18 July 2024

HFA Submission for the Low Carbon Liquid Fuels Consultation Paper

The Hydrogen Flight Alliance (HFA) welcomes the opportunity to provide a submission in response to the Low Carbon Liquid Fuels Consultation Paper. The HFA was officially launched in June 2023 with the attendance of the Hon Mick de Brenni MP, Queensland Minister for Energy, Renewables and Hydrogen, and is working collectively to create a collaborative environment to advance hydrogen electric flight in Australia, using green liquid hydrogen. Our members include:

1. Stralis Aircraft
2. Skytrans Airlines
3. Brisbane Airport Corporation
4. Gladstone Airport
5. Aviation Australia
6. AMSL Aero
7. Royal Flying Doctors Service QLD
8. Toowoomba Wellcamp Airport
9. BOC, a Linde Company
10. H2 Energy Company (h2ec)
11. Griffith University
12. Central Queensland University
13. Queensland University of Technology
14. Hypersonix
15. Fabrum Liquid Hydrogen Solutions

The focus of the HFA is to enable emissions free hydrogen powered propulsion and flight in Australia, working towards commercial flights from 2026. Green liquid hydrogen, produced locally from renewable energy sources in Australia, will be used as fuel, which is converted to electrical power using a hydrogen fuel cell.

Green liquid hydrogen will play a crucial role in aerospace decarbonisation and can be used for direct combustion or with fuel cells to power aircraft. This includes efforts by global leaders such as Airbus. IATA's Aircraft Technology Net Zero Roadmap clearly identifies liquid hydrogen as a key energy solution, with advanced fuel cell flight tests with liquid hydrogen commencing from 2023.

Closer to home, HFA members Stralis Aircraft, AMSL Aero and Hypersonix are all designing, developing and testing new aerospace technology and powertrain systems that will use liquid hydrogen as fuel. These are all being developed in Australia with a global customer base.

The HFA has provided feedback on the most relevant sections of the Low Carbon Liquid Fuels Consultation Paper based on our work to date and priority action areas. If you have any queries or would like to follow up, please get in touch.

Best regards,

J. King

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Chair, Hydrogen Flight Alliance
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LOW CARBON LIQUID FUELS OPPORTUNITY

1. Australia is well placed to produce low carbon liquid fuels because it can generate the abundant zero carbon energy necessary to produce them at globally competitive prices. However, there is more than one low carbon liquid fuel and Australia should differentiate between them based on their environmental credentials and their suitability for different aviation applications. At present, policy direction seems focused on minimising the cost and inconvenience to airlines rather than on the opportunities and overall benefits for Australian citizens and taxpayers.
2. As a starting point, the Australian aviation community should aim for **zero greenhouse gas** liquid fuels not just **zero** or **low carbon** liquid fuels. Even if SAF can achieve net zero carbon emissions by using natural sources of carbon, the combustion of SAF will still generate other greenhouse gas emissions. Green liquid hydrogen, on the other hand, emits **zero greenhouse gases** when consumed in a fuel cell.
3. If the Australian aviation sector is to address climate change responsibly, it should adopt **zero greenhouse gas** liquid fuels as a first priority, **zero carbon** liquid fuels as a second priority and only if there are no other options, **low carbon** liquid fuels. At the very least, it should include green liquid hydrogen as an official low carbon liquid fuel.
4. While Renewable Diesel and SAF currently serve distinct sectors, the transition to a LCLF offers an opportunity to create a fuel supply chain which can serve multiple sectors thus supporting economies of scale and hastening the transition for all. Green liquid hydrogen is a suitable future LCLF for not only aviation, but also long distance and heavy surface transport such intercity and interstate trucking, buses and rail, mining and agricultural equipment, ferries and other passenger and cargo shipping. Green liquid hydrogen can also support medium and long term green energy storage for grid "peaking" plants which will could ultimately replace gas peaking plants, and as a storable green energy feedstock for metal and cement production, other refining, chemical and fertiliser production.
5. Green hydrogen production can be produced utilising excess spilled capacity of renewable electricity generation from wind and solar. Harnessing this spilled energy stabilizes and lowers the overall cost of renewable energy and further drives investment in this greening of the electricity grid.
6. The Consultation Paper makes ten references to hydrogen but none of them to liquid hydrogen. This is despite the fact that IATA's Energy and New Fuels Infrastructure Net Zero Roadmap recognises liquid hydrogen as a key fuel and sets out the need for investment into hydrogen infrastructure now, not later.
7. Many Australian and international aviation companies such as Airbus, ZeroAvia, Joby, Stralis Aircraft, AMSL Aero, Hypersonix and Dovetail are in the process of developing aircraft that will be powered by liquid hydrogen on the basis of its environmental credentials and its eminent suitability as an aviation fuel.

