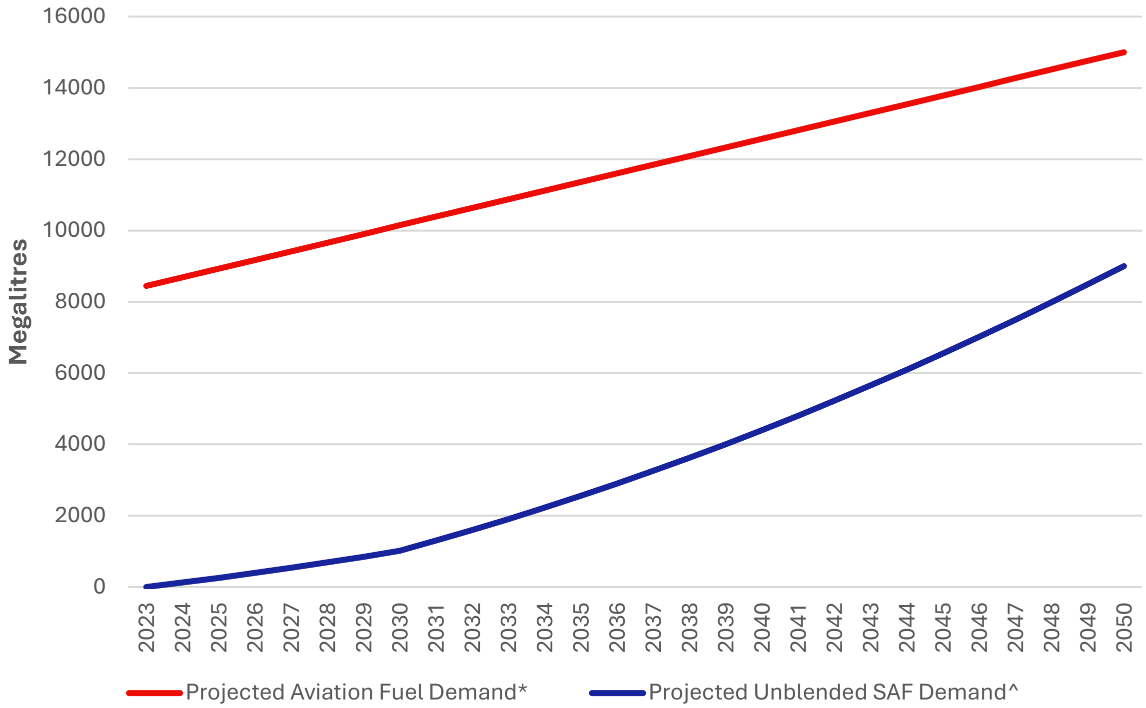
[14] https://www.iea.org/energy-system/transport/aviation#:~:text=In%202023%2C%20aviation%20accounted%20for,pre%2DCovid%2D19%20levels.
[15] https://www.iata.org/en/iata-repository/pressroom/fact-sheets/fact-sheet-sustainable-aviation-fuels/
[16] https://www.iata.org/en/pressroom/2024-releases/2024-12-10-03
[17] https://www.iata.org/en/iata-repository/pressroom/fact-sheets/fact-sheet-sustainable-aviation-fuels/
[18] https://www.qantas.com/au/en/qantas-group/sustainability/our-planet/sustainable-aviation-fuel.html

In Australia, demand for jet fuel is projected to increase by 75% from 2023 to 2050.[19] As aviation fuel demand continues to increase, it is essential to increase the uptake of SAF to lower emissions in the aviation sector, which currently contributes around 2% of domestic greenhouse gas emissions.[20]

Figure 3 Projected Aviation Fuel and Unblended SAF Demand for 2023 to 2050



Notes: *Projected Aviation Fuel Demand has been applied linearly in line with expected increase of 75% from 2030 to 2050. ^Projected Unblended SAF Demand has been calculated based on linear increase of % use of SAF to meet industry-typical targets of 10% in 2030 and 60% in 2050.

SAF is an evolving segment within the aviation fuel market both globally and in Australia. In a scenario where approximately 60% of aviation fuels were replaced by SAF in 2050, Ampol estimates Australian SAF demand could reach 9BL by this time. See next section for further details on the SAF market and domestic opportunity.

Supply opportunities

Australia has a diverse portfolio of domestic feedstocks and existing advantages in farming practices with the potential to support a significant domestic SAF industry. Currently, the majority of domestic feedstocks are being exported for refining into LCLF overseas due to supportive investments, and government incentives and mandates.

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[19] https://www.csiro.au/en/news/all/articles/2023/august/sustainable-aviation-industry-australia
[20] https://www.infrastructure.gov.au/sites/default/files/documents/awp0aviation-white-paper.pdf

Notably, approximately 70% of Australian grown canola and more than 80% of tallow and used cooking oil (UCO) are exported for processing into LCLF.[21] Establishing a LCLF industry could expand the domestic market for growers and feedstock producers in Australia and have flow-on benefits to regional communities and economy.

According to the CSIRO-Boeing SAF Roadmap released in 2023, Australia could have enough feedstock to produce up to 14 billion litres of SAF by 2050 with an estimated production value of $19 billion.[22]

Several benefits are associated with Australia building out its local SAF production industry. With the necessary investments and policy support to establish its refining capacity, Australia could gain economic benefits such as regional job creation opportunities, predominantly supporting feedstock production and collection and leveraging Australian agricultural expertise to develop lower carbon feedstocks over time. Estimates have indicated that an Australian SAF industry could create up to 15,600 jobs by 2050.[23] SAF processing also creates several renewable by-products, including other LCLF and chemical feedstocks, and some production pathways utilise waste streams from other industries, both highlighting the overall emissions reduction impact of a local supply chain. A localised industry will allow supply to both domestic airlines and neighbouring countries with lower emission aviation fuels. A sovereign capability also provides Australia full control over its supply chains, mitigating risk and protecting the country, to some extent, from international supply chain disruptions.

