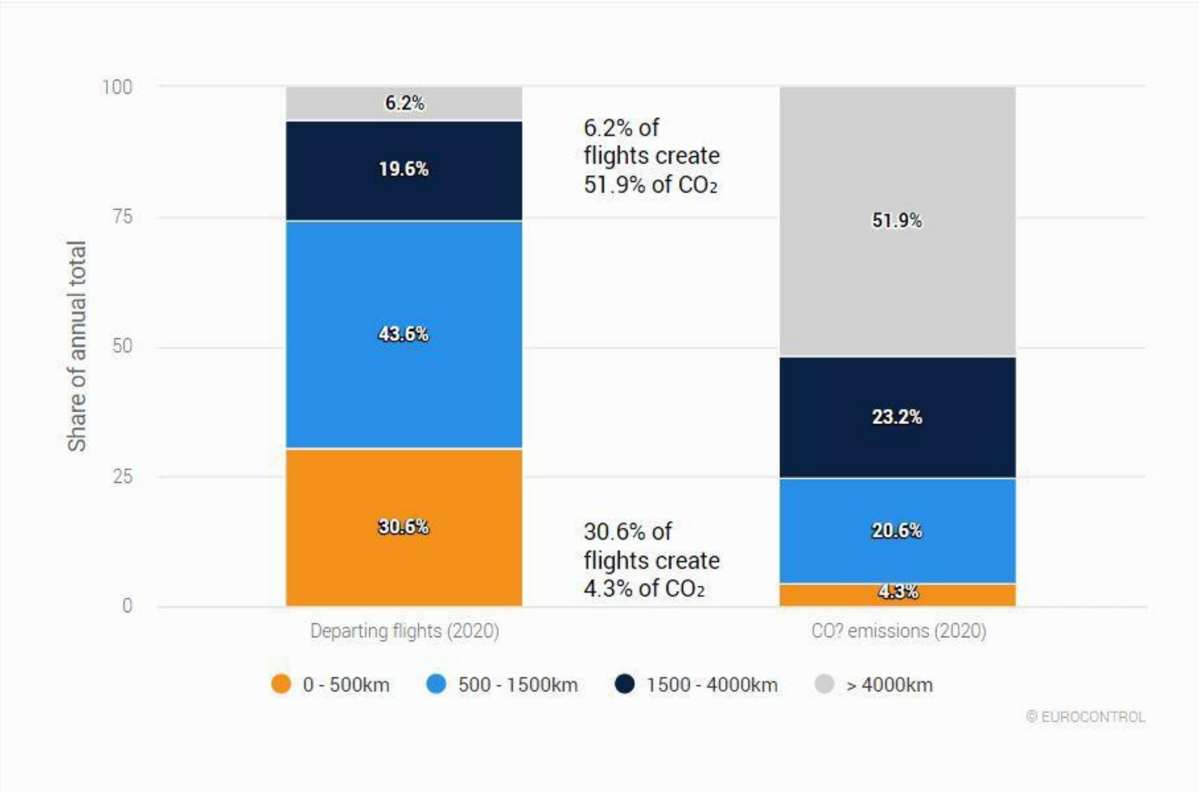
Written evidence submitted by Loganair Ltd.

At the committee meeting on the 30th of March a number of aviation related issues were raised which we believe would benefit from a more detailed response, post hoc.

Domestic versus International air travel

As would be expected from a global industry, generating over $1.7 trillion of GDP (ATAG, 2020) there are significant differences and important nuances within the broad definition of "airlines", particularly in the context of climate impacts. Specifically, we would urge the committee to make a clear differential between "Domestic" and "International" flying activities as a minimum.

Eurocontrol data, (Eurocontrol, 2021) confirms that the majority of EU aircraft emissions are caused by only 6% of flights, the longhaul flights of greater than 4,000km distance and this must be kept in mind when evaluating policy proposals such as Marked Based Measures.



