Good afternoon,

I have reviewed the Aviation Green Paper that was released for public comment:
Aviation Green Paper | Department of Infrastructure, Transport, Regional Development, Communications and the Arts

Here is some comments on it.

Thanks for the opportunity to comment

Steve Cole

[redacted]

Significant points:

- Formation of a Jet Zero Council to help drive and coordinate investigation of possible measures is a significant step forward and greatly supported.
- Initial focus is on reducing emissions through efficiency gains and offset purchases which is not what is needed.
- Focus on new technologies (eg advanced air mobility) and future fuels in paper (eg electrification, hydrogen etc) largely belies the **only mechanism available to decarbonise aviation by 2050 is SAF uptake.**
- **There is a focus on "high quality" offsets.** There is mounting evidence that offsets are of little genuine value and many are worthless. They should not be part of a decarbonisation strategy as they deter investment in real emissions reduction technologies, and competition for genuine ones will lead to high prices the industry wont be able to afford (mirrors my comments on the Defence Future energy Strategy).
- **The paper needs a specific section on "managing the energy transition" noting the role of SAF and limited potential for the other mechanisms to assist with industry decarbonisation.** Not addressing this is a significant strategic failure
- There is broadly insufficient discussion of how an endemic SAF industry can be developed and how important it is to achieve a low emissions future industry. Given its pivotal role, it should be the main part of disucssion of decarbonisation and future aviation.
- Electric aircraft discussion around performance, battery life and maintenance is dated and not reflective of recent reviews. Battery replacement in battery vehicles is a thing of the past and the need to replace batteries in aircraft is unlikely, driven more by increased energy density and thus performance, rather than "failure" per se. grouping electric aircraft (currently flying and in active testing) with hydrogen powered aircraft (not likely to be flying before 2040 and entering service only if they prove viable) belies the difference in their technological development. The paper acknowledges that running costs of electric aircraft are 10% of current aircraft. If this is the case, its plain to see that as they are rolled out they will be "snapped up" by operators who are currently looking for single digit improvements in efficiencies.
- The document fails to appreciate the importance of moves in the EU, UK and US to emissions reduction directives by mandating low carbon fuel uptake. These markets are very much where we look to for future initiatives that Australia will need to

follow, just as we have done for many other environmental and safety initiatives. This does not seem to be understood in the paper.

- Disappointing that in the sector overview the need to decarbonise aviation by 2050 is not addressed in the highlighted section of the sector overview (Section 1) despite being discussed in the minister's foreword. There is much focus on the effects of Covid despite the paper acknowledging that the sector is well on the way to recovery. Decarbonisation is a far more significant issue for the industry to tackle over the next few decades. Is this covid focus only because industry is still sensitive to it? Seems a waste of paper to be discussing post covid recovery when its nearly complete.
- The paper ignores ground transport for passengers at airports despite this being a significant challenge at most capital city airports. The paper focuses on continued growth but existing ground transport is at or beyond capacity at certain times of the day and year. There needs to be a separate section that deals with airport transport integration. The focus on future air transport eg drones and advanced air mobility as solutions for this belies the fact that these will be beyond the means of the majority of travellers who will continue to use cheap ground transport to get to and from the airport. Focusing on improving/implementing rail, light rail and trackless tram solutions would appear to be the best solution to road/terminal congestion at airports.
- Sustainability is discussed simplistically. While this is dominated by Jet A-1 use - sustainability must include airport electricity use, replacement of methane gas use for space heating, improved energy efficiency, and installation of solar PV/battery technologies to decarbonise airport terminal operations, as well as focus on noise pollution and management of ground (soil/aquifer/drainage and air pollution from hydrocarbons and other pollutants (including de-ice fluids), transport of passengers, and recycling and reducing waste streams. None of these are addressed under the sustainability banner.
- No discussion in the document of the need to reduce travel as a decarbonisation solution, only mentioned briefly as a mechanism that "might impact demand". Incentives to reduce excess and unnecessary travel will be pivotal in ensuring emissions can be curtailed.
- The paper seems to think there will be a significant transformation of the industry over the next 20 years. I view this as unlikely given new, ordered and emerging designs fo medium and long haul flights all use Jet-A1 powered engines, apart from some emerging electric niches. Even there the paper seems to underestimate the uptake of electric aircraft in these short haul segments despite commenting that operating costs are 10% of existing platforms (!).
- The paper seems not to appreciate that regional aviation is a relatively small component of aviation in Australia and there is potential to delay uptake of low carbon fuels while prioritising intercapital and international routes. This may be a good mechanism to defer high costs on regional communities and to prioritise emissions reduction to routes that cause the most emissions.
- The paper gives a good discussion of future fuels but limited discussion that new fuels bring the need for distribution and storage systems at airports for fuels that may not be compatible and may not be able to be stored in the same facility as used for Jet A1. Discussion of the impacts and solutions for storage and distribution would be useful as it may provide justifications for chosing locations where the fuels may best be first introduced. Differnet fuels will require significant capital outlays to provide the necessary airport infrastructure.
- Good to see discussion of climate change resilience at airports. One addition might be to draw the link to disaster response. Airfields are key disaster response hubs and so

need to be the most resilient, as during disasters is when they are most needed to support HA/DR activities.

