UK Civil Aviation Authority

UK Aviation Environmental Review 2023

CAP 2620

Contents

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Foreword

Aviation is an important part of our society, bringing benefits to people, businesses and our national economy. But like all fossil-fuel powered transport, aviation has adverse impacts on the environment, including on noise, air quality and climate change. Despite a significant period of transition after EU exit and COVID-19, environmental sustainability has remained one of the UK Civil Aviation Authority's key priorities. This is a priority which I will continue to drive forward as CEO, as we make our contribution towards meeting the UK's target of Net Zero by 2050.

The UK's aviation industry, along with its global partners, is making good progress in developing the necessary technologies to create a more sustainable industry, from advancements in alternative fuels to airspace modernisation. Nationally, this work is largely coordinated through the government's Jet Zero Council, in which we play a key role, and internationally the UK works with other Member States of the International Civil Aviation Organisation to develop new environmental standards and recommended practices.

But to know how to achieve our strategic goals to reduce aviation's adverse environmental impacts, we need to understand comprehensively where we stand today. That is the purpose of this publication. The UK Aviation Environmental Review will report on the state of environmental protection relating to civil aviation in the UK and provide recommendations on how to improve this.

Our first review focuses on environmental impacts in relation to noise, local air quality and climate change. Going forward, we intend to consult widely in 2024 to get views on how we can build on this initial review to provide a more comprehensive understanding of the industry's current and future environmental performance.

Although there is still much to do, the UK Civil Aviation Authority is committed to working with all stakeholders to minimise aviation's environmental impact, enabling the safe introduction of the necessary technology so that consumers can continue to enjoy the benefits which flying brings.

Rob Bishton

Chief Executive Officer, UK Civil Aviation Authority

Executive Summary

The UK Civil Aviation Authority (CAA) has a duty to publish a triennial environmental review of the UK aviation industry.[1] This duty previously sat with the European Union Aviation Safety Agency (EASA), which prepares the environmental report on behalf of all European Union (EU) Member States. It is now incumbent on the CAA to prepare the UK Aviation Environmental Review (UK AER) with respect to the whole of the UK, starting from 31 December 2020 when the UK left the EU.

This document, the UK Aviation Environmental Review 2023 (AER 2023), meets this duty by providing an objective account of the state of environmental protection relating to civil aviation in the UK. When preparing this review, the CAA has primarily relied on information already available to UK institutions and bodies, as well as on publicly available information. In addition, the CAA has engaged the Department for Transport, and the Secretary of State for Transport and consulted with relevant stakeholders and organisations.

Chapters 2-5 of the AER 2023 provide an overview of the environmental performance of the UK aviation industry to date, whilst Chapter 6 outlines measures which are aimed at improving the environmental performance of the industry. The AER 2023 focuses on the industry's impact upon climate change, noise and local air quality, and includes a summary of policies and measures which aim to address, reduce and mitigate these impacts. A set of recommendations, designed to provide suggestions with respect to improving the level of environmental performance in the area of civil aviation in the UK, are outlined below.

This is the first review that the CAA has been required to publish under Article 87 of UK Regulation (EU) 2018/1139. Over time, this and subsequent reviews will enable the performance and effectiveness of different initiatives to be measured, encouraging government, industry, and other interested parties to track the progress of the aviation sector's journey to more sustainable operations.

Moving forward, the CAA plans to report on the environmental performance of the industry on a more frequent basis than the triannual requirement. Starting from 2024, to build on the content of this review and to enable a better understanding of the industry's current and future environmental performance, the CAA plans to formally consult with relevant and interested stakeholders regarding the development of the reporting framework under this duty.

[1] Part IV of Article 87 of UK Regulation (EU) 2018/1139, as retained (and amended in UK domestic law) under the European Union (Withdrawal) Act 2018

Recommendations

The UK AER is required to contain recommendations on how to improve the level of environmental protection in the area of civil aviation in the UK to aid the industry's journey to better environmental performance and more sustainable operations. The recommendations set out in this section are focused on noise, local air quality and climate change, and align with existing Government policy. The CAA intends to further clarify the scope and content of these recommendations in 2024.

Overarching Recommendations

1. The CAA recommends that further research is conducted into the environmental impacts associated with new and emerging technology so that future environmental policy is informed by an extensive evidence base.

2. The CAA recommends that Devolved Administrations and central Government continue to coordinate effectively with one another so that, where applicable, environmental policy commitments set across the UK's devolved functions can be realised.

Noise

3. The CAA recommend that existing noise exposure reduction measures and guidance are regularly reviewed to ensure the Government's overall objective regarding aviation noise is most effectively met.

4. The CAA recommend that the long-term noise performance of the sector is tracked to better understand how noise impacts are changing over time.

Local Air Quality

5. The CAA recommend that the monitoring of air pollution, including ultrafine particles, is continually improved upon so that aviation's impact on local air quality can be better understood.

6. To improve impacts upon local air quality the CAA recommend that Government, local authorities, industry and other interested stakeholders work together to improve surface access at airports through the development of masterplans and strategies.

7. The CAA recommend that sufficient support is provided to industry with respect to the development of novel fuels so that the air quality impacts associated with aviation fuels can be minimised.

Climate Change

8. The CAA recommends that the Jet Zero Strategy and associated emissions forecasts are reviewed at least every five years to account for new research and technological advancements. In addition, it is recommended that the Jet Zero Strategy emissions forecasts are regularly reviewed to ensure that policy measures are delivering the intended emissions reductions.

9. The CAA recommends that work continues to ensure that a Sustainable Aviation Fuel (SAF) mandate comes into force by 2025, alongside ensuring that sufficient support is provided with respect to SAF development. In addition, it is recommended that all parts of Government work together to pioneer the accelerated procurement and use of SAF.

10. The CAA recommends that national and international compliance to reporting of CO_2 emissions for domestic and international aviation that falls under the UK Emissions Trading Scheme and the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) are more closely aligned where appropriate. Should this recommendation be adopted, to exercise the duty outlined in Air Navigation (Carbon Offsetting and Reduction Scheme for International Aviation) Order 2021, Section 15, the CAA would explore potential for oversight of such compliance.

11. The CAA recommends that research and investment into the development of greenhouse gas removals technologies is continued.

12. The CAA recommends that stakeholders continue to support ongoing consultation and engagement regarding the CAA's consumer environmental information project to ensure that in due course consumers are able to access comparable, understandable and accurate environmental information when looking for and booking flights.

13. The CAA recommends that work is continued to further understanding of impacts associated with non-CO_2 emissions so that potential mitigation measures, and the Jet Zero Strategy, can be better informed.

14. To improve impacts upon climate change the CAA recommend that government, the Devolved Administrations, local authorities, industry and other interested stakeholders work together to improve surface access at airports through the development of master plans and strategies.

CHAPTER 1
Introduction

1.1 Over the past 100 years, the aviation industry has developed into a global industry of national and strategic importance to the UK, connecting people, businesses, and goods to all corners of the world. The UK has historically had a significant influence on the development of the aviation industry, from the first commercial jet airliner, the British Comet, to the supersonic airliner, Concorde. These advances in air travel and technology have revolutionised the aviation sector. However, alongside the positive economic and social benefits created by aviation, the industry creates negative impacts upon people and the environment from both noise and emissions. Local impacts, such as changes to air quality and annoyance caused by aircraft noise are associated with long-term public health issues, and at a global level the release of greenhouse gas emissions into the atmosphere due to aviation activity is associated with impacts upon the climate. The environmental impacts of the industry do not only affect people, but they also directly and indirectly impact upon ecosystems and the wider health of the planet.

1.2 As demand for air travel continues to grow, impetus for improving the environmental impacts associated with the aviation industry has never been greater, and progress towards this is already underway, being driven by Government, the UK Civil Aviation Authority (CAA), industry and other relevant and impacted stakeholders. In light of this drive to improve environmental impacts, the next chapter of change for the aviation industry is already being written and the UK is playing a leading role in this space to help shape a sustainable future for the aviation sector by supporting the development of policies and measures that will facilitate cleaner, quieter and more efficient journeys by air.

1.3 This is the first UK Aviation Environmental Review (UK AER) published by the CAA, as the requirement previously sat with the European Union Aviation Safety Agency (EASA)[2] As the UK's aviation regulator, the CAA's statutory objectives are to help deliver high standards of safety, security and consumer protection for the benefit of consumers and the public. With respect to the environment, although the CAA is not an environmental regulator, it has various statutory duties which require it to take account of the environment in its activities and decision making. These include taking

[2] EAER | EASA Eco (europa.eu).

account of the industry's impacts upon areas such as noise, climate change, local air quality, tranquillity and biodiversity.

1.4 This UK Aviation Environmental Review 2023 (AER 2023) provides an overview of the relevant policy, legislation and regulation that applies to the aviation industry with respect to environmental protection. The AER 2023 primarily focuses on the impacts of the industry in relation to the following topic areas:

- Noise;
- Local air quality; and
- Climate change.

1.5 Included within this review is a quantitative outline of the aviation industry's historic impacts in relation to the topic areas outlined above; a summary of future initiatives which aim to mitigate and address the environmental impacts of aviation; and a set of recommendations that provide suggestions on how to improve the future level of environmental performance and protection of the UK aviation industry.

1.6 For this initial UK AER, the CAA has not reported a quantitative estimation of the anticipated future impacts associated with the aviation industry. From 2024, the CAA plans to work with relevant stakeholders to ensure a consistent approach is applied to quantitative forecasting across the relevant environmental impact areas. Forecasts will be incorporated as part of the future reporting framework.

1.7 To inform the development of the AER 2023, the CAA has primarily relied on information already available to UK institutions and bodies, as well as on publicly available information. Both were the most up-to-date available at the time of writing. The CAA has also consulted relevant stakeholders and organisations in the development of this review.

CHAPTER 2

Environmental Protection: Regulatory Framework

2.1 This chapter provides an overview of the domestic and international regulatory frameworks that relate to environmental protection in relation to civil aviation and aerospace in the UK. It is not intended to be exhaustive, nor should it be taken as the only legislation and policy that applies to environmental protection in the aviation sector.

International Civil Aviation Organisation

2.2 Formed in 1947, the International Civil Aviation Organisation (ICAO) is a United Nations (UN) agency established to help Member States work together to achieve the highest possible degree of uniformity in civil aviation regulations, standards, procedures and organisation. The formation of ICAO followed the Convention on International Civil Aviation, commonly known as the Chicago Convention, which was drafted by 54 nations in 1944 and established the core principles permitting international transport by air. Today, the Chicago Convention has evolved to include more than 12,000 international Standards and Recommended Practices (SARPs), each of which have been agreed on a consensus-basis by the 193 ICAO Member States.[3]

2.3 Annex 16 to the Convention on International Civil Aviation outlines the SARPs related to environmental protection. As a Member State of ICAO, the UK has agreed to collaborate with other Member States to improve the level of environmental protection in relation to these SARPs. There are currently four volumes to Annex 16:

- Volume I – Aircraft Noise;
- Volume II – Aircraft Engine Emissions;
- Volume III – Aeroplane CO_2 emissions; and
- Volume IV – Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

[3] History of ICAO and the Chicago Convention - ICAO75.

2.4 ICAO has also agreed to aspirational goals for international aviation with respect to CO_2 emissions,[4] and has prioritised its resources on:

- Airframe, propulsion, and other aeronautical and technological innovations;
- Optimising flight procedures to reduce fuel burn; and
- Increasing the production and deployment of sustainable aviation fuels and clean energy.

Committee on Aviation Environmental Protection

2.5 The UK is a founding member of ICAO's Committee on Aviation Environmental Protection (CAEP). CAEP, a technical committee of the ICAO Council[5] established in 1983, assists the ICAO Council in developing new policies and SARPs in relation to aviation noise, emissions and other environmental impacts. The ICAO Council subsequently reviews and adopts CAEP recommendations, including amendments to the SARPs, and in turn reports directly to the ICAO Assembly where the main policies on environmental protection are defined.[6] The UK is represented in ICAO and CAEP by the Department for Transport (DfT), while the CAA and other specialists are nominated by the UK to CAEP's technical working groups.

European Civil Aviation Conference

2.6 The UK is a Member State of the European Civil Aviation Conference (ECAC). Founded in 1955 as an intergovernmental organisation, ECAC seeks to harmonise civil aviation policies and practices amongst its 44 Member States and, at the same time, promote understanding on policy matters between its Member States and other parts of the world.

2.7 ECAC coordinates European activities with regards to aviation environmental protection[7], supporting the development of environmental guidance to improve efficiency in the use of resources among Member States, and to address the need for capacity building in the domain.

[4] Long term global aspirational goal (LTAG) for international aviation (icao.int).

[5] The ICAO Council

[6] Committee on Aviation Environmental Protection (CAEP) (icao.int)

[7] Environment (ecac-ceac.org)

Domestic Regulatory Framework

2.8 As the UK's aviation regulator, there are a number of duties within the CAA's regulatory framework that directly relate to the environmental protection and performance of the aviation industry. These duties are mainly issued through directions from the UK Government under relevant policy and legislation. This section sets out the environmental duties that currently make up the CAA's regulatory framework.

Environmental Certification

2.9 SARPs adopted by ICAO are incorporated into UK legislation. For an aircraft to be approved to fly it must be issued with a type-certificate and airworthiness certificate. Conformity with ICAO Annex 16 environmental standards for new aircraft designs forms part of this process.[8] This requires aircraft and their engines, propellers, parts, and non-installed equipment, to comply with the environmental protection requirements of Volume I, II and III of Annex 16 to the Convention on International Civil Aviation. This requirement is further ratified in UK Regulation (EU) No 748/2012[9] whereby the responsibility for ensuring compliance against the aforementioned requirements for the issuance of a type-certificate,[10] and airworthiness certificate,[11] sits with the CAA. This responsibility previously sat with EASA; however, following the UK's exit from the EU, since 2021 it has migrated into UK law under the European Union (Withdrawal) Act 2018[12] and the duty to discharge this function now sits with the CAA.

2.10 Further information regarding the specific requirements set out in Volume I, II and III of Annex 16 to the Convention on International Civil Aviation, and how they are applied to the CAA's regulatory functions, is explained in more detail in Chapters 3, 4, and 5 of this review respectively.