[21] https://www.infrastructure.gov.au/sites/default/files/documents/agp2023-submission-c198-graincorp.pdf
[22] https://www.csiro.au/safroadmap
[23] https://www.statedevelopment.qld.gov.au/news-and-events/fuelling-the-future-queenslands-sustainable-aviation-revolution#:~:text=Queensland%20is%20internationally%20recognised%20as,such%20as%20pongamia%20and%20carinata.

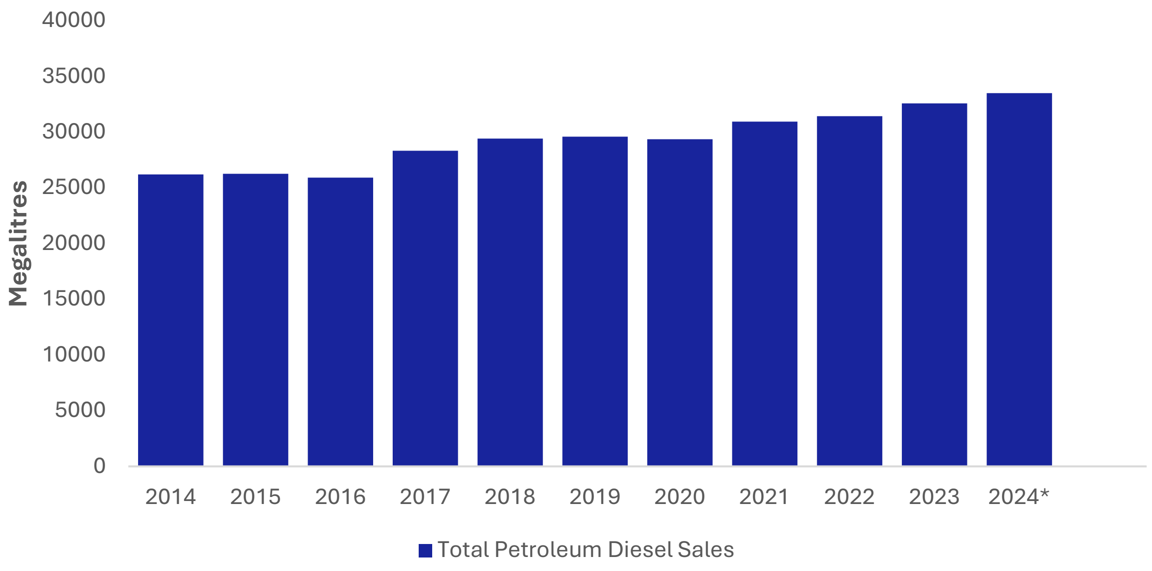
iv. Opportunity for other low carbon liquid fuels

LCLF can be produced by different methods and using different feedstocks, such as waste materials, biomass, or combining hydrogen with captured carbon dioxide. Other than SAF, LCLF can include RD, renewable naphtha and renewable LPG. In line with the benefits already described for SAF, key benefits of LCLF are their ability to be used as a drop-in fuel in place of petroleum-based hydrocarbons and their compatibility with existing infrastructure, which simplify their storage and distribution requirements and reduce the potential investment costs.

Current petroleum diesel market in Australia

From 2014 to 2024, Australian diesel sales averaged 29.2 billion litres per year, with approximately 30.7 billion litres sold in 2024.[24] Diesel is currently Australia's most important and versatile fuel, where it is used for emergency services, enabling the transport of food, equipment and medicines, and as backup fuel for electricity generation for critical services such as hospitals, water and sanitation.[25]

Figure 4 Market size of Australian petroleum diesel [26]



Notes: *Australian Petroleum Statistics 2024 contains data up to November 2024. 2024 figure is calculated based on the average sales from the provided 11 months of data.

QLD, WA and NSW make up the majority of the Australian petroleum diesel market, with approximately 26% (9.5 BL), 24% (8.6 BL) and 23% (8.2 BL) of market share respectively.

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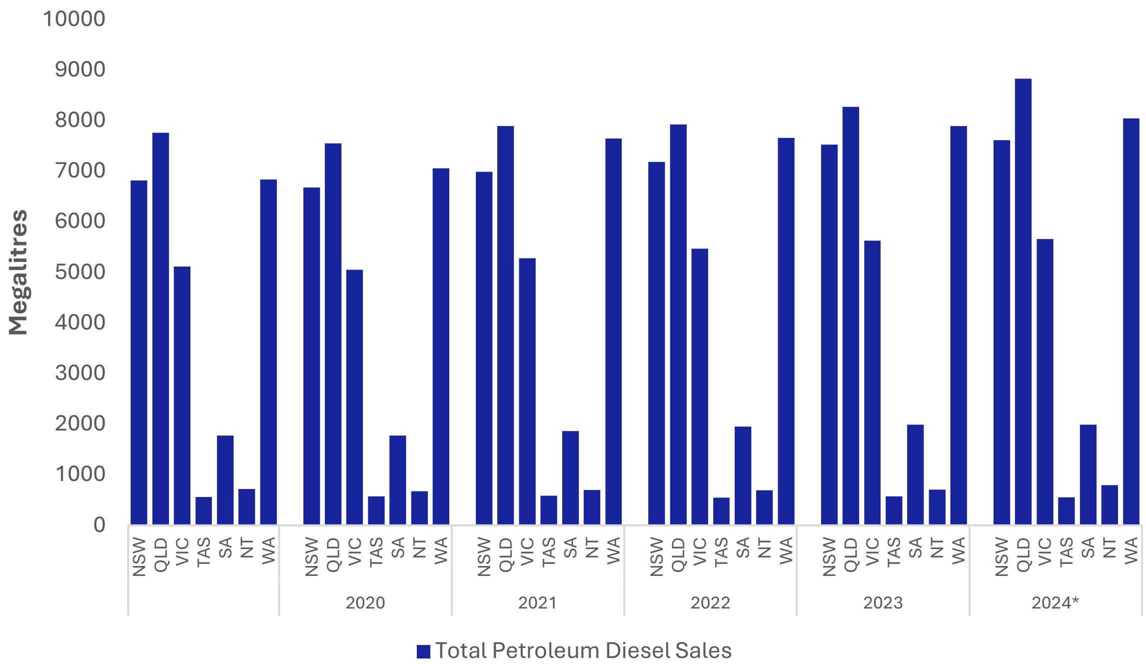
[24] Australian Petroleum Statistics 2024, https://www.energy.gov.au/publications/australian-petroleum-statistics-2024, Average calculated from totals, 2024 value approximated by adding December value based on average sales data in 2024

