A FUTURE MADE IN AUSTRALIA:
UNLOCKING AUSTRALIAS LOW-CARBON LIQUID FUEL OPPORTUNITY

Response to Consultation Paper

1. Purpose of this submission

This submission is a joint contribution from three experienced consultants who have joined together to provide feedback on the policy options for low carbon liquid fuels.

The submission aims to draw greater attention to the unique opportunity that Australia has to domestically produce sufficient low-carbon intensity liquid fuels to replace imported petroleum fuels in the 'hard-to-abate' industry sectors, including transport, agriculture, mining and construction, that cannot be readily decarbonised by electrification. **Fundamental to realising this opportunity is the need to place greater emphasis on the potential for feedstock development than has so far been the case.**

We outline herein an implementation plan for a demonstrated commercial pathway that utilises the technically-proven HEFA fuel production process and capitalises on Australia's significant agricultural production and technological capacity to produce sufficient amounts of its own renewable oils & fats feedstocks. Execution of this advantaged pathway requires:

a) strategic, judicious and patient investment in expanding the production of advanced renewable oil feedstocks;

b) scale-up and diversification of current oil extraction capacity to accommodate diverse oil-bearing feedstocks;

c) establishment of onshore HEFA fuel refining facilities; and

d) implementing the aligned policy settings that are critical for underpinning competitive fuel cost and domestic price outcomes.

Australia can immediately capitalise on this opportunity, without needing to wait for the commercial proving of alternative thermochemical biomass processing technologies, or wishfully hoping for purported and promised future eFuels. Although eFuels are technically feasible, they make very little energetic sense and have very low probability of ever achieving economically competitive cost positions compared to *current* alternative routes.

2. Refuelling Australia for NetZero emissions

If Australia is to achieve NetZero emissions it must wean itself off petroleum-based fuels (petrol, diesel and jet fuels) by replacing them with renewable, low carbon intensity energy sources. Urgent action is needed to accelerate this transition towards the looming 2030 interim emissions targets and set a course for achieving full replacement within the NetZero 2050 timeline.

At the same time, we must reverse our current almost complete dependence on imported fuels by developing a strong domestic fuel production capacity, based on our abundance of renewable feedstocks and energy, coupled with the deployment of proven fuel processing technologies. It is highly unlikely that renewable fuels produced in foreign countries will be exported to any significant degree in coming decades, at least not until those nations have met their own domestic demand and associated decarbonisation goals.

Failure to develop a domestic renewable fuel industry, would consign Australia to an ongoing dependence on imported petroleum-based fuels with continued sovereign exposure to fuel insecurity risks, and result in Australia falling well short of meeting its interim and 2050 NetZero commitments.

3. HEFA and the hard-to-abate market segments

The automobile sector in Australia is heavily dominated by petrol (gasoline) fuelled internal combustion engines (ICE), with diesel-fueled ICEs occupying an increasing but relatively small share. This predominantly urban transport sector has excellent prospects for high levels of true decarbonisation through adoption of EVs which has already started and is forecast to transition rapidly. Legacy petrol vehicles can also be transitioned to low-carbon intensity ethanol fuels.

However, Australia relies heavily on diesel fuels for agriculture, mining, marine, and heavy industrial fuels and on jet fuels for domestic and international aviation (a combined total of approx. 30 M MT/yr). These sectors are much less amenable to electrification and are likely to remain heavily reliant on liquid transport fuels long into the future.

Liquid fuels in these sectors are now able to be replaced with low-carbon renewable fuels, such as biodiesel (BD), renewable diesel (RD), and Sustainable Aviation Fuel (SAF, BioJet), all of which can be made from oils & fats feedstocks using the FAME process (for BD production) or the HEFA process (for RD and SAF production). The HEFA process converts the fatty acid components of fats and oils feedstocks into deoxygenated hydrocarbon products that closely match the structure and provide equivalent performance to petroleum-derived diesel fuels.

4. Does Australia have enough feedstock for FAME and HEFA?

The CSIRO-Boeing 'Sustainable Aviation Fuel Roadmap' report[1] released in 2023 has frequently been cited as highlighting that Australia could meet a large and growing portion of its jet fuel demand through a combination of feedstocks and technologies.