Airspace Change

2.11 Airspace is the portion of the atmosphere controlled by a State above its territory and areas over the sea within which a State is committed, by international treaty, to provide air navigation services (which includes air traffic control). It is an invisible national asset.

[8] As per Article 9(2) of UK Regulation (EU) 2018/1139 UK Regulation (EU) 2018/1139.

[9] Regulation (EU) No 748/2012.

[10] Regulation (EU) No 748/2012 Annex I point 21.B.85 .

[11] Regulation (EU) No 748/2012 Annex I point 21.A.173 .

[12] European Union (Withdrawal) Act 2018.

2.12 For air traffic control purposes, airspace can be divided into two main categories: controlled and uncontrolled. Controlled airspace is where air traffic control needs to have positive control over aircraft flying in that airspace to maintain safe separation between them. Uncontrolled airspace is airspace where aircraft are able to fly freely without being required to abide by instructions in routeing or by air traffic control, although they may request information or a service.

2.13 The design of UK airspace is published and promulgated in the UK Aeronautical Information Publication. Following the separation of regulation and service provision enacted through the Transport Act 2000, the CAA is the regulator for the design of UK airspace and therefore changes to the design of UK airspace must be approved by the CAA. Changes are proposed by an airspace change sponsor, which is usually an airport or a provider of air navigation services (including air traffic control). The CAA requires the change sponsor of any permanent change to the published airspace design to follow the airspace change process set out in CAP 1616.[13] Before deciding whether to approve any change, the CAA must consider a range of factors set out in section 70 of the Transport Act 2000 which include safety, security, operational impacts and the environment.[14]

2.14 Section 70 of the Transport Act 2000 states that after maintaining a high standard of safety in the provision of air traffic services, the CAA must take account of any guidance on environmental objectives given to the CAA by the Secretary of State after the coming into force of this section when exercising its air navigation functions, such as deciding on whether to approve changes to the design of UK airspace (among other factors).This guidance is the Air Navigation Guidance 2017.

2.15 Consideration and assessment of the potential environmental impacts resulting from an airspace change proposal is a necessary part of the CAA's decision making process, and also enables those who are affected by the proposed airspace change to better understand the impacts of the different design options being considered. In order to achieve this, the CAA requires change sponsors to provide an environmental assessment that evolves through the various stages of the airspace change process and is considered by the CAA at various 'gateway' stages within the Airspace Change Process.

2.16 While developing and assessing the environmental impacts of airspace change design options, change sponsors must take into account the Air

[13] www.caa.co.uk/cap1616.

[14] Transport Act 2000 section 70.

Navigation Guidance 2017[15] (see below), including the Government's environmental objectives and priorities as set out in that guidance.

Air Navigation Guidance 2017

2.17 The Air Navigation Guidance 2017 was published following a review of the Government's airspace and noise policies through the 2017 UK Airspace Policy Consultation.[16] The ANG is not just aimed at the CAA but Government also expect that it will be taken into account by the wider aviation industry. Underpinning the ANG are several key objectives, including to:

- provide guidance to the CAA under section 70(2) of the Transport Act 2000, and which the aviation industry should take into account;
- ensure that aviation can continue to make its important contribution to the UK economy and at the same time seek to improve the sustainable development and efficiency of the UK airspace network; and
- emphasise that the environmental impact of aviation must be mitigated as much as is practicable and realistic to do so.

2.18 The Government's environmental objectives with respect to air navigation are chosen to facilitate the Government's overall environmental policies. These environmental objectives are designed to minimise the environmental impact of aviation within the context of supporting a strong and sustainable aviation sector.

2.19 The Air Navigation Guidance 2017 recognises the degree of challenge which can exist in satisfying the expectations of local communities, those impacted by aviation, and the aviation industry's aspiration to further develop the efficiency of the UK airspace network. For example, a key policy issue is how to retain the benefits of aviation while addressing its environmental impacts, and how the CAA should integrate those considerations when making regulatory decisions on the necessary trade-offs between differing airspace objectives, such as increasing airspace capacity, reducing emissions and managing noise.

Environmental Information Provision

2.20 As the UK's aviation regulator, the CAA has duties relating to protecting consumers, including to uphold consumer choice, value and fair treatment when they fly. The CAA's policy position is that creating more informed and

[15] Air navigation guidance 2017 (publishing.service.gov.uk).

[16] UK airspace policy: a framework for the design and use of airspace - GOV.UK (www.gov.uk).

empowered consumers and citizens will result in greater choice, lower prices and better quality products and services for consumers, and improved environmental performance benefitting wider society. The CAA has duties under section 83 of the Civil Aviation Act 2012 to provide information for passengers and consumers about services and facilities available in the market. Section 84 of the Civil Aviation Act 2012 requires the CAA to publish, or arrange for others to publish:

- the environmental effects[17] of civil aviation in the United Kingdom;[18]
- how human health and safety is, or may be, affected by such effects; and
- measures taken or proposed to be taken, with a view to reducing, controlling or mitigating the adverse environmental impacts of civil action in the UK.

2.21 As a public authority, the CAA may also be required to disclose environmental information under the Environmental Information Regulations 2004.[19] This regulation provides a right of access to environmental information held by public authorities, including information about the air, water, soil or food chain, factors affecting them such as noise, energy and emissions, and plans or policies likely to affect the environment. The CAA may not be required to disclose certain environmental information if one of the statutory exceptions applies or if it is in the public interest not to do so.[20]

Spaceflight

2.22 In 2021 the CAA became the UK's space regulator, giving it the authority to license space companies under the Space Industry Act 2018 and the Outer Space Act 1989. Whilst reporting the environmental impacts of spaceflight does not directly fall under the requirements of the UK AER, it is relevant to highlight this responsibility due to the potential consequential impacts to civil aviation that can arise due to spaceflight activities. These consequential impacts could, for example, require other airspace users to route around a launch area to maintain safe separation which has the potential to increase track mileage for some aircraft, resulting in increased fuel burn and greenhouse gas emissions. These consequential impacts are

[17] Environmental effects include matters such as noise, vibration, emissions and the effects of works carried out at airports.

[18] Civil Aviation Act 2012 Section 84 (legislation.gov.uk).

[19] The Environmental Information Regulations 2004 (legislation.gov.uk).

[20] Freedom of Information | Civil Aviation Authority (caa.co.uk).

taken into consideration through the airspace change process, as detailed above.

2.23 With respect to the environmental impacts directly associated with space related activities, when a stakeholder applies for a launch operator or spaceport license under the Space Industry Act 2018, an assessment of environmental effects (AEE) must be completed. The AEE ensures that the potential environmental effects of the intended activities have been considered and, if necessary, proportionate steps to avoid, mitigate or offset the risks and their potential effects have been taken. Further information regarding the CAA's roles, responsibilities, and environmental considerations with respect to spaceflight are available on the CAA website.[21]

Environment Act 2021

2.24 The Environment Act 2021 provides a legal framework for environmental governance and brings in measures for the improvement of the environment in relation to waste, resource efficiency, air quality, water, nature and biodiversity, and conservation. It does so by providing the Government with powers to set new binding targets, including for air quality, water, biodiversity and waste reduction. The Department for Environment, Food and Rural Affairs (DEFRA) published these targets in 2022 after consultation.[22]

2.25 The Environment Act 2021 also requires Ministers to have due regard to the Environmental Principles Policy Statement when making policy. The Policy Statement[23] was published by DEFRA and it contains five environmental principles:

- the integration principle;
- the prevention principle;
- the rectification at source principle;
- the polluter pays principle; and
- the precautionary principle.

2.26 These principles play an important role in supporting environmental improvement plans, such as the 25-Year Environment Plan,[24] and in

[21] Space | Civil Aviation Authority (caa.co.uk).

[22] https://www.gov.uk/government/consultations/environment-act-2021-environmental-targets.

[23] https://www.gov.uk/government/publications/environmental-principles-policy-statement.

[24] https://www.gov.uk/government/publications/25-year-environment-plan.

delivering on the Government's net zero commitment to tackle climate change.

Other Legislation and Policy

2.27 Environmental protection relating to civil aviation in the UK is not only influenced through the functions outlined above. There are a number of other legislative and policy frameworks which contribute to environmental protection or improvement within the UK aviation industry, and these powers are largely delegated across the UK's Devolved Administrations. Chapters 3, 4 and 5 provide further detail regarding this.

CAA Environmental Sustainability Strategy

2.28 Aviation regulators have a role to play in helping the industry meet its environmental commitments. In order to help facilitate the UK aviation industry's journey to more sustainable operations, the CAA published its Environmental Sustainability Strategy[25] in May 2022, which sets out how it will work with the whole aviation and aerospace system to improve environmental performance. The Strategy provides those who are regulated, and other stakeholders, with clarity on the CAA's roles, remit and ambition in the short and medium-term, whilst outlining the longer-term nature of climate change alongside the Government and industry's evolving approaches to this. The Strategy identifies seven key strategic areas where the CAA will focus its expertise and leadership:

- Enabling development of low and zero emission novel technologies.
- Co-sponsoring the modernisation of airspace.
- Reporting on the sustainability performance of industry, including noise, and providing information to consumers on the environmental impact of aviation.
- Advising and supporting the UK Government on domestic and international policy.
- Reducing the impact of its own corporate activities and operations.
- Assessing how relevant regulated activities impact the local environment.

[25] CAA's Environmental Sustainability Strategy | Civil Aviation Authority.

- Using its powers and duties to take account of the impact on the environment in its regulation and oversight.

2.29 To implement and deliver the Strategy's ambition, the CAA has established an Environmental Sustainability Team that drives and coordinates work across the organisation, and an Environmental Sustainability Panel,[26] which acts as a 'critical friend' to provide advice and challenge. The CAA also has specialist resource in its innovation hub, which helps to enable novel technology, and in its Airworthiness and Design & Certification Teams, for safety certification of new aircraft and fuels.

2.30 Figure 2.1 outlines the CAA's roles and the work it is doing with the wider aviation and aerospace industry in order to improve environmental performance in the sector.

CAA Prioritisation Principle

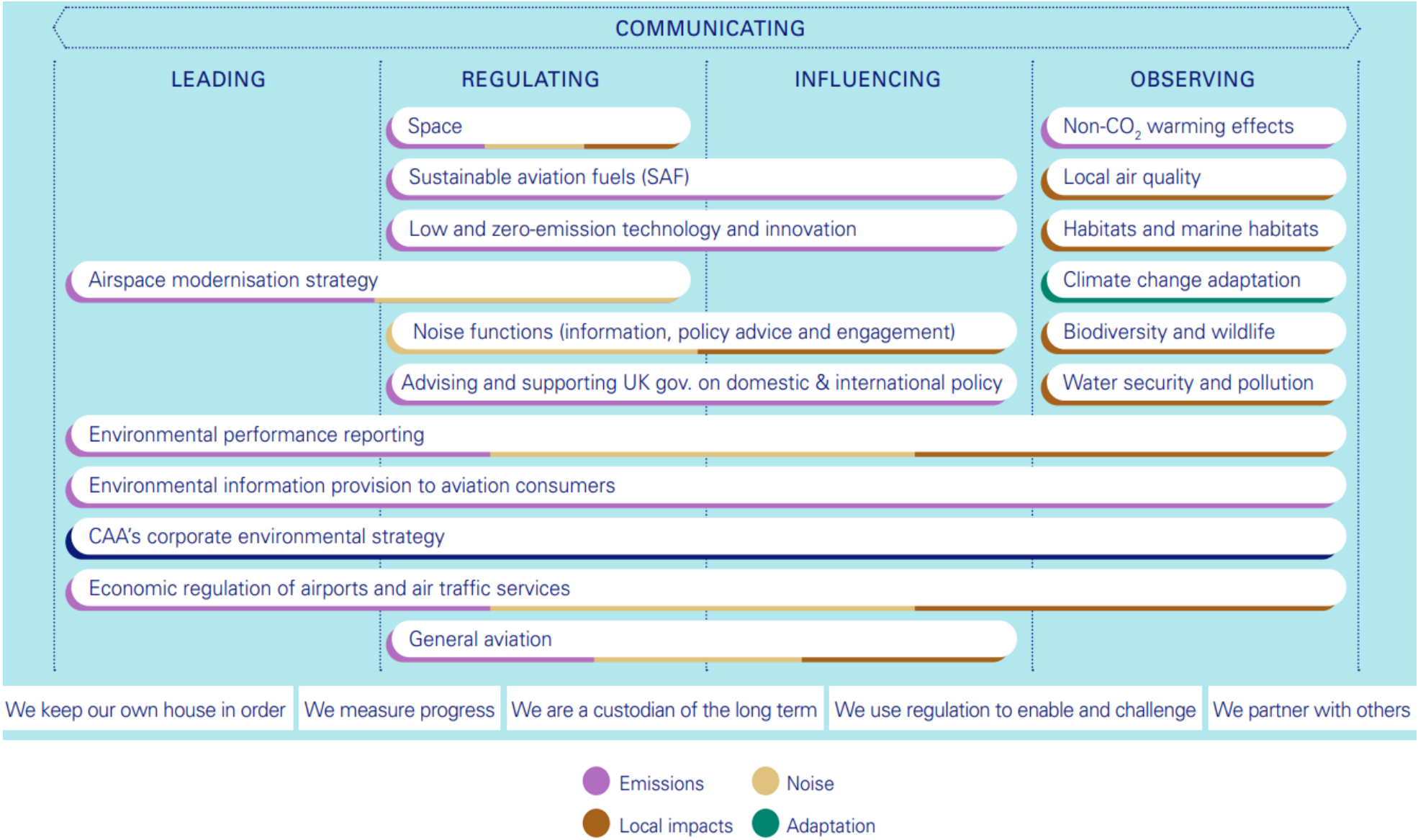
2.31 There are a number of areas in the CAA's regulatory framework where it has a duty to take environmental factors into account when it makes its decisions.

2.32 In some areas of the CAA's work, however, there are no explicit targets or guidelines set by Government, or in legislation, to drive down the effects of emissions, noise or other local impacts. Although the CAA always consider the specific facts of any case in its decision-making, it has designed a proposed prioritisation principle to help it take environmental impacts into account where it has discretion to do so. The principle is applicable across global impacts with a focus on carbon emissions, local impacts of noise and air quality, and impacts on tranquil spaces, biodiversity and other environmental elements.