[25] https://www.dcceew.gov.au/energy/security/australias-fuel-security

[26] Australian Petroleum Statistics 2024, https://www.energy.gov.au/publications/australian-petroleum-statistics-2024

Figure 5 Market size of petroleum diesel by state



Notes: *Australian Petroleum Statistics 2024 contains data up to November 2024. 2024 figures are calculated based on the average sales from the provided 11 months of data.

Australia's advantages for LCLF

Australia is well-positioned to become a leading producer of LCLF due to its endowment in natural resources and other advantages that could support a competitive LCLF market. Australia's vast landmass and suitable climate conditions support extensive agricultural activities, providing abundant biomass and feedstocks necessary for fuel production. Further, Australia is already a producer of feedstocks for LCLF, exporting approximately 400 kt of tallow to the US/Asia and 3.4 Mt of canola seed to Europe in 2022[27]. These advantages, combined with established supply chains and advanced farming practices, position Australia to develop a domestic LCLF industry that could contribute to wider carbon emission reduction efforts.

Renewable Diesel

RD, for heavy vehicle road use, is the LCLF where production has been most focused towards to date and where Ampol has been focussing, alongside SAF since the launch of the BRF project development. RD is a liquid hydrocarbon fuel derived from non-fossil sources and designed as a drop-in fuel for most modern diesel engines. Globally, production of RD accounted for more than 82% of total LCLF production in 2023.[28]

[27] https://www.infrastructure.gov.au/sites/default/files/documents/low-carbon-liquid-fuels-consultation-paper.pdf
[28] https://www.infrastructure.gov.au/sites/default/files/documents/low-carbon-liquid-fuels-consultation-paper.pdf

Ampol is considering the production of RD alongside SAF and is actively supplying imported RD to demonstrate the usability and traceability aspects to the domestic market ahead of any larger scale production. In September 2023, Ampol announced an RD demonstration with Hanson, a leader in building and construction materials, as its first RD customer partner[29], and in December 2024 announced it would supply 100% RD (HVO100) to Volvo Group Australia's Wacol (QLD) truck production facility for first fill of new trucks.[30] Activities such as this contribute materially to the development of a LCLF industry in Australia.

Other LCLF

The global market for LCLF is expanding and production has increased in other types of hydrocarbons, particularly HEFA by-products including naphtha and LPG which carry similar life cycle carbon emissions reduction benefits as SAF and RD. As such, a SAF industry can also provide further carbon emissions reduction benefits in other sectors. As part of the BRF project, Ampol is also exploring the potential to supply these by-products to their respective end markets for which there are also a lack of drop-in alternatives.

v. Barriers to the deployment of SAF

The Australian SAF industry is at an early stage of development, with no SAF projects yet to reach Final Investment Decision (FID) to date, due to several barriers related to cost, demand and feedstock supply which are discussed in Table 1 below.

Early mover projects such as BRF can facilitate the development of the Australian SAF industry, supported by government funding to mitigate some of the key barriers by establishing foundational market practices, technologies and partnerships to drive broader adoption.

[29] https://www.ampol.com.au/about-ampol/news-and-media/ampol-and-hanson-to-conduct-renewable-diesel-trial#:~:text=The%20trial%20will%20allow%20Ampol,to%20its%20Ampol%20Amplify%20additives.

[30] https://www.volvotrucks.com.au/en-au/news/press-releases/2024/nov/volvo-group-australia-announces-hvo-100-factory-first-fill.html

Table 1 Barriers to deployment and potential mitigants

Barrier to Deployment		Potential Mitigants
Barrier	**Description**	
High production costs	• SAF is currently estimated to be 2-5 times more expensive than conventional jet fuel.[31] • Costs are driven by feedstock costs, additional processing and a lack of economies of scale (for early technologies) within the SAF market. • More generally, new production facilities are expensive to build, and these costs must be recovered in order to generate a viable investment case.	• A focus on mature technology allows for scaled up production to establish a functioning SAF market which emerging technologies can capitalise on in time. • Utilising local feedstocks can minimise transportation and import costs, whilst reducing reliability on global supply chains, support energy security supply. As further discussed in Section 6, Ampol is exploring the use of local feedstocks such as tallow, UCO, canola as well as monitoring development in potential future feedstocks such as pongamia, carinata and camelina.
Competition for feedstock	• Australia has significant potential to support a diversified portfolio of feedstocks (including tallow, canola, sugarcane, sorghum, and wheat) for SAF production, however, currently most feedstock supplies are exported Asian and European markets for biofuel production[32], e.g. c.80% of Australian tallow is exported overseas predominantly to US and Singaporean markets.[33] Similarly, canola is often exported to European markets.[34] • The associated transport cost and capability to source and aggregate	• Australia produces an exportable surplus of canola, where over 70% is currently exported to European markets for LCLF processing.[35] The development of a domestic SAF production industry including domestic crushing facilities could provide diversification for farmers and spur developments in local, low carbon novel feedstocks to increase feedstock supply over the long term. • Ampol has conducted analysis into the availability of

