

## THE SUSTAINABLE AVIATION PROGRESS REPORT 2013

www.sustainableaviation.co.uk





#### **Executive summary**

The UK aviation industry is committed to making a positive contribution to the British economy, and meeting the needs of society for air transport whilst minimising any environmental impacts.

This, Sustainable Aviation's (SA's) fourth Progress Report, summarises the activities undertaken during the past two years by this unique coalition of UK industry committed to delivering a successful aviation sector whilst removing, minimising or mitigating any negative impacts on the local and global environment.

Since SA's last progress report, published in 2011, the focus of the group's activities has been on climate change and noise, resulting in in-depth Road-Maps showing how future growth in UK aviation to 2050 can be accommodated without significant increases in absolute  $CO_2$  emissions, and with reductions in noise output.

This report provides more details on a broad section of Sustainable Aviation (SA) activities, undertaken collectively and individually by its signatories, in order to deliver progress against the SA Goals. Some of the key highlights of SA's efforts include:

- Publication of Road-Maps on CO<sub>2</sub> and Noise
- Strengthened commitment and resourcing of SA
- Supporting the launch of, and committing to the implementation of, the UK aviation industry code of practice on, 'Reducing the Environmental Impacts of Ground Operations and Departing Aircraft'
- Delivering further operational improvements to UK air traffic operations
- Publishing our latest position on sustainable aviation fuels
- Expanding SA's engagement work within and beyond the aviation sector

SA will continue its focus on reducing carbon and noise emissions from aircraft operations. Specific actions will include:

- Developing a Sustainable Aviation Fuels Road-Map
- Establishing and reporting on aircraft noise targets
- Promoting the use of improved technology and operational techniques
- Continuing to press for the development of a global emissions trading system
- Raising awareness of SA's work and improving our relationships with stakeholders
- Developing strategies to maintain a sustainable aviation industry in response to changing external factors
- Providing regular updates on SA's work programme through its website and stakeholder briefing sessions

SA looks forward to working with a wide range of stakeholders in delivering this future work, from both within and outside the aviation sector. If you would like to get involved or would just like to learn more, please contact us.



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#### **Chair's Review**

Aviation creates real wealth for the UK. That wealth is measured not just in terms of economic contribution, fundamental though that is, but in social and cultural terms. Aviation enables people to travel the world, to learn about new places and to stay in touch with friends and families in our increasingly globalised society. But aviation also has environmental impacts. As an industry, we need to demonstrate that we can grow – with all the benefits that brings – while at the same time tackling our environmental impacts. To be sustainable we must, and can, do both.

As an initiative, 'Sustainable Aviation' remains a world first. The UK is the first country in the world where the leading airlines, airports, engine and airframe manufacturers and air traffic navigation service providers have developed a joint sustainability strategy. That strategy was published in 2005 and set a series of long-term goals for the industry. Since then, Sustainable Aviation partners have worked collaboratively to improve environmental performance, reporting publicly on progress every two years. This report is our fourth and sets out progress between 2011 and 2013.

The last two years have been significant for aviation in the UK. As the economy slowly recovers from the recession, air traffic has started to recover too. But economic volatility and continuing high oil prices continue to pose challenges. And the role of aviation in future economic growth has been a key topic of political debate. The Government published its Aviation Policy Framework in 2013 and has established an Airports Commission to study how to maintain the UK's global aviation hub status. Environmental issues are central to that debate and Sustainable Aviation has played an important role in setting out a pan-industry view.

In the past two years, Sustainable Aviation's work programme has focussed on three main priorities. First, the UK industry's contribution to the global challenge of climate change, where we have published an updated ' $CO_2$  Road-Map'. Second, producing a counterpart 'Noise Road-Map' for what is the key local environmental challenge for the industry. And finally, raising our profile with key stakeholders so that they are more aware of the work that we are doing.

For both carbon and noise, our approach has been to bring together experts from across the aviation industry – aerospace manufacturing, airlines, airports and air traffic control. Those experts have pooled their experience and knowledge on future technology, operating procedures and sustainable fuels to produce detailed Road-Maps which give Sustainable Aviation's view of how future growth in UK aviation can be accommodated without significant increases in absolute  $CO_2$  emissions and with reductions in noise output.

In terms of raising our profile, we are not seeking name recognition by the general public. But we do need key decision-makers and opinion-formers to be aware of who we are and what we are doing.



An active programme of engagement with senior politicians and Government officials, and a presence at the main party conferences, have helped to achieve that goal.

The work plan towards the goals of Sustainable Aviation's strategy has not been confined just to the three priorities above. We have brought together recognised experts to help lead specialist work packages that can – and will – change the face of aviation in the UK. As this report outlines, we have continued our work to promote the development of sustainable aviation fuels, for example, and to trial and implement new operating procedures. This includes implementing the industry developed code of practice on Reducing the Environmental Impacts of Ground Operations and Departing Aircraft.

Sharing expertise and working in partnership to improve performance is Sustainable Aviation's core strength. This has given us the credibility which has helped us to secure independent scrutiny by an External Advisory Group of international standing. Input from this group of 'critical friends' is important to ensure that Sustainable Aviation remains relevant and focussed. You can read their commentary later in this report.

To support all of this activity and to continue to strengthen Sustainable Aviation moving forward, we agreed in 2012 to create a new Programme Director role. That role will drive progress on our targets and plans and act as a contact point with our many stakeholders. I'm pleased that Dr Andy Jefferson has joined Sustainable Aviation to take on that new role, building on his extensive experience in the aviation industry and sustainability.

Looking ahead, sustainable development remains a key challenge for our industry, and will continue to be central to political debate in the UK as the Airports Commission concludes its work. We will continue to focus on climate change and noise. On climate, we will publish a Sustainable Aviation Fuels Road-Map, setting out what we as an industry can deliver and what support we need from policy-makers in the UK and beyond. On noise, we will continue to support the delivery of the Noise Road-Map. Noise ultimately needs to be addressed at a local level, taking into account the views of local communities around airports. But Sustainable Aviation can play an important role in providing tools and in driving performance improvements nationally. We will maintain a strong focus in particular on quieter operating procedures that take advantage of the latest airspace and aircraft technology. In addition to these two environmental priorities, we will explore what role Sustainable Aviation can play in understanding and enhancing the future socio-economic contribution of aviation in the UK.



It has been an honour to serve as Chair for the past two years. I am proud of what has been achieved, but also conscious that those achievements rely on ongoing collaboration within the aviation industry. I thank all those involved for committing to that collaborative effort. I'm delighted that Jonathon Counsell from British Airways has agreed to take on the leadership of Sustainable Aviation for the next two years and to continue to drive it forward.



Matthew Gorman Chair, Sustainable Aviation 2011-2013 Sustainability Director, Heathrow Airport



#### **SA Advisory Panel Comment**

The Advisory Panel brings together stakeholders and leading experts to provide Sustainable Aviation with external feedback and guidance on its work programme and objectives. Since the formation of the Advisory Panel, we have engaged and challenged, and, we believe, helped to shape the discussion. Since the last progress report, the members of the Advisory Panel have sought to become more actively engaged with the thematic working groups, providing better opportunities for input as the work is being developed rather than reviewing the objectives and deliverables of each project. This closer engagement has worked well, and it is anticipated that at least one Advisory Panel member will be included in each future work stream.

In 2013, the Panel has been involved in the work relating to the Noise Road-Map, alternative fuels and the identification of gaps in research. The latter is an important issue for the aviation industry and stakeholders alike, as academic studies provide the foundation for both policy and industry actions: the opportunity to review current studies and identify gaps in our common understanding is a high priority and this work is seen as both necessary and timely.

The Panel welcomed the Noise Road-Map as a significant and innovative step forward in managing aircraft noise around UK airports by means of a comprehensive list of steps for industry action and topics to advance with Government to keep noise in check. In doing so, the Panel noted that realising the UK sector's prediction of reducing overall noise over the coming decades will require resolve and resources as well as the need to communicate and engage with impacted communities. The Panel is committed to supporting SA on the implementation of its Road-Map.

There will be significant interest in the environmental agenda over the next two years with important decisions on airport capacity to be addressed by the Airports Commission, and international work to examine the role of market measures and alternative fuels in reducing the impact of the sector's greenhouse gas emissions. While there will be many opportunities for industry to engage in these debates, the Panel has always reinforced that SA's strength is its ability to unlock solutions by working together across industry rather than tackle issues in isolation. We hope that this philosophy continues to shape SA's objectives in the years ahead.

#### The SA Advisory Panel:

Tim Johnson, Chair SA Advisory Panel and Aviation Environment Federation Owen Bellamy, Committee on Climate Change Catherine Cameron, Agulhas Applied Knowledge Professor Piers Forster, University of Leeds Roger Gardner, University of Southampton Roger Worth, Department for Transport



#### **1. Strategy and Goals**

SA's strategy was agreed in 2005, together with a vision and series of goals to achieve this. Since then we have regularly reviewed both the vision and goals to ensure they are still relevant and meet stakeholder expectations.

#### **1.1.Sustainable Aviation Vision**

The UK aviation industry, meeting the needs of society for air travel and transport, while removing or minimising any negative impacts on the local and global environment and maximising the contribution to the UK economy.

To achieve this, Sustainable Aviation brings together the UK aviation industry to develop practical and policy solutions for cleaner and quieter flying. It is the first initiative in the world to bring together airlines, aircraft and engine manufacturers, airports and air traffic managers as part of a formal strategy.

