29 November 2023

Aviation Green Paper – Submission

Thank you for providing us with the opportunity to comment on the Australian Government's Aviation Green Paper. We are providing this submission on behalf of Stralis Aircraft Pty Ltd.

Stralis Aircraft is a Queensland based emission free hydrogen electric aircraft manufacturer founded in 2021 to decarbonise air travel, improve passenger experience and create a world class hydrogen-electric aircraft manufacturer in Australia. We see green hydrogen as a fundamentally clean solution that is emission free, lightweight, and economic.

Based on our practical experience with the alternatives, Stralis is convinced that hydrogen electric propulsion is the most commercially viable, truly sustainable solution for aviation. We believe Australia is well placed globally to develop this innovative technology, with ample cheap renewable energy capability, a clear strategy for developing a local green hydrogen industry and the dependence of local communities on air transport to provide essential goods and services.

Green hydrogen, produced locally from renewable energy sources in Australia, plays a crucial role in aviation decarbonisation. Not only can it be used for direct combustion or with fuel cells to power aircraft, but it is used in standard jet fuel and SAF production pathways and is a raw material in power-to-liquid fuels (synthetic fuels).

Initially Stralis is converting a conventional single-engine Beechcraft Bonanza A36 into a 200kW Hydrogen Electric (HE) aircraft to demonstrate the benefits and capabilities of this zero-carbon emissions propulsion technology for regional transport applications. Referred to as the A36-HE, it will utilise Stralis's innovative Hydrogen Electric Propulsion System (HEPS) that is based on turbocharged High Temperature Proton Exchange Membrane (HTPEM) fuel cells and a low-weight electric motor. It will also include liquid hydrogen storage in upgraded wing tip tanks. First test flights are planned from Brisbane airport late 2024.

Our first commercial product to market will be a modified Beechcraft 1900D. The conventional turbine engine and kerosene fuel system will be replaced with our novel Hydrogen Electric Propulsion System and liquid hydrogen storage tank. During the modification, we will inspect and overhaul the airframe and avionics, as well as modernise the interior. Stralis intends to obtain a Supplemental Type Certificate for this product with CASA and the FAA in parallel.

The Stralis team have responded to the most relevant chapters and questions in the Aviation Green Paper and are keen to contribute to the Jet Zero Council's workplan around emerging aviation technology (fixed-wing) and green hydrogen fuel, as a hydrogen-electric powertrain manufacturer based in Australia. If you have any questions or would like to follow up, please get in touch.

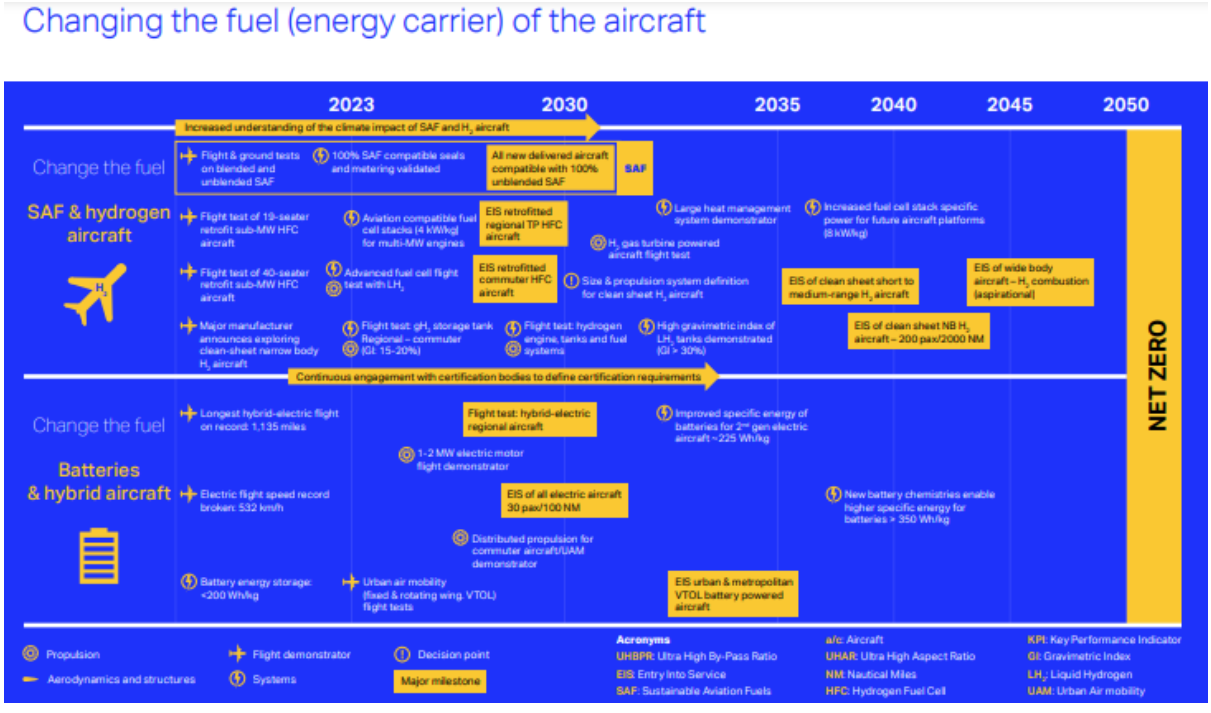
Kind Regards,

Bob Criner
Co-Founder & CEO, Stralis Aircraft
bc@stralis.aero

Chapter 2 – Likely future directions out to 2050

What emphasis should the Australian Government place on these trends to help guide the future of the sector? Are there any other trends the Australian Government could add?