- The lengthy discussion of SAF uptake and mandates by other jurisdictions reinforces earlier comments in this review that the role of SAF needs to be promoted to the head of the queue when the white paper discusses decarbonisation options. None of these governments are focusing on mandating uptake of hydrogen or ammonia power, or fuel efficiency improvements, or use of offsets. The white paper needs to recognise this and focus significantly more on SAF.
- Synthetic fuels that compete with food crops should not be considered at all for aviation decarbonisation. Third generation synthetic fuels use bio feedstocks that are underutilised (eg waste biomass) or low productivity rangeland (marginal) areas.
- Australia doenst have a lack of jet fuel refining capacity at this point in time. The existing refineries could co-process up to 10% bio feedstocks and still remain certified, and given their production is currently around 3 billion litres per annum we are not far short of the 5 billion quoted. The problem is there is currently no demand and no commitment to produce SAF. This section of the white paper needs to be updated noting the recent and significant commitments of SAF producers and refiners.
- The paper uses the term "SAF certification" when speaking about demonstrating its emissions reduction provenance. This is unfortunate as "SAF certification" is principally used to describe the ASTM International led certification for use of SAF by existing aviation platforms and engines. Its recommended that a revised term be used so as not to portray that further certification of platforms and engines is warranted or expected.
- SAF platform certification integrity is not addressed. This needs its own section. All platform operators will need to undertake internal certification assessments that their platforms and engines can use SAF blends from the currently ASTM approved pathways
- SAF targets – comparison with other competitor airlines in the Asia Pacific and as an argument to not have mandatory targets is not sensible as it condemns us to a follower "reactive" strategy given the intentions of the EU, UK and US. It
- The document is silent on the need for "mass balancing" of SAF through existing fuel supply chains. It would be prohibitively expensive to duplicate supply chains, and an understanding of how mass balancing works would go part way to answering the first feedback question on page 86.
- Another challenge relates to certification of a new pathway for SAF production by ASTM international. Some potential producers have no pathway to producing SAF and so assistance to do this might be considered in specific cases.;
- The content on hydrogen aircraft is dated. Hydrogen powered purpose built aircraft are unlikely to be flying now until 2035 (some test platforms will but will be experimental). Saying they will be commencing "widspread deployment" at this time is unrealistic. In fact its relatively optimistic to think that hydrogen powered aircraft will even COMMENCE widespread deployment by 2040.
- Electric aircraft are far more promising. As new battery technologies emerge, battery powered aircraft have the potential to completely disrupt the industry. The paper should consider how adoption may be accelerated if there is widespread agreement in the industry that electric aircraft are going to be adopted.
- The discussion of electric aircraft is relatively dated. It is extremely unlikely that an electric aircraft will require battery replacement given the development and research

of EV batteries. Operating costs and maintenace are absolutely going to be lower as stated elsewhere in the document.

- Given 100% of existing hydrogen is produced from fossil fuels with significant CO2 emissions, care must be observed in supporting hydrogen powered conversions if they end up using black hydrogen and so emit even more CO2.
- 50 % of propeller flights less than 500 km being flown by electric aircraft by 2050 would appear to be spectacularly conservative noting the operating costs of the aircraft are 10% of piston engined aircraft and 2050 is still 25 years away.
- Emphasis on AAM at the expense of facilitating other improved ground transport solutions such as terminal rail, light rail and trackless trams to move people to and from airports would seem to be wrong. AAM is not taking over these roles in other countries as the majority of passengers move between cities and airports by cheap ground transport. There should be greater emphasis in the paper on how current cost effective transport links can be rolled out, requiring no new technologies as the existing technologies are available. Focus on "vertiports" while the document remains silent on the need for improved passenger ground transport seems inappropriate given the vast majority of travellers will continue to use ground transport as it is cheap and can cater to larger quantities of travelers. Even if AAM begins services to and from airports it will be a niche capability accessed by a small subset of travelers due to the cost.
- The lack of a separate section on interconnectivity of aviation with other transport sectors needs to be resolved through a separate section that acknowledges already at most capital city airports passenger movements are at or above capacity, especially during peak times of day and season.

Detailed General comments.

- Good to see the Minsters foreword includes "We have committed to net zero emissions by 2050 and have implemented new reforms to the Safeguard Mechanism requiring annual emissions reductions for Australia's largest emitters, including our largest airlines." There is a significant risk here that the early emissions reductions by airlines will be around operational controls, more fuel efficient aircraft and purchasing offsets. This is not what it is needed – the sector needs to be beginning uptake of SAF so that the SAF production industry can grow in a timely fashion in line with demand to 2050 and beyond.
- Regional services section (page 11) discusses opportunities for regional economies through decarbonisation – through bioenergy feedstock production and green hydrogen. It does not mention SAF production facilities, some of which are likely to be regionally based. It does not mention the role of electrification of aircraft, how renewable electricity benefits regional communities and how electric aircraft can make flights more affordable.
- Page 12. Advance Air Mobility is discussed before the main solutions that are presently either viable or available to net zero aviation –Sustainable Aviation Fuel (SAF) and electric aircraft. The latter is combined in discussion with hydrogen powered aircraft which are not likely to enter service until the 2040s. hydrogen aircraft will thus not significantly contribute to net zero by 2050. The lack of discussion of SAF is a significant omission here noting that SAF is presently available internationally now and numerous organisations are planning to import it or produce it domestically.

