

**Aviation Emissions and Climate Change**  
**Position Paper**  
**Australian Division Royal Aeronautical Society**

The Royal Aeronautical Society was founded in 1866 and is the world's only professional body dedicated to the entire aerospace community. The Society's headquarters are in London and now has more than 17,000 members in over 100 Countries. The Royal Aeronautical Society Australian Division Inc (RAeS AD) is registered as a non-profit organisation and is incorporated in the ACT. There are more than 760 members of RAeS AD.

The Objectives of the Society are to advance Aeronautical Art, Science and Engineering and in particular to promote the Profession of Aeronautics.

The Society maintains a keen interest and high level of scientific knowledge in matters pertaining to research into, and management of, aviation emissions. This paper states the position of, and proposes actions for, the RAeS Australian Division (AD) on aviation emissions and climate change.

**Overview**

Whilst there are climate change sceptics, there is sufficient evidence and agreement by reputable bodies that the climate is changing, that global temperatures are increasing and that greenhouse gas emissions are contributing to the change. The Intergovernmental Panel on Climate Change (IPCC) has assessed that the climate is warming, with the rate of warming between 1951 and 2000 being approximately 0.13°C per decade.<sup>1</sup> The IPCC also found there is greater than 66% probability that a doubling of the carbon dioxide (CO<sub>2</sub>) concentration in the atmosphere from pre-industrial levels of 280 parts per million (ppm) to 560 ppm will increase global average surface temperatures between 2°C and 4.5°C.<sup>2</sup> This climate change is forecast to result in sea level rise of between 0.18 metres (m) and 0.59m, increase acidification of the ocean and increase the probability of extreme weather events. The Australian government has submitted to the United Nations a 2020 carbon pollution target of 25% reduction in emissions relative to the 2000 emissions level.<sup>3</sup> The goal of this target is to stabilise levels of greenhouse gases in the atmosphere at 450ppm CO<sub>2</sub> equivalent or lower.

The International Air Transport Association (IATA) forecasts global passenger traffic to grow at an average of 1.4% per year<sup>4</sup> in the period 2008-2012 (forced down by low to negative growth in 2008-2010) but growth in 2011 is forecast to be 4.7% and in 2012 is 6.6%. The likelihood is that growth will return to its traditional levels of 5% - 6% after the current downturn is finished.

Aviation's economic impact is in the order of 7.5% of global GDP, it generates some 31.9 million jobs, provides direct employment to a global skilled workforce of 5.5 million, is fundamental to the tourist industry, creating 17.1 million direct and indirect tourism related jobs and is essential for business and trade<sup>5</sup>. Over 2.2 billion passengers flew last year and the world's airlines carried more than 41 Million tonnes of cargo<sup>6</sup>.

Aviation has an adverse effect on the environment in terms of noise, local air quality at airfields and contributes to climate change through greenhouse gas emissions. There is a level of conflict between public perception of the problem (which sometimes puts noise ahead of air quality and climate change) and an objective evaluation of the problem which puts climate change as by far the most serious long-term environmental issue. Overall the aviation industry is currently responsible for 2% of global anthropogenic greenhouse gas emissions (particularly CO<sub>2</sub>, nitrogen oxides and water vapour) through combustion of kerosene.

Aviation emissions are placed directly into the atmosphere up to 12 kilometres above the surface of the earth, and there is as yet no practical way to use renewable energy sources as a propellant for the global airliner fleet.

Despite recent improvements in technology and fleet rejuvenation, if emissions continue to increase in parallel with aviation growth, aviation has the potential to move from a marginal to a significant source of greenhouse gases.

Australia's unique position in the global and regional aviation community provides an opportunity to act decisively and to lead efforts to lessen the effect of aviation on the environment and to contribute to resolving what is a global problem. There are economic and political benefits arising directly from such action

### **Current situation**

The Aviation industry has achieved a 70% improvement in the level of emissions in the last four decades<sup>7</sup> and new generation aircraft offer the potential for a further 20% improvement. The industry has successfully de-coupled the impact of Aviation's growth from the related growth in emissions.

At their recent (8 June'09) AGM<sup>8</sup> the 230 IATA airlines committed to a set of three sequential emissions goals for air transport: a 1.5% average annual improvement in fuel efficiency from 2009 to 2020; carbon neutral growth from 2020 and a 50% absolute reduction in carbon emissions by 2050. To achieve these goals the airlines called on ICAO to set binding carbon emission standards on manufacturers for new aircraft, for Governments to work effectively with Air Navigation Services Providers and for the establishment of a legal and fiscal framework to support the availability of sustainable biofuels. This commitment to carbon-neutral growth also recognises that technology, operations and infrastructure improvements alone will not be sufficient to stop the growth in air transport's carbon footprint and recognises that "Positive economic measures are needed to bridge the gap until the full benefits of future technologies – including sustainable bio-fuels are realised". Almost concurrently ICAO's Group on International Aviation and Climate Change (GIACC) issued very similar targets, albeit with a different start base date. These also included recommendations on technology, design, "drop-in" bio-fuels and improved Air Traffic Management (ATM).