- The scenario's do not seem to consider current shifts in economic and political power, including wars and social unrest, and the potential implications i.e., threats to aviation safety, fuel prices and movements, and maintenance parts supply chains. Other big drivers and trends to consider, include AI, climate and natural disasters, social and cultural shifts, workplace demographics, consumer behaviours, decentralisation, and retreat from globalisation.
- Demand and supply side drivers should consider impacts of physical climate change projections on aviation services, not just on physical assets but operations.
- The role and challenges of increasing use and potential interference of AI need incorporating.
- Stralis challenge the proposed timeframe that electric and hydrogen-electric aircraft (which are already flying), are only considered attractive post-2050, as the technology is attractive and being actively pursued and tested in the present time (including Airbus) and aircraft are being deployed commercially from 2026.
- The [IATA Aircraft Technology Net Zero Roadmap](https://www.iata.org/contentassets/8d19e716636a47c184e7221c77563c93/aircraft-technology-net-zero-roadmap.pdf)[1] clearly sets out that both electric and hydrogen aircraft have entry into service (EIS) dates by, if not before 2030 (see roadmap, p3), and that government investment should be starting now. Excerpt below (from p8):



- These technologies in their current form, have the potential to serve approximately 50% of the domestic Australian commercial aviation fleet.

[1] https://www.iata.org/contentassets/8d19e716636a47c184e7221c77563c93/aircraft-technology-net-zero-roadmap.pdf

- Similarly, the IATA Energy and New Fuels Infrastructure Net Zero Roadmap[2] also sets out the need for investment into hydrogen infrastructure now, not later (and electric aircraft on p7). Excerpt below (from p6):

Hydrogen infrastructure

- Recommend a review of the IATA Net Zero Roadmaps series[3] (which includes roadmaps on policy, finance, and operations).
- Recommend a thorough analysis of emerging hydrogen-electric technology and green hydrogen production (with an Australian lens – as the opportunity is greater here) alongside planned deployment, recognising these aircraft will be in commercial service by 2030 and the hydrogen-electric aviation ecosystem needs to start preparing and investing now.
- The role and links to renewable green electricity and hydrogen, and associated government policy are critical, especially the role hydrogen can play in storing energy and stabilising the future renewable energy grid.
- An opportunity exists to build a world-class emission free aircraft manufacturing industry in Australia, that can be tested and can operate using Australian produced green hydrogen. The White Paper presents a great opportunity to develop the policy and investment framework necessary to activate this opportunity and keep Australia competitive in the aviation sector as the world decarbonises.
- Currently, Australia uses 10 billion litres of jet fuel per year, which amounts to $8.3 billion spend – all of which goes offshore. The ability to generate green hydrogen in Australia to fuel emission free aircraft will help to transform the economics and an opportunity to build sovereign resilience of the aviation fuel industry, and aviation sector more broadly.
- Offsets do not reduce aviation's absolute emissions and have a lot of challenges, please review this academic paper for five principles of best practice for carbon offsetting that should be used to develop credible emissions strategies: 'What role for offsetting aviation greenhouse gas emissions in a deep cut carbon world?'[4]. High-quality offsets are hard to come by and there needs to be considerable transparency.
- Support "Industry decarbonisation will require a combination of SAF and emerging propulsion systems (electric, hybrid-electric or hydrogen aircraft) in order to substantively reduce emissions." (p38) Recommend the policy framework needs to actively pursue both

[2] https://www.iata.org/contentassets/8d19e716636a47c184e7221c77563c93/energy-and-new-fuels-infrastructure-net-zero-roadmap.pdf
[3] https://www.iata.org/en/programs/environment/roadmaps/
[4] https://www.sciencedirect.com/science/article/abs/pii/S0969699716302538

and to examine the real opportunity of all options for different aviation segments in Australia, alongside current baseline emissions data for the aviation sector and the different types of zero-emission fuels.

- Stralis is aiming to increase the number of aircraft in the sky utilising more efficient point-to-point route structures and expect that there will be capability to manage that. Government should support the implementation of airspace control and monitoring solutions to allow for greater aircraft numbers and support emission reduction strategies.
- The aviation sectors performance indicators and data reporting need reviewing and improving to reflect today's societal, environmental and policy needs.

Chapter 4 – Regional and remote aviation services

What opportunities do emerging aviation technologies present for regional and remote Australia?

- Inter-urban, regional, and remote aviation services and airlines are well suited to new and emerging electric and hydrogen-electric powertrain technologies. Smaller regional aircraft will be faster and cheaper to certify, meaning that emerging technology innovation will happen in this part of the market first. Thanks to dropping renewable energy, electrolyser, and fuel cell costs, we could save around 65% in engine maintenance and 65% on fuel costs by 2030, compared to a conventional 50 seat aircraft. The lower operating cost of HEPS planes will lead to lower ticket prices and greater market uptake, which will overall lead to more competition and more services in regional Australia.
- Emerging aviation technologies could help address the "decline in the number of passenger flights to smaller regional locations has been attributed to a trend towards the use of larger aircraft."(p65) because the efficiency of larger aircraft will be challenged with the emergence of electric and hydrogen-electric fixed-wing aircraft (it is not just AAM services that could improve connectivity) over a wide range of route lengths (up to 3000km and 80 passenger ranges). Providing the operating cost is suitably low, smaller aircraft come with a lower barrier to entry for new routes. This means many new routes can be trialled and the market can decide what should be kept. Existing fleet and aircraft can also be retrofitted with hydrogen-electric and electric powertrains, helping to manage and prevent stranded assets.
- Based on our business plan and the other 110+ companies currently working on hydrogen aviation worldwide (see Hydrogen Aviation Powerlist 2023[5]), we would challenge the statement that "*Electric or hydrogen powered aircraft may first enter service on short-haul regional air routes, noting the technology is not expected to replace existing turboprops on longer range routes until beyond 2040" (p65).* The White Paper should reflect latest technology developments and ambitions and be actively supporting those efforts, in Australia and globally.
- For example, Stralis Aircraft is working on production and certification of a 15 seat Beech 1900 turboprop retrofit in Australia with an 800km distance, with the intention to enter service in 2026, flying an initial route from Brisbane to Gladstone. ZeroAvia and Universal Hydrogen are already flying hydrogen-electric planes including a Dash-8 aircraft (50 passengers ordinarily) on experimental certificates and have similar entry into service dates of 2026.

