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To:
The Department of
Infrastructure, Transport,
Regional Development,
Communications and the Arts

RE: White Paper on aviation - submission

To whom it may concern, 15/02/23

Thank you for the opportunity to provide input into the White Paper that will be developed to examine issues across the aviation sector. Whilst we understand the multi-dimensionality of air mobility, we would like to focus particularly on one of the four specific areas identified by the Government:

- how to maximise the aviation sector's contribution to achieving net zero carbon emissions, including through sustainable aviation fuel and emerging technologies

It is encouraging to see emission reduction identified as a key issue, and to see that it has not been limited to sustainable aviation fuel (SAF) as the single solution, recognising the need for Australia to also invest in new aviation technologies – similar to the UK Jet Zero Council's two-pronged approach. This is critical for Australia which has a high dependency on aviation for domestic services and access, especially for indigenous, remote and rural communities.

We also note that one aim is for the White Paper to set overarching principles and directions for aviation, and we have identified two broad areas that we suggest requiring consideration, namely managing climate risks and taking a system wide approach. These are summarised below and further detail is provided in the subsequent sections:

Managing Climate Risks

- **Articulate and consider the aviation sectors 'exposure to carbon risk,** from both a domestic and international perspective. Consider growth ambitions and the market mix to Australia and explore ways of reducing aviation emissions *before* investing into SAF.
- **A diversity of technological solutions and responses is necessary** to decarbonise the aviation sector, there is no one silver bullet solution and different solutions lend themselves

to different aircraft types and segments. This approach should not be limited SAF, but include electric propulsion, fuel cells, Liquid Hydrogen and emerging technologies.

- **Support R&D, innovation and create market conditions for new and emerging technologies and practices** to minimise risk and realise the opportunities for Australian aviation. This involves building **workforce capability** critical to a successful low carbon transition and across all areas, e.g. engineering, air traffic control, aircraft maintenance, aviation management, aviation safety, pilot training, flight instruction, aviation logistics etc.

Taking a system-wide approach

- **Investigate constraints and opportunities associated with the wider Australian economic and social systems** in which aviation operates, and the interlinkages and dependencies between broader socio-economic systems and services e.g. health.
- **Identify the availability of sustainable biomass**, studies clearly show that non-emissive sustainable feedstocks are extremely limited and some sources are clearly highly emissive (this is why the Australian Government has now excluded forest biomass as a source of renewable energy). An important question therefore is how much of this should sensibly be made available to aviation, given other societal uses, including a developing bioeconomy? **Strict sustainability criteria for SAF** need to apply to ensure it genuinely reduces emissions and does not undermine other sustainability efforts, including food production and ecosystem protection/restoration.
- **Understand the opportunity costs of allocating scarce resources for SAF,** including land and clean energy, and use metrics such as EROI or CO_2 abated/ kWh of clean electricity to assess societal impacts.
- **Include aviation's non-CO_2 effects**. Regardless of fuel type, the non-CO_2 impacts of aviation on the climate are between 2 and 3 times higher than CO_2 alone for fossil kerosene.

Managing risk

Whilst maintaining Australia's air connectivity provides benefits, we also suggest that increasing our dependence on air travel poses several risks. In particular, we refer to the aviation sector's dependence on international long-haul tourism that is vulnerable to a wide range of potential future disruptions. The Covid-19 pandemic has illustrated vulnerability of the global aviation system, and at the same time provided evidence of the benefits of pivoting to domestic markets to ensure ongoing tourism business.

There are various other disruptions that are plausible (e.g., geopolitical conflict) or even more likely (e.g. increases in the cost of air travel due to carbon pricing), which mean that any business or destination within Australia that has not considered 'exposure to carbon' through their market mix is highly vulnerable. Understanding the level of carbon risk should be central to future aviation and tourism strategies. (Please see paper Becken & Shuker, 2018, abstract attached).

Climate risk management requires diversification in the range of aviation solutions that Australia invests in, to provide a multi-pronged approach and network fit for the future under multiple potential constraints. Therefore, **it would be prudent to invest simultaneously into solutions for both long-haul air travel (notably SAF and hybrid technologies) as well as short-haul and regional air travel (electric and hydrogen electric solutions), along with the option to substitute the former with the latter where possible**.

Diverse fit-for-purpose solutions are required to minimise risk and increase resilience of the aviation sector and should not be limited to SAF, but include electric propulsion, fuel cells and (clean) Liquid

Hydrogen – all of which play a role in reducing emissions associated with the sector. Please refer to Griffith University's Aviation Reimagined webinar series that showcases opportunities in aviation policy and practice toward net zero for Australia). All sessions are free to replay from 2021 and 2022.

If we as a society are investing into SAF, if we don't carefully assess our risk, we could find that we go down a path where we will not get the result we are hoping for with our current agriculture and supply chain challenges. More specific thought needs to be given to the R&D required for technologies and also behavioural change, as well as the workforce literacy in the aviation system to minimise greenhouse gas emissions where possible. There is also a critical need for a reality and sense check on what is truly achievable and attainable in terms of production and availability in a globalised marketplace. Substantial investment would be required to develop refineries at the scale required to produce anticipated quantities, and there is a human rights aspect that needs appropriate consideration.

Taking a system-wide approach

An Aviation White Paper can only provide sound direction if it takes into account concerns, constraints or opportunities associated with the wider economic and social systems in which aviation operates. If a wider systems thinking perspective is not taken there is significant potential for unintended consequences and sub-optimal outcomes for Australia.

We would like to raise several important considerations around the development and use of Sustainable Aviation Fuel (a peer reviewed paper to this effect is forthcoming) and the role of SAF in Australian aviation, recognising there are a broad spectrum of SAF types with widely variable socio and environmental impacts.