- page 12. Our changing climate will have significant implications for hot airport operations which will impact most significantly in regional areas. Increasing temperatures in areas where temperatures are already extreme during summer months is a significant challenge to overcome for regional aviation.
- Page 13. Bundling methods to limit emissions together – SAF uptake, fleet renewal and other efficiency methodologies, and "high quality" offsets together without an action plan to develop and provide regulatory frameworks and support for each means airlines will chose the least cost option. This is offsets. Unfortunately offsets cannot get aviation to zero emissions, particularly as offsets will be in increasing demand across all industrial sectors and ultimately higher cost. Ultimately they are just a delaying tactic to permit ongoing consumption of fossil jet fuel with no real plan to replace it. SAF provides the only solution to decarbonise aviation by 2050 and we need to get on with establishing the industry not focusing on an offset methodology which permits business as usual and delays SAF industry establishment and growth.
- Hydrogen powered aircraft is not a promising technology. It is an experimental technology with no clear sign it will prove cost effective or deliver sufficient performance to replace jet fuel use. It is extremely amibitious to consider that hydrogen passenger aircraft will be flying by 2035. Given the safety issues for hydrogen it cannot be co-stored with Jet A-1 and so there is an entire production, transport and fuel delivery system to develop across every airport in the country. It is unlikely to be cost effective to duplicate fuel storage and distribution systems and so the money would be better spent on supporting development of SAF production in Australia – production of a drop-in replacement fuel that uses existing supply chains and aviation platforms.
- Hydrogen aircraft - if one is produced by 2040 and production commences, cannot contribute in any significant way to decarbonisation of the existing aviation fleet before 2050.
- Elecric aircraft are coming now. Battery technology is advancing rapidly. The aviation sector needs an action plan to faciliate airport charging networks to ensure these aircraft can be adopted as soon as they are available. The White paper should be envisaging that flights of less than 4 minutes should be completely replaced by electric aircraft, with the duration increasing in line with battery technology.
- Deployment of electric powered aircraft will be accelerated by the existing evidence that maintenance and "fuel" costs are significantly lower and so fossil fuel powered aircraft will not be able to compete on short flights. Significant investment in regional airports will be required particularly to support greater electricity demand in isolated areas of the grid.
- Page 17 Transport and infrastructure Net Zero Roadmap and Action Plan. Good to see that the Government is indicating that aviation will have to play its part in emissions reduction. The most important aspect for government is to set emissions reduction targets for the aviation sector. Australia will need to consider mechanisms such as those in the EU and California to guide the energy transition through mandating adoption of low carbon streams into fuels for aircraft and ground support. This will provide certainty for industry to invest in Australia and support the development of SAF and renewable diesel production facilities. Tightening emissions from airport precincts would also drive innovation in ground support and aircraft taxi emissions through NGER. Starting emissions targets at low levels, building as domestic production rises, would minimise impacts on aviation budgets, fight costs and inflation.

- The white paper needs to focus a specific section on “managing the energy transition” noting the overarching need to decarbonise the sector as the only viable solution to meet net zero targets, and the initially higher cost of SAF (which is the only available replacement fuel for existing, in-procurement and planned future fleets). The role of a white paper is strategic – not addressing this strategic issue is a significant failure.
- Page 19. Disappointing that in the sector overview the need to decarbonise aviation by 2050 is not addressed in the highlighted section. This is the biggest challenge the aviation sector will face in coming decades. In fact have to read down to paragraph 6 before net zero emissions is mentioned as the last issue to be addressed. This is such a significant challenge it should be front and centre rather than focusing on the (now) historic effects of COVID-19. By the time this white paper is developed, refined and released, recovery from COVID-19 will be largely complete. other than addressing pandemics as a significant risk for future aviation, and the need for mitigation measures in the event of a future pandemic, it seems to have prominence in this section that is out of proportion to its effect on future aviation development. Given net zero 2050 is government policy why is decarbonisation not more prominent?
- Page 24 aerodromes. One significant issue not discussed is the need to upgrade and refocus passenger arrival to and departure from existing major airports. Melbourne Tullamarine is a good example of how the increase in passenger numbers has not been met with more efficient ground transport solutions. Several times recently I have picked up colleagues and family from the airport and the arrivals and departure lanes are extremely congested and dangerous for passengers. Future reliance on private transport for passengers arriving at and departing from major airports has to be curtailed. Most major airports rely almost entirely on private or ride share vehicles, with a few exceptions. Major work is needed to refocus passenger arrivals and departures to public transport, preferably rail as shifting to buses seems to create further traffic congestion. I have experiienced the same problems at Perth and Mascot. Given public transport is an important emissions reduction solution for airports and commuters, providing effective and affordable solutions to airports should be a significant priority. The problems will only get worse given the announced plans to add new runways and capacity, and for growth in passenger numbers. Early AM arrivals and departures for passengers at Tullamarine is well beyond reasonable capacity already. As specific section dealing with connectivity of airports is required.
- Connectivity of airports seems to be only addressed with advanced air mobility. AAM is unlikely in the foreseeable future to be cost effective for the average passenger and it will become quickly congested if it attempts to support larger numbers of passengers (mentioned on page 31). Relying on AAM to support passenger arrivals/departures from the terminals is fraught and flawed if expectations that significant numbers of passengers will be using it before 2050. Where is the section relating to good old fashioned and highly effective transportation means like trains and buses.
- Page 27 AAM for freight use will compete with airspace for AAM for passengers and will quickly saturate airspace around airports. Its not realistic to think that it can compete with ground transport.
- Transport of passengers to and from airports needs to be considered wholistically as part of the aviation sector. Presently it is left piecemeal in terms of planning and afterthought in most locations and growth estimates for passenger numbers is not being matched by funding for and cosntruction of improved public transport networks.