Sustainable Aviation sets long-term goals and agrees priority areas of work to deliver these, reporting on progress every two years. We focus our efforts on the issues that rely on joint work between the different parts of the aviation industry to improve performance.

Sustainable Aviation engages regularly with policy-makers and opinion formers to communicate its work and to understand their priorities. We aim to be a trusted and credible source of information on environmental issues. Sustainable Aviation focuses on the UK; however its work takes place in a global context. UK aviation has a global reach and our aspiration is that Sustainable Aviation plays a leading role globally in efforts to tackle the industry's environmental impacts.

#### **1.2.Sustainable Aviation Goals**

SA's work programme is developed around seven strategic goals:

#### Goal 1: Social and Economic

A competitive aviation industry making a positive contribution to the UK economy, and meeting the needs of society for air transport, whilst maintaining constructive relationships with stakeholders.

#### **Goal 2: Climate Change**

Aviation incorporated into a robust global policy framework that achieves stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous manmade interference with the climate system.

#### Goal 3: Noise

Limit and, where possible, reduce the impact of aircraft noise.





#### **Goal 4: Local Air Quality**

Industry to play its full part in improving air quality around airports.

#### Goal 5: Surface Access

Industry playing its full part in an efficient, sustainable multi-modal UK transport system.

#### Goal 6: Natural Resources

Environmental footprint of UK aviation's ground-based non-aircraft activities contained through effective management and reduction measures.

#### **Goal 7: Implementation**

Full industry commitment to sustainable development and communicating fully the role of aviation in society in order to support a better understanding of its contributions.



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### 2. Performance against Goals

#### 2.1.Goal 1: Social and Economic

A competitive aviation industry making a positive contribution to the UK economy, and meeting the needs of society for air transport, whilst maintaining constructive relationships with stakeholders

Despite the challenging economic climate over the last few years Sustainable Aviation and its signatories have continued to offer significant economic and social benefits to the UK.

This was perhaps most dramatically demonstrated during the hugely successful London 2012 Olympic and Paralympic Games. If you consider the 204 countries that took part in the Games, their athletes, officials, supporters and the huge variety of luggage and equipment, it is almost impossible to think how this could have been achieved without aviation!

#### London 2012 Olympic and Paralympic Games

During the period of the London 2012 Olympic and Paralympic Games, in addition to the thousands of people taking part or watching the events, aviation handled a wide variety of equipment.

At Heathrow over 75,000 journeys were made by Paralympians, Olympians and team officials with assistance given to nearly 3,000 wheelchair passengers where needed. The airport also handled:

- 5,000 oversized bags including canoes, javelins, bikes, pole vault poles
- 1,300 firearms plus ammunition
- 20,000 members of the media

SA members worked hard throughout the UK over the period of the London 2012 Games to ensure visitors experienced the best of British as well as ensuring a business as usual service was maintained for regular passengers. Despite an increase in air traffic, flight punctuality was not adversely affected. NATS reported that during the Olympics, traffic in the London area was up 3.5 % for a number of days, peaking at 4.5 %. Airport passenger traffic at Farnborough and Biggin Hill Airports rose considerably; by 16 % and 19 % respectively on peak days.

There were just 593 minutes of delay attributable to NATS throughout the whole of the Olympics. That compares to the 2011 figure for the same period which was more than 13,000 minutes.

Sustainable Aviation will continue to focus on finding ways to improve how the industry manages environmental effects of aviation, to enable the on-going social and economic benefits that air travel generates for the UK.



#### 2.2.Goal 2: Climate Change

Aviation incorporated into a robust global policy framework that achieves stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous man-made interference with the climate system.

#### 2.2.1 Current Status

Since our last Progress Report published in March 2011 the industry has remained committed to managing carbon emissions. The total CO<sub>2</sub> emissions produced by SA airlines increased in 2011 compared to 2010 but only slightly increased in 2012 compared to 2011.



#### CO<sub>2</sub> Emissions from SA airlines

Over the last two years the number of aircraft movements operated by SA airlines has increased by over 80,000 flights or 9  $\%^1$ . During this time CO<sub>2</sub> emissions have increased by 1.6 million tonnes or 5.2 %, demonstrating in line with SA's CO<sub>2</sub> Road-Map's modelling, that over time UK aviation will decouple growth in air transport from an automatic growth in CO<sub>2</sub> emissions as full fuel efficiency gains are realised.

Looking at fuel efficiency per revenue tonne kilometre flown by SA airlines it can be seen that over the last 10 years there has been an improving trend in airline fuel efficiency. In the last two years fuel efficiency slightly worsened in 2011 but more than recovered in 2012 to achieve a record level. This improvement reflects the start of airline fleet replacement programmes, replacing older, less fuel efficient aircraft with newer ones and on-going aviation industry operational fuel efficiency initiatives.

<sup>&</sup>lt;sup>1</sup> These figures are calculated from the CAA Airline Statistics for SA member airlines. See <u>http://www.caa.co.uk/default.aspx?catid=80&pagetype=88&pageid=1&sglid=1</u>





SA Airline Fuel Efficiency 2003-12

The future reduction of aviation's environmental impact hinges on a number of steps, as shown below. SA's  $CO_2$  Road-Map explains how each of these steps will contribute to a more sustainable future for UK aviation.



Factors driving Reduction in Aviation's Environmental Impact

#### 2.2.2 Delivering the Sustainable Aviation CO<sub>2</sub> Road-Map

The Sustainable Aviation  $CO_2$  Road-Map, published in 2012, is the result of several months of consultation and analysis involving all four corners of the UK aviation industry. It sets out SA's expectation of  $CO_2$  emissions from UK aviation between 2010 and 2050, taking account of the latest evidence available at the time of publication, and comparing its results with aviation  $CO_2$  forecasts from the Department for Transport (DfT) and from the Committee on Climate Change.



The Road-Map combines an assessment of growth in demand - derived from UK Government forecasts - with our own analysis and judgement concerning the available mitigation opportunities and the extent to which they will deliver improvements in carbon efficiency. Our Road-Map shows that UK aviation can accommodate significant growth to 2050 without a substantial rise in absolute  $CO_2$  emissions.



The SA CO<sub>2</sub> Road-Map (2012)

The mitigation opportunities assessed by the Road-Map include:

- Reductions in fuel-burn enabled by improvements in air traffic management and in operational practices
- The impact of adopting the next generation of aircraft whose fuel-efficiency performance is already known, and whose impact on fleet fuel efficiency can therefore be estimated with some confidence
- The potential impact on fleet-average fuel efficiency of future aircraft types whose fuelefficiency characteristics are not yet known
- Further reductions in CO<sub>2</sub> footprint made possible by the use of sustainable alternative fuels in place of fossil-based kerosene.

The Road-Map also considers further potential reductions in UK aviation's net  $CO_2$  emissions via market-based measures in which aviation plays a part in supporting  $CO_2$  reductions in other sectors. Being based on the DfT's own demand growth forecasts, our Road-Map implicitly accounts for the impact of the price of carbon upon demand for UK aviation.



In 2011, UK aviation accounted for around 5% of global aviation  $CO_2$  emissions<sup>2</sup>. This proportion will fall over the next few decades due to rapid growth in demand for aviation in the developing world.

Looking forwards therefore, significant UK influence over  $CO_2$  emissions from aviation will not be achieved through restricting the scale of UK aviation activity itself, but instead through internationally focussed efforts and the adoption of fuel efficient technology – developed and manufactured in the UK – into airline fleets around the globe. As a result, SA recommends that Government pursues an approach consisting of the following four elements:

- 1. Intensifying R&D support for the UK's civil aerospace manufacturing sector, underpinning the development of fuel-saving technologies which will be deployed at scale on a world-wide basis;
- 2. Encouraging the development and deployment of sustainable aviation fuels offering significant life-cycle CO<sub>2</sub> savings;
- 3. Working with international partners to enable more efficient air traffic management, within the context of increased capacity requirements;
- 4. Continuing to press for the development and implementation of a global carbon-trading solution encompassing all of aviation, with a level playing field for all participants.



Inspired by SA's  $CO_2$  Road-Map, Virgin Atlantic reviewed its own commitment to achieve a 30 % reduction in  $CO_2$  per Revenue Tonne Kilometre between 2007 and 2020. This was to better understand the relative contributions of new aircraft, operational and maintenance best practices, developments in airspace design and the introduction of new sustainable alternative fuels. The combined effects of all of these initiatives mean that Virgin Atlantic is on track to deliver its target.

 <sup>&</sup>lt;sup>2</sup> International Air Transport Association (<u>http://www.iata.org/pressroom/facts\_figures/fact\_sheets/Documents/industry-facts.pdf</u>, viewed 08 Jan 2014)

<sup>•</sup> UK National Atmospheric Emissions Inventory (<u>http://naei.defra.gov.uk/data/data-selector</u>, viewed 08 Jan 2014)





Thomson Airways is TUI Travel's largest airline and with the other five airlines, committed to reduce carbon emissions per revenue passenger kilometre ( $gCO_2/RPK$ ) by 6 % by 2015 as part of a six year target (against a baseline of 2008). In Financial Year (FY) 2012 TUI Travel airlines' relative carbon emissions were 73.0g per revenue passenger kilometre ( $gCO_2/RPK$ ), 6.3 % below the 2008 baseline year. Following the early achievement of our 2015 commitment (by two years), TUI Airlines have now set a more stretching target of reducing TUI Travel's airlines' per passenger carbon emissions by 9 % by 2015 (baseline 2008).