The vast majority of travelers from the UK to European and Rest of the World destinations have no viable alternatives to flying, yet travelers within the UK have a variety of travel options and despite the prevailing public sentiment, flying domestically remains the most carbon efficient mode of travel across the vast majority of city pairs connected by scheduled air services in the UK. This is because over 60% of the UK's domestic air network crosses water and therefore has no viable rail alternative. On the remaining routes very few have an electrified rail option, which is the lowest carbon travel mode, and instead must use diesel powered trains. Over long distances, we believe that high speed diesel rail has an emission factor per passenger equivalent to our aircraft although the rail industry and DfT do not publicly report diesel versus electric rail factors which leads to widespread misconceptions about the carbon efficiency of rail. It is notable that diesel rail emissions in the UK are greater than all domestic flying (DfT, 2021) (1.7 million tonnes CO_2 for diesel rail in 2019 versus 1.4 million tonnes CO_2 for domestic air)

The fact that UK domestic travelers have alternative travel options and that these alternative modes, for the majority of the routes served, result in higher carbon emissions (car + ferry) means that MBMs which cover domestic flights and exclude other modes, have the serious consequence of causing economic harm AND higher net emissions as travelers are forced to swap domestic flights for car based journeys. BEIS emissions factors (BEIS, 2021) suggest that Domestic Air travel has a direct carbon emission factor of 0.13003 kg CO_{2e} per passenger km versus the average for car travel (medium, diesel – larger & petrol emissions are higher) of 0.16496 kg CO_{2e}. Loganair currently have a complaint registered with BEIS regarding the accuracy and methodology used to compute these factors, which we believe understates the emissions of ferry and rail travel and overstates the emissions factors for air travel, but even using the current factors, domestic air travel emits less direct carbon and its equivalent GHGs than driving an average car. The reason that air travel is generally seen as being more polluting is due to the application of the indirect emissions factor, that is the effects of high altitude NO_x and contrails, which we explain later is inappropriately applied to domestic flights.

Frequent Fliers

A point raised in the hearing is that only a small number of flyers are responsible for the majority of aviation emissions and again, we would ask that a clear distinction is made between domestic and international travelers. The focus on emission factors per passenger km, obscures the fact that an average passenger (per BEIS GHG factors) travelling from London to Los Angeles will be responsible for about 896 kg CO_{2e} of direct CO_2 emissions (8,780km x 0.10208), whereas a passenger travelling from Aberdeen to Kirkwall for example, will be responsible for around 26 kg of CO_{2e} (200km x 0.13003) under the same methodology, an order of magnitude difference and clearly demonstrating the relative impacts of short versus long flights depicted by Eurocontrol despite the shorter flight having a higher emissions factor per km. It is vital that the committee understands the integral role domestic flights play in regional economies and societies. Loganair alone carries over 100,000 passengers a year on behalf of the NHS where patients in the Western and Northern Isles and the Isle of Man need to travel for routine or specialist outpatient appointments on the mainland. Similarly, the Northern Isles probably contain some of the most frequent fliers in the UK, when measured by flights taken becuase school children or teachers, as well and nurses and even bankers (RBS, 2019) travel weekly in order to access or maintain vital social and health services. We ask that the committee considers the vital role air services play in the economies of the UK's remoter regions and recognizes the clear distinction in impacts between long haul versus short haul flying. Any proposals for MBMs which target frequent fliers must take account of the vital needs of rural communities, the far lower impact of their shorter travel and the more carbon intensive alternatives available to these groups. Discussions about the impacts of Frequent Flying must differentiate between long haul and domestic travelers, where the domestic travelers are most likely already choosing the mode of travel with the lowest environmental impact.

Taxation on Flying

A point often made, and repeated in the committee hearing, is that aviation fuel is untaxed, the implication being that the environmental impact of aviation is not priced effectively. We concur that aviation fuel is untaxed but would note that this is the case for all modes of public transportation, other than road users where duty is applied. Despite both diesel rail and ferries emitting more CO_2 than domestic flying (DfT, 2021), neither of these industries pay any fuel or other duties. Conversely, air travelers pay Air Passenger Duty in addition to all UK flights being covered by the UK ETS scheme which requires the operators to pay for each tonne of CO_2 emitted (current market price for UKA CO_2 is c. £75 per tonne). In 2019, at market prices the cost of Loganair's operations under the EU ETS was c. €4m and this cost is expected to rise to over £6.5m on the basis of the current higher UKA unit costs. The current consultation on the UK ETS scheme proposes removing access to free allowances for airlines, which would further increase these cost by another 11%.