- Page 30 sustainability drivers are discussed simplistically. Sustainability is not just low carbon emissions, it requires all aspects of the aviation sector to reduce environmental impacts. This is dominated of course by Jet A-1 use but sustainability must include airport electricity use, replacement of methane gas use for space heating, improved energy efficiency, and installation of solar PV/battery technologies to decarbonise airport terminal operaitons. There will need to be sustainability focus on noise pollution and management of ground (soil/aquifer/drainage and air pollution from hydrocarbons and other pollutants (including de-ice fluids), transport of passengers, and recycling and reducing waste streams. None of these are addressed under the sustainability banner. They should be.
- Page 30. Little discussion of the effects of passengers electing to reduce flights to reduce environmental impacts. Its described as "could impact demand". There is going to be a significant need to reduce overall flight demand through voluntary reductions in frequency of travel if decarbonisation and sustainability requirements are to be addressed.
- Page 31 sustainability drivers. Section needs to be broadened to address all aspects of sustainability not just aviation fuel consumption. There is no linkage to net zero operations by 2050 given the statement that "electric/hydrogen powered aircraft are unlikely to comprise a material portion of the australian commercial aviation fleet by 2050". There is no discussion how the sustainability goals can be achieved without government support for a SAF industry given there is "no clean tech alternative". The white paper must address how this industry is to be supported and developed to provide the methodology to decarbonise the aviation sector fuel emissions.
- Page 32. Maximising net zero contribution. "significant transformation of the industry over the next 27 years" is extremely unlikely. Existing newly purchased and on-order aircraft are all Jet-A1 powered and will remain so until at least 2040, apart from some short haul routes (eg Canberra to Sydney and potentially Canberra to Mebourne).
- "High quality offsets" (whatever these are) are going to be in demand in the future across all sectors as this appears to be presently the option of choice due to low costs. This will change in the near future as demand for them grows and competition for them escalates. The low cost nature of aviation means this sector is very vulnerable to price increases, compared to competing sectors like mining that are targeting the same offset schemes. The role of the white paper is to anticipate the likely unaffordability of offsets in the future and so reliance on them for cost effective emissions reductions to and beyond 2050 is fraught.
- The paper needs to discuss and identify what "high quality" offsets actually are, and what measures and controls on this will be in place, given existing schemes have failed to deliver on environmental decarbonisation outcomes. An emerging issue is that offsets are being claimed over sustainability initiatives that should be conducted regardless of the emissions reduction gains, such as re-foresting/rewilding and preventing rangelands and forest land clearing that should not be undertaken anyway if sustainability is the driver.
- the emerging aviation technologies is silent on emerging propulsion and fuel technologies. These need to be addressed given they are the only solutions to meet emissions reduction targets.
- The competitive aviation sector uses airfare prices (domestic air fare index and real best discount fare) as guiding the degree of competitiveness and therefore consumer value. This does not address the current carbon emissions free structure of the industry. Air fares will necessarily rise in future to pay for existing pollution that is not charged, and to pave the way for greater introduction of low carbon fuels. The

white paper needs to consider and address how this is to be done and how the customers can be educated on the necessity of it. Noone today discusses the cost of emissions controls on cars when they buy them. They add significantly to vehicle cost but it is a national legislative requirement and embedded in the vehicle. Buying an airfare in the future should be the same in terms of buying low carbon travel. The white paper needs to consider how this is to be done given SAF is more expensive and will be almost the only solution available to meet net-zero emissions reductions.