The next section summarises the progress made by the aviation industry against each of the specific wedges in the  $CO_2$  Road-Map.





#### 2.2.3 Operations and Air Traffic Management (ATM) Developments

#### Industry departures code of practice

In June 2012 the Aviation industry published 'Reducing the Environmental Impacts of Ground Operations and Departing Aircraft - An Industry Code of Practice.'

This voluntary Code of Practice was compiled by a group representing aerospace manufacturers, airlines, airports, air traffic control (ATC) and the Civil Aviation Authority's Environmental Research and Consultancy Department (ERCD).

It gives advice on four operational techniques aimed at improving the environmental impacts of aircraft operations during the ground operations and departure phases of flight, and includes the use of Fixed Electrical Ground Power (FEGP) and Preconditioned Air (PCA) rather than running aircraft Auxiliary Power Units (APUs); taxi with less than all engines operating; Continuous Climb Operations (CCO); and Airport Collaborative Decision Making (A-CDM).



The four operational techniques offer a range of environmental benefits as detailed below.

#### Environmental Benefits from use of Operational Techniques

Sustainable Aviation has now taken on the responsibility for promoting the implementation of this code across our members. In this progress report we present the initial results but expect to announce further benefits of the work in subsequent reports.





#### Continuous Climb Operations – Establishing a baseline

The work by NATS below provides SA's baseline report on UK achievement of continuous climb operations. To our knowledge this is the first study of its kind and offers ground-breaking insight into this aspect of operational practice and flight efficiency.

#### Background: Continuous Climb versus Stepped Climbs

Continuous Climbs Operations (CCO) are not new. They have always been and continue to be the default practice for airlines and air traffic controllers where airspace structures and traffic conditions allow. The aim of including CCO in the Industry Code of Practice however is to promote the opportunities and benefits for enabling more CCO through procedural and airspace design changes, in order to realise fuel savings and emissions reductions.



Photo Copyright © British Airways plc 2013

Stepped climbs are often required to maintain safe separation between aircraft. Stepped climbs can be procedurally designed into the Standard Instrument Departure (SID) climb profile. They normally arise from airspace standing agreements and the Route Availability Document (RAD) restrictions or may be radar controlled to avoid traffic conflictions.



Over time, improvement in both procedural and tactical continuous climb operations is expected as new airspace design helps create additional airspace and greater segregation between arriving and departing traffic flows.



#### Illustration of Continuous Climb versus Stepped Climb

#### SA Operational Improvements Group Promoting CCO

Promoting the benefits of Continuous Climb Operations (CCO) and encouraging wider uptake is an area of activity that is being led by SA's Operational Improvements Group. In the short term, this means SA helping to raise awareness of the benefits of CCO and seeking opportunities to make procedural or tactical changes to enable more CCO where airspace and traffic conditions allow.

For the mid to long term, achieving more CCO requires structural changes to airspace and further investment in ATC and aircraft technology. Investment in Area Navigation (RNAV) SIDs and controller tools such as iFACTS<sup>3</sup> as well as major airspace changes are examples of improvements that will enable more CCO.

<sup>&</sup>lt;sup>3</sup> Essentially, iFACTS enables NATS controllers to look up to 18 minutes into the future, with this 'look-ahead' capability enabling them to test the viability of various options available for manoeuvring aircraft, as well as providing more time to make decisions.



Percentage achievement of Continuous Climb <sup>1</sup> to a range of Flight Levels <sup>2</sup> (FL) 2012/13							
	FL100	FL150	FL200	FL250	FL300	FL350	FL400
UK Average <sup>3</sup>	63.8	58.7	54.5	51.8	49.8	47.4	47.1
Swanwick							
Area of Responsibility <sup>4</sup>	53.7	47.7	43.2	40.2	38.4	36.5	36.3
Prestwick							
Area of Responsibility <sup>5</sup>	91.2	88.4	84.9	83.0	80.4	76.6	76.1

Source: NATS 2013

#### Notes:

- 1. Continuous climb for the purpose of this study is defined as no level flight exceeding 0.5nm. Level flight for the purpose of this study is defined as a climb rate of less than 150ft per minute.
- 2. A flight level (FL) is the altitude an aircraft flies relative to a standard pressure setting. For instance FL200 means the aircraft if flying at 20,000ft above sea level relative to the standard pressure setting.
- 3. All data relates to the 12 month period 1<sup>st</sup> March 2012 to 28<sup>th</sup> February 2013. UK Average comprises the average CCO achievement for departures from the 15 UK airports where NATS provides the ATC service.
- 4. Swanwick AoR comprises departures from: Birmingham, Bristol, Cardiff, Farnborough, Gatwick, London City, Luton, Stansted, Heathrow and Southampton. In practice, departures from Birmingham are handled by either Swanwick or Prestwick but for the purpose of this study have been grouped with Swanwick.
- 5. Prestwick AoR comprises departures from: Aberdeen, Belfast, Edinburgh, Glasgow and Manchester.
- 6. In practice not all aircraft will want to climb to the higher cruising altitudes. For example smaller jets and turboprops and short sector domestic traffic may request mid altitude cruise levels. We would therefore expect CCO achievement rates to reduce at higher flight levels. This is evident in the data trends in the table above.

Continuous	Climb	Proportion of departing traffic achieving continuous climb				
to FL250 Ba	nding	to FL250 at various Airports				
VERY HIGH	over 90%	Belfast				
HIGH	between 60% and 90%	Aberdeen, Birmingham, Bristol, Cardiff, Edinburgh,				
		Glasgow, Manchester				
MEDIUM	between 30% and 60%	Gatwick, Luton, Stansted, Heathrow, Southampton				
LOW	less than 30%	Farnborough, London City				
VERY LOW	less than 10%	n/a				

#### Source: NATS 2013

		Average altitude of first level off on departure (airport average of all first level offs only)		
VERY HIGH	above 20,000ft	Aberdeen, Birmingham, Manchester		
HIGH	15,000ft - 20,000ft	Bristol, Cardiff, Edinburgh, Glasgow		
MEDIUM	10,000ft - 15,000ft	Belfast, Gatwick, Heathrow, Luton		
LOW	6,000ft - 10,000ft	Farnborough, Southampton, Stansted		
VERY LOW	0 - 6,000ft	London City		
Source: NATS 2013				



	Average length of first level off on departure
	(airport average of all first level offs only)
VERY SHORT 0.5nm - 2.5nm	n/a
SHORT 2.5nm - 5nm	Farnborough, Southampton
MEDIUM 5nm - 7.5nm	Belfast, Bristol, Cardiff, Edinburgh, Gatwick, Glasgow,
	London City, Luton, Stansted
LONG 7.5nm - 10nm	Aberdeen, Birmingham, Heathrow, Manchester
VERY LONG over 10nm	n/a
	11/ d

Source: NATS 2013

This first report offers a baseline report, a snapshot of performance in 2012/13. In future years as we continue to track progress against these parameters, we hope to observe not only an increase in total proportion of aircraft achieving continuous climbs but also an increase in the average altitude of the first level off and a reduction in the average length of the first level off. All of these measures will reflect improved flight efficiency, providing both fuel and emissions reductions in support of SA's goal to mitigate aviation impacts on Climate Change.

Case studies from other SA members of work on specific operational improvements to reduce fuel consumption and  $CO_2$  are presented next.

## Birmingham Airport

Working proactively with air navigation service provider NATS and airlines including many SA members, Birmingham Airport has successfully launched an "efficient airfield" campaign, reducing CO<sub>2</sub> emissions on the ground and in the air.

### BRITISH AIRWAYS

For a number of years, British Airways has been using reduced engine taxiing for inbound Airbus aircraft (A319, A320 and A321). This means taxiing using one instead of two engines. From August 2013, this was extended to outbound Airbus aircraft. A conservative estimate of the carbon dioxide saved at Heathrow and Gatwick each year through using this procedure is 20,000 tonnes  $CO_2$ . There are additional airfield and environmental efficiencies that result from this initiative.



## easyJet

In 2011 easyJet was the first commercial airline to trial a revolutionary nano-technology – an ultrathin polymer coating applied to the paint surface of aircraft - which reduces the build-up of debris on the aircraft's structure, leading-edge and other surfaces therefore reducing drag. Estimates suggest that this new technology could reduce easyJet's fuel consumption by 1-2 %.



Following the publication of the industry departures code of practice, Heathrow has worked with its airline customers to sign up British Airways, Royal Brunei, Emirates, Delta and Air New Zealand.



#### **Collaborative Environmental Management**

At Manchester, the airport's Collaborative Environmental Management (CEM) group provides a forum for detailed discussion around local operational and environmental improvement initiatives. Bringing together airline and ground handling representatives, air traffic controllers and airport operations, the CEM provides a unique perspective on what can and can't be delivered, and why. For example, the CEM has driven ownership of initiatives such as FEGP usage, with a 10 % improvement year on year.





NATS has worked with other SA partners to develop a number of trials and tools to improve the efficiency of aircraft flights within and beyond UK airspace, including:

- Topflight – NATS is leading a trial involving Airbus, British Airways, Boeing and NAV Canada as part of the Single European Skies programme. The objective is to demonstrate optimum flights between North America and Europe, with average  $CO_2$  savings of 1.6 tonnes per flight.

- Flight Profile Monitoring Tool – which tracks aircraft performance at any phase of the flight and identifies areas for improvement. A trial of the Tool at Edinburgh Airport showed that 95 % of departures were achieving continuous climb and, following work with airlines, continuous descent approaches increased by 15 % to 70 % overall. Over a year, this equates to 510 tonnes of CO<sub>2</sub>.