The report estimated that Australia already has sufficient local biogenic feedstocks to produce 60% of local jet fuel demand in 2025, growing to 90% by 2050 through both the expansion of thermochemically-processed crop residue and waste feedstocks and the eventual introduction of synthetic eFuels (Power-to-Liquid) based on green hydrogen and carbon capture. Unfortunately, both of these approaches still have significant levels of technical risk and uncertainty about ultimate commercial viability, and it would be unwise to rely heavily on these technologies (that are unproven at any

[1] CSIRO (2023) '*Sustainable Aviation Fuel Roadmap*', CSIRO, Canberra

meaningful scale) for achieving our NetZero objectives within the timelines of current policy and international commitments.

Disappointingly however, the CSIRO report overlooked the significant prospects for expansion in production of HEFA feedstocks by omitting consideration of:-

a) the immediate opportunity to onshore currently high levels of exported surplus canola and cottonseed oil feedstocks,

b) the emerging potential for expanded production of existing oilseed crops and the imminent introduction of new cover-crop oilseeds[2], and

c) the subsequent implementation of recently-developed game-changing Biomass Oil technology[3] that enables the production of high yields of oils in the vegetative tissues of dedicated high-biomass energy crops and in the post-harvest residue (stubble) of food and feed crops.

Taken together, these technology developments could enable the HEFA feedstocks for a sufficiently large-scale production of BD, RD and SAF fuels to meet a large proportion of demand for diesel and aviation fuel replacement (post-electrification) needed to achieve NetZero-2050 targets. A staged implementation pathway for how this could be developed, deployed and scaled-up is provided below (and summarised in the attached diagram).

5. The way forward

<u>Phase 1</u> (2025-2030) – Accessing and scaling up existing oil feedstocks[4]

- Retaining onshore the currently exported tallow (~550,000 MT) and used cooking oil (~20,000 MT) would provide approx. **0.6 M MT** of renewable fuel feedstock.
- Retaining onshore and domestically crushing the currently exported canola grain (5.4 M MT) and cottonseed (0.6 M MT) would generate approx. **2.5 M MT** of renewable fuel feedstock.
- Australia currently devotes around 13 M HA of its cropping land to the production of exported cereal grains. A significant portion of this could be switched to producing additional oilseed crops for domestic fuel feedstock, a change that would also have desirable cropping systems diversification benefits. Given the range of production regions, a practical target would be to increase cropping of canola or related Brassica crops by around 1 M HA, and to reintroduce minor oilseed crops (such as safflower and linseed/Linola) across approx 0.5 M HA. This could generate approx. 2.75 M MT of additional oilseed, which upon crushing would yielding approx. **1.2 M MT** of renewable fuel feedstock.

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[2] Sindelar, A. *et al*., 'Winter oilseed production for biofuel in the US Corn Belt: opportunities and limitations', *GCB Bioenergy* (2017) 9, 508–524, doi: 10.1111/gcbb.12297

[3] Vanhercke T. *et al*. 'Metabolic engineering for enhanced oil in biomass', *Progress in Lipid Research* (2019) 74, 103-129, doi: 10.1016/j.plipres.2019.02.002

[4] Feedstock estimates are annual volumes for currently exported fats & oil volumes (for tallow & UCO) and potential extractable oil yield from currently exported oilseeds.