[31] https://www.statedevelopment.qld.gov.au/__data/assets/pdf_file/0025/85480/SAF-sust-aviation-fuel-report-summary.pdf
[32]https://www.infrastructure.gov.au/sites/default/files/documents/agp2023-submission-c198-graincorp.pdf
https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Biofuels%20Annual_Canberra_Australia_AS2022-0029.pdf
[33]https://www.abc.net.au/news/rural/2024-02-04/tallow-exports-have-exceeded-one-billion-dollars/103408312
[34]https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Biofuels%20Annual_Canberra_Australia_AS2022-0029.pdf

	solid biomass materials such as Municipal Solid Waste (MSW) or agricultural residues as a feedstock can lead to higher production costs.	domestic feedstock for use in potential LCLF projects at the Lytton refinery *(see Section 6 for further information)*. • Ampol has also entered into a MOU with GrainCorp to explore the supply of domestic feedstocks, including additional crushing capacity to supply canola oil, to BRF.[36] • Continued research and development into future potential SAF feedstocks such as pongamia, carinata and camelina can also support a diversified portfolio of domestic low carbon feedstocks and ensure long term continuity of supply.
Supply and demand incentives	• Significant investment will be required to support SAF production in Australia, with sufficient de-risking of capital investment to encourage development in the sector. • To stimulate these production investments, sufficient certainty and magnitude of supply- and demand-side measures are required.	• Government support such as production tax credits could help encourage initial capital investment in the Australian SAF industry, as well as bridging some of the gap to competition from other jurisdictions supported by their own incentive schemes. • Demand certainty can be provided by measures such as a mandate, to provide confidence in the establishment of a SAF market and encourage initial investment in SAF projects.

[36] https://www.graincorp.com.au/ampol-graincorp-and-ifm-unite-to-explore-the-creation-of-an-australian-renewable-fuels-industry/

vi. SAF feedstock market analysis

Domestic feedstock market

As an agriculturally intensive country, Australia has a diverse portfolio of feedstocks with the potential to support a large and globally competitive LCLF industry. Feedstocks identified for SAF production in Australia include carbohydrates (e.g. sugarcane), wastes (e.g. tallow and UCO), agricultural residues, oilseeds (e.g. canola) and Power to Liquids (PtL) (i.e. hydrogen and carbon dioxide).[37] The focus of this report and Ampol's immediate focus is on the commercially mature HEFA pathway, which converts biogenic feedstocks, including oilseeds and waste fats into LCLF.

Emerging feedstocks, such as carinata, pongamia, and camelina, have also been identified as potential resources for SAF. The Queensland Government and industry are actively undertaking initiatives to investigate the viability of these novel crops and there is growing interest from international investors including Japan. A domestic LCLF production industry will further encourage development of these emerging feedstocks.

CSIRO's Sustainable Aviation Fuel Roadmap indicates there is enough feedstock to supply almost 5 billion litres of domestic SAF production in Australia in 2025 and up to 14 billion litres by 2050[38]. In this regard, CSIRO's modelling estimates in 2025 Australia has enough feedstocks to produce 60% of local jet fuel demand using biogenic feedstocks, and this is estimated to reach 90% by 2050 as biogenic sources continue to grow and hydrogen production increases. While there will be competition from RD users for the same feedstock, there is enough available to develop a functioning, scaled renewable fuel industry. Many of the feedstocks Ampol is contemplating, such as canola, tallow and UCO, are currently aggregated and exported to international markets on such a scale for LCLF production. With targeted policies, there is an opportunity for Australia to kickstart the LCLF production industry using existing domestic feedstocks through the commercially proven HEFA pathway.

Ampol's research findings on domestic feedstock availability

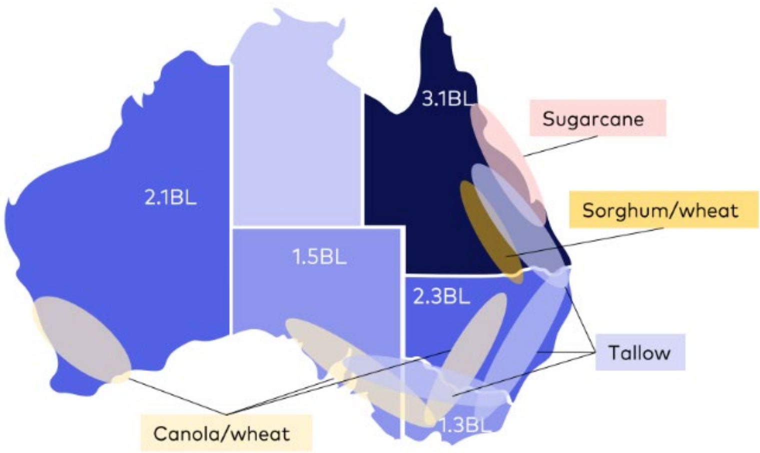
Ampol has conducted domestic analysis and market reviews to date, including research on the availability of domestic feedstock sources for use in BRF. Ampol's findings indicate that a diverse range of agricultural feedstocks (including tallow, canola, sugarcane, sorghum, and wheat) are available across Australia for SAF production across a range of conversion pathways, including Hydro processed Esters and Fatty Acids (HEFA), ethanol and biomass pathways.