[5] https://simpliflying.com/reports/hydrogen-aviation-powerlist-2023/

- The IATA Aircraft Technology Net Zero Roadmap[6] (and supporting infrastructure and policy roadmaps) clearly set out that both electric and hydrogen aircraft have entry into service (EIS) dates by, if not before 2030 (see roadmap, p3), and that government investment and infrastructure development should be starting now.
- It would also help to define what policy makers are deeming to be 'short haul' and 'longer range' routes, and a more thorough analysis of technical specifications and ambitions against current and projected domestic aviation activity is needed to help the sector and decision-makers understand what is anticipated to be available and when, and for what segments. A cost-benefit analysis of different options would also be beneficial, on economic, social, and environmental grounds.
- These new technologies and economic efficiencies for smaller aircraft open opportunities for more direct flights and useful routes between small and regional airports without going via the international airport hubs which decreases efficiency and timeliness and increase costs to consumers. This would help reduce door-to-door travel times, improve regional and rural connectivity, and could also improve urban connectivity where access to international hubs in cities is difficult (e.g., Bankstown, Moorabbin, Archerfield airports have potential).
- Government supported, subsidised or underwritten remote air services and routes, would lend themselves well as test and experimental flight routes and systems for new and emerging aviation and propulsion technologies, as support is already available to run these routes. Recommend integrating criteria and opportunities into future service agreements, to not only help test and develop infrastructure and capability, but to activate the transition.
- Regional and remote airports, especially those owned by local councils, have the opportunity for economic diversification and other sources of revenue through renewable energy[7] and H2 investment and production, essentially monetising renewables. This can be done in partnership. This approach can also increase resilience of the airport and aviation sector, in terms of localised clean fuel production and supply, benefits for other local off-takers, generation of jobs, and reducing fuel transport miles in terms of cost and emissions.
- Recommend a clear roadmap is needed for net zero and emerging aviation technologies (to include emerging propulsion and powertrain technologies) to align with strategies for green electricity and hydrogen generation, which should all be working toward zero emissions. This should include a section specifically for remote and regional communities, to identify a clear pathway to support transition.
- Recommend the Australian Government's Regional Airport programs and the Regional Investment Framework incorporate renewable energy and green H2 generation aligned with net zero and emerging electric, H2, hybrid and other aviation technologies.
- Regional development agencies, and regional investment and government funding, could actively support and develop airports and their role as hubs in decarbonisation, renewable energy, green H2 production and broader transport innovation and transition. Airports are also great locations for access and logistics centres, and for refuelling with green fuels.
- The regional opportunities presented for Australian domestic H2 production include fuel security and sovereign capability, mitigate supply disruptions, diversify fuels and sources, decrease dependence on imported fuel, facilitate local options for production and

[6] https://www.iata.org/contentassets/8d19e716636a47c184e7221c77563c93/aircraft-technology-net-zero-roadmap.pdf

[7] https://www.mountisaairport.com.au/media/airport-takes-flight-to-carbon-reduction and https://reneweconomy.com.au/australian-airports-are-ideal-hosts-for-large-scale-solar-installations-researchers-say/ and https://www.rmit.edu.au/news/media-releases-and-expert-comments/2021/apr/airports-solar (for larger airports)

decarbonisation, generate jobs and economic development for Australia's regions, and support Australia's plan to become a renewable energy superpower.

What are specific issues experienced by the regional and remote aviation sector in the context of decarbonisation? What elements should the Transport and Infrastructure Net Zero Roadmap and Action Plan include to recognise the specific circumstances of the regional and remote aviation sector?

- Current regional aircraft fleets in Australia are typically older, less fuel-efficient, and there are concerns around the cost impact of converting these to new emerging technologies such as hydrogen electric. To accelerate the transition to net zero, the White Paper should include actions that support and incentivise these operators to convert their fleets to emission free alternatives, resulting in reduced aircraft operating costs in future.
- Concerns around access to new fuels such as hydrogen and concerns around associated costs can be addressed and present opportunities for regional and remote airports. There are also existing concerns with current fuels with regards to access and price. The smaller the airport, the harder it will be to set up and generate green electricity and hydrogen production, however the technology exists and there are many advantages. There will still be mobile distribution and re-fuellers for new fuels like hydrogen, so infrastructure at airports is not essential, especially for regional and remote airfields that currently have minimal refuelling infrastructure.
- Government support and investment in hydrogen and regional airports, should facilitate smaller scale onsite green hydrogen generation systems that can be trialled and tested at rural and remote airports, especially where these aircraft are planning to be deployed.
- Additional considerations in terms of benefits of a shift to green hydrogen, are those operators working in and around iconic natural tourist attractions which are directly threatened by climate change such as the Great Barrier Reef, are increasingly required to demonstrate 'real' emissions reduction and transformational shifts. The shipping of jet fuel and kerosene across these protected areas to service aircraft would also be reduced.

What are the challenges faced by regional and remote aviation and airports posed by our changing climate?

- Important to review and consider current climate projections and their impacts on different regions across Australia. Climate risk should be a consideration of all airports and airlines in Australia, as part of their standard risk assessment and reporting.
- The recent CSIRO and Boeing study on SAF, did not consider the impacts of climate change on SAF production, neither did it consider exports which will take away a significant component, and present considerable drawbacks.
- Projected climate changes and the implications for aviation assets and operations should be a key part of the White Paper. Recommend some analysis is undertaken for aviation in Australia, including specific investigation for regional and remote aviation services and the implications for regional and remote communities.