- The increased domestic oilseed crushing in the above scenario would require an increase of 9 M MT/yr in throughput capacity of the Australian seed crushing infrastructure. New crushing plants would need to be built in strategic locations near to oilseed crop production regions. The crushing activity would also generate an increased output of protein meal for which expanding domestic and nearby export markets are readily available.
- Taken together, the above measures could generate a combined domestic availability of around **4.3 M MT** of renewable low CI oil feedstock, sufficient to generate **3.9 M MT** (= 4.9 B L) of BD/RD/SAF fuels through a combination of FAME & HEFA processes. This is equivalent to almost half the current size of the Australian jet fuel market, indicating that the HEFA pathway alone already has the potential to reach complete saturation of the Australian aviation fuel market within the currently approved blend limit of 50% SAF with conventional jet fuel.
- Build large-scale (>2 M MT/yr) HEFA processing plants on the East coast and West coast for efficient centralised production of RD & SAF.
- Given the lag-time for constructing HEFA process facilities, it is envisaged that the initial deployment of available oil feedstock would be first directed to utilising the existing idle capacity for biodiesel production.
- Prepare for deployment of intermediate oilseed crops ('oilseed cover crops'):
  - develop and deploy Carinata as winter rotation crop within current summer cropping systems (e.g. cotton cropping) and in marginal areas
  - evaluate Camelina & CoverCress in Australian farming systems
- Initiate development of very-high oil content versions of current oil-bearing seed crops (canola, safflower, linseed, cottonseed, lupin).
- Evaluate Biomass Oil technology on multiple crop platforms and ag-systems to determine best deployment options for Australian agriculture, including:
  - dedicated Biomass Oil versions of high-biomass C4 energy crops (e.g. Sugar/Energy-canes, Sorghum, Miscanthus)
  - coproduct Biomass Oil in post-harvest crop residue (stems and leaves) of feed grains and food crops (e.g. dual-purpose feed wheat, triticale & canola)
- Establish/expand plantations of perennial oil-bearing tree crops on marginal lands in Northern Australia:
  - Pongamia, currently under evaluation in Queensland
  - Tamanu (*Calophyllum*) under pilot scale evaluation in Northern Territory

<u>Phase 2</u> (2030-2035) – Increase oil feedstock supply through sustainable intensification.

- Expand deployment of intermediate oilseed crops (Carinata, Camelina, CoverCress) and oil tree plantation crops (Pongamia & Tamanu).

- Introduce high oil productivity versions of oil crops that do not compete with food crop production:
  - high-oil lupin and cottonseed
  - initial Biomass Oil crops (noting that R&D has already commenced on expressing the Biomass Oil trait in vegetative tissues of tobacco[5], sugarcane[6] and sorghum[7]).
- Establish additional (multiple) seed crushing facilities in regions of expanded oil crop production.
- Expand HEFA processing capacity (scale & location) to match the ramp up of feedstock availability.

<u>Phase 3</u> (2035-2050) – Expand renewable fuel industry to supply full domestic demand for BD, RD & SAF required to meet NetZero by 2050.

- Introduce second-generation Biomass Oil crops.
- Continue to expand oil feedstock production and HEFA processing capacity (scale & location) to meet domestic market demand for renewable fuels.
- If further expansion beyond domestic requirements is viable, develop export markets for RD & SAF fuels within Asia-Pacific region.

6. Policy and enablers needed to develop an LCLF industry in Australia

The above analysis demonstrates how Australia can develop a domestic fats and oils feedstock capacity and establish the infrastructure required for feedstock processing and fuel production via the FAME and HEFA pathways. However, unlocking this opportunity will not happen without strong supporting government policies. These policies are needed to either mandate or stimulate the demand for replacement of petroleum-derived fuels with renewable low-carbon liquid fuels, and include market support mechanisms that can deliver these fuels cost-competively. Strategically directed R&D funding is also needed to accelerate the development and deployment of the advanced oil crop technologies that can maximise feedstock availability and affordability in the medium and long-term. We support a combination of targeted supply-side and demand-side policies across the industry, including specifically:-

a) supply side fixed capital grant incentives,

b) supply side CI based production tax incentive, requiring use of domestic feedstock,

c) demand side Low Carbon Fuel Standard with obligations on fuel producers and importers,

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[5] Mitchell, M.C. *et al*. 'Increasing growth and yield by altering carbon metabolism in a transgenic leaf oil crop'. *Plant Biotechnology Journal* (2020), 18, pp. 2042–2052, doi: 10.1111/pbi.13363

[6] Parajuli, S. *et al*. 'Towards oilcane: Engineering hyperaccumulation of triacylglycerol into sugarcane stems'. *GCB Bioenergy* (2020), pp 1-15, doi: 10.1111/gcbb.12684

[7] Vanhercke, T. *et al*. 'Up-regulation of lipid biosynthesis increases the oil content in leaves of *Sorghum bicolor*'. *Plant Biotechnology Journal* (2018), pp. 1–13, doi: 10.1111/pbi.12959

d) demand side mandates for domestic airlines and domestic marine, and

e) research grants to evaluate oilseed cover crops, develop very-high oil content seed crops, and evaluate biomass oil technology deployment options.