Queensland currently has the largest SAF production potential at 3.1 billion litres per annum (BL) deriving from its diverse feedstocks such as sugarcane, crops and tallow,

[37] https://www.csiro.au/safroadmap
[38] https://www.csiro.au/safroadmap

which can be used for HEFA, ethanol and biomass conversion pathways and are generally low in carbon intensity. This is followed by NSW (2.3BL), WA (2.1BL), SA (1.5BL) and VIC (1.3BL). In addition, oilseeds and starch crops are also available for conversion pathways in other jurisdictions. The following figure summarises the types of feedstocks available across Australia in broad regions and the equivalent theoretical LCLF production by state, based on Ampol's investigations into the production and estimated availability of biobased feedstocks over the past ten years.

Figure 6 Suitable feedstock types and availability across Australia, expressed in potential BL (billion litres per annum) of LCLF production, Ampol



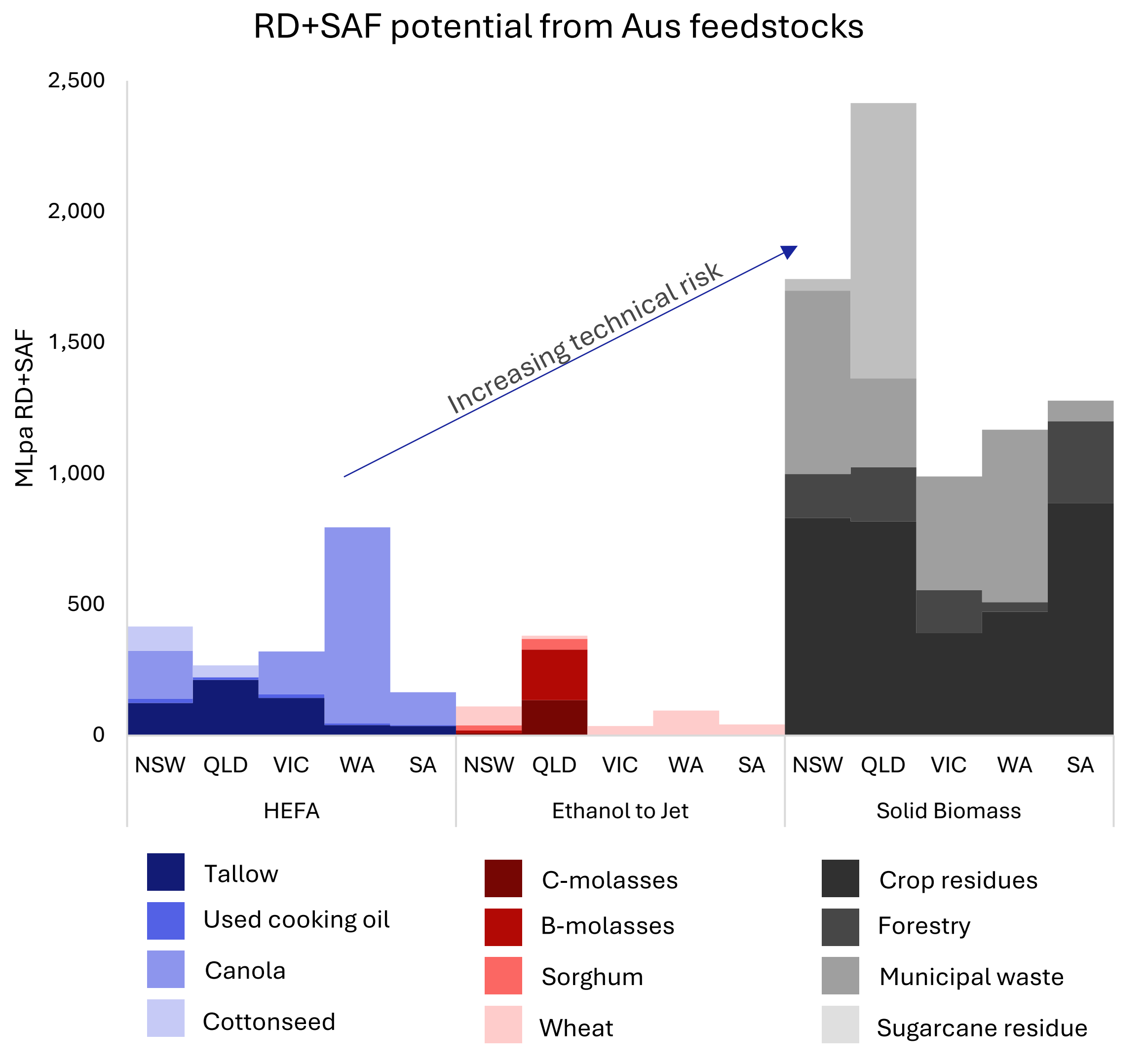
Ampol has considered the levels of available feedstocks by state, and these were modelled against three different conversion pathways (HEFA, ethanol-to-jet, and solid biomass pathways) in the figure below over the past 10 years. Our analysis contemplated the feedstock availabilities against the required uplift in technology risk from the HEFA production pathway. Ampol's research on technology pathways assessed the following criteria:

- Current and future domestic feedstock production and availability
- Feedstock import options
- Refinery capex cost
- Synergy with existing refinery operations
- Technology maturity
- Carbon Intensity
- Endproduct pricing

As shown in the CSIRO's SAF Roadmap, HEFA is currently the most mature pathway with similarities to traditional oil refining and the pathway being used in most commercial-scale productions with other less mature pathways having low Technology Readiness

Levels (TRL)[39]. Other conversion pathways are expected to account for more of production over time as technologies and alternate feedstock supply chains mature.