Chapter 5 – Maximising aviation's contribution to net zero

General Feedback:

- Commend the announcement of the Jet Zero Council but it would be helpful to extend to academic representatives and those working in emerging zero emission propulsion and emerging technology development which would appear to be a current gap. The UK and New Zealand Jet Zero council equivalents for example focus on both SAF and emerging zero emission technologies that include hydrogen electric.
- Green H2 and emerging technologies need to be included in the mix alongside and in conjunction with SAF, which seems to have a disproportionate focus.
- The term Sustainable Aviation Fuel (SAF) encompasses a wide variety of types, with highly variable sustainability credentials. SAF should be unpicked to provide further detail on the wide variety of different types, and associated sustainability and decarbonisation performance. This is important to define and explain, to avoid being misleading and potentially greenwashing less-desirable solutions. We recommend only using SAF as a 'prefix' to the type of SAF being referenced which would act as the suffix i.e., SAF-PtL (Power-to-Liquid). This would provide clear differentiation and clarity and help prevent confusion for decision makers and consumers.
- PtL SAF that utilises green H2 as an input to the process has energy inefficiencies when compared to using that green H2 directly in aircraft for use with fuel cells or direct combustion.
- The green paper highlights that the AAA recommends delivery of a program to drive emissions reduction at airports, however an international Airport Carbon Accreditation scheme[8] already exists and many Australian airports are already accredited. Recommend promotion and a roll out of the ACA scheme to all airports and targets set.

Given there are several measures that industry and government could pursue to help achieve net zero by 2050 in aviation, are there specific measures that more emphasis and support should be given to?

- More emphasis and clarity that Australia's aviation emissions that are accounted, are only for domestic aviation. International aviation emissions are currently excluded from the accounts. This level of transparency is critical to create the right roadmap and policy.
- Separately international aviation emissions should be recognised and reported, and the strategy to address net zero emissions covered, in terms of long-haul and significantly larger aircraft. However, the net-zero opportunities and resulting strategies are quite different.
- The domestic aviation market needs clarity and robust information on the options for decarbonisation for different types of aircraft, and different length of journeys, keeping abreast of developments worldwide. Globally, most domestic aviation services could be serviced by emerging battery, hydrogen-electric and hybrid technologies, and it is estimated that 50% of global air travel CO2 emissions come from flights under 2200km[9] which could be serviced by the new emerging technologies and will not need drop in fuels including SAF.
- Electric and hydrogen-electric technologies have the potential to address 100% of Australia's reported domestic aviation emissions. For example, the Stralis SA-1 aircraft alone is

[8] https://www.airportcarbonaccreditation.org/
[9] https://theicct.org/sites/default/files/publications/ICCT_CO2-commercl-aviation-2018_20190918.pdf

anticipated to be able to do 95% in terms of range, but there are many other hydrogen-electric powertrain and aircraft developments happening globally which will also be responding to demand.

- There are a range of measures and recommendations covered in our answers to the other chapters and question areas, please consider. We also recommend a review of the full suite of IATA Net Zero Roadmaps series[10] and measures, in particular for this question, the roadmaps on policy and finance.

What should be included in relation to aviation in the Australian Government's Transport and Infrastructure Net Zero Roadmap and Action Plan (including for sectors, such as GA and airports)?

- Recommend reviewing and extracting the relevant recommendations from the iMOVE CRC *Framework for an Australian Clean Transport Strategy (FACTS)*[11] which looks at decarbonising all transport sectors including aviation and identifies a wide range of actions and responsibilities for all tiers of government, including the federal level.
- Recommend aviation is included and recognised in the Australian Government's Transport and Infrastructure Net Zero Roadmap and Action Plan, alongside shipping.
- Provide clarity about what Net Zero means for the *Australian Government's Transport and Infrastructure Net Zero Roadmap and Action Plan* in relation to a clear definition, as we understand it only relates to domestic aviation and shipping emissions, and international aviation and shipping emissions are excluded. Provide clarity as to how the national transport and infrastructure roadmap and action plan, and the Aviation White paper align to Australia's carbon accounts and Nationally Determined Contributions.
- If the focus is only on domestic aviation, then the roadmaps and policies should align – looking at the best options and policies to decarbonise the domestic aviation sector, as the domestic aviation market could transition to electric, hydrogen-electric and hybrid aircraft.
- SAF will be an expensive and potentially limited commodity and should be ringfenced for long haul and international flights, and large aircraft where alternative decarbonisation options and emerging technologies are currently limited.
- Support development of airports, in particular regional airports, as renewable energy and H2 production hubs and emerging aviation technology and transport innovation and refuelling hubs. This aligns to the IATA Net Zero infrastructure roadmap and the work in New Zealand to develop Pilot Hydrogen Hubs, to trial, test and develop clean energy technologies for aviation. See the ARUP and MBIE report for New Zealand.[12]
- Recommend the Australian Government's Regional Airport programs and the Regional Investment Framework incorporate renewable energy projects and green hydrogen generation or partnership opportunities, aligned with net zero and emerging electric, hydrogen, hybrid, and other aviation technologies.
- Emission reduction targets should be developed and consulted on (aligned to robust data and analysis of baseline emissions by segments aligned to opportunities and supporting strategy and policy), for different transport segments, and targets set to phase out fossil fuels and shift to alternatives. See the FACTS document (above) for recommendations.