- Page 38 Regional variations. Regional passengers will be faced with larger costs associated with uptake of SAF – due to longer domestic travel distances and less fuel efficient transport solutions. The white paper needs to consider how regional passengers can be suppported during the energy transition to ensure air travel remains affordable.
- Page 44. The white paper needs to mention how accessibility of air services to people living with disabilities can be supported during the energy transition given there will likely be impacts on air travel costs. Ths is discussed in detail in Section 3.
- Page 47. Economic regulation of airports. Noting the dot point comments above, there is inadequate linkages between traveller transport to and from airports, and airport growth and development meaning significant congestion at airport arrival/departure locations is widespread. Ensuring these aspects are cinsidered in quality of service monitoring, or some other mechanism that considers how planning arrangements between airports and commonwealth and state governments can be aligned.
- Page 52 regional economies. Regional populations are likely to face greater impact from rising airfares due to uptake of SAF/use of offsets due to the longer domestic travel requirements, and the number of isolated communities. The white paper needs to consider how these people are supported during the energy transition. Characteristics of regional markets needs to discuss the effects of uptake of SAF (as the only viable option to decarbonise longer routes) and how isolated communities can be protected. There is discussion of electric aircraft but no discussion of SAF.
- Page 55. Responsibilities for regional infrastructure. The white paper needs to discuss how regional aviation can be supported during the energy transition. The previous section discussed trials and development of electric aircraft for regional short haul routes. This has significant implications for regional aviation infrastructure around provision of charging infrastructure. Aside from flight line recharging points, local electricity grids may need enhancement to support the load demand of charging of large battery systems. These will need to be coordinated if the rollout of electric aircraft is supported and is not hindered. This is not discussed in this section but is in the following setion on page 58 – it would benefit from a link here.
- Page 56. The transition to net zero opportunities for regional communities ignores the infrastructure demands that will need to be met. There will need to be charging at the flight line, upgrtades to electricity networks and in somecases generation, and potentially storage solutions. For hydrogen, storage and delivery systems will need to be developed funded and built. There needs to be a section in the white paper that discusses infrastructure issues for future energy solutions. The transition to net zero also affects space heating and electricity use at the aerodrome. This needs to be discussed as part of the broader sustainability initiatives and in the following section but is ignored in this section.
- Page 57. Great discussion of options for decarbonisation! However the decarbonisation challenges needs to include discussion of the infrastructure costs for new fuels (electricity and hydrogen) and how these will be supported is not addressed. This needs to be a key focus of the white paper especially noting the comment ”….

Making these infrastructure upgrades to support decarbonisation technologies challenging for these airports" – so – how is the white paper going to address this issue given it has been raised as a "concern"

- Page 57. Electric aircraft may have a higher capital cost but likely much lower operating costs (especially as Jet-A1 costs continue to rise). This should be discussed here noting there may be flow on benefits for regional communities. This is discussed on page 58 so a link would be useful. The discussion on page 58 sort of contradicts the comment on the previous page that purchase of electric aircraft in terms of capital cost might have the opposite effect!!
- Page 59. Climate change resilience discussion should cover all of the risks in paragraph 2 – severe storms and rising temps are mentioned in the following paragraphs but not incldued in paragraph 2 overview. Also severe storms damage infrastructure which needs to be addressed aside from flight delays.
- Page 70. Interesting that AAM is discussed before electric aircraft. The former is a niche and largely developmental aircraft platform with limited opportunity to manage significant numbers of travellers before 2050. Electric aircraft by comparison are already flying and commuter short haul aircraft are expected to be widely available by 2030 (eg Eviation Alice). It sends the wrong message that AAM is discussed before electric passenger aircraft given the low potential to significantly reduce emissions by the former before 2050.
- Page 70 good to see discussion of climate change resilience at airports. One addition might be to draw the link to disaster response. Airfields are key disaster response hubs and so need to be the most resilient, as during disasters is when they are most needed to support HA/DR activities.
- Page 71. **What opportunities do emerging aviation technologies present for regional and remote Australia?** The white paper needs to consider fully the regional economic and energy security benefits of local production of SAF and adoption of electric aircraft. Production of SAF will be regional in terms of feedstock and so there is benefits to regional communities around agriculture and related industries. Regional areas are also the areas where SAF and its precursors will be produced and there is the opportunity to leverage jobs and economic value from production of feedstocks for SAF. This is discussed on page 69. Resilience of the electricity grid will need to be addressed to permit rollout of electric aircraft noting many regional airfields are at the extreme end of the electricity grid or are supported by standalone generation. Electric aircraft present the opportunity to substanrtialyl reduce costs of travel due to low fuel costs. The first electric aircraft are likely to be in the 4-20 passenger range, ideally suited to remote areas with lower passenger numbers. Hydrogen makes little sense as an aircraft fuel given its high production cost and the need to duplicate refuelling facilities. Hydrogen storage is incompatible with kerosene fuel storage due to combustion risks. So finding a suitable site for storage of high pressure hydrogen in many locations may be challenging. Given hydrogen aircraft are not anticipated to be flying until the late 2030s is inconceivable that hydrogen can significantly contribute to aviation decarbonisation prior to 2050.
- **Page 71. What are specific issues experienced by the regional and remote aviation sector in the context of decarbonisation?** Remote locations, poor infrastructure services, especially electricity supply. Long distance flight routes with low passenger numbers, marginally economic. May need subsidies to assist with aircraft early retirement and replacement with low carbon alternatives due to the low financial viability of the services. Lack of SAF industry in Australia to support uptake.