As a result of this combination of taxes, a passenger travelling for business will pay far more net tax when travelling domestically by air than they will under any other mode of transport. Travel on diesel rail or heavy fuel oil burning ferry services receives a net subsidy in the UK through national government support to these industries. Whilst road users pay VAT and Fuel Duty, business users are able to claim back these costs via the mileage allowance which more than offsets the tax revenue raised on these journeys via Fuel Duty and VAT. There is no such allowance for air travel so consequently business travelers pay a far higher tax for traveling by air than they would via road. Even private passenger journeys on Loganair's network can pay similar levels of tax, directly and indirectly, as they would when travelling by car, for example:

Flight Aberdeen to Kirkwall; APD £13 per passenger, plus UKA ETS charge of £1.74 (26kg CO_2 x £75 per tonne less the 11% free allowances Loganair were entitled to under ETS), total tax £14.74 or 12 pence per mile travelled and 26kg of CO_{2e} total emitted.

Drive from Aberdeen to Kirkwall (via Scrabster/Stromness ferry) ; 225 miles (medium, diesel car, 0.26549 kg CO_{2e} per mile) causes 59.7 kg of CO_2 emissions plus another 4kg from the ferry for a total of 63.9kg of CO_{2e}. Assuming a Fuel Duty charge of £0.5295 per liter plus VAT of £0.28 per liter and the average fuel consumption of a new diesel car of 5.0 liters per 100 km traveled (DfT, 2021) a total of £14.72 in tax is raised.

In this example, despite emitting 59% less CO_{2e} than driving, the domestic air passenger pays the same in taxes despite aviation fuel not being liable for duty. The effective rate of tax of 12p per mile compares poorly to the equivalent tax for our Los Angeles economy passenger, who being exempted from UK ETS and despite paying an APD rate of £84 is only charged 0.15p per mile, nearly 100 times less while creating 40 times as much CO_2. If this passenger flew to Los Angeles as the sole occupant in a large private jet they would be charged the higher rate of APD at £554 for their trip, a tax per mile of 10p, which is still a lower rate than our Kirkwall passenger despite now emitting around 48 metric tonnes of CO_2, over a thousand times more (computed using the Eurocontrol emission calculator tool and assuming a G650 aircraft).

Loganair does not oppose applying carbon based taxation and in fact we support this approach where it applied equally and does not distort the market. For domestic travel this means that competing modes of transport must also pay for their carbon costs, either directly through inclusion in the UK ETS scheme or indirectly via Duty taxation where ETS inclusion would be inappropriate. As an airline, Loganair has been paying for its direct CO_2 emissions under ETS for over 10 years, yet competing and higher aggregate emitting modes of domestic travel (i.e. diesel rail) have not. The reality is that the UK tax regime currently encourages business to take the most carbon intensive mode of transport, driving in a private car. This can only be seen as a policy failure which in our view is caused by a myopic fixation on aviation and a blurring of the impacts of long versus short haul with no assessment of domestic flying in the context of alternative travel modes. Applying further MBM or taxation or SAF mandates to domestic aviation without correcting the existing distortions will not only cause further economic harm generally and impact rural and regional economies specifically the hardest but will also increase the environmental damage from the transport sector as a whole by driving consumers to higher emitting forms of travel, a clear and easily avoidable example of carbon leakage. MBMs and aviation taxation must be more sophisticated and directed at the modes of flying which cause the most environmental damage and which current pay the least per mile travelled or tonne of CO_2 emitted. Care must be taken to ensure that domestic flying, which is a vital part of the UK's social and health networks and a fraction of the UK's overall transport emissions is not inadvertently penalized by policies intended to curtail the environmental damage caused by long haul flying.

Indirect Effects of aviation emissions

The indirect effects of aviation were raised by a witness at the committee meeting with the statement that these effects were "two to three times" the impact of the direct CO_2 emissions alone. We believe that this is misleading and as with other issues, applies differently to short haul, domestic flights and widebody long haul flights.