[10] https://www.iata.org/en/programs/environment/roadmaps/
[11] https://transportfacts.org/ and https://transportfacts.org/wp-content/uploads/2022/06/FACTS-a-Framework-for-an-Australian-Clean-Transport-Strategy-2022.pdf
[12] https://www.mbie.govt.nz/dmsdocument/25936-hydrogen-hubs-at-nz-airports-phase-1-report-pdf

How can the Australian Government ensure all emitters in the aviation sector play a role in meeting Australia's emissions reduction targets?

- Provide clarity about what Net Zero means for Australian aviation in relation to its carbon accounts, as we understand it only relates to domestic aviation emissions and international aviation emissions are excluded.
- Recommend including and reporting on international aviation emissions as well, but clearly separating out domestic and international, and developing a good understanding and distinct strategies for each, to achieve emissions reduction targets.
- Emission reduction targets should be developed and consulted on, for different transport sectors, including aviation. Any strategy or roadmap should recognise the different aviation sub-sectors and players, detailing the roles and opportunities for effective emission reduction. See the FACTS document for a range of aviation policy recommendations by tier of government (summarised on p6-9).

What are the benefits and risks associated with updating the National Greenhouse and Energy Reporting (NGER) scheme and/or other policy mechanisms to enable unique claims on sustainable aviation fuel (SAF) sourced through common infrastructure? How can risks be managed?

- There are benefits to recognising new and emerging fuels, and their use, as it helps monitor system changes and investment. Where fuel is used and emissions are released, they should be accounted for, and nearly all SAF releases emissions still, in varying quantities.
- Risk around the way the term SAF is being used, without clarity on what type of SAF – please see earlier suggestion about it being used as a 'prefix'.
- SAF is not the only solution either, currently the green paper seems quite unbalanced in this regard. Other green aviation energy sources exist such as renewable hydrogen and electricity, these also need to be included and accounted.
- Not all SAF is equal, and there are varying degrees of emission reduction, this will need to be determined and accounted for, and similarly for different shades of hydrogen and electricity.
- Domestic versus imported supply should be tracked, and associated transportation emission considerations factored in. Sufficient and robust data and certification will be needed for unique claims.

What types of arrangements are necessary to support industry confidence in the quality standards and sustainability certification of SAF?

- The term Sustainable Aviation Fuel (SAF) encompasses a wide variety of types, with highly variable sustainability and emissions reduction credentials. SAF should be unpicked to provide further detail on the wide variety of different types, and associated sustainability and decarbonisation performance. This is important to define and explain, to avoid being misleading and potentially greenwashing less-desirable solutions. We recommend only using SAF as a 'prefix' to the type of SAF being referenced i.e., SAF-PtL (Power-to-Liquid). This would provide clear differentiation and clarity and help prevent confusion for decision makers and consumers. Standardised suffix could then be developed to reflect the different types.
- Please review the recent academic paper 'Implications of preferential access to land and clean energy for SAF'[13] (2023) that suggests all SAF emits CO2 emissions and re-

[13] https://www.sciencedirect.com/science/article/pii/S0048969723025044

sequestration can take decades, permanent removals of CO2 are potentially inhibited by SAF, SAF production is energy intensive with a risk of clean energy displacement.

- Transparency of the data used in quality standards and certification level will be critical, and the ability to review and compare. It is not just about the full suite of greenhouse gas emissions for aviation, as radiative forcing and contrails are also a key consideration – sufficient and robust data and information will be needed to support industry and consumer confidence.
- Similar quality standards and sustainability certification will be needed for different shades of hydrogen and electricity, as these are also being used in aviation.

Should policy and regulatory settings be refined to support development of domestic SAF production capability and industry take-up of SAF?

- Existing and new policy and regulatory settings should be considered to support domestic production and capability for a wide range of new and emerging fuels and technologies for aviation, and to help facilitate their use, to include renewable hydrogen and electricity. Policy needs to explore the different aviation routes and segments in Australia and consider the most fit-for-purpose and appropriate emission free technology and fuel for each.
- SAF is only one solution and will not get aviation to net zero. There seems to be an undue focus on SAF, perhaps pushed by existing dominant and incumbent players, without sufficient regard to the other options and emerging technologies and stakeholders that are not traditionally engaged in aviation policy and planning i.e. hydrogen producers and powertrain developers.
- For some airline operators (e.g. Sounds Air, NZ[14]), SAF is not being entertained as an option where net-zero solutions exist with comparably better energy access and economics, such as electric or hydrogen-electric.

  "By 2030, the next generation of electric aircraft will be able to fulfil all the sectors that we fly". Sounds Air Chairman and Director Rhyan Wardman, interview with Radio New Zealand.
- Not all SAF is equal, and there are varying degrees of emission reduction, how will this be determined and accounted for, and similarly for different shades of hydrogen and electricity.
- Please review the academic paper 'Implications of preferential access to land and clean energy for SAF'[15] (2023) and considerations it raises.

What are the current and future challenges in developing an Australian SAF production industry, including challenges associated with growing, refining, and consuming feedstocks?

- Realism about cost and availability, and a pragmatic and thorough analysis of where the SAF that will be available is best directed for use i.e. long haul, international and large aircraft.
- Where alternative solutions exist or are emerging that will reduce emissions more substantially for other aviation sub-sectors, these should also be actively supported by governments and challenges addressed.
- There is no silver bullet solution for decarbonising aviation, it will require a wide variety of solutions and system changes, not least behavioural.
- Need to examine and be realistic about exports and what quantity will be available domestically and need to consider and incorporate the impact of climate projections on production and availability.

[14] https://www.ch-aviation.com/portal/news/124526-new-zealands-sounds-air-talks-electric-aircraft-plans
[15] https://www.sciencedirect.com/science/article/pii/S0048969723025044

- Please review the academic paper 'Implications of preferential access to land and clean energy for SAF'[16] (2023) led by Australian academics on the challenges surrounding SAF, including: SAF emits CO2 emissions and re-sequestration can take decades, permanent removals of CO2 are potentially inhibited by SAF, SAF production is energy intensive with a risk of clean energy displacement.