- Page 71. What are the challenges faced by regional and remote aviation and airports posed by our changing climate? Well covered on page 70. But need to emphasise the criticality of airports as transport hubs for HA/DR and evacuations/logistics centres. So they need to be more resilient than other regional infrastructure.
- Section 5 page 74. Reliance on offsets is fraught. We currently consume several planets worth of resources, so there is never going to be enough offsets for all decarbonisation efforts. Many offset programs have been verging on scams, and effective ones need to be implemented to achieve other sustainability goals including reforestation, habitat protection and enhancement, and to arrest land clearing. Its likely any offsets will become too costly to simply use as fuel burn offsets. Its not recommended to rely on offsets as a significant contributor to aviation decarbonisation, simply because they will become too expensive.
- 5.1 page 75. Placing SAF as the last discussion point in dot point 3 belies its importance as a decarbonisation method. SAF is proven and in widespread production overseas, and it can be burned in existing platforms, and it is being mandated in key leading oveseas jurisdictions. Offsets will become more expensive due to competition for them, and new propulsion technologies such as hydrogen or another fuel will come too late to participate in decarbonisation by 2050. Efficiency gains from propulsion will be modest and not significantly reduce overall emissions, especially noting the growth in the sector by 2050. The emphasis in this dot point should be on the solutions most likely to contribute to decarbonisation – namely SAF and electric aircraft.
- **What opportunities are there to develop domestic bioenergy feedstock production and collection in Australia's regions, and what policy settings from Government would support this?** There is potentially unlimited feedstock available in Australia for production of SAF.
- Aviation is a hard to abate sector only because the present industry is based on abundant and cheap Jet A-1. This section and the whole document needs to focus on why the sector is so reliant on low cost fuel and has limited ability to absorb higher prices. It is inevitable that fossil based fuels will rise in cost, from the combined effects of reduced global demand, and spiralling production costs. Facilitating transition to SAF will increase sovereign energy independence, and improve our balance of payments deficit. SAF can release consumers from increasing fossil fuel supply constraints and cost structures.
- Page 74. As discussed above this whole section appears to focus first on solutions with limited potential to decarbonise the industry. This section provides good overview of the limitations of efficiency gains, new propulsion technologies but these "non-solutions" are discussed first, and SAF, the only viable solution, last. Offset problems are discussedm but there is no mention of the real problem with them – so many are needed its likely the cost of them will escalate due to competition from other industries, to the point the industry cant afford them.
- Flight alternatives: the paper doesn't discuss reducing flying at all. This is a simple way to avoid emissions rather than reducing or offsetting. There needs to be a specific discussion of alternatives to flying, around the existing mention of videoconferencing-elimination of emissions is the cheapest form of emissions reduction. There needs to be incentive programs for business travel to reduce the high levels of existing travel and perhaps for individuals as well. **Perhaps an incentive program to reward people who elect to travel less frequently rather than more frequently (?)**

- The discussion of SAF is unnecessarily negative, this whole dot point needs to be realigned given these fuels provide the only means to significantly contribute to decarbonisation of aviation by 2050.
- This page discussed retrofitting of aircraft. Not sure on what aircraft and what is to be retrofitted but the ability to do this at scale across a plethora of platforms is fraught and a distraction from real emissions cuts. Retrofitting with alternative propulsion systems, eg electric will continue to be a niche activity due to the limited solutions available and the certification issues. It is more likely that new build aircraft will be sought due to these design complexities. Replacing Jet-A1 burning engines with another Jet-A1 burning engines is just an efficiency mechanism and should be discussed in the section on efficiency gains, not as a separate solution. Retrofitting of hydrogen engines is even less likely due to the different technologies.
- Page 75 worthwhile discussion on cost effectiveness of duplication of fuel types in airports. This will have to be considered on a case by case basis as the ability to support different fuel types will vary geographically. For some locations, supporting decarbonisation may be safely left until approaching 2050 noting the logistics challenges of providing SAF or high kVa electricity to regional sites (noting that these sites support a relatively small percentage of emissions).
- The problem with Qantas/Virgin targets is their emissions from long haul flights are so high. As a result they can just apply overseas jurisdiction SAF uptake mandates and these would likely satisfy the overall emissions reduction targets they have set themselves. Thus there may be little incentive to use SAF domestically without Government direction to do so. This "double dipping" – using foreign SAF mandates to demonstrate emissions reduction goals would mean Australia's domestic emissions would not decline, even as airlines increase that uptake beyond 10%. Ie the entire commitment may be to international flights, and domestic flights may not decarbonise much at all.
- Net zero operations of airports is laudable but a distraction given the volumes of Jet-A1 that they place into aircraft. Making airports responsible for emissions from fuel farms and taxying aircraft may assist in reducing overall flying emissions.
- Non-CO2 emissions. There needs to be discussion of the actions that need to occur. What research programs. When will these emissions become significant because we have reduced CO2 emissions sufficiently? At what point will actions to curb these emissions have to commence?
- Page 79. Lengthy discussion of SAF uptake and mandates by other jurisdictions reinforces earlier comments in this review that the role of SAF needs to be promoted to the head of the queue when the white paper discusses decarbonisation options. None of these governments are focusing on mandating uptake of hydrogen or ammonia power, or fuel efficiency improvements, or use of offsets. The white paper needs to recognise this and focus significantly more on SAF.
- Page 80. Discussion of strategic plans and roadmaps focuses heavily on hydrogen. This is unrrealistic as hydrogen is unlikely to support significant decarbonisation of the aviation sector before 2050. The role of hydrogen may be to support lower carbon SAF utilising green hydrogen. Otherwise it is at best a distraction. Disappointing the section table does not discuss SAF-industry support initiatives by the States and Territories.
- **Answers to questions on page 80.** Australia must match commitments by the EU, UK and US regarding uptake of SAF. It is highly likely that Australia will be penalised through border initiatives if we fail to do so. Support for domestic production of SAF and utilisation of domestic feedstocks for SAF should be a