Indirect effects are the additional warming effects caused by exhausts of jet aircraft at high altitude, separate to the direct impacts of CO_2 and other GHG emissions. These effects primarily comprise of the formation of contrails which increase overall cloudiness and can cause Infra-Red (IR) radiation which would otherwise have escaped into space to be reflected back to earth with a warming effect and also through the complex interaction of Nitrous Oxides with background atmospheric Methane, Ozone and Carbon Monoxide. The combination of reactions includes the creation of additional Ozone (warming effect) and the destruction of Methane (cooling effect) leading to a net warming effect (Lee, 2021). It is crucial to note that whereas the direct effects of CO_2 emissions are long lasting as CO_2 has a GWP_{100} of 1, that is its net warming effect is the same after 100 years as after 1 year, the impacts of the indirect effects are more localized and temporary, acting over a period of hours or several years. This makes comparisons between direct and indirect effects challenging as recognized by the EU ATTICA study (Fuglestvedt, 2009). Further, whilst this is an area of active study, the level of confidence in the quantitative impacts of these effects is far lower than our confidence in the impacts of direct CO_2 emissions as shown by the broad range of the 5% to 95% confidence intervals on the chart below.

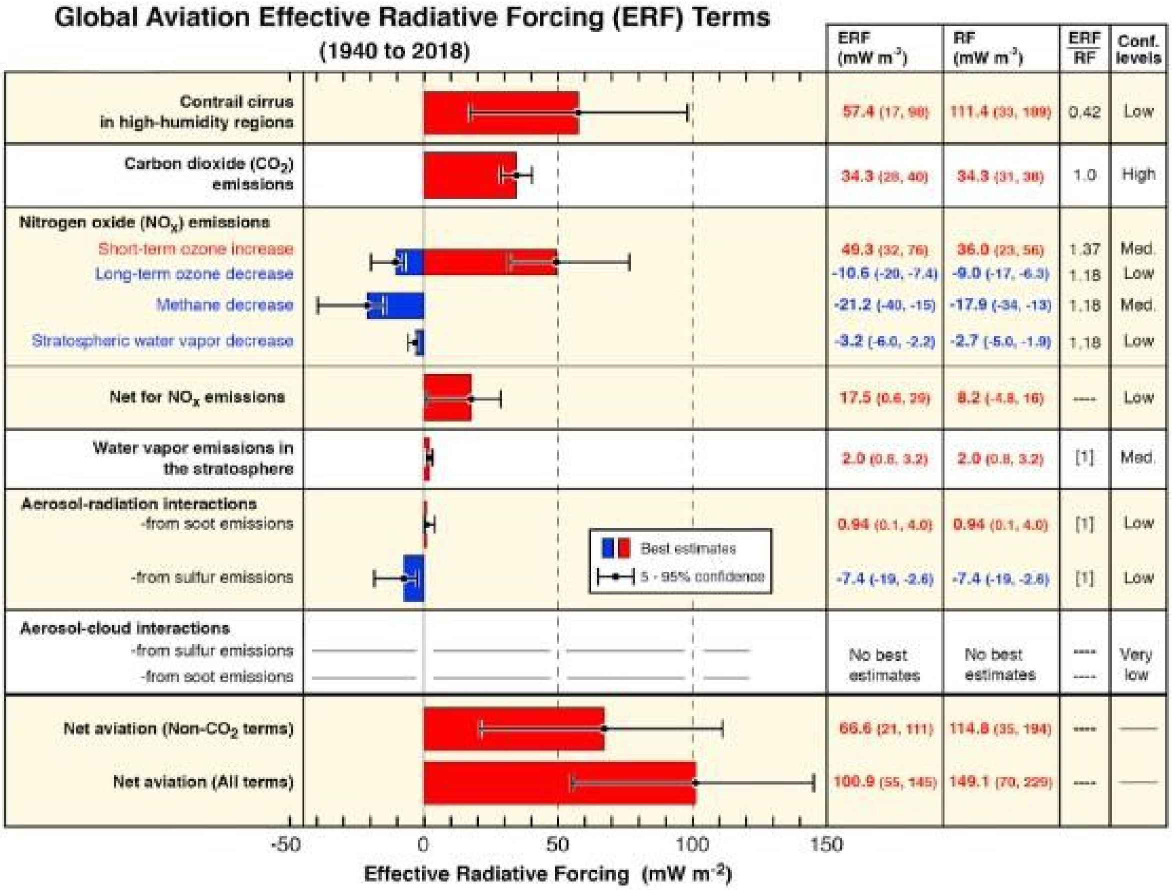


Table taken from D.S. Lee et al (Lee, 2021)