The cost of fuel remains over 25% of the airlines operating costs and is likely to rise. It is therefore in the interests of both the Aviation industry and of the Global community to reduce total fuel burn and hence emissions.

Internationally, Governments and the aerospace industry are reacting to this challenge. To name but a few initiatives:

- In UK, the Royal Aeronautical Society with representatives from industry, Government and academia has set up a professional body “Greener by Design”<sup>9</sup> to study ways of mitigating the environmental impact of aviation and to identify current research projects which have the potential to inform the debate. Omega<sup>10</sup> has been established as a one stop shop providing impartial world class academic expertise on environmental issues facing aviation.
- “The Silent Aircraft Initiative”<sup>11</sup> sponsored by Cambridge University in UK and MIT in USA with partners from industry, airlines, airport operators, Government and academia, has the objective of developing a unique concept design for the 2030’s, and identifying challenges to make the necessary technical breakthroughs. Areas already identified by these groups include Blended Wing Body/Flying Wing configuration, light weight airframe materials, laminar flow, even more efficient combustion design, open rotor and advanced turboprop engine designs, new airframe/engine integration configurations, free flight navigation, optimum range operations, etc.
- In Europe, the Advisory Council for Aeronautical Research set out in 2001<sup>12</sup> a strategic research agenda which gave high priority to, and set ambitious goals for reducing the environmental impact by 50% for CO<sub>2</sub> and 80% for Nitrogen oxides.
- The Canadian Government has established the Green Aviation Research and Development Network (GARDN)<sup>13</sup> to bring together partners from academia, industry, public and non profit sectors to conduct leading edge research. Currently it is sponsoring nine research projects within the Canadian industry on environmental issues.

Australia is neither represented on any of these groups or projects, nor does it have any local equivalents. The RAeS Australian Division has access to skills and contacts to assist in the creation and effective use of such a body. RAeS is independent, neutral and in a position to utilise its extensive global network for this purpose.

### **Australia’s role**

Australia is a geographically large country, far from its overseas markets and is more dependent on aviation than most. It is located in what will soon be the largest aviation market in the world. Whilst Australia may be a relatively small player in the global sense, it is recognised internationally for its high technology and safety standards, particularly so in the Asia/Pacific region.

Australia is well placed to take a leading role and to contribute meaningfully to the global debate on aviation and the environment and is also in a strong position to develop aviation policies and operational practices appropriate to our region. As an example, Australia has a great deal of experience in developing operational best practices in ATM and took a very worthwhile leadership role in recent APEC meetings on this subject<sup>14</sup>.

### **Australia’s Political and Commercial Opportunities**

In addition to its Aero-political role, Australia has world class facilities for research at Defence Science and Technology Organisation (DSTO) and Commonwealth

Scientific and Industrial Research Organisation (CSIRO), Universities, Government bodies, innovative organisations such as Airservices Australia and a small but capable aerospace design and manufacturing industry. Australia should create opportunities for these organisations to collaborate with both local and overseas counterparts to develop technologies and operational procedures to reduce climate change.

Specifically, Australia should collaborate with the Royal Aeronautical Society, European Union (EU) and European aerospace companies in their “Clean Sky Joint Technology Initiative”. Collaboration can include funding and/or use of Australian resources such as CSIRO, DSTO, the Australian aviation and manufacturing industry, Australian aviation agencies such as Airservices, CASA and the like. There are aspects of the problem in which Australia has a special capability and interest such as Air Traffic Management (ATM) services, and long range travel, which are relevant on a global scale.

A great deal of work is underway across the globe to find alternative fuels to kerosene. Synthetic fuels made from coal or gas have been trialled successfully as a “drop in” fuel for instance by Airbus in the A380. They offer sulphur free and low particle count emissions, but take a significant amount of energy to produce. Their prime advantage is that they provide a strategic alternative in the event of a shortage of kerosene and there are predictions that by 2030 up to 30% of aviation fuel could be synthetic.

Bio-fuels made from plants and algae have the advantage that they absorb CO<sub>2</sub> from the atmosphere when growing, and release CO<sub>2</sub> when burnt so there is little net change in CO<sub>2</sub> in the atmosphere. Plants such as halophytes, pongamia, jatropha, and algae have their advantages and disadvantages, and their production in Australia would need to be in accordance with Australian biosecurity and biodiversity laws. Nevertheless there is a significant opportunity for Australia in this area. The value of growing, harvesting and refining bio-fuel provides an economic and leadership opportunity for Australia. The active support of the Government and investment of public and institutional funds will be needed to take advantage of this opportunity. Irrespective of the source of the feedstock, Australia needs to develop bio-fuels that meet internationally agreed sustainability criteria such as those being developed by the Roundtable on Sustainable bio-fuels.