- 3Di Tool – identifies variations in actual aircraft trajectories and routes, compared with an optimum profile. Data is used to inform improvements in airline procedures and air traffic control performance, with a target of saving 60,000 tonnes of  $CO_2$  in 2015.



airport, and a continuous descent approach to the landing airport; as well as adopting best practices whilst on the ground. Results were measured to calculate reductions achieved and it has been estimated that approximately 630 tonnes  $CO_2e$  could be saved per year.



#### **Steeper Approaches**



Photo Copyright © easyJet plc 2013

Through Sustainable Aviation we are continuing to research the feasibility of slightly steeper approaches. For example, British Airways have conducted simulation tests and noise analyses with Airbus, and Heathrow Airport led a group including BA and NATS on a research visit to Frankfurt Airport in April 2013 to learn from their recent experience of testing a 3.2 degree approach angle.

The results of this work are encouraging, although further research and regulatory work is required to ensure the concept can be safely introduced into standard operating practice.

Sustainable Aviation is committed to supporting this and will continue to work with our partners in the UK, as well as with regulators and partners overseas to identify opportunities and benefits around steeper approaches.



Photo Copyright © NATS 2013



#### 2.2.4 Imminent and Future Aircraft Developments

The UK aerospace industry has continued to develop new aircraft engines and airframe technology in the last two years. The next two sections provide a summary of this activity.

#### New Aircraft Engines

#### The New Rolls-Royce Trent XWB Engine on the Test Rig

Photo Copyright © Rolls-Royce plc 2013

- **Rolls-Royce Trent 1000** Powering the new Boeing 787 aircraft. The Trent 1000, which first entered service in 2011, is 12 % more fuel-efficient than the Trent 800, which entered service in 1996.
- Rolls-Royce Trent XWB Designed for the new Airbus A350 aircraft, the Trent XWB was first test flown in February 2012 and achieved airworthiness certification in February 2013. It will provide an improvement in fuel efficiency of more than 15 % compared to the Trent 700, which entered service in 1995.
- Rolls-Royce BR725 Entered service in December 2012 on the Gulfstream G650. The BR725 is the latest and most advanced member of the BR700 engine series. It demonstrates a 4 % improvement in specific fuel consumption and a 21 % reduction in NO<sub>x</sub> emissions, compared to its predecessor the BR710.



#### New Aircraft Designs

In general there is at least a 15 % improvement in fuel efficiency and carbon emissions from the next generation of aircraft, currently in final development or initial entry into service, compared to those they are replacing. The remainder of this section details results of the airframe manufacturers' work over the last few years.



#### First Flight of the new Airbus A350 XWB Aircraft in June 2013

Photo Copyright © Airbus S.A.S. 2013

- Airbus A380 Introduced in 2007, the A380 incorporates as much as 25 % composites, with its carbon-fibre reinforced plastic composite centre wing box saving up to 1.5 tonnes of weight. As a result, the double-deck jetliner has a very low fuel burn of less than 3 litres per passenger per 100 kilometres. In-service experience has shown a fuel consumption of 20 % less than similar sized aircraft they are designed to replace.
- Airbus A350 The newest Airbus aircraft has been developed using the very latest in aerodynamics, design and advanced technologies to provide a 25 % step-change in fuel efficiency compared to existing aircraft of this size. The aircraft is currently undergoing a comprehensive flight test programme.
- Airbus A320 new engine option (neo) The A320neo offers a 15 % fuel burn saving compared to current single-aisle aircraft operations, with 11.5 % provided by its new engine options (CFM International's LEAP and the PW1100G PurePower from Pratt & Whitney) and 3.5 % from the use of Airbus' Sharklet wingtip devices.



#### First Flight of the Boeing 787-9 Dreamliner in September 2013



Photo Copyright © Boeing 2013

- **Boeing B787** The Boeing 787 Dreamliner offers a 20 percent improvement in fuel efficiency and CO<sub>2</sub> emissions over the plane it is designed to replace. It has a 60 percent smaller noise footprint than the Boeing 767.
- Boeing 777X Launched by Boeing in November 2013, this aircraft looks to further develop the Boeing 777, aiming to achieve a 10 % improvement in fuel consumption. Engine supplier GE was the first partner announced on the program and their GE9X engine is designed to deliver greater than five percent fuel efficiency. In addition, the fourth-generation 777X composite wing has a longer span than today's 777 which has been optimised to deliver greater efficiency and significant fuel savings.
- **Boeing B747-8** The Boeing 747-8 offers a 16 % reduction in CO<sub>2</sub> emissions compared to the B747-400 series.
- Boeing 737 Max The Boeing 737 Max offers a 14 % reduction in fuel and carbon emissions compared to the B737 next generation aircraft in service today. Boeing has selected GKN plc to manufacture the Advanced Technology Winglet for the 737 MAX. Production of the winglets will take place at the GKN site at Cowes on the Isle of Wight in the UK. The winglet is one of a number of design updates that will result in less drag and further optimize the 737 MAX performance, especially on longer-range missions.





#### First Flight of the Bombardier CS100 Series in September 2013

Photo Copyright © Bombardier 2013

• **Bombardier CSeries** – The Bombardier CSeries aircraft offer a 20 % improvement in fuel efficiency and carbon emissions compared to current aircraft in the 100-149 aircraft seat market. The aircraft had its first flight in September 2013.



#### New Aircraft orders - Upgrading SA Airline Fleets

SA's member airlines continued to show commitment to improve their fleet fuel efficiency and reduce carbon emissions through placing significant orders for the next generation of aircraft:

• **British Airways** - In April 2013, International Airlines Group and British Airways (BA) signed a memorandum of understanding to buy 18 A350-1000 aircraft. This is in addition to confirmed orders already for the introduction of 12 A380 and 42 B787s into the BA fleet from mid-2013.



Photo Copyright © British Airways plc 2013

• **easyJet** - In 2013 easyJet announced that it has entered into arrangements with Airbus to acquire 35 current generation A320 aircraft for delivery between 2015 and 2017 and 100 new generation A320neo aircraft for delivery from 2017 until 2022.



Photo Copyright © Airbus S.A.S. 2013



Thomson Airways - From February 2011 Thomson Airways, part of the TUI Travel Group commenced the replacement of a third of the airline fleet with 22 Boeing 737-800 aircraft. These aircraft offer a fuel-efficiency improvement of 15 % compared with the aircraft they replace. The overhaul is part of a wider programme by Thomson Airways to upgrade its fleet, which includes taking delivery of four Boeing 787 Dreamliners, which started in May 2013. In June 2013 TUI travel also announced an order for 60 Boeing 737 MAX aircraft with an option for 90 more. The planes, to be powered by CFM LEAP-1B engines, are scheduled for delivery between January 2018 and March 2023. Finally, in July 2013 TUI Travel announced that it will be the first in Europe to use the new innovative Split Scimitar Winglets, reducing fuel burn by an additional 2 % (modified aircraft will begin flying from early 2014).



Photo Copyright © TUI Travel plc. 2013

 Virgin Atlantic - During 2012 Virgin Atlantic saw entry into service of 10 A330-300 aircraft. These aircraft are at about 30 % more fuel (and therefore CO<sub>2</sub>) efficient on a per-trip basis than the aircraft they have replaced, and around 19 % more efficient on a per seat basis. From autumn 2014, Virgin Atlantic will be welcoming the first of 16 Boeing 787-9 Dreamliners into their fleet. These aircraft will be around 21 % more efficient per trip and 28 % more efficient on a per seat basis than similar-sized aircraft flying today.





Photo Copyright © Airbus S.A.S. 2013

#### 2.2.5 Developing sustainable aviation fuels

In the last two years SA members have continued to make progress on the development of sustainable biofuels along with successful flight trials.

- British Airways / Rolls-Royce novel fuels test SA members have continued to work collaboratively on a number of projects to advance the commercialisation of sustainable low-carbon fuels for aviation. One of these was the British Airways Rolls-Royce novel fuels test programme supported by the US Federal Aviation Association's Continuous Lower Energy, Emissions and Noise (CLEEN) framework. During 2013 four novel fuels were selected for in-depth rig and emissions testing which was conducted in conjunction with Sheffield University. Each of the fuels investigated contained synthetic aromatic components, which may ultimately enable the production of completely synthetic drop-in sustainable fuels without the need to blend with fossil kerosene. All the fuels performed within the expected boundaries of fossil kerosene. Sustainability assessments were also carried out with reference to the Roundtable on Sustainable Biomaterials standard.
- Aerospace partnership work In March 2012 Airbus, Boeing and Embraer signed a memorandum of understanding to work together on the development of drop-in, affordable aviation biofuels. The three leading airframe manufacturers agreed to seek collaborative opportunities to speak in unity to Government, biofuel producers and other key stakeholders to support, promote and accelerate the availability of sustainable new jet fuel sources.
- Thomson Airways Biofuel flight Thomson Airways became the first UK airline to operate commercial flights on sustainable biofuel when TOM 7446 took off from Birmingham Airport to Arrecife in Lanzarote on 6 October 2011. Carrying 232 passengers on a Boeing 757-200, the landmark flight, which was given full backing by the then UK Aviation Minister Theresa Villiers.