When discussing aviation's indirect effects it is crucial to understand that the effects described are estimates of the global and cumulative impacts of aviation's historic emissions. The paper cited (Lee, 2021) is a retrospective analysis of the total impact of indirect effects which are then compared to the well understood direct effects to produce an equivalent "indirect impact per flight". This is definitively not a statement that each flight has an indirect impact. This is noted in the BEIS methodology for the GHG emissions factors and also explained further in Teoh and Schumman (Schumman, 2020) who estimated that only 2.2% of all flights generated around 80% of all contrails, believed to be the most important indirect effect. The reason for this is that contrail formation is typically caused by aircraft flying at very high altitudes for extended periods of time and encountering blocks of super-saturated air. The conditions required for contrail formation are well understood and defined by the Schmidt-Appleman criterion (Whelan, 2009) requiring specific combinations of temperature, pressure and relative humidity. Under normal (ISA) atmospheric conditions, even if encountering super-saturated air, turboprop aircraft of the type which make up the majority of Loganair's fleet do not cause contrails. This is because at the typical cruise altitudes these aircraft operate at (20,000 to 26,000 feet) the ambient temperature is too warm to permit contrail formation, even in super-saturated air. This was confirmed by Teoh and Schumman's (Schumman, 2020) observations which found that turboprops did not contribute to contrail formation. Jet powered aircraft operating over the same routes will tend to fly at higher altitudes and above 29,000 feet, typical temperatures plus super-saturated air will cause contrails. However, in UK domestic operation, jet aircraft will spend typically only 20 to 40 minutes at these altitudes (between 28,000 and 32,000 feet) and so the likelihood of contrail formation is far lower than a long haul flight where the aircraft will cruise higher (between 36,000 and 42,000 feet) and for up to 10 hours. Further, most of the RF effect of contrails is caused at night (Struber, 2006), where surface IR radiation is trapped by the clouds whereas daytime contrails reflect an amount of inbound IR back into space, with a cooling effect. Given that short haul and domestic flights predominantly operate during daylight hours, whereas a long haul flight will predominantly occur during local nighttime at some point in its journey, it can be seen that the impacts are again, largely caused by long haul flying.

The conditions necessary for the complex NO_x reactions to occur are also most prevalent at the lower pressures found at higher altitudes (227hPa or 37,000 feet) (Skowron) which means that the long-haul flights which cruise higher and for far longer are also the primary source of the indirect NO_x effects associated with air travel. For this reason, we believe that the application of the 90% factor on the BEIS GHG emissions factors for domestic flights is totally inappropriate and highly damaging, given that it leads the formal government statistics to suggest that driving a car is less environmentally damaging, despite cars emitting significantly more CO_2 than flying.

The multiplier for indirect effects used by BEIS is effectively a Radiative Forcing Index (RFI) defined by the IPCC (2009) as "the ratio of total radiative forcing to that of CO_2 emissions alone". The source ATTICA reports cited by BEIS in their methodology, specifically Fuglestvedt 2009, contains a section discussing metrics and makes several powerful arguments against the use of RFI's – "**Quite apart from the difficulties in defining an appropriate value for the RFI, the application itself is flawed (Wit et al 2005, Foster et al 2006) because it is not an emissions metric. As illustrated in Section 6.1, present-day ΔF is affected by emissions from many different time periods in the *past*; this is why radiative forcing and associated measures such as the RFI should not be used to assess the impact of *present* emissions on future climate**" [1] The use of the multiplier for aviation is technically equivalent to factoring up the emissions of rail travelers in the current day to account for the effect of historic water vapor emissions from steam engines over the last century. It is positively unhelpful in making current day decisions and policy, particularly where it is used in a comparison with other transport modes, none of which are treated in a similar way. For example, the equivalent indirect effects of shipping are generally deemed to be negative[2], or to have a net cooling effect as the reactions of Sulphur and NO_x breakdown low level Ozone and CH_4 reducing their climate impacts. Clearly, we do not want to incentivise any industry to emit more fossil fuels and so these indirect effects are excluded from UK government reporting, but it is not unreasonable to expect a consistent approach to indirect effects, particularly where UK government is publishing comparisons between modes in the context of overall climate impact reductions.