In addition Australia could undertake research aimed to lessen the impact of aviation on the environment by collaborating with:

- RAeS and the “Greener by Design” initiative to promote the issue of aviation and the environment,
- Cambridge University and MIT on the “Silent Aircraft initiative”.
- Engine manufacturers on combustion chamber design to reduce Nitrogen Oxides.
- Boeing and Airbus on the next generation concept designs.
- Research into the impact of long range flying on fuel efficiencies with respect to optimum payload range.
- Research into contrail reduction.

Australia could also contribute to the greater use of ADS-B for ATM, including management of aircraft movements on the ground, on approach and on landing, continuous descent procedures and required navigation performance (RNP) operations. IPCC estimates that globally improved operations could save fuel and CO<sub>2</sub> by up to 6% and that a further 12% could be saved by addressing airport and airspace inefficiencies. Australia has been at the leading edge of these developments and there is considerable value in taking an even higher international profile in the development and implementation of these new technologies and procedures.

Similarly, Government could provide tax and other incentives to encourage the Australian airline industry to rapidly introduce new equipment and new technologies which lead to step change reductions in emissions. In doing so Australia will place itself in the forefront of the industry, leading to commercial opportunities for Australian companies and organisations to exploit their expertise and experience.

### **Proposed RAeS AD Actions**

The RAeS AD is neutral, independent, and has the technical know-how to significantly contribute to resolving the issues relating to aviation and its effect on the environment. The RAeS AD also can assist Government and Industry to determine and prioritise targets and action necessary for the industry to address these environmental issues. Where appropriate RAeS AD is able to collaborate with the Society's New Zealand Division, UK headquarters and its global network of industry leaders and experts.

This paper proposes:

1. That RAeS AD encourage Government to work with Australian aviation industry and aviation agencies to reduce aviation emissions by participating in information exchange and research programs through provision of funds and/or expertise. This should be both nationally and internationally in partnership with overseas bodies.
2. That RAeS AD promote the aims of Greener by Design which are:
  - To produce and negotiate constructive proposals that will achieve a significant further reduction in the impact of noise and emissions
  - To promote environmental awareness within the industry
  - To inform the public and Government about aviation's environmental performance; and
  - To establish and promote best practice in, for example airport and flight operations
3. That RAeS AD recommend Government take a stronger leadership role in Asia/Pacific and place Asia/Pacific on an equal footing with the US and European blocks when it comes to negotiating international arrangements for control of aviation emissions.
4. That RAeS AD encourage Government to invest as a matter of priority, in research into the production of synthetic and sustainable aviation fuels.

5. That RAeS AD offer to assist the Government establish a body with partners from academia, industry, public and non profit sectors to carry out leading edge research and collation of data into the reduction of Aviation emissions.

6. That RAeS AD continue to work with, and where appropriate through, EA to promote the aims of the Society in respect to Aviation emissions.

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<sup>1</sup> Intergovernmental Panel on Climate Change (IPCC) 2007, *Climate Change 2007: The Physical Science Basis*, Summary for Policymakers, Contribution of Working Group 1 to the Fourth Assessment Report, February, Paris.

<sup>2</sup> Ibid, p 12.

<sup>3</sup> Wong, Hon Penny, 2009, *Australia Submits Revised Target to United Nations*, Press Release, Canberra, 6 May 2009

<sup>4</sup> International Air Transport Association (IATA) 2009, *Fact Sheet: Industry Statistics*, May 2009, <http://www.iata.org/NR/rdonlyres/8BD4FB17-EED8-45D3-92E2-590CD87A3144/0/FactSheetIndustryFactsMAY2009econmarkup.pdf>, downloaded 9 May 2009.

<sup>5</sup> ICAO News release P10 12/07 30 Nov 2007

<sup>6</sup> ICAO News release P10 13/07 21 December 2007

<sup>7</sup> Air Travel Greener by Design , Meeting aviation's environmental challenge Sept 2003

<sup>8</sup> <http://www.iata.org/pressroom/speeches/2009-06-08-01.htm>

<sup>9</sup> [www.greenerbydesign.org.uk](http://www.greenerbydesign.org.uk)

<sup>10</sup> [www.omega.mmu.ac.uk](http://www.omega.mmu.ac.uk)

<sup>11</sup> [silentaircraft.org](http://silentaircraft.org)

<sup>12</sup> European Aeronautics vision for 2020 published by Office for Official Publications for the European Community ISBN 92-894-0559-7

<sup>13</sup> [www.nce.gc.ca/media/newsrel/2009/070109\\_e.htm](http://www.nce.gc.ca/media/newsrel/2009/070109_e.htm)

<sup>14</sup> 6<sup>th</sup> APEC Transportation Ministers meeting Manila 27-29 April 2009