6.1 Supply Side policy:

To enable a thriving low carbon liquid fuels industry in Australia, production support mechanisms are required to address the high up-front capital costs and the "green premium" for production of these fuels.

The **fixed capital grant incentive** as defined in the consultation paper is an appropriate mechanism to provide up-front support for new facilites to enable them to offset construction costs. Whilst it requires Government to select the most meritorious projects, providing these grants for commercially available technologies such as HEFA would enable a pathway to production in the shortest possible time. These types of grants could be provided through the ARENA Advancing Renewables Program or similar mechanisms.

As well as construction grants, there needs to be **long term production incentives** for domestic manufacturing that offsets the cost of production. In absence of an economy wide carbon tax, petroleum fuels will continue to be lower cost than renewable fuels, so a mechanism is required to bridge this "green premium".

Contracts for Difference (CfD) are considered as one way to support production, however these are complex to manage and administer over time, and can favour established operators who have already commercialised operations. Whilst they can be responsive to market conditions, they require the Government to effectively underwrite selected production facilities with a CfD, and those without will have a higher risk of failure.

Production tax incentives have been used successfully overseas to support biofuels programs, and are the most efficient way of supporting domestic production. The benefit of this incentive is that it is available to all eligible domestic producers, it does not require government outlay, and it is low complexity to manage through the tax system. The other opportunity with a production tax credit is that the eligibility criteria can de defined such that it only applies when using domestic feedstock. This provides an incentive for feedstock to be maintained in country instead of exported, without creating contentious export tariffs or export controls.

With any supply or demand side policies, they need be targeted at the primary policy objective to be successful. The most effective way to reduce emissions from low carbon fuels is to define the policies based on the reduction in Carbon Intensity (CI) across the lifecycle of the fuel. In the case of production tax incentives, these can be linked to specific CI reduction which drives the right solutions, as is the case with the SAF credit under the US Inflation Reducton Act (IRA).

6.2 Demand Side policy

In addition to supply side support, domestic production of low carbon fuels in Australia will require demand side policy that enables the market to develop. Experience in overseas markets is that those with effective demand side mechanisms generate the

most growth in renwable fuels. The challenge is to define the policy as a market mechanism, a defined mandate, or both.

The best way to consider demand side policy is to look at the success of these over the past 10-15 years in the US and EU in reducing emissions and developing a low carbon fuels industry.

In the US the Renewable Fuels Standard (RFS) mandate has been in place since 2008 and has resulted in significant quantities of biofuels being sold each year, however the resulting reduction in emissions are not measured and improved as it is a purely volume-based mandate.

Similarly in Europe there are numerous biofuel related targets including the Renewable Energy Directive (EU RED) based on energy content, with sub-targets for advanced biofuels produced from certain feedstocks. A 2023 analysis found that the EU's complex policy approach to biofuels lacks a long-term outlook and that the ever-shifting web of policies has reportedly affected investor confidence.

A successful demand side policy that has been in place in California since 2011 is the **Low Carbon Fuel Standard** (LCFS) which has resulted in 10% reduction in emission to 2018 and 50% of the state's diesel being low carbon in 2023. The LCFS is a CI based policy that requires the fuel producers and importers to reduce the average CI of their petroleum fuels each year to meet declining targets.

The obligation on the fuel suppliers ensures the regulatory compliance burden is on a limited number of large corporations, and not on customers or consumers. The fuel suppliers then compete for the lowest cost LCFS generation, and can buy credits from third parties and recover the overall costs of these credits from the market.

The program provides a range of defined methods to create LCFS credits including the use of low carbon fuels. The LCFS does not rely upon assumptions about the technical or commercial feasibility of any particular technology but provides regulatory certainty for innovators and investors in emerging low carbon fuel technologies without picking winners among these technologies.

Australia has had the experience of biofuels mandates in NSW since 2007 and Queensland since 2017 that have proven to be less than effective. The uptake of ethanol and biodiesel blends has not met the targeted percentages since the programs were introduced, primarily as a result of insufficient customer uptake. The obligation is on the fuel suppliers to sell blended biodiesel and ethanol in their products, however this is not aligned with customers who are unwilling to buy these products due to lower energy density or higher cost. There have also been no penalties for non-compliance by any of the fuel suppliers.