How can policy and regulatory settings support research and development and subsequent investment in emerging low and zero emission technologies and related infrastructure?

- Innovation in emerging zero emission aviation technologies has significant potential to create new jobs in this sector, and to revitalise aircraft development and manufacturing in Australia. However, Australia is not currently competitive on the global stage, as other countries have significantly more government policy and financial support for innovative startups in this space, e.g. in the USA the Inflation Reduction Act is injecting over $400B USD into decarbonisation technologies, the FAA has the Fuelling Aviation's Sustainable Transition (FAST) Grants[17] program which includes $46.5M USD in FAST Tech grants for low-emission technology, to develop and demonstrate new aviation technologies to reduce emissions. Stralis recommend Australia continue and expand their EATP scheme, with a significant component for fixed-wing commercial aircraft (passenger and freight).
- NASA has invested US$74M in magniX (a former Australian company that the Stralis founders used to work for that moved to the US in part due to additional funding incentives like this) and US$179M to GE to demonstrate technology, develop certification regulations and train the workforce for future electric aircraft technology development. In the UK, the ATI Programme has been allocated £685 million from the government for the financial years 2022 to 2023 through 2024 to 2025.
- International cleantech investors are far more likely to invest their money in these countries that have strong policy and investment frameworks, making Australia uncompetitive currently in this space. Significant investment and programs are needed to support these emerging industries early on, which have the potential to return significant financial benefits back to the economy through jobs and high value exports.
- Make it easier for start-ups in Australia, we are in a global market and need real incentives for early-stage initiation.
- Any government funding going into emerging technologies will be highly leveraged by startups, that will be able to raise additional capital from international investors and use it to create more jobs and development here in Australia.
- CASA capability needs to be developed to support and work alongside emerging technology developers, learning from international examples and experiences and working closely with FAA and EASA. The NASA EPFD project mentioned above was specifically designed to fund and advance the FAA's understanding of these emerging technologies to support bringing them to market sooner. The process of experimental flight testing and working towards STC provides a great learning and capability development opportunity for the whole aviation ecosystem, but CASA will need to be sufficiently resourced to provide the necessary support and in a timely manner.
- Government investment and funds are currently limited for industry players working on emerging aviation technology that is working towards net zero outcomes, especially with

[16] https://www.sciencedirect.com/science/article/pii/S0048969723025044
[17] https://www.faa.gov/general/fueling-aviations-sustainable-transition-fast-grants

regards to fixed wing aircraft. Industry R&D and early design and prototype and experimental stages need more support, and not just through academic and research funding which can limit and stifle progress and timeliness.

- Policy and regulatory alignment are critical, across government and different tiers of government.
    - For example, renewable energy and hydrogen development and investment policy needs to be recognising and planning for domestic demand from aviation. At present, aviation is often not recognised in these strategies in Australia, and the focus tends to be around exports which needs to shift to domestic supply.
    - In terms of hydrogen strategy and planning, green hydrogen (including liquid) will be critical for the future of aviation, for direct combustion, use with fuel cells, and for producing some forms of SAF such as PtL.
    - Utilising the opportunity of airports as potential innovation and renewable energy hubs, including hydrogen (for an example see Christchurch Airport's Kowhai Park).
- Fossil fuel subsidies (including for aviation) are increasingly questioned in a society working toward net zero and countries are starting to introduce policy to withdraw those subsidies.
    - For example Canada – *"Our argument was that continuing to have fossil fuel subsidies while introducing policies like carbon pricing was like bailing water out of a leaking boat, without fixing the leak itself. You never really get to the root of the problem"* (Philip Gass, Interim Co-Director, Energy & Lead, Energy Transitions).
- Recommend fossil fuel subsidies are reviewed and consideration is given to ringfencing associated monies to invest in new emerging technologies and renewable clean fuels that support an effective net zero transition away from fossil fuels.
- Monies and investment, including consumer schemes, that go into one off offsets, could be better routed through investing in 'insets' and/or net zero projects. For example, R&D for new emerging aircraft technologies and fuels, retrofits, and/or new aircraft that will help transform the BAU and the broader aviation sector toward net zero. Rather than paying for one-off offsets, an airline and/or its customers could invest to retrofit a plane with a hydrogen-electric powertrain that eliminates those aircrafts fuel emissions forever.
- Please also see the responses below, to the questions for Chapter 9 –Emerging Aviation Technologies.

What information and guidance is needed to support regional aviation's net zero transition in the context of these emerging technologies?

- The White Paper and any associated roadmaps or action plans should clearly set out baseline emissions data for aviation, by sub sectors, and for the regions. What is the scale of the challenge, from different angles, and how do the opportunities align, funded on robust baseline emissions data. Evidence based policy and decision making.
- The data should inform a clear roadmap and guidance surrounding the opportunities and target areas for reducing emissions, including planning and investment for alternative technologies and fuels, that align to the data and recognises the range of solutions, different aviation sub-sectors and services.
- One size will not fit all, and the future will be more complex, but with that comes opportunities and benefits including localised energy production, economic diversification, building Australia's capability and skills, and ensuring sovereign resilience in the future.
- Please also see the responses above, to the questions for Chapter 4 – Regional and remote aviation services.