Thomson Aircraft refuelling with Sustainable alternative fuels

©TUI Travel plc

- British Airways and Solena biofuel project Greensky London is a joint initiative between British Airways and technology company Solena Fuels. This state of the art facility will convert 500,000 tonnes of residual municipal waste into 50,000 tonnes of sustainable jet fuel, along with road transport fuels and electricity. During 2013 a number of key technology partners were selected as the project progressed through pre-Front End Engineering Design. Good progress was also made on site, planning, financing and off-take agreements. British Airways has committed to take all of the aviation fuel produced for ten years - a contract worth £500 million at today's oil price. British Airways is also an investor in the project.
- Virgin Atlantic and LanzaTech biofuel project In October 2011 Virgin Atlantic was the first airline to partner with LanzaTech. The technology uses a microbe to convert waste carbon monoxide gases from steel mills (which would otherwise be flared off direct to the atmosphere as CO<sub>2</sub>) into ethanol subsequently converted to jet fuel through a second stage process. LanzaTech estimates that its process can apply to 65 % of the world's steel mills, offering the potential to provide 19 % of the world's current jet fuel demand. The China plant that will make the fuel recently (Nov 2013) received The Roundtable of Sustainable Biomaterials (RSB) certification. RSB is widely recognised to be the gold standard, biofuels sustainability certification scheme, approved by leading non-governmental organisations (NGOs). Virgin Atlantic expect to start buying commercial volumes of sustainable fuel from 2015-16.
- Sustainable Aviation Fuel Users Group SA members Airbus, British Airways, Boeing, TUI Travel (parent company of Thomson Airways) and Virgin Atlantic continue to work with 26 other members to accelerate the development and commercialisation of sustainable aviation biofuel in support of meeting the industry's goal of carbon-neutral growth beyond 2020. To achieve this they have developed five global recommendations:
  - Create a strategic focus on sustainable fuels for aviation



- Adopt harmonised and robust sustainability standards
- Promote stable, long-term policy to attract investment
- Ensure that renewable fuel policies and programs support and incentivise sustainable fuels for aviation
- o Provide targeted national, regional, and local backing for this industry sector

The future success of sustainable aviation biofuels will require ongoing commitment from all producers, suppliers, users and regulators. Clearly, this topic will remain a key focus for Sustainable Aviation over the next few years.

#### 2.2.6 Investing in research and development

To maintain the rates of efficiency improvement which are highlighted above it is critical to maintain investment in research and development to discover the new technologies that will enable the next step change in performance.



#### Aerospace Growth Partnership (AGP)

In March 2013, the AGP was announced. It is a seven year initiative created through the collaboration of industry, including SA members, and Government working together. Amounting to £2 billion it seeks to secure the future for the UK aerospace industry focusing on accelerating the development of advanced aero-structures, propulsion systems and advanced aircraft systems.

#### UK Aerospace Technology Institute (ATI)

The ATI has been set up following the AGP commitment to allow industrial and academic researchers to develop technology plans. The first initiative, the UK Aerodynamics Centre (<u>www.ukaerodynamics.co.uk</u>) was announced in March 2012, and is now based on the Cranfield University campus.

#### National Aerospace Technology Programme (NATEP)

A further output of the AGP, the NATEP is designed to support the development of new technologies in the supply chain. About 250 companies will take part in the programme running to March 2017.

#### 2.2.7 Aviation carbon emissions trading

Over the last few years much has occurred in regards to carbon trading of aircraft emissions.

 Global Solution – The 37th Session of the International Civil Aviation Organisation (ICAO) Assembly in 2010 instructed the UN aviation body to prepare and deliver both the market based measure<sup>4</sup> (MBM) framework and feasibility report for consideration by its next

<sup>&</sup>lt;sup>4</sup> Market Based Measures is a term used by ICAO which they define as including emissions trading, emission related levies - charges and taxes, and emissions offsetting; all of which aim to contribute to the achievement of specific environmental goals, at a lower cost, and in a more flexible manner, than traditional command and



Assembly in 2013. At the 2013 Assembly ICAO announced that it had agreed to develop a global MBM for international aviation. ICAO's States agreed to report back in 2016 with a proposal for a global MBM scheme capable of being implemented by 2020. Alongside this the International Air Transport Association (IATA) has endorsed a carbon neutral growth 2020 strategy (CGN2020) and in June 2013 endorsed a resolution which provides governments with a set of principles on how governments could:

- Establish procedures for a single MBM
- $\circ~$  Integrate a single MBM as part of an overall package of measures to achieve CNG2020
- EU Emissions Trading Scheme (ETS) In October 2012 the European Commission's lead Directorate General on climate change issues (DG CLIMA) announced that it is 'stopping the clock' for applying the EU ETS to flights to and from non-EU countries whilst progress is made towards a single global solution outlined above. Following the announcement by ICAO in 2013 the EU announced its proposal to amend the EU ETS so that aviation emissions would be covered for the part of flights that takes place in European regional airspace. This proposal, if approved by the EU Council and Parliament, will take effect from January 2014.
- UK Carbon budgets During 2012 the UK Government explored how to account for international aviation and shipping emissions in the setting of UK carbon budgets to achieve an 80 % reduction in UK CO<sub>2</sub> by 2050. In October 2012 SA gave evidence to the UK Parliament Energy and Climate Change select committee on this matter, highlighting the evidence developed in the SA CO<sub>2</sub> Road-Map and encouraged the UK Government to account for international aviation emissions in the UK Carbon budget but to ensure this is delivered through an effective global emissions trading scheme. In December 2012, the Government announced that recognising uncertainty over the international framework for reducing aviation emissions and particularly the treatment of aviation within the EU Emissions Trading System, it was deferring a firm decision on whether to include international aviation and shipping emissions within the UK's net carbon account. As regards the recent EU proposal the UK Government are still deciding their position.

SA remains committed to working with others to achieve an effective global emissions trading scheme that will effectively manage any remaining carbon emissions created once all other reduction and mitigation initiatives are exhausted.

#### 2.2.8 Non CO<sub>2</sub> Impacts

SA has continued to monitor emerging research and evidence in regard to non- $CO_2$  emission impacts on climate change. As a result an updated technical paper on this topic will shortly be available on the SA website.

control regulatory measures. Market-based measures are among the elements of a comprehensive mitigation strategy to address greenhouse gas (GHG) emissions from international aviation that are being considered by ICAO.



#### 2.3.Goal 3: Noise

#### *Limit and, where possible, reduce the impact of aircraft noise.*

In the last few years SA and its members have continued to conduct a wide range of activities to reduce both aircraft noise and the adverse impacts experienced by local communities around airports. The most significant result of this work was the publication of the SA Noise Road-Map.

#### 2.3.1 Developing the SA Noise Road-Map

During 2012 SA established a Noise working group with the task of developing a Noise Road-Map, using a similar approach to the  $CO_2$  Road-Map, which would project how noise from UK aviation is likely to change between 2010 and 2050.

The Noise Road-Map, launched by SA at the Houses of Parliament in April 2013, assesses the potential to address noise issues from aircraft operations in five areas:

- Introduction of new aircraft and engine technology
- Improved operational procedures
- Improved land use planning controls around airports
- Improved industry communication and community engagement on issues of aircraft noise
- Use of operational restrictions as a last resort, once all other opportunities have been explored

This approach is consistent with the ICAO balanced approach for aircraft noise management although SA has added communication and community engagement. The resultant predicted change in UK noise output is shown below.



#### SA Noise Road-Map (2013)



The SA Noise Road-Map is the result of detailed work, involving all four sectors of the industry represented by SA, which assessed the likely technology advancements in aircraft and engine noise reduction achievable by 2050, as well as rates of airline fleet replacements to include new, quieter technologies. This is then multiplied by the latest UK Government aviation growth forecasts to produce a total UK aviation noise output result. In summary it shows that future growth in UK aviation can be achieved without increasing noise output. The ability to reduce noise output as growth occurs is dependent on how future aircraft and engines are designed, and must take into account an inevitable trade-off between optimising the reduction of  $CO_2$  emissions and noise.

The Noise Road-Map also explores the challenge of how individuals react to aircraft noise events, a complex issue made up of many variables as characterised in the following chart.







A better understanding of how these variables interact is essential in order to identify and implement the right measures to minimise the number of people annoyed by aircraft noise. SA members are committed to supporting research activities into this area going forwards.

The aviation industry has made a series of commitments to continue to reduce noise from aircraft operations. The most immediate of these is that UK airports and their aviation partners will use the tools used in the SA Noise Road-Map to develop a picture of noise output for their own airport.

Achieving the projected reduction in noise output is also dependent on the appropriate support from UK Government, local authorities and community groups in implementing the solutions identified.

#### 2.3.2 Noise Reduction from New Aircraft and Engine Technology

#### **New Engines**

SA aerospace manufacturers have continued to invest and develop new technologies that reduce source noise from aircraft. A summary of some of these initiatives in aircraft engine design are presented below:

• Zero splice intake liner – This relatively small increase in the acoustic liner area of new jet engines has been very effective in reducing fan noise from aircraft engines on departure. This is illustrated in the pictures below.



• Engine bypass ratios – Increasing the size of the front fan of the engine, relative to the compressor stages behind, enables more air to bypass the combustion section of the engine and therefore the exhaust jet speeds are reduced which greatly reduces the engine noise. The chart shows how this has resulted in reductions in noise from successive Rolls-Royce engines.





Source: Rolls-Royce

#### Effect of increasing engine bypass ratio to reducing noise

• Engine Nozzle lip treatments – Novel serrated engine casings have been tested to promote faster mixing of the jet exhaust with the atmosphere whilst minimising the turbulence created in the mixing process. These new designs are now entering service on various aircraft.