Stralis Aircraft (Brisbane)

Dovetail (Melbourne)

Joby (USA)

Airbus (France and Germany)

ZeroAvia (UK)

AMSL Aero (Sydney)

OPTIONS TO SUPPORT AUSTRALIAN DOMESTIC LOW CARBON LIQUID FUEL PRODUCTION

8. There is a broad consensus in the energy literature that SAF will cost somewhere between three and six times as much to produce as fossil kerosene. The national and global aviation markets are expected to contract significantly if these costs are all transferred to the consumer.
9. The round-trip efficiency of liquid hydrogen (LH2) is fundamentally much more efficient than SAF. Only 12% of the renewable energy produced makes it to propulsion via SAF in comparison to 25% of the renewable energy making it to propulsion via LH2.
10. As a result, airlines are lobbying their respective governments to subsidise the production of SAF, a cost that will fall on all taxpayers rather than just passengers raising issues around equity. Equity aside, this might be justified by airlines with legacy aircraft that have significant remaining operating life, but it will not make sense for retrofit or new hydrogen-electric aircraft operating over distances that can be flown using less expensive zero-emission fuels, such as liquid hydrogen. Note that companies advancing hydrogen-electric aircraft such as Stralis Aircraft, ZeroAvia and Dovetail, have business plans that incorporate or target aircraft retrofits which enable legacy aircraft to also transition.
11. It should be in everyone's interests to reduce the cost of aviation. The HFA urges the government to include liquid hydrogen as an official low carbon liquid fuel so that it reduces the overall cost of future aviation for Australians. In contrast to the assertion on Page 6 of the Consultation Paper that medium distance aviation in Australia is projected to remain reliant on liquid fuels such as SAF out to 2050, HFA proposes the following categorisation of fuels based on current industry developments.

range	short	medium	long
fuel	green electricity	green hydrogen	SAF
sector	urban	regional and remote	international

12. On 24 Jun 24, Joby flew 523 miles in California with an aircraft powered by liquid hydrogen and a fuel cell. The market capitalisation of the company increased by US $1 billion (30%) – a testament to confidence in the market (medium range electric planes) and in the technology (liquid hydrogen and fuel cells).
13. Unlike SAF, liquid hydrogen does not require a refinery to produce. It requires relatively simple industrial equipment, electricity and water. This means of production will enable regional and remote Australia to achieve higher levels of fuel security than with fuel distributed from refineries located near capital cities.
14. The HFA urges government to consider supporting the establishment of liquid hydrogen production capacity in remote and regional Australia as a cost effective and reliable fuel supply so that limited and expensive quantities of SAF can be reserved to support long distance flights.

Design Of Production Incentives To Incentivise The Production Of SAF

15. As a rule, carbon-based fossil fuels are currently the lowest cost aviation fuels without environmental taxes or market incentives. In the highly competitive aviation market, aircraft operators should not be expected to transition to low-emission fuels for altruistic reasons only.
16. The HFA recommends carefully designed market mechanisms to increase the production of green liquid hydrogen steadily in line with net zero targets.
17. The challenge with cost effective production of fuels, including SAF and liquid hydrogen, is to scale up in such a way that might not be commercially viable in the short term but minimise the overall cost in the long term to anyone providing funding.
18. Liquid hydrogen is a good example of a fuel whose cost of production responds to scale. In small quantities (100kg/day), the levelised cost of green liquid hydrogen might be somewhere between $50 and $100 per kg. At industrial scale (10 tonnes per day), the cost might be somewhere between $10 and $20 per kg.
19. To incentivise the production of green liquid hydrogen as a low carbon liquid fuel, the HFA proposes that the government underwrites a step change in production so that meaningful economies of scale can be achieved. This will allow customers to plan their operations based on a reliable supply and a predictable price.
20. Hydrogen hubs and physical locations where liquid hydrogen is produced and used are beneficial and enable smaller companies who need low volumes to set up and operate, including R&D or pilot projects to help spread costs and risks. Government can also play a key role in connecting production partners with off takers.