2.33 The prioritisation principle is currently under review as part of a refresh of the Environmental Sustainability Strategy and the CAA will consult with stakeholders and the public on this proposed prioritisation principle before it is applied in decision-making.

[26] The CAA's Environmental Sustainability Panel | Civil Aviation Authority.

Figure 2.1: CAA Environmental Sustainability Strategy



CHAPTER 3

Aviation Noise

3.1 This Chapter outlines the environmental protection measures in the UK relating to civil aviation and noise.

3.2 Noise can be defined as undesirable or unwanted sound and in some cases, is harmful to human wellbeing. According to the World Health Organization, 'environmental risks constitute 25% of the burden of disease. Widespread exposure to environmental noise from road, rail, airports and industrial sites contributes to this burden'.[27]

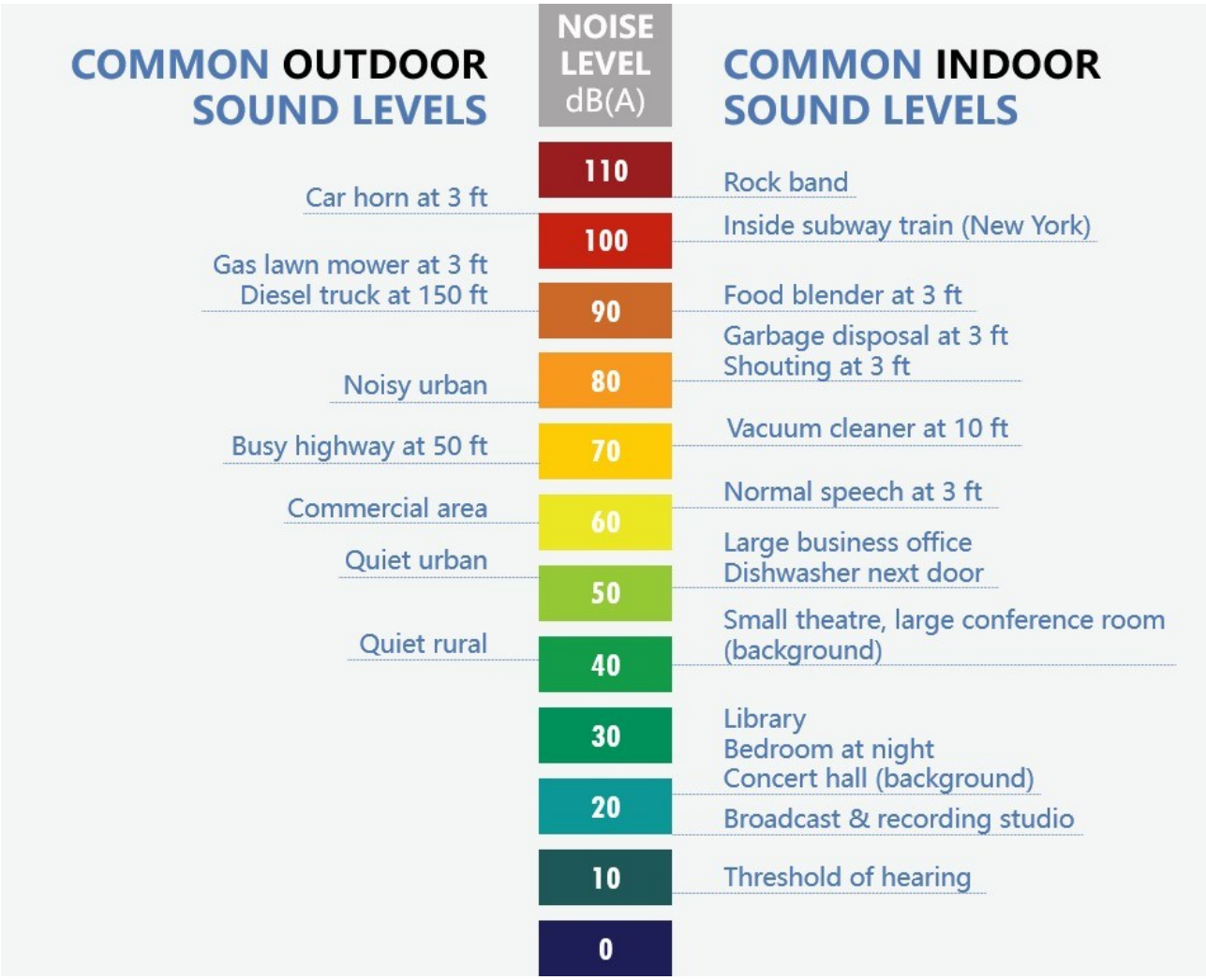
3.3 Aviation noise can affect human health and wellbeing in a variety of ways. The most common adverse health effects associated with aviation noise are annoyance, sleep disturbance, cardiovascular disease and cognitive impairment.27

Measuring Noise

3.4 Unlike most other forms of pollution, noise pollution depends not just on the physical aspects of sound itself, but also on the human reaction to it. The level of sound is generally measured in terms of decibels (dB). On the decibel scale, a doubling of noise energy results in an increase of 3dB. A change of 3dB is generally considered to be the minimum that is perceptible under normal conditions, although there can be circumstances where smaller changes are noticeable. A change of 10dB corresponds to a ten-fold change in noise energy but is perceived as a doubling or halving of loudness. A-weighted decibels (dBA) are often used in measurements of aviation noise. This takes account of the frequencies that people are most sensitive to, as the human ear is less sensitive to sounds at low and high frequencies. Some examples of typical noise levels are outlined in figure 3.1 below.

[27] WHO Burden of Disease from Environmental Noise, 2012.

Figure 3.1: Common outdoor and indoor sound levels



Information source: Federal Aviation Administration

3.5 Some noise impacts can be measured objectively (for example, sleep disturbance or hearing loss), while most are subjective (for example, annoyance). Exposure-response studies are typically used as a methodology for establishing associations between human impacts (referred to as 'response') and objective measures of exposure. These studies yield exposure-response relationships, which may be used to determine population impact levels and identify mitigation strategies. Consequently, various noise metrics are used to measure noise which may be used to associate with different impacts in humans.

More information on the noise metrics used to address aviation noise are described in CAA ERCD Report 0904.[28]

Modelling Noise

3.6 Noise contour maps make it possible to identify how many people live in areas where there is significant annoyance from noise. They are used to measure progress against the Government's stated aim to limit and where possible reduce the total adverse effects on health and quality of life from aircraft noise.[29] They also allow the consideration of noise or projected noise when working within affected areas.

3.7 In the UK, average summer day $L_{Aeq,16h}$[30] noise contour maps are typically produced annually between 16 June and 15 September, 7:00am to 11:00pm. Contours are normally plotted from 51 dBA to 72 dB $L_{Aeq,16h}$ at 3dB intervals. Airports are also encouraged to produce average summer night $L_{Aeq,8h}$ contours between 11:00pm and 7:00am which are normally plotted from 45 dBA to 72 dB $L_{Aeq,8h}$.[31]

Managing Aviation Noise

International Noise Policy

ICAO Balanced Approach to Aircraft Noise Management

3.8 As an ICAO Member State, the UK has agreed to collaborate with other Member States to improve the level of environmental protection across a number of areas, including aircraft noise.

3.9 The main overarching ICAO policy on aircraft noise is the Balanced Approach to Aircraft Noise Management[32] (ICAO Doc 9829)[33] which was adopted by the ICAO Assembly in its 33rd session in 2001. The Balanced Approach consists of various measures to reduce noise which can be classified into the four key principles set out below.

1. Reduction of Noise at Source

[28] Metrics for Aircraft Noise, ERCD Report 0904, CAA, January 2009.

[29] Overarching Aviation Noise Policy, Department for Transport, 27 March 2023.

[30] L_{Aeq} and other noise metrics used to address aviation noise are described in CAA ERCD Report 0904.

[31] 51 dB $L_{Aeq,16h}$ and 45 dB $L_{Aeq,8h}$ are considered the Lowest Observed Adverse Effect Levels (LOAEL) for day and night respectively and are regarded as the point at which adverse effects begin to be seen on a community basis. (Source: Para 3.5 Air Navigation Guidance 2017).

[32] The Balance Approach to Aircraft Noise Management (icao.int).

[33] Guidance on the Balanced Approach to Aircraft Noise Management (Doc 9829) | ICAO Store.

3.10 Reduction of noise at source refers to aircraft noise which has been controlled since the 1970s through the introduction of noise limits for aircraft certification, as set out in Volume I of Annex 16 to the Convention on International Civil Aviation. The primary purpose of noise certification is to ensure that the latest noise reduction technology is included in aircraft design, ensuring that noise reductions offered by technology reflect a reduction in noise impacts around airports. The noise limits outlined in Volume I of Annex 16 are referred to as 'chapters' and the way in which aircraft are certified varies depending on aircraft type, as outlined below. CAEP assists the ICAO Council in formulating the noise standards for aircraft certification.[34]

3.11 The following section outlines the various noise certification chapters that aircraft are required to comply with:

Jet and Large Propeller Aeroplanes

3.12 Noise certification standards for jet and large propeller[35] aeroplanes are defined by three reference noise measurement points - approach, sideline and flyover, and are set as a direct function of maximum take-off mass in recognition that heavier aircraft produce more noise. Since 1972 four aeroplane noise standards have been developed for this category of aircraft. The progression in noise performance as a result of the different noise standards is illustrated in figure 3.2. The effect of the noise standards on the landing and take-off noise footprints of a typical 75 tonne twin-engine jet aeroplane is illustrated in figure 3.3.[36]

[34] Reduction of Noise at Source (icao.int).

[35] Larger propeller aeroplanes refer to aeroplanes with a maximum certified take-off weight greater than 8,618kg for which a type certificate was submitted after 1 January 1985. For larger propeller aeroplanes for which a type certificate was submitted before 1 January 1985 the requirements of Annex 16 Volume I Chapter 5 apply.

[36] EPNdB (also referred to as EPNL), SEL and other noise metrics used to address aviation noise is described in CAA ERCD Report 0904.

Figure 3.2: Progression of ICAO Noise Standards for aeroplanes

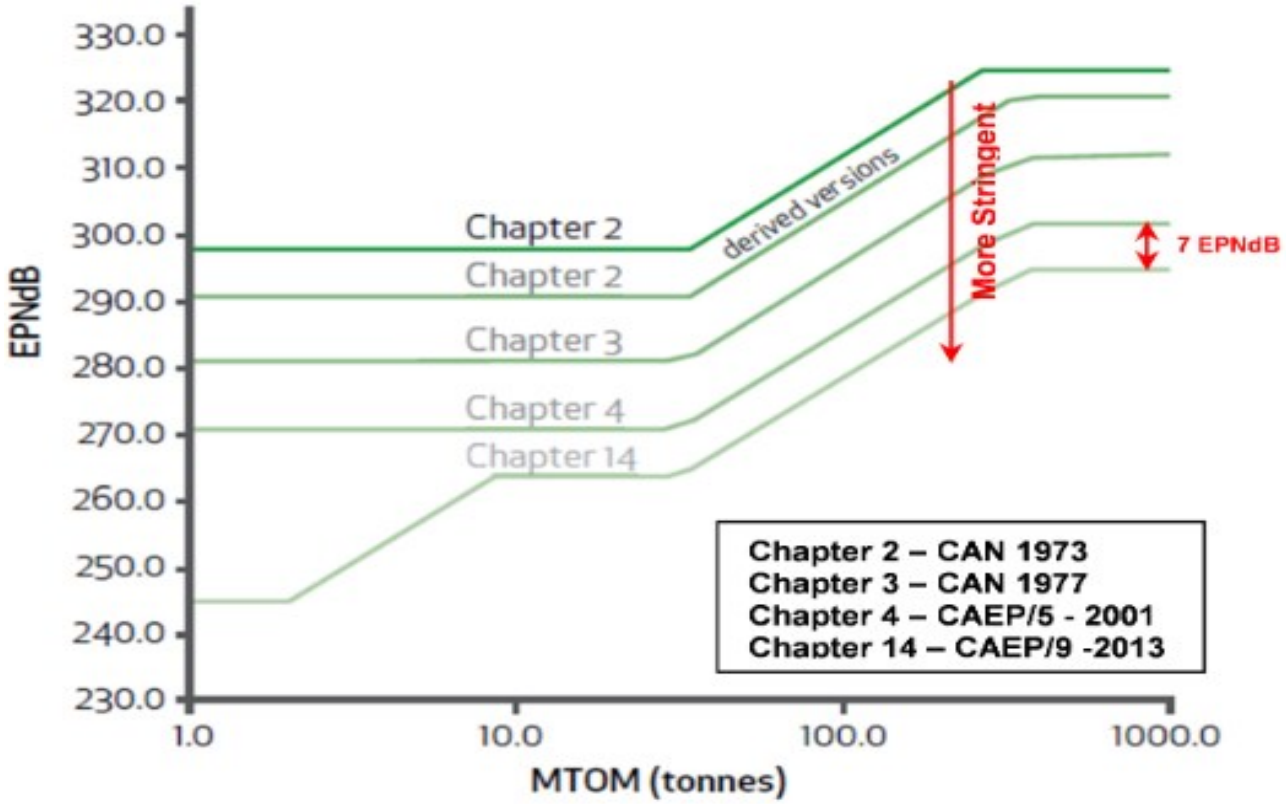
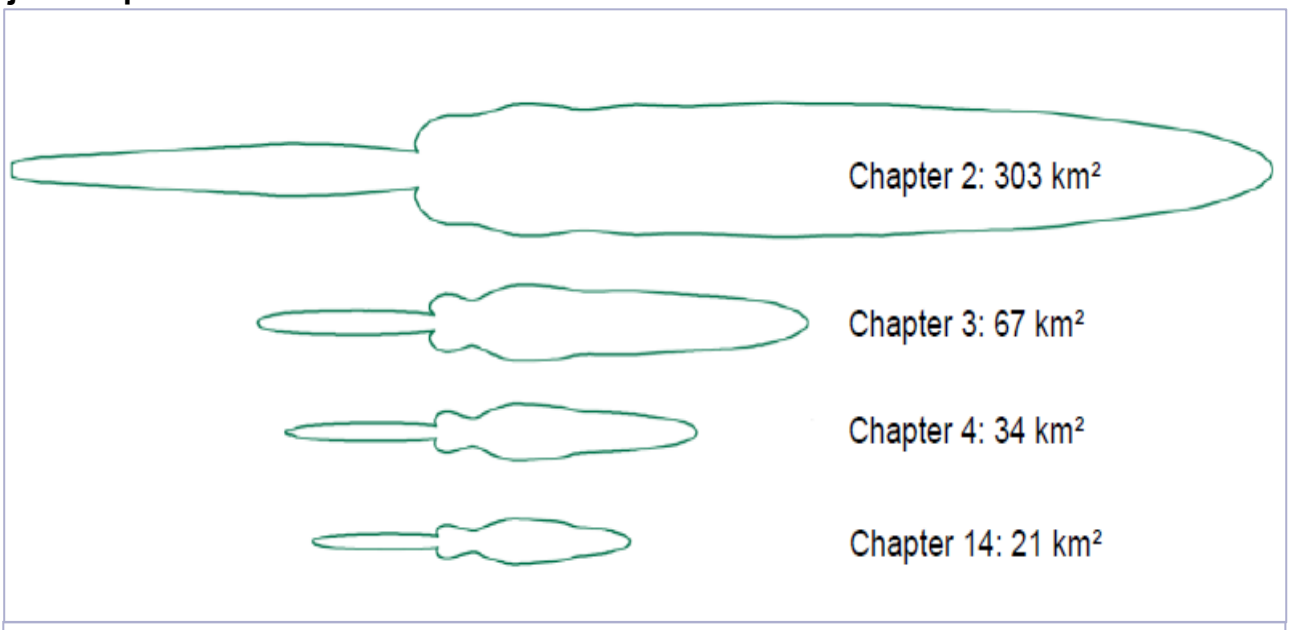


Image source: ICAO Reduction of Noise at Source

Figure 3.3: Landing and take-off noise footprints for a notional 75 tonne twin-engine jet aeroplane



Area of 80dBA SEL arrival and departure noise footprint for a 75-tonne aircraft just meeting respective ICAO noise limits.