To put this work in context, on take-off a Trent 1000 powered Boeing 787 is at least 3dB quieter than the generation of aircraft it replaces, equivalent to halving the noise footprint.

#### **New Aircraft**

• Airframe noise benefits – As the noise from the engines reduces, noise created by air flow over the airframe of the aircraft will become more important. Airframe manufacturers are now conducting research into options to address this, which is further considered in the noise research section of this report.

Combining these noise reductions from aircraft airframe and engines, new aircraft offer a step change in noise reduction compared with those they replace which is summarised next.



- Airbus A380 Introduced in 2007, the A380 is the quietest wide body jetliner flying today. It generates 50 % less noise energy on departure than its nearest competitor, as well as three-to-four times less when landing.
- Airbus A350 Airbus engineers have developed or improved several functionalities that will be offered as standard on the A350 XWB. These include the Automatic Noise Abatement Departure Procedure (NADP), which optimises the thrust and flight path to reduce the noise over crowded areas. This means considerably less noise around airports, mitigating noise nuisance for local communities.
- **Airbus A320neo** The A320neo will offer a reduction in engine noise compared with the current A320 family aircraft due to its new engine options (CFM International's LEAP and the PW1100G PurePower from Pratt & Whitney).
- **Boeing B787** The B787 offers a 60 % smaller noise footprint compared with today's similarly sized aircraft.
- **Boeing B747-8** The B747-8 offers a 30 % smaller noise footprint compared with the B747-400 series it is designed to replace.
- **Boeing 737 Max** The B737 Max offers a 40 % reduction in the noise footprint compared with the B737 next generation aircraft in service today.
- **Bombardier CSeries** The Bombardier CSeries aircraft has just commenced a test flight programme. It has been designed for urban operations and aims to offer the lowest noise levels of any commercial aircraft in production.

As airlines continue the process of replacing their current fleets with these newer aircraft, so the noise benefits they offer will be realised.



Photo Copyright © Gatwick Airport Ltd. 2013



#### 2.3.3 Noise Reduction from improved operating techniques

In the SA Noise Road-Map, operational improvements are identified as being able to offer between a 1 and 5 dB reduction in noise by 2030 compared to a 2010 baseline. The precise level of noise reduction will vary for different communities depending on their current noise exposure and local scope for adopting new techniques. Key operational techniques to reduce noise are:

- Continuous Descent approach (CDA)
- Continuous Climb operations (CCO)
- Steeper approaches
- Displacing runway thresholds
- Operational noise respite
- Performance based navigation (PBN)
- Reduced engine taxi
- Use of FEGP

At the 11 airports in the London airspace region, use of CDAs by arriving aircraft increased by 15 % between 2006 and 2012 to 75 %. At the same airports and over the same time, CCOs increased by 9 % to 57 % of all departing aircraft. Further CDA trials have been carried out by NATS and airlines at Edinburgh airport in 2012, where over a 15 % improvement in use of the technique was achieved following data sharing and awareness raising forums<sup>5</sup>.

The industry has also worked with local communities to run trials exploring opportunities to improve aircraft track accuracy and options for providing predictable respite. The following case studies provide an insight to the range of noise related operational trials currently underway across the UK aviation industry.

A CDA implementation plan to ensure more UK airports realise the successes seen at Edinburgh will be developed by SA members over the coming years.

<sup>&</sup>lt;sup>5</sup> See <u>http://www.nats.co.uk/environment/corporate-responsibility-2013/30-minutes/air-traffic-management/flight-profile-monitoring/</u>





Making every journey better Heathrow Early Morning Noise Respite Trial

From November 2012 until March 2013 Heathrow airport, in partnership with HACAN, NATS and British Airways, launched an "Early Morning Noise Respite Trial" to test whether creating noise relief zones under the flight path could ease disturbance in the early morning period for residents. On average, 17 flights arrive at Heathrow each morning between 0430 and 0600.

The trial tested out the concept of routing these early morning arrivals in order to – week by week – consistently avoid one or other of these zones, providing definite periods of noise relief for local communities. Working with HACAN to consult local communities in order to understand their views was essential, and feedback was positive overall on the noise respite trial itself and on the airport's efforts to engage more effectively. A full report on this trial has recently been published. (See http://www.heathrowairport.com/noise/noise-in-your-area/early-morning-trial )



#### Stansted Airport – Required Navigation Performance (RNP) Trial

Over the years, London Stansted has trialled a range of different solutions to improve departure track keeping, working closely with aircraft operators and other stakeholders to achieve 99% compliance.

In collaboration with the Airports Consultative Committee's Environmental Interest Group (EIG), including SA signatory easyJet, Stansted has recently undertaken a trial of new precision navigation techniques (RNAV RNP1 with Radius-to-Fix (RF) path terminator technology) on two departure routes. This trial, the first of its kind in the UK, has already achieved a much tighter concentration of departure tracks. The lateral dispersal of tracks from the Airbus A319 and A320 plus the Boeing B738 and B747-8 flying the departure trial have shown a high degree of concentration with the flights diverging no more than 150 metres from the mean track. This has greatly reduced the area of noise exposure to local communities as indicated by the easyJet departures shown in the following pictures.







#### 2.3.4 Noise Reduction through improved land use planning controls

How land around airports is developed is a crucial factor in determining the number of people significantly affected by aircraft noise. Historically the aviation industry has made significant progress in reducing the size of airport noise contour areas. The SA Noise Road-Map highlights that despite over a 5 % increase in air traffic movements across six major UK airports between 1998 and 2010, the number of people included within the 57Leq noise contour dropped by 188,400, or almost 40 %<sup>6</sup>. How future noise sensitive developments are provided close to airports will be a key factor that will require careful consideration moving forwards. SA members are committed to working with Government and local planning authorities to ensure the best possible outcomes are realised.

#### 2.3.5 Noise Communication and Community Engagement opportunities

Over the last two years SA airport members have been focussing on delivering against their noise action plans. This has involved detailed conversations with communities around airports to understand their concerns and seek to implement actions to address them.

In the SA Noise Road-Map a 'Benchmark for Constructive Engagement' was developed and since publication of the report SA has been engaging with a number of Airport Consultative Committees to explore how industry can use this to improve community engagement.

<sup>&</sup>lt;sup>6</sup> See SA Noise Road-Map page 15-16



#### 2.3.6 Noise Reduction potential through research and development

The key to continually finding new ways to reduce annoyance from aircraft operations is by better understanding the opportunities and targeting investment as effectively as possible. A number of exciting airframe and engine ventures have been established by the manufacturing sector.



#### Airbus Aircraft Noise Technology Centre (ANTC)

The ANTC at the University of Southampton is a key research centre on aircraft noise in the UK. Established by Airbus in 2008, the Centre's focus is on developing methods and technologies to reduce the noise generated by airlines both inside and outside the cabin. ANTC, led by Professor Xin Zhang, brings together academic staff, research fellows and PhD students using state-of-the-art computer simulations and wind tunnel testing to develop new noise reduction concepts. Undergraduates also work with the research team, inspiring the next generation of engineers for the industry. Study topics include landing gear aerodynamics, duct acoustics and engine nacelle noise, advance prediction methods for noise, and jet and rotor noise.

(See <a href="http://www.southampton.ac.uk/antc">http://www.southampton.ac.uk/antc</a> )



Computational aero-acoustic simulation of noise radiated from a wing with high lift devices extended and spoiler deployed for a steep landing approach





#### Rolls-Royce University Technical Centre (UTC) In Noise Technology

The Rolls-Royce UTC in Gas Turbine Noise in the Institute of Sound and Vibration Research at the University of Southampton offers a breadth and depth of knowledge, independence of thought and an aptitude for innovation which helps ensure that the best technology is built into Rolls-Royce engines. Research activities include theoretical, computational and experimental studies of aircraft noise sources. (See <a href="http://www.southampton.ac.uk/engineering/research/centres/noiseutc.page">http://www.southampton.ac.uk/engineering/research/centres/noiseutc.page</a> )



The Institute of Sound and Vibration Research anechoic chamber used to develop low noise technology for Rolls-Royce engines

In addition to the specific case studies above, a further key step in aeronautical research and development came in late 2010 with the setting of key targets in the European Flightpath 2050 strategy. The aviation manufacturing industry has agreed to support research to achieve a perceived reduction in noise emission from aircraft in flight of 65 % in 2050, relative to the capabilities of typical new aircraft in 2000 (see <a href="http://ec.europa.eu/transport/modes/air/doc/flightpath2050.pdf">http://ec.europa.eu/transport/modes/air/doc/flightpath2050</a> strategy.

A final research challenge highlighted by the SA Noise Road-Map is the need for improved understanding of how the factors that lead to someone becoming significantly annoyed from aircraft noise interrelate. SA is committed to supporting further research into this.



#### 2.4 Goal 4: Local Air Quality

Industry to play its full part in improving air quality around airports.

Air quality, largely related to concentrations of nitrogen dioxide ( $NO_2$ , a component of  $NO_X$ ), is a matter of concern at some UK airports.

While road traffic is generally the primary source, progress is being made not only in reducing emissions from aircraft but also in understanding the relative contributions from other airport-related sources.

SA members have continued to work to improve air quality over the last two years.