If mandates are to be used in Australia, they must be targeted at the most impacted obligated party, and have enforceable penalties for non-compliance. The challenge for production of Renewable Diesel (RD) and Sustainable Aviation Fuel (SAF) is that a biorefinery can produce either product from the same feedstock, however RD has a higher yield so is the more attractive output. For manufaturers to produce SAF, there must be an additional incentive for the supplier or a mandated obligation with the buyer.

The primary avenue for airlines to buy large quantities of higher priced SAF than petroleum Jet (and pass on the cost to consumers) is if they are equally mandated to do so. There is already the obligation for international airlines to meet the CORSIA requirements, so the focus in Australia should be on domestic use of SAF. **A mandate for the use of SAF by domestic airlines is a suitable policy** to drive adoption of low carbon fuels. **Similarly for domestic marine fuels, a mandate for the use of low carbon liquid fuels** would drive demand in this sector.

A combination of demand mechanisms is the best approach to enable large scale production of low carbon fuels with both:

- an LCFS obligation for fuel suppliers and importers, and
- a mandate for domestic airlines and marine to use low carbon fuels

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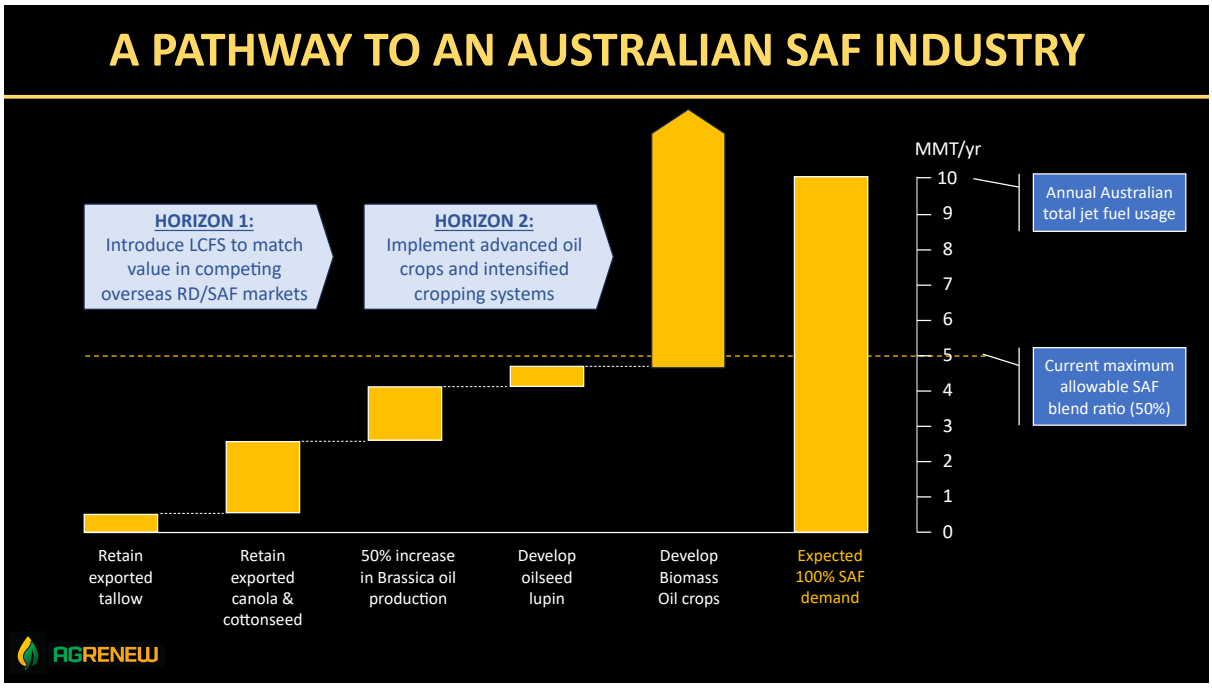

Excerpted from the '**Scaling-up domestic fats & oils feedstock production for an Australian renewable fuels sector**' presentation by Allan Green at *Bioenergy Australia 'Renewable Fuels Week' – Canberra, 20 March 2024*.