3.13 Noise standards have also been developed for light propeller aeroplanes, helicopters and tiltrotors. Standards for supersonic aeroplanes were developed for Concorde. Work is ongoing in ICAO to develop new noise standards for future supersonic aeroplanes.[37] ICAO is also considering the development of noise standards for Emerging Technology Aircraft.[38]

2. Land-Use Planning and Management

3.14 Effective land-use planning and management around airports can help minimise the number of people affected by aviation noise. It also ensures that reductions in noise achieved by the latest generation aircraft are not offset by increased residential development around airports. ICAO guidance on land-use planning and management is contained in Volume I Part IV of Annex 16 and in ICAO Doc 9184.

3.15 Noise charges are also a possible noise management tool in the ICAO Balanced Approach. ICAO first developed policy regarding this in 1981 as the ICAO Council recognise that, although noise reductions are being achieved in aircraft noise at source, some airports need to apply noise alleviation or preventative measures either due to the volume of air traffic at an airport, or due to the number of people affected in the vicinity of an airport. If noise related charges are levied, ICAO recommends that this should only be done at airports experiencing issues with noise pollution and that the charges should be designed to recover no more than the alleviation or prevention of noise impacts, which should be non-discriminatory between users and not be established at levels prohibitively high for the operation of certain aircraft. ICAO Doc 9082 outlines ICAO's policies on charges for airports and air navigation service providers; ICAO Doc 9562 provides advice on determining the cost basis for noise related charges and their collection; and information on noise related charges actually levied is provided in ICAO Doc 7100.[39]

3. Noise Abatement Operational Procedures

3.16 The way in which aircraft operate in the vicinity of an airport may also influence the noise impacts experienced by those on the ground. These impacts can be improved by implementing low-noise operational procedures that are safe and cost-effective. ICAO assists on the development and standardisation of low noise operational procedures, such as noise preferential routes and noise abatement procedures. The appropriateness of these measures is bespoke to each airport as it depends on its physical layout and surroundings. In addition, each ICAO State has its own process for changing the notified design of airspace.[40] ICAO's

[37] https://www.icao.int/environmental-protection/Pages/Supersonic-Aircraft-Noise-Standards-Development.aspx.

[38] https://www.icao.int/environmental-protection/Pages/noise_new_concepts.aspx.

[39] Land-use Planning and Management (icao.int).

[40] In the UK, CAP1616 outlines guidance on the regulatory process for changing the notified airspace of design.

recommendations[41] on operational procedures are contained in the following documents:

- ICAO Doc 8168 Procedures for Air Navigation Services - Aircraft Operations (PANS-OPS) Volume I Flight Procedures: This document provides guidance on noise preferential runways and routes, displaced thresholds, approach and landing operating procedures and Noise Abatement Departure Procedures.
- ICAO Doc 8168 Procedures for Air Navigation Services - Aircraft Operations (PANS-OPS) Volume II – Construction of Visual and Instrument Flight Procedures: This document includes the consideration of noise aspects on the planning and definition of departure routes, including the compromise involved in concentrating or spreading aircraft noise.
- ICAO Doc 9931: Continuous Descent Operations Manual. This document provides guidance on Continuous Descent Operations and Continuous Climb Operations that may present benefits for both noise and emissions.
- ICAO Doc 9888: Noise Abatement Procedures: Review of Research, Development and Implementation Projects – Discussion of Survey Results. This document provides a summary of research conducted in 2006 and 2008 regarding noise abatement procedures: review of research, development and implementation projects.
- ICAO Doc 10031: Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes. This document provides environmental assessment guidance to support decision making when analysing proposed air traffic management operational changes.
- ICAO Doc 10177: Manual on Operational Opportunities to Reduce Aircraft Noise. This manual identifies and reviews various operational opportunities and techniques for minimising noise in civil aviation operations. It is intended to be used in conjunction with the Guidance on the Balanced Approach to Aircraft Noise Management (Doc 9829).

4. Operating Restrictions

3.17 Operating restrictions should be explored as a last resort after all other elements of the Balanced Approach have been exhausted. Chapter 7 of ICAO Doc 9829 outline examples of operating restrictions. These include:

- curfews;
- night-time restrictions;
- noise quotas / budgets; and

[41] Noise Abatement Operational Procedures (icao.int).

- restrictions relating to the nature of flight.

3.18 In addition to those mentioned above, some operating restrictions have led to the phase-out of certain aircraft, such as Non-Noise Certified aircraft in the 1980s and Chapter 2 aircraft in the 1990s. Operating restrictions of this kind can have significant economic implications for some airlines and countries, particularly for those that are developing. The ICAO Assembly in 2001 urged states not to introduce any operating restrictions at any airport for Chapter 3 aircraft before fully assessing other available measures to address airport noise in accordance with the Balanced Approach. A number of safeguards were also listed by the Assembly which would need to be met if restrictions were imposed on Chapter 3 aircraft. For example, these safeguards noted that restrictions should be based on the noise performance of the aircraft as determined by the certification procedure conducted consistent with ICAO Annex 16, Volume I, and should be tailored to the noise problem of the airport in question, in addition to the individual circumstances of operators from developing nations being taken into account. These policies were adopted as ICAO Assembly Resolutions and remain in force following the 41st session of the Assembly.[42]

3.19 The aim of the Balanced Approach is to address noise issues at the individual airport level, in addition to identifying noise related measures that achieve maximum environmental benefit most cost-effectively using objective and measurable criteria. ICAO identifies that 'the process for implementation and decisions between elements of the Balanced Approach is for Contracting States and it is ultimately the responsibility of individual States to develop appropriate solutions to the noise problems at their airports, with due regard to ICAO rules and policies'.

UK Noise Policy and Regulation

3.20 In the UK, Government policy on the control of aircraft noise is the responsibility of the DfT. However, this policy is that noise issues are best handled at a local level by the airport and the relevant local authority whilst engaging with people who are affected by noise (with the exception of Heathrow Airport, Gatwick Airport and Stansted Airport, where DfT retains direct responsibility for regulating aviation noise).[43] That means decisions, including whether aircraft can operate at night, and how many aircraft are allowed to fly on any given day, are generally made by local authorities when they give permission for an airport to be built or expanded. The CAA has the final say on where aircraft are allowed to fly and has a legal obligation to consider noise impacts as well as safety and the efficiency of airspace when deciding whether a proposed route is acceptable.[44]

[42] Operating Restrictions (icao.int).

[43] Section 80 Civil Aviation Act 1982.

[44] In the UK CAP1616 outlines guidance on the regulatory process for changing the notified airspace of design.

Application of the ICAO Balanced Approach

3.21 The requirement to take account of the ICAO Balanced Approach is brought into UK law through UK Regulation (EU) 598/2014.[45] As noise management is a devolved matter in the UK, the requirements of UK Regulation (EU) 598/2014 were enacted into domestic law for each Devolved Administration via the following regulations:

- England and Wales: The Airports (Noise-related Operating Restrictions) (England and Wales) Regulations 2018
- Scotland: The Airports (Noise-related Operating Restrictions) (Scotland) Regulations 2019
- Northern Ireland: The Aerodromes (Noise Restrictions) (Rules and Procedures) Regulations 2003

3.22 UK Regulation (EU) 598/2014 relates to the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at airports within a Balanced Approach. This regulation outlines the process to be followed (in accordance with the Balanced Approach) for the introduction of noise-related operating restrictions on an airport-by-airport basis so as to help improve the noise climate, and to limit or reduce the number of people significantly affected by the potentially harmful effects of aircraft noise. The objectives of the regulation are as follows:

- to facilitate the achievement of specific noise abatement objectives, including health aspects, at the level of individual airports, while respecting relevant legislation within the UK; and
- to enable the use of operating restrictions in accordance with the Balanced Approach so as to achieve the sustainable development of the airport and air traffic management network capacity from a gate-to-gate perspective.

3.23 The regulation outlines the general rules on aircraft noise management which stipulates that airports should only implement operating restrictions after consideration of the other measures of the Balanced Approach. When considering the other measures of the Balanced Approach in relation to this regulation, as appropriate and in accordance with the relevant environmental noise regulations (see below), competent authorities are required to ensure that the noise situation at airports for which they are responsible for are assessed on a regular basis, such that, where a noise problem is identified a noise abatement objective for the airport is defined. This noise assessment, and abatement objective, should be carried out in accordance with Directive 2002/49/EC,[46] also known as the Environmental Noise Directive (END).

[45] Regulation (EU) 591/2014.

[46] Directive 2002/49/EC.

Environmental Noise Directive

3.24 The END relates to the assessment and management of environmental noise, mainly from transport, which is required to be undertaken every five years. As noise management is a devolved matter in the UK, the requirements of the END are enacted into domestic law for each devolved nation as follows:

- Environmental Noise (England) Regulations 2006 (as amended)
- Environmental Noise (Wales) Regulations 2006 (as amended)
- Environmental Noise (Scotland) Regulations 2006 (as amended)
- Environmental Noise Regulations (Northern Ireland) 2006 (as amended)

3.25 With respect to aviation, the regulations require that strategic noise maps are created by airports that have more than 50,000 movements per year, or those that are near an urbanised agglomeration of more than 100,000 people[47] where the level of aviation activity means that air traffic noise from the airport causes an L_{den} value of 55 dBA or greater; or an L_{night} value of 50 dBA or greater, anywhere within the agglomeration.[48]

3.26 Airports that are required to create a strategic noise map based on the criteria above must subsequently compile a Noise Action Plan based on the results of the noise mapping. Across all Devolved Administrations, Noise Action Plans must meet the requirements of Annex V of the END which states the following elements must at least be included:

- a description of the airport and other noise sources taken into account;
- the authority responsible;
- the legal context;
- any limit values in place;
- a summary of the results of the noise mapping;
- an evaluation of the estimated number of people exposed to noise, identification of problems and situations that need to be improved;
- a record of the public consultations organised in accordance with Article 8(7);
- any noise-reduction measures already in force and any projects in preparation;
- actions which the competent authorities intend to take in the next five years, including any measures to preserve quiet areas;

[47] Where population density is equal to or greater than 500 people per km^2.

[48] L_{den}, L_{night} and other noise metrics used to address aviation noise is described in CAA ERCD Report 0904.

- a long-term strategy;
- a financial information (if available): budgets, cost-effectiveness assessment, cost-benefit assessment; and
- provisions envisaged for evaluating the implementation and the results of the action plan.

3.27 Estimates in terms of the reduction of the number of people affected (annoyed, sleep disturbed, or other) must also be provided, in addition to a summary document, not exceeding ten pages in length covering all the aspects mentioned above.

3.28 A common noise assessment methodological framework for entities which are required to assess noise under the END was introduced into UK law in 2018. This framework was developed through the Common Noise Assessment Methods in the EU project, led by the European Commission's Joint Research Centre which formed the basis for Directive 2015/996/EC.[49] Directive 2015/996/EC was subsequently incorporated into UK law in 2018 through amendments to the Environmental Noise Regulations for each Devolved Administration, as outlined above.

3.29 The competent authorities and bodies responsible for implementing the Environmental Noise Regulations are as follows:

- Making and, where relevant, approving noise maps and action plans for major designated airports under section 80 of the Civil Aviation Act 1982– in England this is the Secretary of State for Transport.
- Making and, where relevant, approving noise maps and action plans for major non-designated airports – in England, Scotland and Wales, this is the airport operators; in Northern Ireland, it is the Northern Ireland Department of Environment.
- Collecting and adopting noise maps and action plans – in the UK, this is the DEFRA.

Designated Airports for Noise Regulation

3.30 In the UK, the airport operator is responsible for the control of aviation noise locally. However, Section 80 of the Civil Aviation Act 1982 gives the DfT power to designate airports for the control of aircraft noise, and these 'controls' are defined in Section 78 and 79 of this Act.[50] These powers relate to setting appropriate requirements for the purpose of limiting, or mitigating, the effect of noise and vibration from aircraft taking-off or landing at an aerodrome, in addition to requiring the designated airport to report the noise impacts of their operations

[49] Directive 2015/996/EC.

