Comments on the consultation paper on the Sustainable Biofuels Mandate

Since 2017, The School of Aviation, Massey University and Oceania Aviation* have worked collaboratively on a research programme evaluating biodiesel applications in general aviation. We are making a joint submission to the consultation paper on Sustainable Biofuels Mandate.

First, we would like to express our support for the proposed Sustainable Biofuels Mandate as the transport sector contributes a significant proportion of green-house gas (GHG) emissions. The impact of climate change caused by the increase of GHG emissions on our life and economy is real and is now close to home given the recent unprecedent torrential rains and floods in New Zealand and around the world.

The technology to produce biofuels from varieties of biomass and to use the biofuels in existing engines in the transport sector has been developed for decades and widely available. Biofuels are a source of sustainable energy, which can be produced from the biomass absorbing part of GHG emitted to the atmosphere, as stated in the consultation paper. This proposed Mandate should lead to reduction of GHG emissions and our carbon foot-print.

We would like to offer the following comments from our research experience in biodiesel applications in general aviation.

1. The proposed initial emission reduction percentage for 2023 to 2025 should be different for different industries in the transport sector.

2. The emission reduction percentage for biofuels and their blends can be affected by the performance efficiency., For example, the engine performance could be lower with 100% biofuels when compared to 50% bio-blends. It could be more complicated than the proposed method to calculate the (supplier's) GHG emission reduction, which might not truly reflect the advantage of supplying a "high reduction percentage" biofuel or biofuel blend.

3. Domestic biofuel production should be encouraged to reduce the "carbon-foot-print" from transportation of overseas biofuel products. The lifecycle emission value of NZ made biodiesels should be established.

Further comments on the paragraphs above:

<u>Para 1</u>

The process to change fuels for aviation engines is relatively long. There are two reasons.

a) There should be a process to test each biofuel blend used in different aircraft. Different engines can perform differently with the same blend. The difference in engine performance might not cause any difficulties in land-based transport engines, for example, rail trains and heavy-duty trucks, but it could cause some aircraft performance issues related to safety. For example, an engine's response speed to the demand of change of fuel intake is slower with some biodiesel blends with high portion of biodiesel content than that with jet fuel. (Research published in 2017). This slow response might affect the aircraft during take-off, for example. A high biodiesel blend would have a low lifecycle emission. Another aspect is that the physical properties of some biofuels can be very different from that of fossil fuel, e.g., high viscosity in low temperature. Most aircraft engines operate in a low temperature environment, which is different from land use engines. A high viscosity fuel certainly would affect an aircraft engine

*Oceania Aviation is New Zealand's leading aircraft maintenance, repair and overhaul provider with significant experience in piston and turbine engines.

performance in air. Therefore, it would need more time to implement the procedure to be able to use this type of fuel in the general aviation safely.

b) The compliance process to get the approval to change fuel for different types of aircraft by CAA (Civil Aviation Authority) is demanding and requires carefully prepared documentation.

Para 2

The proposed method for calculating a supplier's GHG emission reduction is

$$\text{Reduction}[\%]=100\times\frac{E_f - E_{b+f}}{E_f} \quad (1)$$

where E_f is Emissions if all the supplier's fuel s were fossil; E_{b+f} is Emissions of actual fossil fuels with the supplier's biofuels. It can be assumed that the E_{b+f} of a high percentage biofuel blend should be relatively low, so its reduction percentage is relatively high. Therefore, this product might be recognised as a favourable fuel.

However, the actual engine performance by using different biofuel blends should be taken into consideration. For example, some of our experiments results shown in the following diagram, Figure 1, (where D100 is 100% diesel (fossil), B100 is 100% biodiesel, and B50 is 50/50 biodiesel/diesel blend in a single cylinder diesel engine,) show that work efficiency of high biodiesel blends is lower than that of diesel. (The detail of this work is in preparation for a publication.) So there may be a requirement for extra fuel or some auxiliary system to assist the high biofuel blends to meet the work output level. It is possible that the actual emission reduction percentage might not be shown by formula (1) above.

The proposed formula (1) could be modified by a factor for E_{b+f} to reflect the work efficiency issue. This factor would be different for the biofuels for diesel engines and the biofuels for petrol, and the factor should be chosen based on available testing data. Massey University and Oceania Aviation, have the experience and facilities to carry out AvGas engine and aviation diesel engine tests with biofuels to collect more data for general aviation sector in New Zealand.

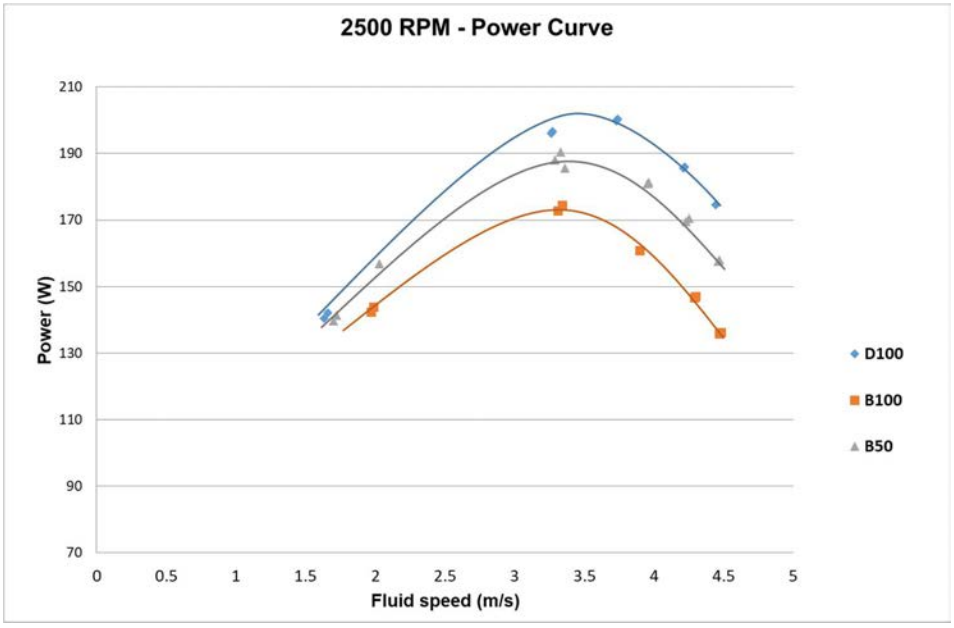

Figure 1

Para 3

The production of commercial biofuels is very limited in New Zealand at present. Domestic biofuel production needs to be supported, if the proposed Sustainable Biofuels Mandate is going to be a reality.

Massey University purchased biodiesel derived from waste cooking oil from a company in Christchurch. The source of waste cooking oil was the restaurant chain outlets, e.g. “Burger King” and its likes. There are many cooking outlets, like takeaways, which produce waste cooking oils regularly, but the waste cooking oils have not been disposed in an environmentally friendly manner. It would secure a certain amount of biodiesel feedstock as well as protect our environment.

New Zealand Z (Z) has invested in biodiesel production using New Zealand tallow as the feedstock. We are considering use of the biodiesel by Z in our aviation diesel engine tests to see the engine performance results.

The list in Appendix I of the consultation paper was based on US data. It would be very good idea to have the lifecycle emission data for the domestic biodiesel made from waste cooking oil and tallow, which should give us a comparison and an indication on what is the best investment for biofuels for New Zealand.