Figure 7 RD and SAF potential using Australian feedstocks, Ampol



This assessment concluded that whilst solid biomass provides the highest level of available feedstocks, the lack technical maturity did not meet Ampol's commercialisation requirements. Furthermore, ethanol to jet had improved technical maturity but lack of available domestic feedstock led to over-reliance on imported feedstock.

[39] Low carbon liquid fuel opportunities for Australia - CSIRO

vii. Viability of the import market for HEFA feedstocks

Feedstocks for the HEFA process include vegetable oils, waste oils, or fats. While emphasis is placed on sourcing domestic feedstock as this will have natural logistical competitive advantage for a domestic product market, imports for feedstock will need to be considered as an option in case of unexpected supply chain disruptions, maintaining of competition between international and domestic feedstocks and potentially customer preference for certain types of feedstocks.

Considerations for imported HEFA feedstocks

1. **Competition**

With significant policy measures in place predominantly in the US and EU, sourcing of feedstock for RD and SAF production is a global activity, and a significant portion comes from the APAC region. As demand for LCLF increases, particularly through the ratcheting EU mandates, it is anticipated that competition for feedstock in the region will increase. To feed a large-scale plant over the long term, imported feedstocks therefore don't provide a secure and reliable foundational supply without any other advantaged access.

There is however a large spot market for these feedstocks currently and maintaining the optionality of importing feedstocks as supply dynamics inevitably unfold between producing regions will be important in maintaining efficient and competitive supply of LCLF to market.

2. **Logistics and carbon intensity**

In the context of a domestic renewable fuel market, imported feedstocks will be at a disadvantage to local ones feeding into a domestic production facility on both logistics cost and carbon intensity, simply due to transporting feedstocks from a greater distance.

Aside from additional carbon emissions associated with transportation over greater distances, an additional consideration in the field of emissions reductions is the level of traceability and verification achievable with imported feedstocks. In a potential domestic "sustainability certification" scheme, the requirements to satisfy end customers of emissions claims may be more easily fulfilled by local feedstock producers adhering to local certification or calculation frameworks.

3. **Biosecurity restrictions**

Largely valid only for oilseed imports, Australia has stringent biosecurity and quarantine measures in place which may restrict the import of some feedstocks. The Department of Agriculture, Fisheries and Forestry oversees all plant imports, and these are subject to biosecurity measures governing soybean and canola imports.[40] This could be a consideration in times of drought or other local supply disruption where it is reasonably required to import feedstock to ensure continuity of supply.

3. Project Overview

i. Aim and objectives

Ampol is uniquely placed to be a key player in the Australian LCLF industry with experience and skills in manufacturing, blending and distribution. With an existing refinery at Lytton Queensland, Ampol has been producing fuels from crude oil for over 50 years.

Ampol is playing a pivotal role in advancing Australia's LCLF industry through the proposed BRF Project. By investigating the establishment of an at-scale LCLF production facility, Ampol is not only demonstrating its commitment to renewable energy solutions but also to creating a foundation for the development of future technologies and facilities. The proposed project will produce RD and SAF predominantly from locally sourced feedstocks, with the potential to reduce reliance on imported fuels and reducing greenhouse gas emissions relative to end use of liquid fossil fuels. Additionally, the initiative supports local economies, encourages innovation in feedstock development and supports the development of the industry to lead to a lower-carbon and more self-reliant energy future for Australia.

In line with Ampol's Future Energy and Decarbonisation Strategy, the shift to manufacturing LCLF from other feedstocks with significantly lower carbon intensity is a natural progression for Ampol. This project proposes a LCLF plant at the Lytton refinery capable of producing at least 450ML per annum of LCLF, leading to a reduction of 0.9 – 1.1 million tonnes of Scope 3 CO2 emissions from Ampol's customers.

To ensure continuity of supply, the project will need to secure access to commercially viable feedstocks across a range of products including tallow, canola, UCO and other biogenic feedstocks. This feedstock supply in an increasingly competitive market will be crucial to project success.

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[40] https://www.agriculture.gov.au/biosecurity-trade/import/goods/plant-products/seeds-for-sowing

Given current global technology advancements and feedstock access, Ampol will build a HEFA plant that can produce up to 90% SAF and the remainder in RD with the ability to swing between products as required. The plant will be based at the Lytton refinery to take advantage of existing infrastructure (tanks, pipelines, wharf access etc), refinery processing capability and deep expertise in hydrocarbon manufacturing.

Ampol's existing fuels distribution network and strategic infrastructure provides BRF with privileged access to tankage and pipelines plus road and sea transport distribution. This allows LCLF to be seamlessly and safely integrated with Ampol's existing business.

ii. Technology and feedstock selection

1. **Technology selection:**

Ampol has balanced technology risk against future plant viability to assess various SAF technology pathways to determine the most appropriate technology for the BRF Project. This assessment was based on the Technology Readiness Level of each pathway.

Given the advantages of co-locating BRF at the Lytton refinery, Ampol has undertaken a review of technology and feedstock fit specifically at the Brisbane site, considering a broad range of technical pathways for SAF production. This review considered the degree of synergies with existing refinery operation, ease of feedstock aggregation and transport to Lytton, in addition to risk and scale associated with technical maturity.

From this, a short list was examined, in conjunction with a major process licensor, including several configuration and revamp options at Lytton for Hydrotreating of Esthers and Fatty Acids (HEFA) and ethanol-to-jet pathways. From the shortlist, Ampol concluded that the HEFA pathway is the most appropriate technology for the BRF project on the basis of feedstock availability, refinery synergies and capacity to deliver material volumes of LCLF to market by 2030.