[50] Section 80 Civil Aviation Act 1982.

to the Secretary of State for Transport. There are currently three designated airports for the control of aircraft noise, Heathrow Airport, Gatwick Airport, and Stansted Airport. The CAA provides technical advice to the DfT in relation to the control of noise at the designated airports.

Aircraft Noise Certification

3.31 Article 9(2) of UK Regulation (EU) 2018/1139, brings into UK law the requirement for aircraft and their engines, propellers, parts, and non-installed equipment, to comply with, where applicable, the environmental protection requirements of Volume I of Annex 16 to the Convention on International Civil Aviation. This is further ratified in UK Regulation (EU) No 748/2012 whereby the responsibility for ensuring compliance against the aforementioned environmental protection requirements for the issuance of a type-certificate[51], and airworthiness certificate,[52] sits with the CAA.

3.32 In addition, the Aeroplane Noise Regulations 1999 (as amended)[53] apply and outline further requirements, such that any civil subsonic jet aeroplanes with a maximum take-off mass of 34,000 kg or more, or with more than 19 passenger seats, shall not be operated at any airport in the UK on or after 1 April 2002 unless that aeroplane complies with requirements which meet the standards specified in Part II, Chapter 3 of Volume 1 of Annex 16 to the Convention on International Civil Aviation. This effectively bans the noisiest aeroplanes from UK airports and sets a requirement for subsonic jet and larger propeller aeroplanes to meet Chapter 3 noise standards (see figure 3.2). Regulation 25 gives the CAA the ability to grant specific, temporary exemptions from this ban. The CAA's Noise Certification[54] function oversees the application of these Standards for UK registered aircraft.

Airspace Regulation

3.33 The Transport Act 2000 and the Civil Aviation Authority (Air Navigation) Directions 2023 establish the CAA as the UK airspace regulator responsible for making decisions related to changing the design of UK airspace. Section 70 of the Transport Act 2000 states that after maintaining a high standard of safety in the provision of air traffic services, the CAA must take account of any guidance on environmental objectives given to the CAA by the Secretary of State after the coming into force of this section when exercising its air navigation functions, such as deciding on whether to approve changes to the design of UK airspace (among other factors). This guidance is issued under the Air Navigation Guidance 2017 which sets out the Government's key environmental objectives with respect to air navigation, and noise considerations form part of this. See

[51] Regulation (EU) No 748/2012 Annex I point 21.B.85.

[52] Regulation (EU) No 748/2012 Annex I point 21.A.173.

[53] The Aeroplane Noise Regulations 1999 (caa.co.uk).

[54] CAA's Noise Certification

Chapter 2 for further information regarding the CAA's duties with respect to its air navigation functions.

3.34 Consideration and assessment of the potential environmental impacts resulting from an airspace change proposal including noise is a necessary part of the CAA's decision making process, and also enables those who are affected by the proposed airspace change to better understand the impacts of the different design options being considered. In order to achieve this, the CAA requires change sponsors to provide an environmental assessment that evolves through the various stages of the airspace change process.

3.35 While developing and assessing the environmental impacts of airspace change design options, change sponsors must take into account the Air Navigation Guidance 2017, including the Government's environmental objectives and priorities as set out in that guidance.

CAA Noise Advisory Functions

3.36 The CAA undertakes a number of other noise related functions which sit outside its direct regulatory duties, outlined above. These include:

Commercial Function

3.37 Monitoring noise around UK airports, publishing information regarding noise levels and likely impacts, and advising on noise management and mitigation. Work is undertaken for a range of customers including: the UK Government, public authorities, the aviation industry and local communities.

Advisory Functions

3.38 Collaborating on and reviewing research into the effects of noise, offering advice regarding how these effects can be reduced. This work is usually undertaken for, or on behalf of the UK Government and can include providing advice, guidance and best practice, in the UK and internationally.

3.39 In 2021, the CAA was directed by the DfT to take on certain additional noise functions, which came from the former Independent Commission on Civil Aviation Noise (ICCAN). The aims of the additional noise advisory functions are to:

- support Government to take informed decisions on noise policy;
- encourage the aviation sector to follow best practice in managing aviation noise impacts, including balancing the needs of relevant parties and engaging communities; and

- improve the level of understanding about aviation noise mitigation and confidence in how aviation noise is treated in the UK.[55]

UK Aviation: Noise Impacts

3.40 The CAA's Strategy and Policy team commissioned the CAA's Environmental Research and Consultancy Department (ERCD) to undertake noise modelling in order to estimate the aggregate number of people in the UK exposed to more than 51dB $L_{Aeq,16h}$ average summer day and 45dB $L_{Aeq,8h}$ average summer night respectively, from 2019[56] to 2022. The noise footprint of eight[57] airports were modelled to inform this and these airports were selected based on the previous CAA publication, CAP 1731[58] which was commissioned by the DfT in 2018 in support of the Aviation 2050 Consultation.[59] The eight airports utilised in this analysis are: Birmingham, Edinburgh, Glasgow, London Gatwick, London Heathrow, London Luton, London Stansted, and Manchester. The noise outputs are as follows:

- Approach 1: To give an indication of the number of people exposed to more than 51 dB $L_{Aeq,16h}$ daytime and 45dB $L_{Aeq,8h}$ night-time in the UK, a population dataset representative of each year was used. Table 3.1 below outlines this data.
- Approach 2: To give an indication of how noise exposure has changed from 2019 to 2022, a 2019 population dataset was applied to each year modelled. Table 3.2 below outlines this data.

3.41 Further information regarding the noise modelling methodology is explained in Appendix I.

[55] Further information regarding the CAA's noise advisory functions can be viewed here: CAA noise advisory functions | Civil Aviation Authority.

[56] Modelling was undertaken from 2019 as this was the busiest year for air travel prior to COVID-19 pandemic (Latest quarterly statistics | Civil Aviation Authority (caa.co.uk)).

[57] To inform future iterations of the AER, the CAA intends to review the number of airports selected for noise modelling to ensure that the most comprehensive indication of the number of people exposed to aviation noise in the UK is provided.

[58] CAP1731: Aviation Strategy – Noise Forecast and Analyses (caa.co.uk).

[59] Aviation 2050 Consultation.

Table 3.1: Approach 1 - Estimated area and population exposed to daytime and night-time noise in the UK (Population dataset representative of each year)

	Day (51 dB $L_{Aeq, 16h}$)		Night (45 dB $L_{Aeq, 8h}$)	
YEAR	**Contour area (km^2)**	**Population**	**Contour area (km^2)**	**Population**
2019	825	1,400,800	877	1,365,100
2020	262	313,600	302	336,400
2021	347	473,800	399	506,600
2022	596	949,900	715	1,032,000

Table 3.2: Approach 2 - Estimated area and population exposed to daytime and night-time noise in the UK (Population dataset 2019)

	Day (51 dB $L_{Aeq, 16h}$)		Night (45 dB $L_{Aeq, 8h}$)	
YEAR	**Contour area (km^2)**	**Population (2019)**	**Contour area (km^2)**	**Population (2019)**
2019	825	1,400,800	877	1,365,100
2020	262	312,400	302	334,500
2021	347	471,900	399	503,900
2022	596	940,500	715	1,023,700

CHAPTER 4

Local Air Quality

4.1 This Chapter outlines the environmental protection measures in the UK relating to civil aviation and local air quality.

4.2 Poor air quality has the potential to impact upon the health of individuals, in addition to that of flora and fauna. Air pollution is transboundary in nature, meaning that pollutants from sometimes hundreds of miles away can impact upon the air quality in any specific area. Around airports, local air quality is mainly affected by emissions from aircraft, aircraft support vehicles, airport terminal generators and traffic on local roads. Given the number of potential sources, managing local air quality around airports requires a coordinated approach across many different industries and bodies.

4.3 There are a number of policy measures in place which aim to address local air quality, and these apply both directly and indirectly to the aviation industry. Measures which apply directly to the aviation industry include those that reduce emissions at source, such as ICAO engine certification requirements which aim to improve aircraft engine performance and thus reduce engine exhaust emissions. Measures which impact indirectly on the aviation industry include, amongst others, requirements for local authorities to ensure that the total concentration of particular pollutants in a given area, which aviation activities may contribute to, remain below specific thresholds set in policy. If these thresholds are exceeded the local authority must develop an action plan setting out measures that aim to bring pollutant concentrations back within their respective compliance thresholds.

Managing Local Air Quality: International Framework

ICAO Standards and Recommended Practices

4.4 As an ICAO Member State, the UK has agreed to collaborate with other Member States to improve the level of environmental protection across a number of areas, including aircraft emissions and local air quality.

4.5 Volume II of Annex 16 to the Convention on International Civil Aviation contains Standards and Recommended Practices (SARPs) for aircraft engine emissions. These ICAO SARPs are only applied to subsonic and supersonic aircraft turbojet and turbofan engines with a thrust greater than or equal to 26.7 kilonewtons (kN). These standards do not apply to smaller turbofan and turbojet engines

(thrust less than 26.7 kN),[60] turboprop, turboshaft, piston engines, auxiliary power units and general aviation aircraft engines due to the large number of models, the economic cost of compliance, and small fuel usage compared to commercial jet aircraft.[61]

Certification of Subsonic Engines

4.6 Engines intended for propulsion at subsonic speeds, where applicable, are certified under test conditions uninstalled from the aircraft. The emissions are measured against an idealised landing and take-off (LTO) cycle which account for aircraft from the ground up to 3,000 feet above ground level. This is known as the ICAO Reference LTO Cycle.[33] The time in each operating mode of the ICAO Reference LTO Cycle, and applicable rated thrust settings are displayed in Table 4.1 and Figure 4.2.

Table 4.1: ICAO Reference LTO Cycle

LTO operating mode	Time in operating mode (minutes)	Thrust setting (% of Maximum)
Take-off	0.7	100%
Climb	2.2	85%
Approach	4.0	30%
Taxi/ground idle	26.0	7%

[60] With exception to the Smoke Number. See below.

[61] ICAO Doc 9889 2nd Edition (icao.int).

Figure 4.2: ICAO Reference LTO Cycle

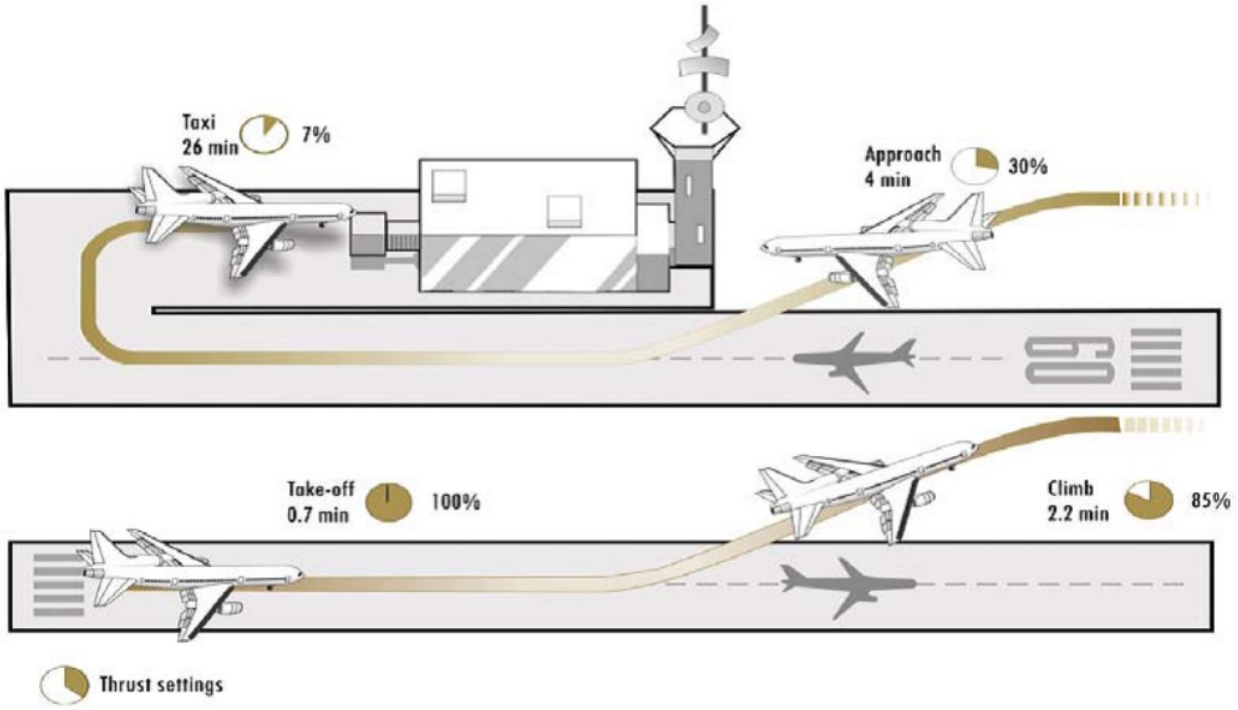


Image source: ICAO Local Air Quality Technology

4.7 The thrust setting applied to each LTO operating mode is a percentage of maximum rated take-off thrust approved for use under normal operating conditions, without the use of water injection.[62]

4.8 Part III, Volume II of Annex 16 to the Convention on International Civil Aviation outlines the certification standards for several pollutants, and the ICAO Engine Emissions Databank[63] hosted by EASA, contains data for all certified engines for which manufacturers have made data available. The databank outlines each engine's compliance against the various emissions standards for the following pollutants:

Gaseous Emissions

Carbon Monoxide

4.9 Carbon Monoxide (CO) is a colourless, odourless gas formed during incomplete combustion of heating and motor fuels. It acts as a respiratory poison in humans and warm-blooded animals.[64]

[62] Volume II of Annex 16 to the Convention on International Civil Aviation.

[63] ICAO Aircraft Engine Emissions Databank | EASA (europa.eu).

[64] Microsoft Word - Doc 9889.2nd Edition.alltext.en.docx (icao.int).

4.10 The CO standard applies to engines that have a rated thrust greater than 26.7 kN which are manufactured on or after 1 January 1986.

Hydrocarbons

4.11 Hydrocarbons (HC) are a compound made entirely of carbon and hydrogen.

4.12 The HC standard applies to engines that have a rated thrust greater than 26.7 kN which are manufactured on or after 1 January 1986.