significant priority. Australian govt should provide more support to the emerging SAF industry in this country noting the strategic fuel reserve benefits, reduction in the trade deficit resulting from reduced Jet-A1 imports, and the regional economic benefits and job creation in areas with limited opportunities for economic growth. Australia needs to include emissions reduction measures for airports to ensure they remain on track for net zero by 2050. This should include "waypoints" that ensures measures are adopted earlier rather than later. GA emissions must decline as well. Measures to adopt ethanol into aviation gasolene need to be considered, including support for operators to undertake the necessary certifications and modifications to permit them to use low but increasing blends of ethanol. Jet A-1 GA operators need to be held to the same standards regarding uptake of SAF, noting on most facilities the fuel farm services all aircraft.

- Section 5.2. SAF is expensive at 50% blend. It is not expensive at a 5% or 10% blend which is all that is needed to commence the transition. Even meeting a 5% blend target would be a significant stretch target for a future domestic SAF production industry.
- Demand for SAF is not high. There is no operators currently using it and none have committed to offtake from plants. This dot point needs revision noting that its extremely unlikely domestic operators will uptake SAF while the cost is higher. Low blends initially are a solution to the cost problem.
- This section should focus on the balance of payments (import costs) of finished fuels and crude oils that would be relieved by a domestic SAF industry
- This section needs to note that existing refineries can uptake up to 10% biocrudes into existing crude oils without compromising the certification of the jet fuel. It also needs to note that both existing refineries can or are being modified to accept SAF or its precursors, and there are numerous other companies proceeding with refinery plans across the country.
- Last paragraph of page 80 finally states that SAF is the "main lever" reinforcing comments above that it is not treated as such as you read through this paper.
- Page 82. This paragraph needs to indicate that the costs discussed are for 50% blend SAF and that the costs are directly proportional to the blend rate. It is inconceivable that at this time 50% SAf could be provided to offset jet fuel use. However, beginning at a few percent is possible and the cost difference is marginal.
- This section notes the strong incentives in the EU and US but doesn't draw the obvious link that Australia must and will likely be forced to follow suit. We cant afford to sit on our hands.
- Page 83. Synthetic fuels that compete with food crops should not be considered at all for aviation decarbonisation. Third generation synthetic fuels use bio feedstocks that are underutilised (eg waste biomass) or low productivity rangeland (marginal) areas.
- Australia doenst have a lack of jet fuel refining capacity at this point in time. The existing refineries could co-process up to 10% bio feedstocks and still remain certified, and given their production is currently around 3 billion litres per annum we are not far short of the 5 billion quoted. The problem is there is currently no demand and no commitment to produce SAF. This section of the white paper needs to be updated noting the recent and significant commitments of SAF producers and refiners.
- Page 84. The paper uses the term "SAF certification" when speaking about demonstrating its emissions reduction provenance. This is unfortunate as "SAF certification" is principally used to describe the ASTM International led certification for use of SAF by existing aviation platforms and engines. Its recommended that a

revised term be used so as not to portray that further certification of platforms and engines is warranted or expected.

- In fact the paper doenst address SAF platform certification integrity at all. This needs its own section. All platform operators will need to undertake internal certification assessments that their platforms and engines can use SAF blends from the currently ASTM approved pathways
- Demand signals mandates. It should be noted that global demand for SAF is high but not in Australia and so there is minimal incentive for local industry to invest. most are looking for offtake agreements before commencing. Thus the supply side is dependent on the demand side – umless there is a mandate it will be difficult for the industry to flourish in a timely manner.
- SAF targets – comparison with other competitor airlines in the Asia Pacific and as an argument to not have mandatory targets is not sensible. This condemns us to a follower "reactive" strategy given the intentions of the EU, UK and US. It would be more sensible to apply mndates to all airlines operating to and from australia, and not on flights to and from countries that have no mandate.
- The document is silent on the need for "mass balancing" of SAF through existing fuel supply chains. It would be prohibitively expensive to duplicate supply chains, and an understanding of how mass balancing works would go part way to answering the first feedback question on page 86.
- Page 86. Australia as a SAF producer – need to incldue the balance of trade benefits from reducing import of fossil fuels.
- **Page 86 questions**. The SAF industry will absolutely need regulatory settings and policy to support its development. Currently all potential producers and importers are looking for offtake agreements especially with Defence. Low level mandated uptake would not appreciably affect ticket prices if the uptake can be at specific sites but taken as a percentage of overall airline fuel use. For example, uptake at Brisbane or Sydney airports at 50% might permit operators to claim 5 or 10% emissions reduction across all sectors. The blend ratio could commence lower until local production increases.
- Main challenge for the industry is lack of certainty around policy and lack of uptake agreements with fuel users.
- Another challenge relates to certification of a new pathway for SAF production by ASTM international. Some potential producers have no pathway to producing SAF and so assistance to do this might be considered in specific cases.
- Page 87. The content is dated. Hydrogen powered purpose built aircraft are unlikely to be flying now until 2035. Saying they will be commencing "widspread deployment" at this time is unrealistic. Such would depend on the design efficiency and effectiveness of hydrogen as a fuel source, and widespread adoption of fuel production and distribution systems. There is issues of storage at airports and delivery to aircraft as well as the engines themselves. This will likely require significant development and will slow potential rollout. Companies will have to tool up and commence production of new aircraft designs. Its extremely unlikely therefore that "widespread deployment" of hydrogen powered aircraft will occur before 2040, in fact its relatively optimistic to think that hydrogen powered aircraft will even COMMENCE widespread deployment by 2040.
- Electric aircraft are far more promising. As new battery technologies emerge, battery powered aircraft have the potential to completely disrupt the industry. The paper should consider how adoption may be accelerated if there is widespread agreement in