Chapter 6 – Airport development planning processes and consultation mechanisms

General Feedback:

- There are a lot of changes, including infrastructure and capability development that will be needed to help airports prepare and equip themselves for emerging aviation technologies and new fuels, including electric and hydrogen-electric fixed wing aircraft.
- The Hydrogen Flight Alliance has identified the following airport related considerations:
    - Determining requirements, locations, responsibilities and operational procedures for the transport, storage, and handling of hydrogen (gas and liquid) on, in and around the airport. Identify infrastructure needs (buildings, ground, mobile, renewable energy, electrical infrastructure, water) and determine the buffer/safety zones required for hydrogen airside.
    - Liquid hydrogen shifts operational practice substantially but could be more effective once procedures worked out. For example, dispensing, refuelling, and defueling systems at airports need to be defined e.g., truck, pipe, hydrant, ship, robotic. Liquid hydrogen storage management solutions including venting and boil off gas management, also need consideration.
    - Mapping and documenting the applicable regulatory requirements, for hydrogen liquefaction, transportation, storage, refuelling, and use at airports.
    - Airport safety and emergency services requirements, procedures, and equipment to respond to a hydrogen specific incident – define capabilities and competencies required. For an example, see Cranfield's immersive training programme in the UK[18].
    - Designing and delivering hydrogen safety training, skills development, and clear procedures for aviation stakeholders for safe storage and handling of hydrogen and hydrogen-electric aircraft– licenses required to work safely.
    - Community and public awareness of hydrogen at airports and its use in aircraft.
    - What operational and access procedures need to change for hydrogen use and refuelling airside. Airside access approvals if mobile refuelling adopted.
    - Broader airport strategy, integration, and investment opportunities – ground transport applications. Consider the opportunity for airports as renewable energy, hydrogen, and aviation innovation and intermodal hubs.
    - Secure broader longer term green hydrogen availability and supply at airports and airport solutions for diversions.
- In line with the IATA Roadmaps for Infrastructure, and the need to develop capability in Australia, a recommendation would be to actively support hydrogen pilot and demonstration facilities and green H2 Hubs at Airports, please review this New Zealand Government report.[19]

What else can airlines and airports do to support better management of aircraft noise?

- It is worth noting that electric and hydrogen electric propulsion and aircraft will be quieter than combustion engine aircraft. Transitioning to new cleaner and quieter technologies will

[18] https://www.cranfield.ac.uk/-/media/images-for-new-website/research-projects/swee-research-projects/trilema/thomas-budd-trilema-h2-safety-and-training-for-airport-fire-and-rescue-presentation.ashx?la=en&hash=627E0FA505035E541130E09BBF94E73A9D86E883

[19] https://www.mbie.govt.nz/dmsdocument/25936-hydrogen-hubs-at-nz-airports-phase-1-report-pdf

help to better manage aircraft noise. These technologies also substantially reduce noxious emissions and pollutants.

Chapter 9 – Emerging aviation technologies

General Feedback:

- "Australia is positioning itself to be a leader in the uptake and development of emerging aviation technologies." – while perhaps true for drones we have not seen much to date to back up this statement for propulsion technologies, but Australia can play a much bigger role than it currently is.
- This chapter and the orientation of the questions appears drone, eVTOL and AAM focussed, and one would expect to see more recognition of the opportunities and developments for fixed wing aircraft with new emission free propulsion technologies.
- Research is needed to examine the national and regional opportunity of different emerging aviation propulsion and aircraft technologies (fixed wing) for Australia's domestic aviation market, broken down by different aviation sub-sectors and aircraft/route types. Similarly, to understand potential and projected green hydrogen availability and potential nationally and in the regions.
- Electric, hydrogen electric, hydrogen direct combustion and hybrid powertrain technologies and emerging new aircraft designs deserve their own section and attention. Electric and hydrogen electric technologies have the potential to address 100% of Australia's domestic aviation emissions.
- Governments and industry will need to work together to develop community and consumer awareness and education around emerging aviation technologies, including the use of hydrogen in aviation.
- H2 timeframe should be revisited, as it is currently framed as a future 2050 fuel – it should be brought forward to recognise what is currently happening in terms of national and international investments in H2 and related aviation technologies and recognise the need for a considerable lead in time for infrastructure development and ecosystem preparedness and deployment.

How can we build on Australia's strengths to ensure that Australian industry in the sector is able to be competitive internationally?

- Australian and Queensland financial investment into supporting the design, testing, R&D, certification and manufacturing of hydrogen-electric powertrains and aircraft. In comparison to the USA and UK, the amount of investment going into this space in Australia is extremely low (e.g. $30M AUD for the EATP program vs. $250M USD for the FAA FAST program or $253M USD for the NASA EPFD program) and is forcing international investors to choose companies and projects in these countries as places to invest their money.
- Develop training and procedures for pilots, maintenance mechanics and ground handling personnel.
- Subsidy or assistance to help fund cost gap between conventional and hydrogen-electric aircraft fuel costs when technology is initially deployed from 2026, and airlines are retrofitting or replacing aircraft.

- Determining requirements, responsibilities and operational procedures for the transport, storage, and handling of liquid hydrogen on, in and around the airport.
- Designing and delivering hydrogen safety training, skills development, and clear procedures for aviation stakeholders.
- Undertaking a safety, incident and emergency response capabilities and competencies assessment and gap analysis for airports.
- Secure broader longer term green hydrogen availability and supply at airports engaged in hydrogen-electric flight and airport solutions for diversions.
- Hydrogen Flight Alliance priorities for green hydrogen infrastructure and supply chain:
    i. Funding and securing cost-effective green hydrogen supply and liquefaction for domestic use in Australia.
    ii. Resolving and funding Australian mobile liquid hydrogen transportation, storage, and refuelling solutions within Australia.
    iii. Mapping and documenting current and changing regulatory requirements for hydrogen as a fuel, and hydrogen-electric aviation at all stages of the hydrogen and aviation supply chain.
    iv. Research green liquid hydrogen production, use and cost projections including infrastructure requirements from 2024 to 2034 and beyond.
- Stralis's SA-1 hydrogen-electric aircraft would improve competition by lowering the barrier to entry for new airlines by reducing the purchase price (per seat) for an aircraft with an operating cost closer to that of a single-aisle. It would also support more point-to-point routes, through lower operating costs, major airports may become less of a bottleneck.
- Can the government support the creation of new routes and open access between regional airports? Incentivise moving traffic away from “slot-constrained airports”. Not just with AAM (short range) but also with fixed wing hydrogen electric.