#### 2.4.1 Working across the industry to implement Reduced Engine Taxiing



Since the launch of 'Reducing the Environmental Impacts of Ground Operations and Departing Aircraft - An Industry Code of Practice' in June 2012, SA signatories have been making steady progress on increasing the use of reduced engine taxi, where it is safe to do so. Introducing this across the wide variety of aircraft types and airports in the UK has raised a range of operational challenges. These have ranged from aircraft and engine operating restrictions to airport jet blast safety limits and airport taxiway flow capacity concerns. The four sectors of the aviation industry have jointly worked to explore these issues and resolve them where possible. Airlines are working to review standard operating procedures and deliver crew training on the use of reduced engine taxi. Airports have been exploring solutions to jet blast risk issues. NATS have been carrying out risk studies of aircraft taxi flow capacity implications and manufacturers have been reviewing aircraft operating restrictions for use of reduced engine

taxi. So far SA airlines are reporting a positive use of reduced engine taxi after landing with some operators achieving 50 % or more of their arrivals using the procedure. With flight safety the priority, reduced engine taxi on departure is proving harder to implement due to relatively short taxi distances at some airports and to the need to ensure all engines are safely working before take-off. We will report on how this develops, along with figures to quantify the benefits to  $CO_2$  and air quality in our next Progress Report.





#### Birmingham Airport - Encouraging reduced engine taxiing and used of FEGP

Birmingham Airport have been working collaboratively with airlines and air traffic control to encourage the use of reduced engine taxiing (RET), particularly for arriving aircraft and 70 % of the major airlines at the airport now employ RET. This is further improved by the efficient airfield programme, with 90 % of movements now able to taxi continuously to stand.

Once on stand airlines are encouraged to use the Fixed Electrical Ground Power (FEGP) rather than the onboard Auxillary Power Unit, improving local air quality and providing energy at lower carbon intensity. Birmingham Airport has employed a system of automatically charging airlines for FEGP use, whether it is used or not, in order to improve its uptake. This has resulted in a significant increase in use of FEGP from 52 % in 2008 to 88 % in 2012.







#### **Heathrow Clean Vehicle Partnership**

To minimise emissions from vehicles Heathrow Airport has developed a Clean Vehicles Partnership.

As well as sharing knowledge and best practice, the partnership promotes collaborative working amongst companies, and provides a number of services including support in setting up and monitoring clean vehicle trials, improving driver behaviour through driver training and telematics trials. Additional support is provided through free consultancy advice, monitoring tools and seminars and workshops on the issue.

22 companies operating over 3,000 vehicles at Heathrow are actively participating in the partnership.

#### Low emissions vehicles

Heathrow's Air Quality Strategy focuses on trialling and adopting various new, cleaner technologies.

850 vehicles, that's 11 % of the entire airside fleet at Heathrow, are electric, making it one of the largest fleets of electric airside vehicles in Europe. As well as electric tugs that move baggage around the airfield, electric cars and vans are used on the airport to transport staff, and trials have started on electric specialist ground support vehicles such as belt loaders, cargo loaders and push back tractors.

The airport is also trialling hydrogen technology, and worked with the Greater London Authority (GLA) in 2012 to support the UK's first publicly accessible hydrogen fuelling station. The station is part of the HyTEC project, introducing zero emissions hydrogen fuel cell taxis into London that can now be fuelled at Heathrow. In 2013 the airport will deploy the first hydrogen fuel cell vehicle used by airport companies, as well as assessing hybrids to test their effectiveness and suitability.



#### 2.5 Goal 5: Surface Access

Industry playing its full part in an efficient, sustainable multi-modal UK transport system.

Over the last few years SA Members have continued to improve the effectiveness of their individual staff travel plans, and have supported a range of wider airport surface access strategies.

UK airports efforts to encourage further use of public transport by passengers to access the airport has paid off in recent years as summarised in the table below.

#### Passenger (Pax) use of Public Transport to access UK Airports

	2010		201	1	2012	
Airport	Pax using public transport to access the airport	% of Pax using public transport to access the airport	Pax using public transport to access the airport	% of Pax using public transport to access the airport	Pax using public transport to access the airport	% of Paxusing public transport to access the airport
Birmingham	2,228,823	26.0%	2,584,889	30.0%	2,765,987	31.0%
Gatwick	11,496,345	40.5%	12,872,108	42.2%	13,627,669	43.5%
Heathrow	16,534,359	39.2%	18,685,464	40.7%	17,551,847	40.6%
Luton	2,771,126	32.8%	2,865,335	31.1%	3,014,900	32.4%
Stansted	8,282,470	47.9%	8,391,054	48.9%	8,375,703	50.7%
Total	41,313,123	39.4%	45,398,851	40.7%	45,336,106	41.5%

#### Notes:

Based on CAA 2012 passenger survey data

Passenger figures are for non-transferring passengers only

Total public transport includes passenger use of bus, coach, train or tube to access the airport Birmingham airport data provided directly from the airport

Specific case studies for Heathrow Airport and NATS are shown below, but for more information on other UK airport future targets and strategies please visit the relevant airport website.





**Heathrow Commuter** helps employees from any of the 360 plus companies based at the airport to choose a more cost effective and sustainable way of travelling to and from the airport for work; providing a vast number of products, services, staff discounts and public transport options.

Based at a central location for commuters, Heathrow Commuter is served by all the local bus services within the Heathrow Free Travel Zone. Services include;

- Heathrow Travelcard which offers staff at least 30 % discount off bus and rail travel on selected routes.
- **Heathrow's Car share scheme**, launched in 2002, has had a considerable impact on staff travel to and from the airport:
  - Encouraging a cut in solo car journeys by employees from 71 % in 2004 to 58.8 % in 2011
  - Attracting over 8,000 members in total and at least 50 new members every month
  - Since 2009, the Heathrow car share scheme has also helped its members drive over
    24 million fewer miles, saving nearly 12,500 tonnes of CO<sub>2</sub>
- Heathrow's Cycle Hub is a one stop shop, encouraging staff to cycle to work. Members receive discount in store, free labour on bike servicing with the discount applied to any parts required and free maintenance training; whilst also offering companies the ability to run a salary sacrifice scheme. To date, over 2,100 Heathrow employees have joined the Heathrow Cycle Hub.

# NATS

#### NATS Sustainable Travel Programme

Since 2008 NATS have implemented a raft of sustainable travel measures such as car sharing, 'salary sacrifice' schemes for bicycles and buses, a low emission car scheme, season ticket loans, motorbike purchase scheme and increasingly flexible IT to promote connectivity away from the office.

Since its launch in 2009 the Cycle to Work Scheme has helped over 15 % of NATS people to 'get on their bikes' and the Low Emissions Car scheme, since its launch in the spring of 2012 has resulted in almost 300 low emission cars being ordered.



#### 2.6 Goal 6: Natural Resources

Environmental footprint of UK aviation's ground-based aircraft activities contained through effective management and reduction measures.

SA members have continued to explore and develop initiatives to improve the industries use of natural resources over the last few years.

#### 2.6.1 SA Waste Working Group

Following the publication of the Aircraft Cabin Waste Recycling Guide in 2010, the SA Waste Working Group has continued to meet to share best practice experience to improve recycling of aircraft waste.

The SA Waste Working Group has specifically explored options for the better management of international aircraft cabin waste. Currently, due to UK waste regulations, international catering waste from aircraft arriving from outside the EU cannot be recycled but must be sent for landfill or incineration. SA continues to assess ways to reduce the contamination of recyclable aircraft waste such as newspapers with international cabin waste that cannot be recycled, in order to increase the proportion of off-aircraft waste which can be recycled.

The following cases studies provide a further insight to some of this work.



#### Birmingham Airport: Proactive waste strategy and food recycling

Birmingham Airport is committed to dealing with waste in the most responsible way. The airport company engages proactively with terminal tenants and concessions to promote recycling. Recently, three tenants were invited to take part in a trial to recycle food waste, from kitchen scraps to left over sandwiches. The trial was a great success with nearly three tonnes of waste collected in only the first three months, enough to fill 33 wheelie bins. Due to its success the airport is now rolling out the scheme to other tenants who are keen to take part. The food waste is taken to an anaerobic digestion plant where it is used to generate electricity.





#### Thomson Airways: recycling on-board

Thomson Airways had a three-year commitment [2010-13] to recycle more than three million of the drink cans used on its flights. By working in partnership with the cabin crew, cleaners and ground handlers and amending operating procedures on-board the aircraft, Thomson achieved its three-year commitment partway through the summer 2013 season. The cans saved equated to 48 tonnes of aluminium, a valuable and easily recycled commodity.

#### 2.6.2 Energy, Water and Construction Management

In addition to tackling waste issues the aviation industry is also focussed on reducing energy and water consumption from the buildings they own on the ground. The following case studies give a flavour of the successes of this work.



#### **NATS Energy Management**

As well as changes in the skies, over the past seven years NATS has introduced a number of sustainability measures on the ground too. Since 2008 NATS' energy consumption has fallen 29 %, with water usage also dropping by 45 %.



#### Virgin Atlantic resource management

Although most of Virgin Atlantic's carbon emissions come from flying its aircraft, it also has significant ground-based facilities, with properties including offices, training centres, hangars, warehouses and lounges. The airline has set targets for ground energy, ground transport and waste as well as standards on sustainable design and buying. By the end of 2012 Virgin Atlantic had achieved the first of its targets, i.e. to reduce electricity and gas use by 10 % between 2008-09 and 2011-12; to increase fuel efficiency and reduce  $CO_2$  emissions from ground transport by 30 % between 2009 and 2012; and to recycle or otherwise divert from landfill 75 % of waste generated by Virgin Atlantic-managed UK sites.