2. **Feedstock strategy:**

BRF is developing a long-term sustainable feedstock strategy that considers all aspects of the value chain including market impact, pricing dynamics and diversity of product.

Australia is well-positioned to capitalise on the production of HEFA LCLF due to its abundant agricultural and waste resources. The country's vast land area supports significant production of oilseed crops like canola, which can be used as feedstocks, while its extensive livestock industry generates large quantities of tallow and other animal fats, both of which are predominantly exported to other jurisdictions for LCLF production. Additionally, Australia's strong supply chain infrastructure for transporting agricultural products enhance its capability to supply domestic markets. The combination of these factors, alongside its proximity to Asia-Pacific markets with growing demand for sustainable fuels, makes Australia uniquely advantaged in the HEFA feedstock sector.

Ampol has entered into an MOU with GrainCorp and IFM Investors to explore the establishment of a LCLF industry in Australia. A key component of this MOU is the assessment of executing a feedstock agreement to initially supply HEFA feedstocks for the BRF facility. This assessment work is ongoing with an aim to execute a supply agreement in 2025.

iii. Expected greenhouse gas reduction

The default life cycle emissions associated with HEFA SAF production are reasonably well established. CORSIA provides life cycle emissions numbers, including land use change, on a global basis for Ampol's anticipated mix of feedstocks, including tallow, UCO and canola.

Using these default values, life cycle carbon abatement of a 450 million litres pa SAF plant is calculated to be in the range of 0.9 – 1.1 million tonnes of CO2 emissions per annum.

In addition, actual emissions data for components of the supply chain may eventually be collated and utilised, and recognition provided for lower life cycle emissions specific to Australian feedstocks. For example, CSIRO has demonstrated lower carbon emissions for Australian grown canola under Europe's Renewable Energy Directive scheme methodology than the global default values for canola in that scheme. This same type of research and methodology could be applied to emerging domestic emissions accounting schemes such as the Guarantee of Origin.

In Phase 2 the project will consider the scope 1 and 2 emissions of BRF SAF production and aim to identify potential mitigations in Phase 3. Ampol is also assessing the carbon intensity impacts of using its excess hydrogen produced at the refinery and / or using HEFA renewable by-products LPG and naphtha as feedstocks to produce the required hydrogen. This could lower life cycle emissions attributable to the fuel manufacturing process compared to default values, which typically assume the hydrogen source for the HEFA process comes from steam methane reforming.

iv. Expected cost range

The total project cost range is estimated to be between $1 - $2 billion based on current Class IV estimates. This cost will be further refined in Phase 2 as the project works towards a Class III estimate.

As a large capital works project, the project is following a clear staged process to ensure appropriate levels of risk management are applied where decisions on capital deployment need to be matched with accuracy of the investment decision. As decisions on capital exposure increase, so does accuracy in cost estimation to allow for project progression without exceeding acceptable risk tolerances. The project utilises the AACE 18R-97 cost estimation framework to determine accuracy levels at each project Phase Gate.

v. Project timeline

The project delivery schedule for BRF involves design and construction that could take approximately 5 years. Should BRF proceed on this schedule key milestones would include Financial Investment Decision in 2027 and project commissioning in late 2029.

Should BRF progress to later phases, the project delivery schedule will be further refined in conjunction with Licensor development of Process Design Packages (PDP) and FEED design.

vi. Key risks and mitigation

Table 2 BRF Risks and Associated Actions

Risk	Mitigating Action
Lack of supporting government policy	Aside from government grants, currently there is no policy across State and Federal governments that supports the establishment of LCLF production or demand in Australia. Given the high upfront capital costs of these plants, the downstream impact is SAF and RD pricing at multiples of current hydrocarbon jet fuel. Without incentive to the producer and / or end user, it is likely that this cost differential will prevent critical mass in the market and support a self-sustaining industry. The project has developed a range of preferred policy positions that will support the development of a domestic LCLF industry, focusing initially on SAF, and implementing plans to advocate and engage with key stakeholders in the policy design process. Ampol sees demand and supply side measures as key to establishing a LCLF industry in Australia. This includes direct policy advocacy along with establishing a coalition of support across the industry, given the mutual benefits that government policy can deliver.
Feedstock access	Global feedstock supply for LCLF is a constrained and competed resource. The BRF project has a HEFA plant base case requiring a mix of tallow, UCO and canola to ensure it can meet the nameplate output of 450 million litres per annum. Having secure access to this feedstock is vital for the project to achieve required investment hurdles, and as such is exploring a long-term feedstock supply agreement with Graincorp as previously noted.
Lack of social acceptance for SAF products	Feedstocks required for a HEFA plant are a vital element in ensuring emissions reduction benefits are obtained from the produced LCLF. These benefits could be eroded from lack of confidence in carbon emissions reductions claims or traceability, as has played out in recent years in international markets.

	The project will mitigate this risk by ensuring rigorous analysis of the carbon intensity of every feedstock to ensure they are acceptable to be used for LCLF production, including advocating for robust calculation methodologies in evolving Australian policy and schemes for domestic use. Within the bounds of a domestic supply chain adhering to domestic principles, a higher level of traceability should be achievable for the satisfaction of domestic fuel users.

vii. Social licence and expected stakeholder engagement activities

The BRF Project is actively attempting to building social licence through a multi-faceted approach that includes public education, stakeholder engagement, and industry development. By raising awareness of SAF as a critical solution for reducing carbon emissions in the aviation sector, Ampol is intending to help the public understand the role LCLF play in addressing climate change. The company's engagement with major airports ensures that key infrastructure and supply chains are prepared for the integration of SAF, reinforcing confidence in the project's viability. This collaborative approach highlights Ampol's commitment to transparency and alignment with the needs of the broader community.