How could the Australian Government create an environment that fosters private investment in emerging aviation technologies?

- Aviation requires significant amounts of private investment, and non-dilutive funding and/or demonstrating support from government is critically important.
- Australian funding environment:
    - VC funding – much smaller pool and much lower appetite for risk compared to US or Europe
    - Government grants – much smaller pool, e.g. EATP was $30M AUD vs. UK ATI £685, FAA FAST program $250M USD (and 25% applicant, 75% FAA funding contribution split), NASA EPFD program $253M USD, US IRA >$400B USD. This has a multiplier effect because VCs prefer to invest in places where there is more government support.
    - Corporate funding – pretty much non-existent
    - Customers – Whilst the smaller players are certainly dabbling in new tech, there is no incentive to accelerate the transition to net zero in Australia. None of the big players are moving. Overseas we see United, Alaska, BA and many more supporting the development of new tech.

- Clear direction from government – if they are supporting a technology then being clear about their support and reasoning for supporting it would go a long way make Australia a less risky place to invest.
- See also the response to the investment question below.

What skills are needed for the emerging aviation technology sector workforce?

- H2 (gas and liquid) safety and handling, training, and skills development will be needed across the aviation ecosystem.
- Develop new higher education courses/programs to meet the need of emerging technologies in aviation including electric and hydrogen-electric fixed wing aircraft.
- TEQSA need to be mentioned on the list.
- Include development of micro-credential and short courses, and additional modules or components of existing courses and qualifications to meet the demand and requirements for the new technologies and fuels such as Hydrogen.
- Facilitate Australian institutions to learn from and build partnerships with those leading internationally on training and skills, such as Cranfield University's 'Hydrogen Safety in Aviation' immersive training programme for practitioners[20].

How can the Australian Government best work with states and territories to foster a supportive environment for investment in manufacturing of these technologies?

- Determine a consolidated roadmap and plan for supporting, enabling, and advancing R&D, and manufacture of emerging technologies such as hydrogen-electric aircraft in Australia, and to not tie funds only to manufacturing that applies advanced robotics and/or Industry 4.0 and/or 5.0 equipment.
- Need access to Australian and state government funding and support, and more broadly non-dilutive funding to facilitate a strong investment environment for emerging technology R&D and manufacturing.
- Investors actively encourage a move to the U.S. to enable access to further non-dilutive funding sources and broader access to markets and a regulatory environment that is being developed to support roll out.

What regulatory roles in particular do stakeholders see as critical for the Australian Government to lead to enable the advantages of new technologies while managing the risks?

- See comments below re: CASA.

How will priorities of Government agencies need to evolve as the uptake of emerging aviation technologies continues?

- See comments below re: CASA.

Do Government policies and regulations need to change to better support growth in emerging aviation technology manufacturing?

- CASA and associated compliance policies and regulations will need to consider and incorporate emerging technologies such as hydrogen-electric, and provide a supportive and nurturing framework for development, drawing on learning from FAA and EASA.

[20] https://www.cranfield.ac.uk/-/media/files/brochure/hydrogen-safety-in-aviation.ashx

- CASA will need sufficient and dedicated resources and to build their own capability to support and learn from emerging technologies testing and certification processes worldwide, to be able to work alongside and support proactively those developing new technologies in Australia.
- Currently it would be easier for emerging technologies to go to the U.S. or Europe, and that situation needs to change to secure and maintain Australian grown outfits.

Chapter 10 – Future industry workforce

How can government policy enable industry to support the net zero economy and the future skills, training, and workforce needs that entails (including future fuels)?

- Setting out clear targets and a roadmap, recognising the roles and opportunities for different aviation sub-sectors and for the regions across Australia. A clear policy direction with programs that support the transformation will create a strong foundation for investment and development.
- An existing workforce challenge is low wages, and it is challenging getting maintenance staff and LAMES. Wages in the aviation sector are comparatively lower than other industries in Australia, or what is available overseas, but the skills shortage is also driving prices/wages.
- The manufacturing sector in Australia for high quality aerospace parts is limited. There is a lot happening that is considered world leading, but it is typically very niche and largely export driven. The problem seems more to be that it isn't scaling into more general competitive support for local industry.
- Whilst there are companies who can do it, there is a distinct lack of competition and options. We will regularly go overseas for parts because it’s easier and cheaper to get them, so the aerospace manufacturing industry needs supporting and reinvigorating.
- Industry and workforce cultural considerations:
    - An apathy in the aerospace industry in Australia.
    - Safety and innovation are not mutually exclusive.
    - Aerospace has lost its shine as a job – whereas in the U.S.A and Europe it appears to still be an exciting thing.
    - We regularly hear from investors that we don’t have good talent in Australia.
    - Australians are in leadership positions in big aerospace businesses and startups across America – there is a lack of support here in Australia.
    - Lack of the big players like SpaceX, Tesla, etc. where things happen fast.

Would an analysis of future skills and workforce need, help position the aviation industry to pre-emptively respond to emerging needs?

- Yes potentially, but please note the responses made to the previous question.

How should governments and industry prepare Australian workers for the new skills required for the technological transition and net zero fuels?

- Develop new higher education courses/programs to meet the need of the aviation emerging technologies, TEQSA need to be mentioned on the list.
- Focus on the development of Micro-credential and short courses to meet the demand of the new technologies such as Hydrogen.