First, as discussed above, there is a limited availability of sustainable biomass (globally and in Australia), and the strategic question is how much of this should sensibly be made available to aviation (alongside a developing bioeconomy). The Australia Bioenergy Roadmap (ARENA, 2021), which also correctly excludes use of forest biomass, suggests a theoretical resource potential for bioenergy of over 2,600 PJ per year, noting that no constraints of access, sustainability and competing land use have been taken into account. This is an important limitation, especially when ensuring that biofuel does not conflict with food production. Assuming, a 50% conversion efficiency, a maximum of 1,300 PJ bioenergy could be available. According to Australian Petroleum Statistics (Department of the Environment and Energy, 2019) a total of 9,402 ML of jet fuel were sold in Australia in 2018/19, equating to 329 PJ. This would mean that aviation would demand around 25.4% of the total available bioenergy of 1,300 PJ. As noted, this figure does not include consideration of sustainability criteria, which would substantially reduce the available biofuel.

Second, the production of bioenergy is not zero carbon. Without fertilisers, we will not have the sustainable yields that are required for food, let alone the biofuel sector. Fossil fuel (gas) is primarily used for production of nitrogen fertilisers which will be a significant input into growing resources for SAF. Fossil fuel is also used in the harvest and transport of SAF. The reason why the use of forest biomass is not allowed by the Australian Government is because of the long time lag between burning woody forest biomass – where the emissions are instantaneous – and the time needed for new tree growth to remove an equivalent amount of carbon from the atmosphere. With the shrinking 'carbon budget', we cannot afford delays of potentially hundred of years. This is why we strongly support exclusion of native forest biomass as a feedstock. When modelling biofuel, it will also be necessary to consider the impacts of climate change on crop yields as more extreme weather events are experienced, which are predicted to worsen into the future.

Third, there are also considerable constraints with the production of e-fuel (or synthetic kerosene). Here, the electrolysis of water, capture of carbon, and process to generate hydrocarbons requires significant inputs of energy, mostly electricity but also heat (often using gas). In a scenario where 'clean electricity' is infinitely available in Australia this is not a constraint. However, the realities of energy systems being already strained (black outs occur) and the imperative of decarbonising what is a carbon-heavy grid, clean electricity is, indeed, a scarce resource. Clearly, clean electricity will face supply constraints just like biomass. This needs to be considered in aviation (growth) scenarios.

Fourth, SAF production involve a complex and energy intensive production process with high associated energy losses, e.g., measured through EROI. For the case of e-fuel, for example, the overall efficiency is as low as 15%, when measured on a wake-to-wheel basis. The energy invested into producing SAF could be used elsewhere with a major greater carbon abatement benefit. For example, investing into renewable energy capacity with the aim of switching off coal plants results in 10-fold emissions savings compared with using that same amount of clean electricity to produce synthetic kerosene (see UK Climate Change Committee, attached graph).

Fifth, the issue of aviation's non-CO_2 effects (including contrail formation) are also critical to be aware of. Regardless of fuel type, the non-CO_2 impacts of production and use need to be considered in assessing the overall climate impact. The non-CO2 climate impacts are between 2 and 3 times higher than CO_2 alone for fossil kerosene.

Wider mobility system

Given the scarcity of resources and the high opportunity costs associated with 'making SAF" (e.g. land to grow biofuel, renewable electricity for e-SAF) it is essential the White Paper considers aviation in the wider *transport sector* context, and not in isolation. Whilst this might sound paradoxical, this is an avenue that multiple countries are pursuing now to a) improve multi-modal mobility and b) maximise carbon reduction opportunities.

China has long been an example of high-speed rail complementing air travel, and more recently several European countries (notably France) are divesting or regulating away from short-haul flights and instead investing into long-distance rail travel. The benefit of electric rail, relative to e-SAF, is that the direct use of electricity provides much larger efficiencies than the complex conversion into hydrocarbon fuel. The air route between Melbourne and Sydney is one of the busiest in the world. A High Speed Rail link between them via Canberra has been discussed for many years and so the time sems right for implementation as part of a low carbon mobility strategy.

The White Paper should set a realistic pathway, that considers current and future fuel demand for aviation in Australia in a wider mobility context, and what level of SAF supply is needed, and what proportion is possible and practicable. This also helps to target its use and application, where is it needed most e.g., defence or long-haul flights where other decarbonisation options do not exist given that battery and hydrogen electric would appear to be only potentially feasible for short/regional trips.

We are happy to provide more detail in a follow up conversation if that is of any benefit.

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Additional material

Contents lists available at ScienceDirect

Tourism Management

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A framework to help destinations manage carbon risk from aviation emissions

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ABSTRACT

Global tourism is booming, and so is demand for air travel. Recognising that travellers come with a carbon footprint increases the complexity of decision-making for destinations that seek to attract more visitors. The carbon risk inherent in travel to and from a destination could be substantial but current approaches of accounting and lack of transparent data impede a full understanding of exposure and trends. This research therefore takes a demand-focused approach and proposes ten carbon risk indicators that help destinations assess their absolute and relative risk to the economic, financial, social and environmental costs of carbon. The analysis generates global benchmarks for carbon-, passenger- and itinerary-related indicators, and presents a list of most exposed destinations, approximated by departure airports. A comparative assessment of four airports highlights how differences in passenger volumes, geography, route network and travel behaviour by markets influence exposure. Recommendations for destinations are provided.

Climate Change Committee (CCC) (2020). Sixth Carbon Budget Report. Electricity Generation. https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Electricity-generation.pdf