Considerations Regarding Emissions And Sustainability Criteria

21. SAF encompasses a wide variety of fuel types, with highly variable sustainability credentials. Therefore, the Guarantee of Origin Scheme should apply to SAF. Different SAF can be categorised according to their emissions and sustainability performance so that consumers understand their environmental impact. Each category should be classified for its emissions and sustainability performance. Without it, the only achievement of the low carbon liquid fuel opportunity might be more greenwashing.

22. There is general agreement in the literature that the use of SAF in an existing jet engine means that the engine will operate under the same conditions as for kerosene since equivalent thrust and energy output will be required for the aircraft to operate. The consequence is that even though SAF might reasonably claim to achieve net zero carbon emissions, it will not neutralise the other emissions associated with carbon fuel combustion such as carbon monoxide, volatile organic compounds and NOx.
23. For example, the amount of NOx released by SAF fuelled engines is largely unchanged since emissions are dependent on the temperature of combustion rather than the formulation of the fuel itself.
24. Therefore, if the Australian aviation sector is to properly address climate change, it should adopt **zero greenhouse gas** liquid fuels as a first priority, **zero carbon** liquid fuels as a second priority and only if there are no other options, **low carbon** liquid fuels.
25. At present, international aviation emissions are not included in Australia's total emissions. This is an international convention but it distorts emissions figures and conceals Australia's particular dependence on international aviation. As part of the low carbon liquid fuels opportunity, the HFA recommends that Australia take account of greenhouse gas emissions on international flights in order to take full responsibility for their environmental impact and allow market mechanisms to eliminate them.
26. As for sustainability, there are widespread concerns about the ability of a SAF industry to obtain the necessary quantities of biomass. The solution to these concerns is to use the other main ingredient of SAF, hydrogen, as an aviation fuel wherever possible. This will reduce the total input energy required for aviation fuel, reduce the demand for biomass and reduce the total cost of aviation fuel. In practice, it means that SAF can be reserved for long distance aviation, something which liquid hydrogen is unlikely to achieve in the short and medium term.

Design Of Demand Side Mechanisms

27. If the aviation industry is to reduce its actual greenhouse gas emissions (as opposed to offsetting them), the relative total cost of high carbon liquid fuels needs to exceed the total cost of low carbon liquid fuels. The total cost is a complicated calculation because it involves the residual value of current aircraft and supporting infrastructure and the cost of new aircraft and supporting infrastructure.
28. Moreover, this transition needs to occur progressively so that the many stakeholders involved have the time to change over efficiently. A transition that exceeds the capacity of the various supply chains to change will only result in disruption and waste. This should not be interpreted as an excuse to go slowly. Supply chains should change as quickly as they can.
29. The HFA recommends that market signals are clear and unambiguous. Industry operators should be in no doubt that the change is inevitable.
30. The simplest way to reduce the difference in cost between high carbon and low carbon liquid fuels is to remove all of the subsidies for high carbon liquid fuels. This should be communicated and scheduled so that all stakeholders have reasonable (but not indefinite) time to prepare and adjust. It will be a painful but necessary adjustment. It will be successful if the pain is shared by all players.
31. The orderly removal of subsidies will free up revenue to fund subsidies for underwriting the infrastructure and demand for low carbon liquid fuels. As already explained, this should be done in line with Australia's net zero obligations and with capacity that achieves meaningful economies of scale.
32. Demand can be stimulated by additionally introducing a carbon price (or ideally a greenhouse gas price) and mandated fractions of low carbon liquid fuels for aircraft operators. Voluntary schemes are unlikely to work because aviation is such a competitive

market and margins are thin. If aircraft operators know that everyone is bearing the same fuel costs, they are more likely to accept their contribution to the achievement of net zero.

OUTSTANDING QUESTIONS

33. Will liquid hydrogen be officially recognised as a low carbon liquid fuel?
34. If not, where is the financial and policy support for liquid hydrogen in Australia in accordance with guidance from IATA and with Australia's net zero obligations?
35. Will the Hydrogen Production Tax Incentive apply to liquid hydrogen?