the industry that electric aircraft are going to be taken up more rapidly than first thought. – need for a scenario around this?

- Page 88 discusses GA use of avgas, why is not blending with ethanol being considered as an option to reduce emissions. It should at least be discussed and ruled out if there are clear reasons to do so.
- The indication of 1-2 hour flights by 2030 seems to be too conservative noting the advances in batteries and the current electric platforms being developed.
- The paper should discuss regional aviation and the fact that the relatively low contribution to national emissions means adoption of low carbon alternatives could be delayed for a few years until technologies mature
- Discussion of retrofit of existing light and GA training aircraft should be considered in the light that these aircraft contribute a minute proportion of aviation emissions. They do point to the very good operating economics of electric aircraft.
- Agree with deferring aging turboprops given the relatively small component of emissions they cause. Recommend that the white paper consider the relative contribution of emissions of different aircraft and consider apportioning support to decarbonise in part based on this and the ease of changeover or conversion.
- The discussion of electric aircraft is relatively dated. It is extremely unlikely that an electric aircraft will require battery replacement given the development and research of EV batteries. EV batteries are now considered to be whole of EV life components. Recycling of batteries is also unlikely as most are put to a second use as stationary storage. Recycling batteries will still yield value given the materials held in them. this whole section needs to be revised as it is not correct. Operating costs and maintenace are absolutely going to be lower. That is the whole point. Battery powered heavy trucks are yielding savings of up to 30% and they are a good exemplar for small commercial aircraft in terms of powertrain.
- Given 100% of existing hydrogen is produced from fossil fuels with significant CO2 emissions, care must be observed in supporting hydrogen powered conversions if they end up using black hydrogen and so emit even more CO2.
- There appears little evidence that hydrogen needs to be used as a transport fuel. It is dangerous (leaky, difficult to store and transport, highly explosive) and it has a very low energy content per unit volume. Green Hydrogen is needed to replace the near 1,000,000 tonnes of black hydrogen currenty used in Australia and for decarbonisation of steel production. Burning it as a fuel is the lowest value for the product and therefore the least likely to be the end use. Focusing the aviation paper on hydrogen means there is inadequate attention to the areas that need the most development – synthetic fuels and electrificiation. Green Hydrogen will of course be needed for deoxygenation during production of synthetic fuels from biomass.
- Section 7 page 121. Why is the only decarbonisation option being discussed electrification? The section should discuss use of synthetic aviation fuel for turbine GA aircraft and synthetic components for aviation gasoline (AVGAS) eg ethanol for piston engined aircraft.
- Page 125. Avgas – need to explore “drop-in” replacement fuels that do not necessitate new propulsion technologies – only modifications for some engines and airframes. Why are alternatives not being explored more actively? Why is ethanol not being discussed – if it is completely incompatible why is it being adopted by piston engined cars eg E85 ie 85% ethanol? There are octane boosters available, just would like to see options explored. There is likely to be renewable components.

- Renewable diesel is not discussed with respect to piston engined aircraft as a possible re-engine fit in some applications. RD is produced widely in SE Asia and is shortly to be introduced to Australia with commercial production a few years away.
- Section 9 Emerging aviation technologies. 50% of propeller flights less than 500 km being flown by electric aircraft by 2050 would appear to be spectacularly conservative noting the operating costs of the aircraft are 10% of piston engined aircraft in flight schools. Given 2050 is still 25 years away the uptake of electric aircraft is more likely to be exponential in the sectors where their performance is adequate. Suggest there is a rethink of this with respect to the comments on page 154.
- Emphasis on AAM at the expense of facilitating other improved ground transport solutions such as terminal rail, light rail and trackless trams to move people to and from airports would seem to be wrong. AAM is not taking over these roles in other countries as the majority of passengers move between cities and airports by cheap ground transport. There should be greater emphasis in the paper on how current cost effective transport links can be rolled out, requiring no new technologies as the existing technologies are available. Focus on "vertiports" while the document remains silent on the need for improved passenger ground transport seems inappropriate given the vast majority of travellers will continue to use ground transport as it is cheap and can cater to larger quantities of travelers. Even if AAM begins services to and from airports it will be a niche capability accessed by a small subset of travelers due to the cost.
- The lack of a separate section on interconnectivity of aviation with other transport sectors needs to be resolved through a separate section that acknowledges already at most capital city airports passenger movements are at or above capacity, especially during peak times of day and season.
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Thank You
Dr. Steve Cole
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