Nitrogen Oxides

4.13 Nitrogen oxides (NOx) is a general term for both nitrogen dioxide (NO_2) and nitrogen monoxide (NO). They are gases which are formed mainly from the combustion of fossil fuels. NO is the dominant portion of these gases however it oxidises rapidly to form NO_2 which is harmful to health. As this reaction takes place quickly and is reversible, NOx is used to refer to both gases.

4.14 The stringency of the NOx standards have increased over time via recommendations to the ICAO Council from the CAEP. The latest standards were informed by the 8th CAEP meeting in 2010 (CAEP/8).[65]

4.15 Unlike HC and CO, there are more stringent NOx standards for New Type engine designs and less stringent NOx standards for In-Production engines that vary depending on when an engine was manufactured. For further information regarding the various NOx standards see Part III, Volume II of Annex 16 to the Convention on International Civil Aviation.

Non-Gaseous Emissions

Smoke Number

4.16 Smoke refers to the carbonaceous materials in exhaust emissions which obscure the transmission of light. The production of smoke usually occurs from unburnt, or partially burnt fuel.

4.17 The smoke number applies to engines with a date of manufacture which is on or after 1 January 1983 and before 1 January 2023. In addition, the standard applies to engines with a date of manufacture on or after 1 January 2023 that have a maximum rated thrust less than or equal to 26.7 kN. The smoke number has been superseded by the non-volatile particulate matter (nvPM) standard for engines with a rated thrust greater than 26.7 kN and date of manufacture after 1 January 2023.[66]

[65] Committee on Aviation Environmental Protection (CAEP) (icao.int).

[66] Local Air Quality Technology Standards (icao.int).

Non-volatile particulate matter

4.18 Non-volatile particulate matter (nvPM) are particles that exist at the gas turbine engine exhaust nozzle exit plane that do not volatilise when heated to a temperature of 350°C. nvPM consists mainly of black carbon.

4.19 The Standards for nvPM apply to new type and in-production engines from 1 January 2023 and apply to those engines with a rated thrust greater than 26.7 kN. The nvPM standard replaces the smoke number for these engines. For further information see Part III, Volume II of Annex 16 to the Convention on International Civil Aviation.

Intentional Fuel Venting

4.20 Part II, Volume II of Annex 16 to the Convention on International Civil Aviation states that all turbine engine powered aircraft intended for operation in international air navigation manufactured after 18 February 1982 shall be designed and constructed as to prevent the intentional discharge into the atmosphere of liquid fuel from the fuel nozzle manifolds resulting from the process of engine shutdown following normal flight or ground operations.

Certification of Supersonic Engines

4.21 Turbojet and turbofan engines intended for propulsion at supersonic speeds which were manufactured on or after 18 February 1982 are required to comply with the applicable standards for the following pollutants:

- Smoke Number
- Hydrocarbons;
- Carbon Monoxide; and
- Nitrogen Oxides

4.22 Further information regarding the certification standards for supersonic engines is available in Part III, Volume II of Annex 16 to the Convention on International Civil Aviation.

Managing Local Air Quality: National Framework

4.23 The UK air quality framework is currently derived from a mixture of domestic and international legislation. The following regulations are applicable, both directly and indirectly, to the UK aviation industry.[67]

[67] Information in this section is derived from Air Pollution in the UK 2022 (Defra, 2022) unless referenced otherwise.

Legislation Regulating Total National Emissions of Air Pollutants

National Emission Ceilings Regulations (2018)

4.24 As mentioned above, air pollution is transboundary in nature. Given these potential transnational impacts, the European Community agreed to set emission ceilings through the National Emission Ceilings Directive.[68] This Directive was transposed into UK law in 2018 as the National Emission Ceilings Regulations (NECR).[69]

4.25 The NECR sets national emission reduction commitments for five air pollutants, these include: nitrogen oxides (NO_x), sulphur dioxide (SO_2), non-methane volatile organic carbons (NMVOC), ammonia (NH_3) and fine particulate matter ($PM_{2.5}$). These national emission reduction commitments need to be met in two phases. This first phase is from 2020-2029 which is in-line with commitments set by the Gothenburg Protocol under the International Convention on Long-Range Transboundary Pollutants[70] (CLRTAP), of which the UK is party. The second phase sets more stringent emission reduction commitments which need to be met from 2030 onwards. The 2030 targets are only set in the EU Directive and the NECR and do not form part of CLRTAP.

4.26 Although air quality is a devolved matter in the UK, the NECR applies to the whole of the UK and therefore the UK Government and Devolved Administrations work together to meet the commitments set within the regulations. As part of this, at least once every four years Government is required to produce a National Air Pollution Control Programme[71] setting out the policies and measures required to meet the emissions reductions commitments of the NECR.

4.27 The reporting requirements for NECR are closely aligned with those of CLRTAP and emissions from the following aviation related activities are reported under both:

- Domestic (civil) aviation LTO cycle;
- International (civil) aviation LTO cycle; and
- Airport support machinery.

4.28 The emissions inventories reported as part of these obligations are published on the National Atmospheric Emissions Inventory website.[72]

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[68] Directive 2016/2284/EC.

[69] The National Emission Ceilings Regulations 2018 (legislation.gov.uk).

[70] The Convention and its achievements | UNECE.

[71] Air Quality: Revised UK National Air Pollution Control Programme - GOV.UK (www.gov.uk).

[72] Data - NAEI, UK (beis.gov.uk).

Legislation Regulating Concentrations of Pollutants in Ambient Air

Air Quality Standards Regulations (2010)

4.29 In the UK, concentrations of air pollutants in the ambient air are regulated through the Air Quality Standards Regulations 2010 and as air quality is a devolved matter this is enacted into domestic law for each devolved nation via the following regulations:

- The Air Quality Standards Regulations (2010) in England
- The Air Quality Standards (Scotland) Regulations (2010)
- The Air Quality Standards (Wales) Regulations (2010)
- The Air Quality Standards Regulations (Northern Ireland) (2010)

4.30 These regulations set limit values, target values and long-term objectives for ambient concentrations of the following pollutants: sulphur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter (both PM_{10} and $PM_{2.5}$), lead (Pb), benzene (C_6H_6), carbon monoxide (CO), ozone (O_3), arsenic (As), cadmium (Cd), mercury (Hg), nickel (Ni) and polycyclic aromatic hydrocarbons.

4.31 In addition, concentrations of fine particulate matter ($PM_{2.5}$) in England are regulated by more recent legislation, the Environmental Targets (Fine Particulate Matter) (England) Regulations (2023).

Environmental Targets (Fine Particulate Matter) (England) Regulations (2023)

4.32 The UK Environment Act (2021) established a duty for the UK Government to set a target in England to reduce $PM_{2.5}$ concentrations, alongside at least one further long-term target on air quality. The long-term target is part of the wider framework for setting legally binding environmental targets, which also covers biodiversity, water, waste reduction and resource efficiency.

4.33 Within this framework, in January 2023 the Environmental Targets (Fine Particulate Matter) (England) Regulations (2023) came into force. These regulations set two new targets for:

- ambient concentrations of particulate matter measured as $PM_{2.5}$; and
- the reduction of $PM_{2.5}$ population exposure over the period between 2018 and 2040.

Local Air Quality Management Framework

4.34 Requirements for local air quality management are set out in Part IV of the Environment Act (1995) as amended by the Environment Act (2021), and the Environment (Northern Ireland) Order (2002). Authorities are required to carry out regular reviews and assessments of air quality in their area and take action to improve air quality in those areas where objectives set out in regulation have

been breached, or areas where it is thought there is a risk that they will be breached.

4.35 Local authorities in England, Scotland, Wales and Northern Ireland undertake a review and assessment against the respective[73] air quality strategies' objectives prescribed in the following regulations (as amended):

- Air Quality (England) Regulations (2000)
- Air Quality (Scotland) Regulations (2000)
- Air Quality (Wales) Regulations (2000)
- Air Quality (Northern Ireland) Regulations (2003)

4.36 When the review and assessment process identifies an exceedance of an Air Quality Strategy objective, the local authority must declare an Air Quality Management Area and develop an Action Plan to tackle problems in the affected areas. Action Plans formally set out the measures the Local Authority proposes to take. As of 2022, local authorities in England (including London) must now state a date by which each measure will be carried out to secure achievement of air quality objectives.

UK Clean Air Strategies

4.37 The Clean Air Strategy 2019[74] is the UK Government's framework document which sets out policy action to improve national emissions of the following five damaging pollutants:

- fine particulate matter ($PM_{2.5}$);
- ammonia (NH_3);
- nitrogen oxides (NO_x);
- sulphur dioxide (SO_2); and
- non-methane volatile organic compounds (NMVOCs).

4.38 The strategy outlines the policy action required to achieve statutory emissions reductions commitments, reduce background pollution and minimise human exposure to harmful concentrations of pollution. The strategy focuses on tackling air pollution in England; however, it also highlights action being taken in Scotland, Wales and Northern Ireland.

[73] See section 2.5.2 of Air Pollution in the UK 2022 (Defra, 2022) for further information regarding the air quality strategies and objectives for each Devolved Administration.

[74] Clean Air Strategy 2019 (publishing.service.gov.uk).

4.39 In relation to aviation, the Clean Air Strategy 2019 notes that the consultation, Aviation 2050,[75] outlined the proposed policies which aim to improve aviation related emissions and air quality. Due to COVID-19, Government did not provide a formal response to the Aviation 2050 consultation but instead published Flightpath to the Future,[76] a strategic framework which builds on the responses received to Aviation 2050. This established the Government's ambitions and commitments for aviation over the next ten years. In respect to air quality, Flightpath to the Future notes that the policy proposals set out in Aviation 2050 remain relevant and that Government will publish next steps in due course.

4.40 As air quality is a devolved policy area, each Devolved Administration has published, or intends to publish, its own strategy to achieving cleaner air. These are as follows:

- Scotland: Cleaner Air for Scotland 2;
- Wales: The Clean Air Plan for Wales; and
- Northern Ireland: The Department of Agriculture, Environment and Rural Affairs (DAERA) is developing Northern Ireland's first Clean Air Strategy.

Environmental Improvement Plan 2023

4.41 The Environmental Improvement Plan 2023[77] (EIP) is the first five-yearly statutory review of the 25 Year Environment Plan. The EIP applies to England only and is a delivery plan setting out how Government will improve all aspects of the environment. The clean air chapter of the EIP builds upon the 2019 Clean Air Strategy, setting out Government's delivery plan to achieve its statutory air quality targets. It builds on the vision set out in the 25 Year Environment Plan, and on the 2019 Clean Air Strategy and accounts for the new powers and duties under Environment Act (2021).

4.42 Policies related specifically to aviation are not referenced within the EIP; however, as the EIP should be considered alongside other strategies, such as the Clean Air Strategy 2019, which remains the Government's strategy for air quality the section above still applies.

Local Air Quality: CAA Responsibilities

4.43 The CAA's role on air quality is secondary to that of the Government and local authorities, who are statutorily empowered to engage on air quality issues as outlined above. However, the CAA does have a duty to consider local air quality when exercising a number of its regulatory functions. These are outlined below.

[75] Aviation 2050 (publishing.service.gov.uk).

[76] Flightpath to the future (publishing.service.gov.uk).

[77] Environmental Improvement Plan (publishing.service.gov.uk).

Aircraft Engine Emissions Certification

4.44 Article 9(2) of UK Regulation (EU) 2018/1139 brings into UK law the requirement for aircraft and their engines, propellers, parts, and non-installed equipment, to comply, where applicable, with the environmental protection requirements of Volume II of Annex 16 to the Convention on International Civil Aviation. This is further ratified in UK Regulation (EU) No 748/2012 whereby the responsibility for ensuring compliance against the aforementioned environmental protection requirements for the issuance of a type-certificate,[78] and airworthiness certificate,[79] sits with the CAA. Further information regarding the specific certification Standards for Volume II of Annex 16 is detailed above.

Airspace Regulation

4.45 The Transport Act 2000 and the Civil Aviation Authority (Air Navigation) Directions 2023 made underneath that Act establish the CAA as the UK airspace regulator responsible for making decisions related to changing the design of UK airspace. Section 70 of the Transport Act 2000 states that after maintaining a high standard of safety in the provision of air traffic services, the CAA must take account of any guidance on environmental objectives given to the CAA by the Secretary of State after the coming into force of this section when exercising its air navigation functions, such as deciding on whether to approve changes to the design of UK airspace (among other factors). This guidance is issued under the Air Navigation Guidance 2017 which sets out the Government's key environmental objectives with respect to air navigation, and local air quality considerations form part of this. See Chapter 2 for further information regarding the CAA's duties with respect to its air navigation functions.

4.46 Consideration and assessment of the potential environmental impacts resulting from an airspace change proposal, including impacts upon local air quality is a necessary part of the CAA's decision making process, and also enables those who are affected by the proposed airspace change to better understand the impacts of the different design options being considered. In order to achieve this, the CAA requires change sponsors to provide an environmental assessment that evolves through the various stages of the airspace change process.

4.47 While developing and assessing the environmental impacts of airspace change design options, change sponsors must take into account the Air Navigation Guidance 2017, including the Government's environmental objectives and priorities as set out in that guidance.

Local Air Quality: Aviation Industry Performance

4.48 As outlined above, the UK is required to report national emissions of certain pollutants under the NECR and CLRTAP. Emissions originating from aviation

[78] Regulation (EU) No 748/2012 Annex I point 21.B.85.

[79] Regulation (EU) No 748/2012 Annex I point 21.A.173.

related activities are included as part of these reporting obligations, which include emissions from:

- domestic (civil) aviation LTO cycle;
- international (civil) aviation LTO cycle; and
- airport support machinery.

4.49 The following section[80] outlines the latest aviation specific emissions reported as part of the NECR and CLRTAP, in addition to the national totals reported for all sectors, for the following five damaging pollutants outlined by the Clean Air Strategy 2019:

- nitrogen oxides (NO_x);
- sulphur dioxide (SO_2);
- ammonia (NH_3);
- non-methane volatile organic compounds (NMVOCs); and
- fine particulate matter ($PM_{2.5}$).

4.50 For the purpose of outlining aviation specific emissions for this review, domestic and international (civil) aviation LTO cycle emissions have been consolidated and reported as 'aircraft emissions'. Airport support vehicles are reported as 'airport support vehicles emissions', and emissions from all sectors reported under NECR and CLRTAP are reported as 'national emissions'.