Making every journey better

#### Heathrow's new Terminal 2

Due to open in June 2014 the new Terminal 2 will be Heathrow's most sustainable terminal yet. Due to handle around 20 million passengers per annum when fully developed, Terminal 2 will be home to 23 Star Alliance member airlines as well as SA member Virgin Atlantic Little Red, and Aer Lingus plus Germanwings.

During construction, over 99 % of material from the demolished old Terminal 2 was recycled or reused for energy.

During operation the airport anticipates that the building's  $CO_2$  emissions will be 40 % lower than building regulations require whilst waste management and segregation at source within the terminal will support the airports aim to recycle or compost 70 % of airport waste by 2020.

Key design features include skylights and 10-metre-high, floor-to-ceiling windows which maximise the natural light, sophisticated lighting control systems to keep energy use down, solar controlled glass and angled louvres to avoid overheating, shorter aircraft taxi distances between the gates and take-off and landing which reduces emissions and water-efficient fittings in the terminal to reduce water consumption.





#### 2.7 Goal 7: Implementation

Full industry commitment to sustainable development and communicating fully the role of aviation in society in order to support a better understanding of its contributions.

During the last two years SA and its members have been busy on a range of activities to ensure we continue to improve how we work to deliver the goals and communicate this work with our stakeholders.

#### 2.7.1 Resourcing Sustainable Aviation

In July 2012 SA members committed to invest in a full time dedicated position to improve coordination and delivery of SA's work programme.



The appointment of Dr Andy Jefferson as Programme Director has greatly helped SA deliver the SA Noise Road-Map within a tight timescale and to raise awareness of SA with our stakeholders.

Dr Andy Jefferson Programme Director Sustainable Aviation

In addition to this, SA members have invested in a number of further initiatives to help improve how SA carries out its work and how it engages with its stakeholders.

These include:

- Expanding the SA Communications and engagement work including responding to numerous Government and regulator consultations, but especially the Aviation Policy Framework. SA has also presented at the political party conferences, the Farnborough International air show, and a number of specific sustainable aviation related conferences
- Working with the SA Advisory panel to review and improve how SA engages them and how they challenge SA's work programme and priorities
- Reviewing how SA works with its members
- Reviewing and working to update SA's website to make it more accessible to its stakeholders

In addition to this SA members have also been exploring ways to embed the work of SA on a more local level. The following case studies give a flavour of this work.



# YOUR LONDON AIRPORT

#### 10 point sustainability plan – 10 issues and 10 years to achieve them.

Inspired by the work of SA and as part of Gatwick Airport's continuing commitment to sustainable development a ten point Sustainability plan has been developed. This sets a series of commitments which the airport aims to meet by 2020. The commitments are:

- 1. Demonstrate we are a trusted and valued neighbour by making a positive contribution to Gatwick's local community
- 2. Fulfil our role as an economic driver of local regional and national significance
- 3. Increase sustainable access options for our passengers and staff
- 4. Reduce carbon emissions by 50 % against a 1990 baseline
- 5. Work with airlines and partners to improve air quality
- 6. Reduce the impact of operational noise
- 7. Generate no waste to landfill and recycle 70 % of Gatwick waste
- 8. Reduce energy (against a 1990 baseline) and water consumption (against a 2010 baseline) by 20 %
- 9. Improve the quality of water leaving the airport
- 10. Have an award winning approach to on-airport biodiversity



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#### Heathrow Sustainability Partnership Case Study

With 320 companies employing 76,500 people, like SA, Heathrow relies on collaborative working.

A Sustainability Partnership was established in 2010 to create and deliver a shared sustainability strategy for Heathrow.

Led by a Board involving CEOs of 13 airport companies (which employ 80 % of Heathrow's workforce) including SA members NATS and British Airways, the Partnership is committed to enhancing Heathrow's social and economic benefits while minimising its environment and community impacts. Behavioural changes deliver shared ownership of challenges, joint problem solving and a greater performance improvement across the airport. The Partnership agrees priorities and targets for members to improve Heathrow's sustainability performance through shared action plans.

Each member company champions at least one programme, bringing in other Partnership members and expertise from their own companies to support.

In 2011, the Partnership piloted four projects focusing on commuting, waste, vehicles and employment; the success of which led to the development of a 27 point action plan launched in 2012 focusing on transport, resources and people. Since this time, the projects are being implemented gradually.

- Over 2,000 new employees signed up to the car-share scheme with 802 employees now regularly car-sharing, saving approximately 650 tonnes of CO<sub>2</sub> every year
- Over 2,200 vehicles assessed for NO<sub>x</sub> and CO<sub>2</sub>, enabling a reduction target for NO<sub>x</sub> of 2.9 % (2.9 tonnes) for CO<sub>2</sub> of 4.6 % (1,276t)
- Waste action plans created for 95 % of Partnership companies
- A Heathrow Academy was established for construction, aviation and logistics, enabling local, unemployed residents to secure 42 construction jobs and 75 aviation & logistics jobs between July and December



#### 3. Future Work Programme and Next Steps

This section focuses on our future work and is presented by the incoming Chair to Sustainable Aviation, Jonathon Counsell.

During 2013 SA reviewed its future work priorities for the next two years to focus on those areas that will enable it to deliver against its stated goals. SA recognises that the key priorities will continue to exist in the areas of climate change and noise as these represent the primary sustainability impacts of the aviation industry. In addition, SA recognises that it is important to always address the environmental impacts of the aviation industry within the broader socio and economic benefits.

Reflecting this, the SA key priorities for the period 2013 – 2015 are:

- 1. Develop an SA Sustainable Aviation Fuels Road-Map to inform the review of EU Renewable Energy Directive
- 2. Develop a programme of noise reduction operational improvements to support delivery of the Sustainable Aviation Noise Road-Map
- 3. Develop new guidance policy on noise nuisance and land use planning controls close to airports
- 4. Undertake future scenarios work to identify the potential jobs, skills, innovation and economic value UK aviation could make to the UK economy
- 5. Understand latest developments in UK aviation environment research and encourage Sustainable Aviation members support in this area

To enable closer assessment of the progress against our activities SA will consider clear targets for its stated goals and ensure clear line of sight between SA's work programme and delivery against these goals and targets.

In addition SA will continue to progress other work programme activities to support its core activities including:

- 1. Sustaining work on the issue of interdependencies between  $CO_2$ , Noise and  $NO_x$  emissions and reporting updates as they emerge
- 2. Maintaining a close watch on EU and International climate work including the EU ETS, ICAO and the United Nations Framework Convention on Climate Change (UNFCCC) activity
- 3. Updating Sustainable Aviation's Non-CO<sub>2</sub> position paper



SA will also update the  $CO_2$  and Noise Road-Maps in 2015, in line with its commitment to deliver biannual updates on the core Sustainable Aviation documents.

Finally, we will continue, with the support of the SA Advisory Panel, to monitor our work programme and initiate any additional activities that will support delivery of our goals and any identified issues affecting the sustainability of our industry.

In closing I would like to take this opportunity to thank our out-going chairman Matt Gorman for his great work in helping build and develop Sustainable Aviation and I really look forward to continuing the important task of improving the sustainability performance of our vital industry'



Jonathon Counsell Incoming Chair of Sustainable Aviation (2013-2015) Head of Environment, British Airways

The new Boeing 787-8



Photo Copyright © Lance Kuhn, Boeing 2013



#### 4. Governance

Sustainable Aviation's (SA's) Strategy and Work Programme are confirmed by its Council, made up of representatives of the member organisations. SA's terms of reference are to concentrate on issues that are most effectively addressed through cross-sector co-operation with most projects delivered by teams comprising airlines, airports, manufacturers and NATS. Additional information on signatories' own individual sustainability programmes is available from their websites.

A list of individual signatories of Sustainable Aviation (SA) can be found here: <u>http://www.sustainableaviation.co.uk/about-us/</u>.

Reporting to the Council is the SA Working Group, comprising work streams for the 2011-2013 period on:

- Climate change
- Noise
- Operational improvements
- Communications
- Aircraft waste and recycling
- Sustainable aviation fuels

In addition, an Advisory Panel (previously called the Stakeholder Panel) of recognised external sustainability experts provides rigorous challenge to the Council and to the work programme. The Advisory Panel meets both independently, and on a regular basis with the Council in order to track progress against the goals.

A chart depicting how this is organised is shown below:





#### Glossary

ACARE Advisory Council for Aviation Research and Innovation in Europe

- A-CDM Airport Collaborative Decision Making
- **AOA** Airport Operators Association
- **APU** Aircraft Auxiliary Power Unit
- ATC Air Traffic Control
- **ATM** Air Traffic Management
- BATA British Air Transport Association
- CAA UK's Civil Aviation Authority
- **CCC** UK's Committee on Climate Change
- **CCO** Continuous Climb Operation
- **CDA** Continuous Descent Approach
- **CO**<sub>2</sub> Carbon Dioxide
- ERCD Civil Aviation Authority's Environmental Research and Consultancy Department
- EU ETS European Union Emissions Trading Scheme
- FEGP Fixed Electrical Ground Power
- IATA International Air Transport Association
- ICAO International Civil Aviation Organisation
- NO<sub>2</sub> Nitrogen Dioxide
- NO<sub>x</sub> Oxides of Nitrogen
- PCA Pre-conditioned air
- **RNAV** Area Navigation
- **RNP** Required Navigation Performance
- **SA** Sustainable Aviation



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