Ministry Of Higher Education and Scientific Research

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Ensuring environmental safety of aviation activity

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1.Climate change

Introduction

Aircraft emit a range of greenhouse gases throughout different stages of flight. Aircraft are fairly unique in that they directly emit gases into the higher levels of the atmosphere. When emitted at this altitude, the same gases can have very different effects than when emitted at ground level.

Scientific evidence strongly indicates that these greenhouse gases contribute to climate change.

Greenhouse gases move throughout the atmosphere and so do not respect international boundaries. This means that they are an international issue regardless of where the emissions were released.

Types of greenhouse gases created by aviation

Many different gases contribute to climate change. *CO2* is generally viewed as the most problematic greenhouse gas. It has a long life cycle and plays a key role in global warming. In aviation, it is primarily generated by burning carbon-rich ‘fossil fuels’ in engines. Other gases emitted by aircraft are:

- Oxides of nitrogen (*NOx*):
- Ozone (*O3*) – created by the reaction of *NOx* and sunlight:
- Soot and aerosols:
- Water vapor – causing contrail or man-made cirrus clouds.

Less is known about the effects of these other gases. Some researchers predict that these gases have a far greater effect than *CO2* when emitted in the higher levels of the atmosphere.

Factors contributing to aviation's *CO2* emissions
The main factors are:

1) Aircraft type:
2) Flight profile and distance:
3) Weight of the aircraft:
4) Operational procedures:
5) Use of next generation biofuels:
6) The weather:
7) Efficiency improvements:

1. Aircraft type:

Each aircraft will burn fuel at a different rate. There can be variances between models: air frame design and modifications will affect drag and weight; different engines will operate at varying levels of efficiency depending upon the range that they are designed to fly. Between aircraft families the variances can be even greater.

2. Flight profile and distance:

Aircraft burn fuel and emit emissions at differing rates during the different stages of a flight. These can be broadly categorized as:

- Take-off and climb to cruise altitude:
- At cruise altitude:
- Landing:
- Efficiency and distance:
- External factors.

3. Weight of the aircraft:

The lighter an aircraft is, the less fuel it will burn. Reducing unnecessary weight on an aircraft can therefore reduce *CO2* emissions (as well as fuel costs). Airlines are always looking for ways to reduce the weight of their aircraft, and have taken a wide range of steps to do so. These include:

- using lighter types of paint:
- taking fewer and lighter catering trolleys on board:
- removing in-flight magazines:
- reducing the baggage allowance rates.

4. Operational procedures:

Changes to aircraft operational procedures both in the air and on the ground can reduce the amount of fuel they burn and hence the volume of *CO2* they emit.

Continuous Climb Operations and Continuous Descent Operations aim to make the climb to or descent from cruising altitude more efficient. Just as in a car, smoother acceleration and deceleration burns less fuel, so a smoother, steadier climb with fewer changes of speed will require less aircraft fuel. A similar principle applies to descent, where a smoother descent, perhaps begun earlier, reduces the need for braking and re-acceleration.

5. Use of next generation biofuels:

Conventional jet fuel, in common with other road transport fuels such as diesel and petrol, is based on fossil fuels and has a high carbon content - creating high levels of *CO2* emissions. The aviation industry has looked at alternatives, such as biofuels (fuels derived from organic matter such as plants) which enable overall *CO2* emissions to be reduced by taking account of the carbon absorbed during plant growth. Instead, there is a concerted effort to produce biofuels from waste sources.

6. The weather:

❖ Headwinds will require more fuel to be burnt so increases emissions, although a tailwind will help reduce emissions.

❖ Bad weather such as snow, high winds or fog can cause delays with take-off and landing which see aircraft idling on the ground or being held in stacks which increases the emissions of the aircraft.

❖ Temperature can result in higher and lower emission rates; with aircraft requiring less fuel to take off in colder temperatures due to the air being denser which enables the engine to run more efficiently.

❖ indirect environmental effects can also occur from bad weather such as an increase in the amount of de-icing fluid needed to be used in prolonged spells of cold weather.