4.51 Reporting under the NECR and CLRTAP account for emissions within the UK and Gibraltar. Further information regarding the reporting methodology and process can be found at the National Atmospheric Emissions Inventory.[81]

[80] Source of data presented in this section: © Crown 2023 copyright Defra & BEIS via naei.beis.gov.uk, licenced under the Open Government Licence (OGL).

[81] NAEI, UK National Atmospheric Emissions Inventory - NAEI, UK (beis.gov.uk).

Nitrogen Oxides (NO_x)

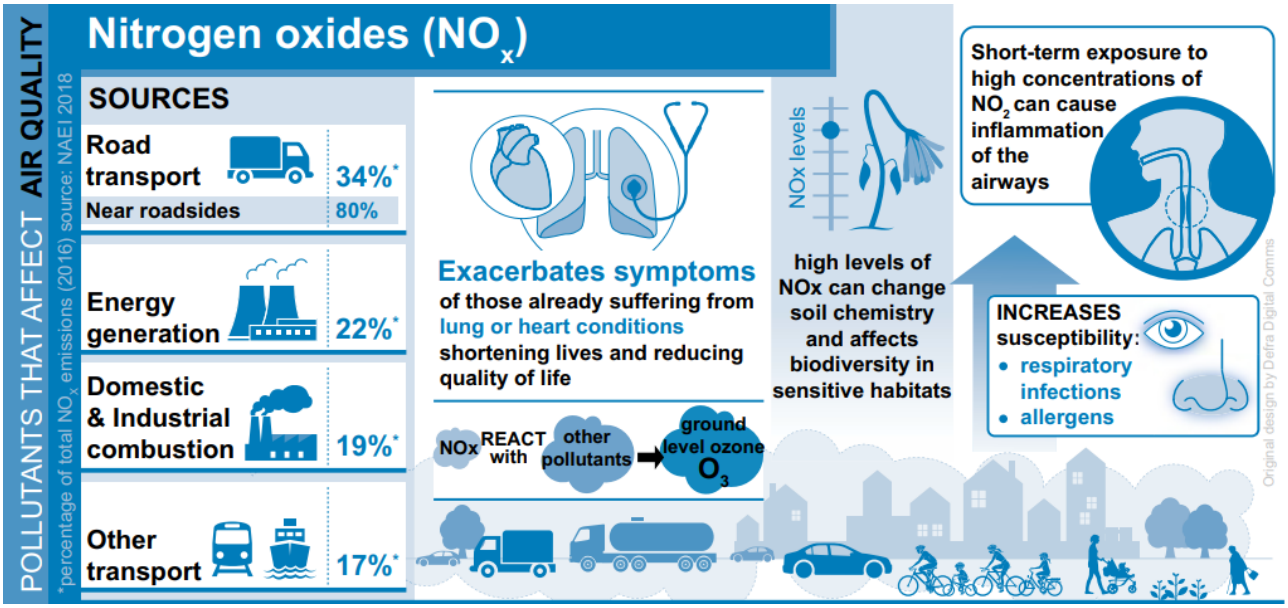


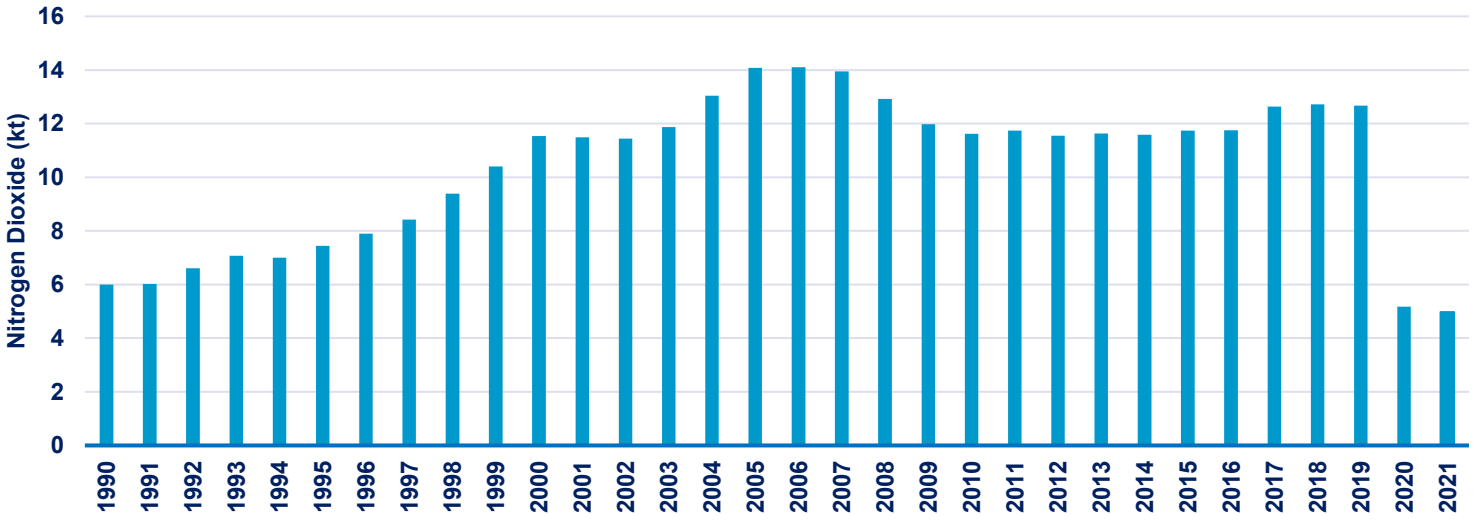
Image source: DEFRA Clean Air Strategy 2019

4.52 Nitrogen oxides (NO_x) are a group of gases that are formed during combustion of any fuel with oxygen at high temperatures. The majority of NOx emitted as a result of combustion is in the form of nitric oxide (NO). When NO reacts with other gases present in the air, it can form nitrogen dioxide (NO_2) which is harmful to human health. It is also important in the formation of ozone (O3) which can also impact upon health. NO converts to NO_2 quickly and this reaction is reversible; therefore, it is usual scientific practice to refer to the two gases together as NOx. For reporting and measurement purposes, NOx is reported as NO_2 because of this fast interconversion.

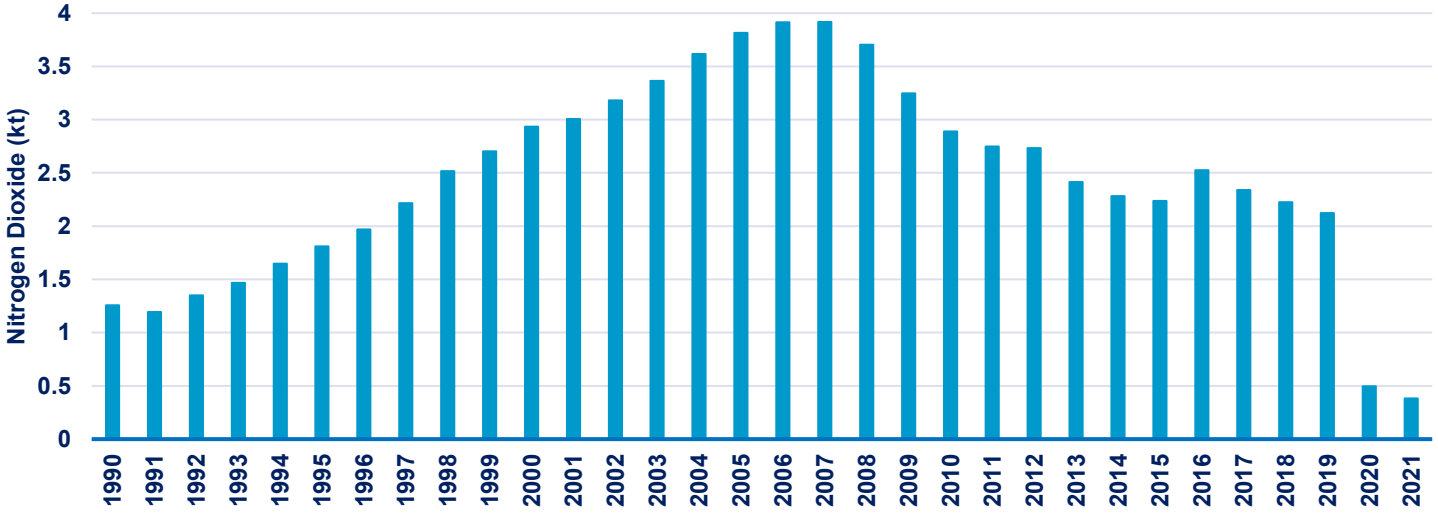
4.53 Short-term exposure to concentrations of NO2 can cause inflammation of the airways and increase susceptibility to respiratory infections and to allergens. It exacerbates the symptoms of those who are already suffering from lung or heart conditions, shortening their lives.[82]

[82] Clean Air Strategy 2019 (publishing.service.gov.uk).

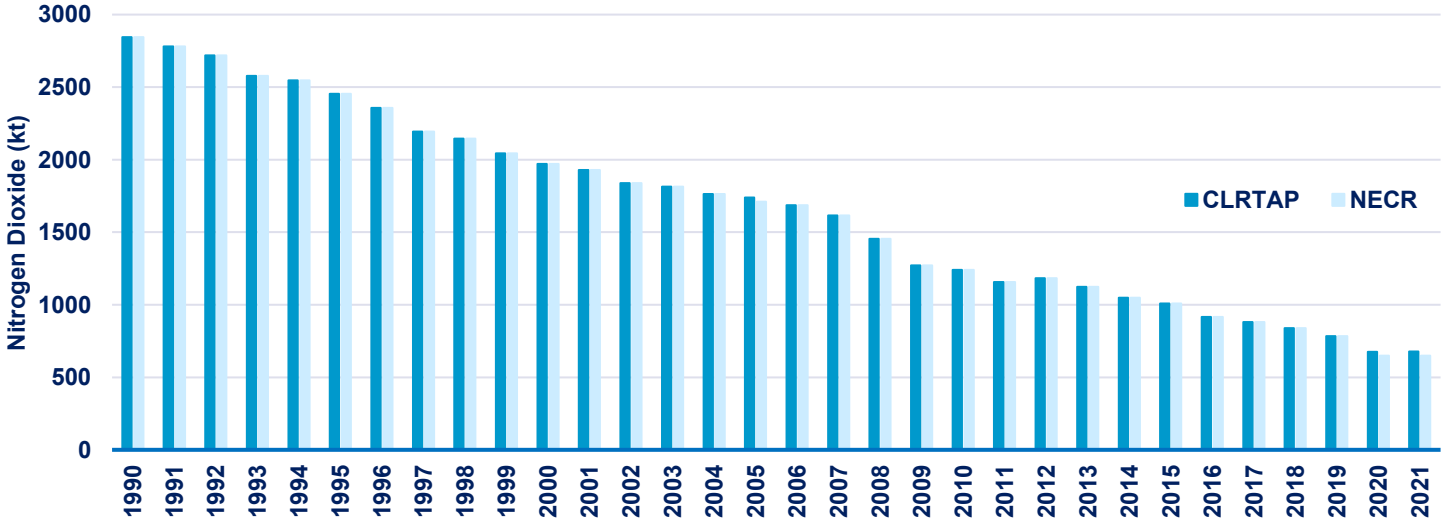
Aircraft Emissions: Nitrogen Dioxide (NO_2)



Airport Support Vehicles Emissions: Nitrogen Dioxide (NO_2)



National Emissions: Nitrogen Dioxide (NO_2)



Sulphur Dioxide (SO_2)