Ampol is also working closely with government bodies to align BRF with national sustainability and energy security goals, fostering regulatory support and potential policy incentives. By developing a LCLF industry, Ampol is addressing the challenges faced by hard-to-abate sectors like aviation and heavy transport, which are crucial for Australia's net-zero ambitions. This initiative not only demonstrates Ampol's leadership in energy transition but also encourages cross-sector collaboration, ensuring long-term economic, environmental, and social benefits for Australia.

Ampol utilises a Community Engagement Standard and a National Stakeholder Engagement Framework. These policies ensure Ampol provides information on operations, activities, systems, and processes.

Key community communication tools the BRF Project will utilise include:

- 24-hour community hotline
- Community email address
- Community updates
- Community meetings/briefings
- Stakeholder meetings
- Individual engagement
- Community Working Group
- Newsletter
- Sponsorship

- Community Events
- Website updates
- Ampol Volunteer Day

Developing and maintaining positive and professional relationships with stakeholders is integral to how Ampol does business and builds trust and respect with neighbours, local community, staff, academia, industry peers, investors, and strategic partners including the Australian Government, through ARENA.

viii. Interim findings, challenges and lessons learnt

1. Production pathway summary and assessment

HEFA (Hydroprocessed Esters and Fatty Acids) was chosen as the preferred production pathway for LCLF at the Lytton site due to its strong alignment with existing refinery infrastructure, technical readiness, and feedstock supply chain maturity. HEFA technology leverages established hydroprocessing methods that can be integrated into existing refinery operations, reducing the need for significant additional capital expenditure compared to alternative technologies. This compatibility ensures a smoother transition to LCLF production while minimising operational disruptions.

Additionally, HEFA benefits from a reliable supply of feedstocks such as canola oil, tallow, and other fats and oils, which are readily available in Australia. Its ability to produce both SAF and RD makes it highly versatile and ideal for addressing hard-to-abate sectors like transport and aviation. With a proven track record globally and a relatively low carbon intensity using feedstocks available domestically, HEFA represents a scalable and practical solution to support Australia's energy transition and reduce greenhouse gas emissions.

2. Anonymous feedstock strategy

See Section ii in Project Overview.

3. Sustainability

Advancing sustainability in HEFA LCLF projects requires navigating complex challenges, particularly in ensuring the carbon intensity of feedstocks like canola are accurately and fairly measured in a domestic context. Australian canola presents a unique opportunity to demonstrate lower carbon intensity outcomes compared to international sources. Research by CSIRO highlights the benefits of Australian agricultural practices, such as no-till farming, efficient fertiliser use, and reliance on rain-fed systems, which can significantly lower the carbon intensity of production. Addressing these issues will require ongoing collaboration between policymakers, industry leaders, and researchers to develop frameworks that promote lower intensity farming practices while supporting LCLF growth.

Additionally, Australia's proximity to key Asian markets reduces transportation-related emissions, enhancing the overall sustainability profile of HEFA fuels. However, scaling up production to meet growing demand will require careful management to avoid over-intensification of agriculture, which could affect soil health, water resources, and biodiversity. By fostering innovation, supporting robust policy development, and leveraging Australia's natural advantages, the industry can balance its growth with broader environmental and social sustainability objectives.

4. Conclusions and Next Steps

Australia has the opportunity to develop a SAF and RD industry supported by projects such as BRF due to several reasons:

1. Australia's net zero carbon emissions by 2050 targets signal the need for the development of a LCLF industry to support hard-to-abate sectors such as the aviation and heavy transport industries. SAF and RD represent the most viable pathways to carbon emissions reductions in the aviation sector and some heavy transport applications respectively, which are considered too hard-to-abate and difficult to electrify in the medium term.
2. Australia has a diverse range of feedstocks. It is estimated that there is enough feedstock to supply almost five billion litres of SAF production in Australia in 2025. Currently, Australia produces surplus canola, with over 70% of canola production being exported for use in the LCLF industry in Europe. Utilising Australian produced feedstock in a domestic SAF and RD industry will enable diversification for Australian growers and spur development of alternate feedstocks and production technologies.

Developing an Australian LCLF industry will provide several benefits to the Australian economy:

1. Estimates have indicated that an Australian SAF industry could create up to 15,600 jobs by 2050.[41] SAF processing also creates several renewable by-products, including other fuels, and some production pathways utilise waste streams from other industries, both highlighting the overall carbon emissions reduction impact of a local supply chain.

[41] https://www.statedevelopment.qld.gov.au/news-and-events/fuelling-the-future-queenslands-sustainable-aviation-revolution#:~:text=Queensland%20is%20internationally%20recognised%20as,such%20as%20pongamia%20and%20carinata

2. Australia's liquid fuel energy security is of increasing strategic national importance due to our dependence on imported refined fuel and crude oil, with several Federal Government initiatives already underway to bolster Australia's domestic fuel security.

To help achieve this, the Federal Government has put measures in place to support remaining domestic crude oil refining capabilities through the Fuel Security Act, and the Future Made in Australia Act which identifies support for a domestic LCLF industry as Australia transitions to a net zero economy.

Ampol's BRF Project is progressing well with key milestones being met including assessment and selection of technology pathway and associated licensors. Ampol's MOU with IFM Investors and Graincorp is progressing well to support the establishment of an Australian renewable fuels industry, and the Federal Government is progressing key policies to support the burgeoning industry. Ampol will continue to work through the current pre-FEED activities to develop the required business case to move into FEED and eventual FID. Ampol remains focused on the development of the BRF Project and will utilise the current work to assess if the project continues to meet organisational needs as scope is further refined and project definition increases.

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