In terms of mitigating any indirect effects from aviation, we are very positive that this can be done cheaply and quickly. The solution to contrail formation is a minor adjustment to the cruise altitude of the aircraft (temporarily climbing or descending by c. 2,000 ft is generally sufficient) (Schumman, 2020) to avoid the super-saturated blocks of air. Advances in meteorology and computing allows for accurate climate modeling of planned flight paths and accurate forecasting of potential contrail formation and we have been working with innovative UK companies such as Satavia to assess how to integrate their technology into our flight planning processes. Such adjustments to cruise altitude will incur a minor (1% to 2%) fuel burn penalty and consequent increase in direct CO_2 emissions. However, the advice from the scientific community is contradictory on this subject with climate scientists generally wary of increasing direct emissions, even by minor amounts in exchange for

[1] Transport impacts on atmosphere and climate: Metrics (Fuglestvedt, Shine)
[2] Fulestvedt 2008, Lauer 2007, Lee 2006

avoiding indirect effects due to the longer lasting effects of direct CO_2 emissions versus the shorter lived, indirect effects (Fuglestvedt, 2009). Whereas the majority of scientific literature on this topic is based on theoretical modelling, the significant drop in air travel caused by the Covid pandemic permitted researchers in Canada to study the observed effects of the reduction in flying and test for the expected impacts. This study was unable to find to find the expected temperature variations predicted by the modelling, suggesting that the stated effects are at the lower end of the likely range and reinforcing the point that the RFI is a historical rather than current day emissions metric (Digby, 2021)

Loganair believe that technical solutions are available to the industry and can be applied quickly and globally to address the majority of indirect effects but that what is required is a clear scientific consensus that the trade (direct versus indirect emissions) is environmentally appropriate along with policy to reflect this. The indirect effects are primarily caused by long haul flying but the use of crude estimates mean that domestic flights are unfairly and unscientifically tarred, leading to damaging public perceptions and higher carbon emissions as consumers mistakenly believe that driving is a lower impact mode of travel (versus domestic flying). Currently the ETS scheme disincentivises domestic airlines from avoiding indirect effects as the resulting higher direct CO_2 would lead to a higher ETS tax bill.

Summary

Loganair has committed to achieving net zero by 2040 which we believe will be achieved through the introduction of Hydrogen fuels across the majority of our fleet. We expect to be amongst the first commercial airlines in the world to operate this type of aircraft in commercial service, in this decade. This fuel produces no carbon emissions at the tail pipe and is being actively developed as a propulsion fuel by numerous major aircraft manufacturers such as Airbus and Embraer as well as smaller new entrants such as ZeroAvia. We recognize that SAF is a crucial decabonisation pathway for Long Haul flights where hydrogen or other zero emissions technology is not applicable. The current consultation on the SAF mandate proposes to require all UK airlines to pay for blending a small proportion of SAF into the UK's jet fuel supplies. As previously explained, we believe that the imposition of a SAF mandate on domestic flights will further exacerbate the competitive distortion between domestic flying and alternative, higher emitting modes of ground transport which are not similarly required to adopt bio-fuels, to the detriment of both domestic airlines and also the UK's decarbonization ambitions. It will also consume cashflow which would otherwise be used to invest in zero emissions hydrogen technology. At the current market prices of SAF, a low (sub 5%) blend supplied to regional airports costs in the order of $600 per tonne of CO_2 abated due to the high costs of the SAF, the duplicated logistic costs and the low amount of CO_2 abated at these blends. These costs are far higher than the peak social costs for carbon assumed by BEIS which are projected at £355 per tonne CO_{2e} in 2075 and consequently represent very poor value, particularly as the increased costs on domestic flying will lead to carbon leakage into road and ferry traffic. We therefore believe that SAF, which is central to the long haul industry's decarbonization plan should be resourced from this sector of the industry.

May 2022

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