7. Efficiency improvements:

In addition to reducing emissions levels overall, the aviation industry seeks to increase its efficiency. In environmental terms, this means reducing the level of emissions per passenger or tone of freight carried.

Consumer ability to reduce *CO2* emissions

The easiest way to reduce CO2 emissions from flying is to reduce the amount you fly. This is not always practical: aviation is an important and convenient form of transport for millions of people**.**

Some steps can be taken to reduce emissions without ceasing to fly:

1. Select airlines with modern (i.e. more efficient) aircraft:
2. Consider flying economy rather than business or first class:
3. Fly with airlines with lower *CO2* performance figures:
4. Use public transport to get to the airport.
5. Make a carbon offset payment when you fly.

2. Air quality

Introduction

Poor air quality is known to have a damaging effect on health. Depending on the level and type of pollution, symptoms can range from minor irritation to severe effects (particularly amongst those suffering from respiratory illnesses). Air pollution can also damage vegetation and ecosystems.

Pollutants are emitted from aircraft engines, particularly affecting those working and living near an airport. Ground vehicles operating at airports, passenger transport, employee transport and delivery vehicles also contribute to aviation's pollutant emissions.

Types of pollution created by aviation

The main pollutants that are monitored are:

- Nitrogen dioxide (*NO2*)
- Nitrogen oxides (*NOx*)
- Particulate matter (PM)

Carbon monoxide, polycyclic aromatic hydrocarbons, benzene and 1,3-Butadiene are also amongst pollutants of concern.

Aviation's contribution to protecting from air pollutants

The aviation industry is working to reduce the level of pollutants emitted through improvements to aircraft and engine design, operational procedures and fuels.

Changes made by airlines

Airlines can help to improve air quality by:

1) Switching off main engines on arrival and, where possible, limiting the use of aircraft auxiliary power units by using fixed electrical ground power, ground power units and pre-conditioned air.
2) Delaying the switching on of main engines until absolutely necessary on departure.
3) Whilst parked at aircraft stands, operating aircraft on the lowest possible energy draw (e.g. turning off unnecessary electrical systems such as In Flight Entertainment).
4) Reducing the number of engines used when taxiing.
5) Applying reduced-thrust take-off.

Changes made by airports

Airports can help to improve air quality by:

- Optimizing the most efficient flow of aircraft when moving between runways and stands.
- Investing in lower emission ground vehicles for use at the airport.
- Considering charging higher landing charges for aircraft with higher *NOx* emissions.
- Developing surface access strategies that encourage the use of public transport.

In 2013, one monitoring station at Heathrow showed that local air quality annual mean limits for *NO2* had been exceeded. All other airports were within legal limits. Heathrow has developed a dedicated website, Heathrow Airwatch, to allow data to be closely monitored and presented in order to tackle this issue.

Air quality policies

EU Member States are set air quality targets through European legislation. Some of these targets are reflected as UK-wide objectives whilst others are devolved objectives with separate targets for England, Scotland, Wales and Northern Ireland.

Defra is the Government department with responsibility for setting national policy on air quality to meet these targets. At a local level, local authorities are required to assess air quality and Air Quality Management Areas (AQMAs) are declared if national air quality objectives are not being met.

There are no specific air quality targets for the UK aviation industry. Instead, air quality at airports is measured as part of a local authority's duties around air quality and any issues are dealt with between the airport and local authority.

Different airports have different obligations for monitoring and reporting air quality, with some reporting requirements necessary by law through planning obligations.

Question

1. Many different gases contribute to climate change. CO_2 is generally viewed as the most problematic greenhouse gas, why?
2. Factors contributing to aviation's CO_2 emissions, the main factors are?
3. Factors aircraft type contributing to aviation CO_2 emissions?
4. Flight profile and distance the can be broadly categorized as?
5. How does aircraft weight affect CO emissions?
6. How does the weather affect CO_2 emissions?
7. What steps can be taken to reduce emissions without giving up flying?
8. How airlines can help improve air quality through?
9. How can airports help improve air quality?