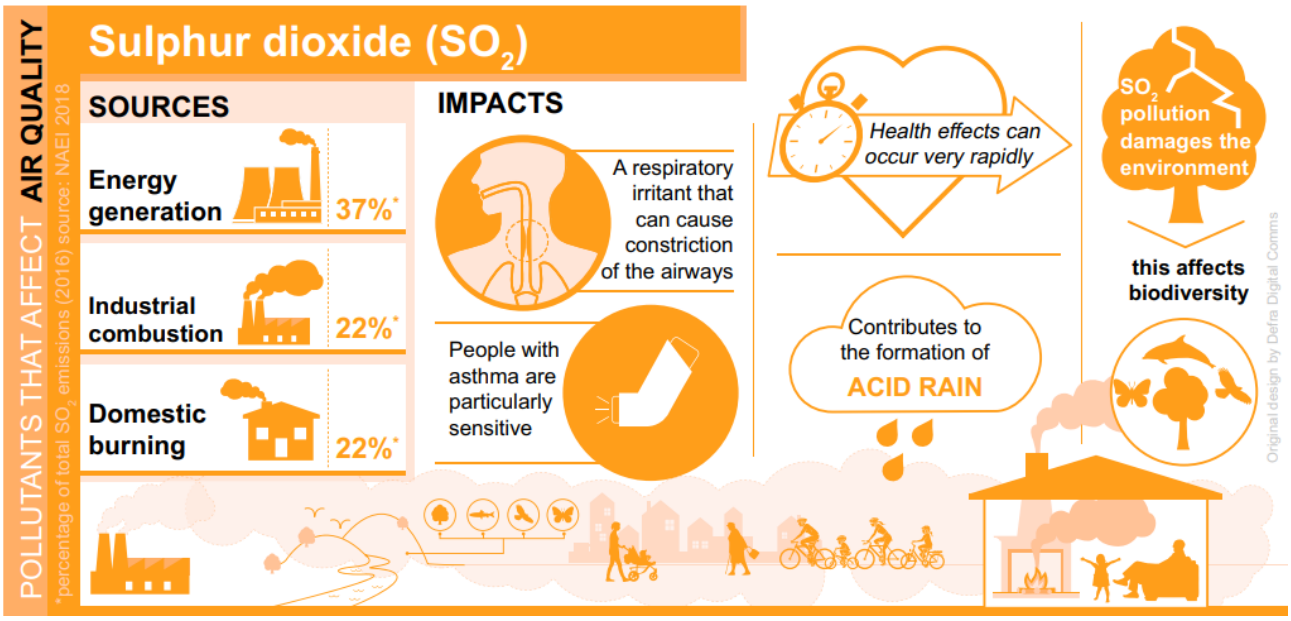


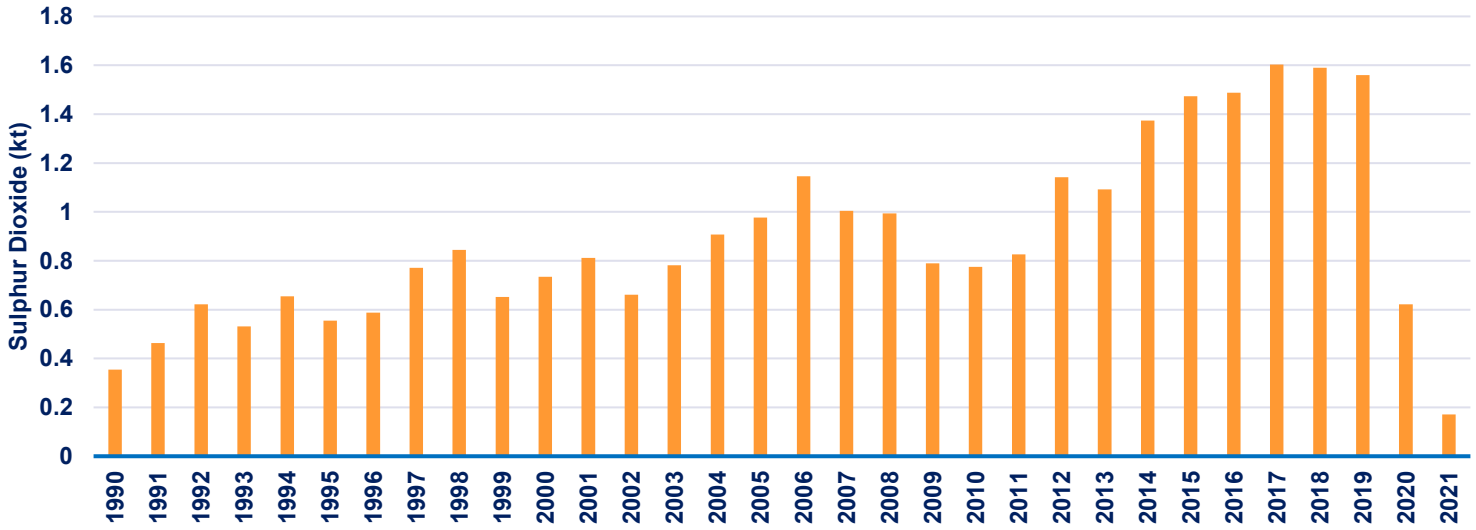
Image source: DEFRA Clean Air Strategy 2019

4.54 Sulphur dioxide (SO_2) is a corrosive, acidic gas formed from the combustion of solid and liquid fuels that contain sulphur. It is harmful to health and combines with water vapour in the atmosphere to produce acid rain. SO_2 pollution episodes in ambient air are also associated with asthma and chronic bronchitis and can be a significant component of particulate matter. Sulphur in coal played a contributory key role in the health impacts of the London smog in 1952, where estimates of the resulting mortality range between 8,000 and 12,000 deaths. SO_2 emissions caused significant harm to forests and freshwater habitats in the Northern Hemisphere in the 1970s – 1980s. Following concerted action to reduce SO_2 emissions, such episodes no longer occur in the UK.

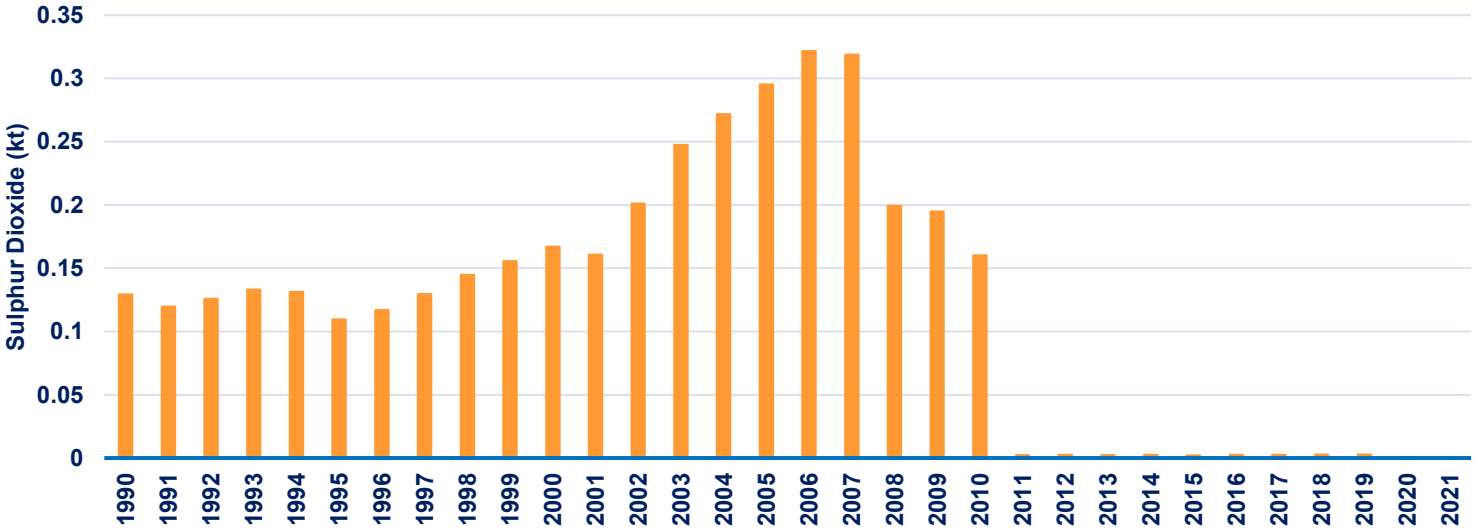
4.55 Emissions of SO_2 have reduced considerably at the national level due to restrictions on the sulphur content of liquid fuels, alongside the shift away from reliance on coal for energy generation. Domestic coal burning however can result in significant indoor exposure to SO_2.[83]

[83] Clean Air Strategy 2019 (publishing.service.gov.uk).

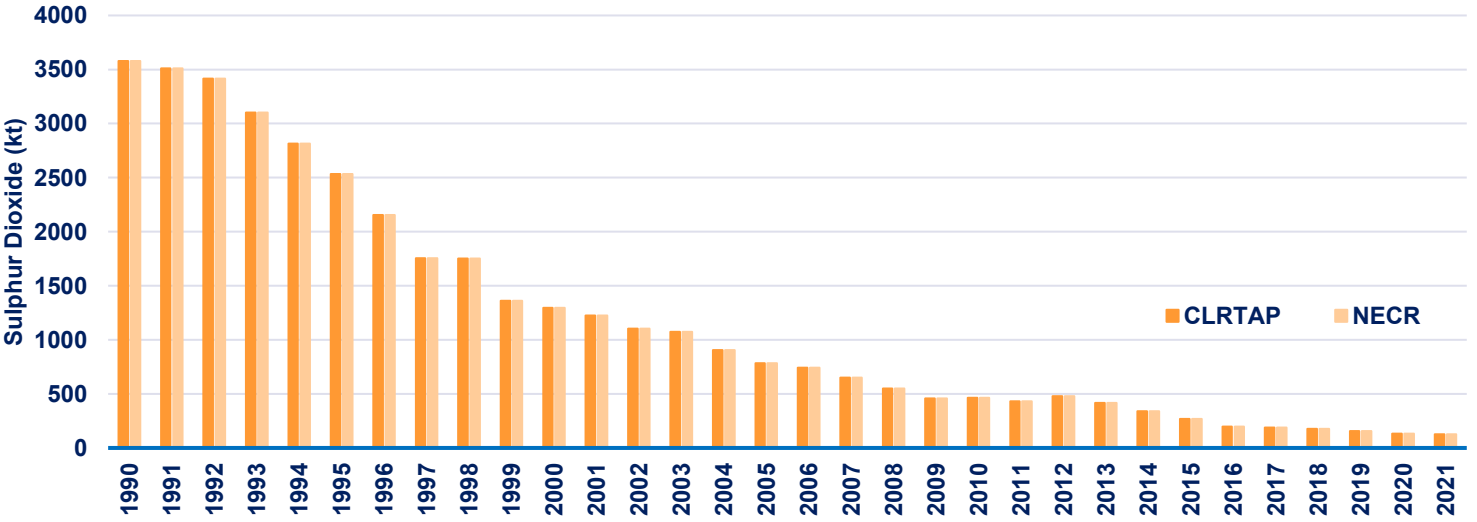
Aircraft Emissions: Sulphur Dioxide (SO_2)



Airport Support Vehicles Emissions: Sulphur Dioxide (SO_2)



National Emissions: Sulphur Dioxide (SO_2)



Particulate Matter

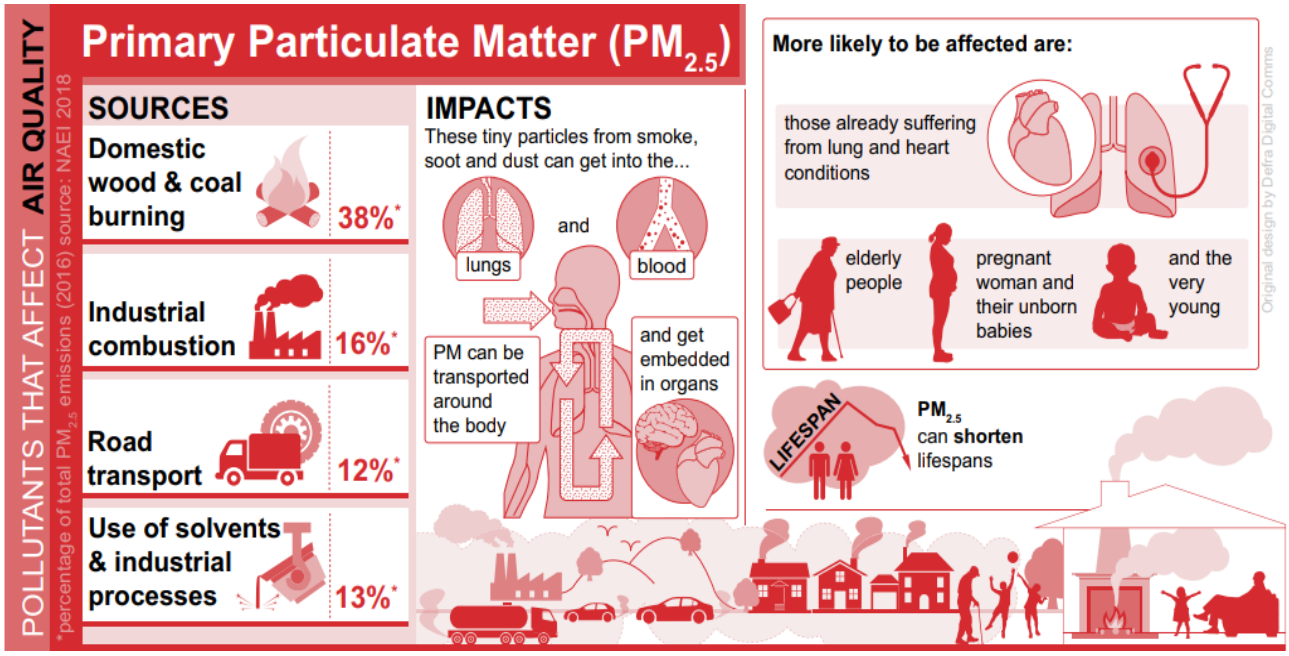
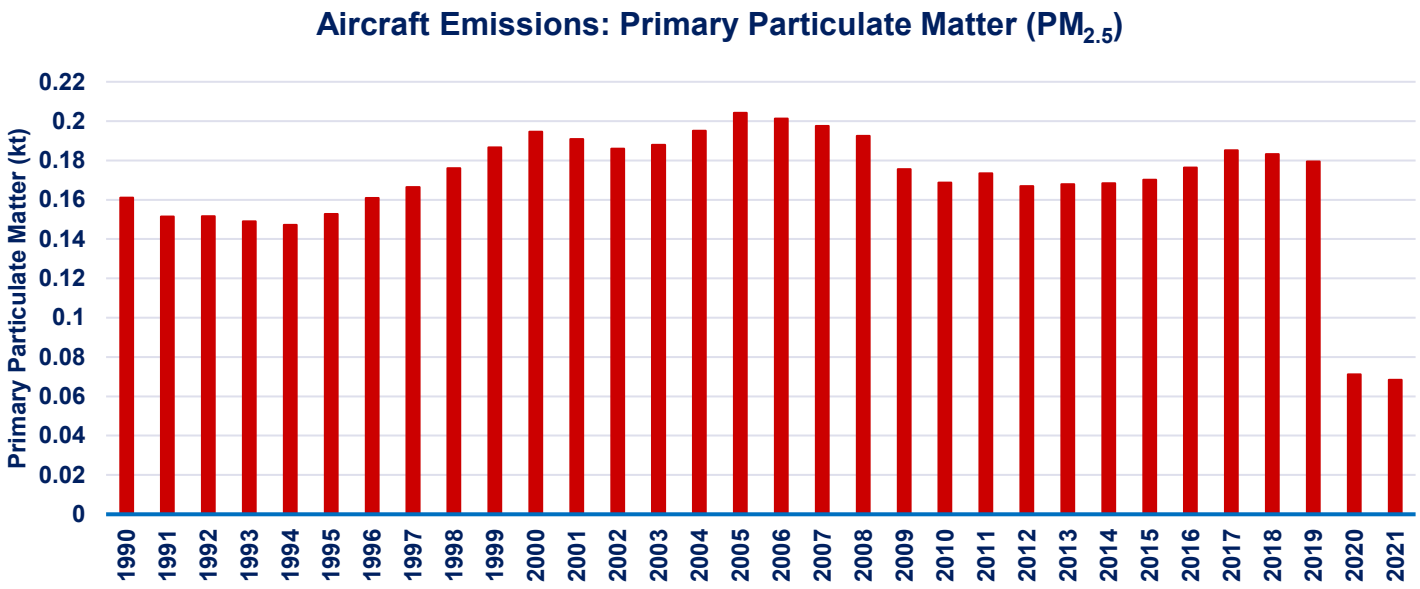


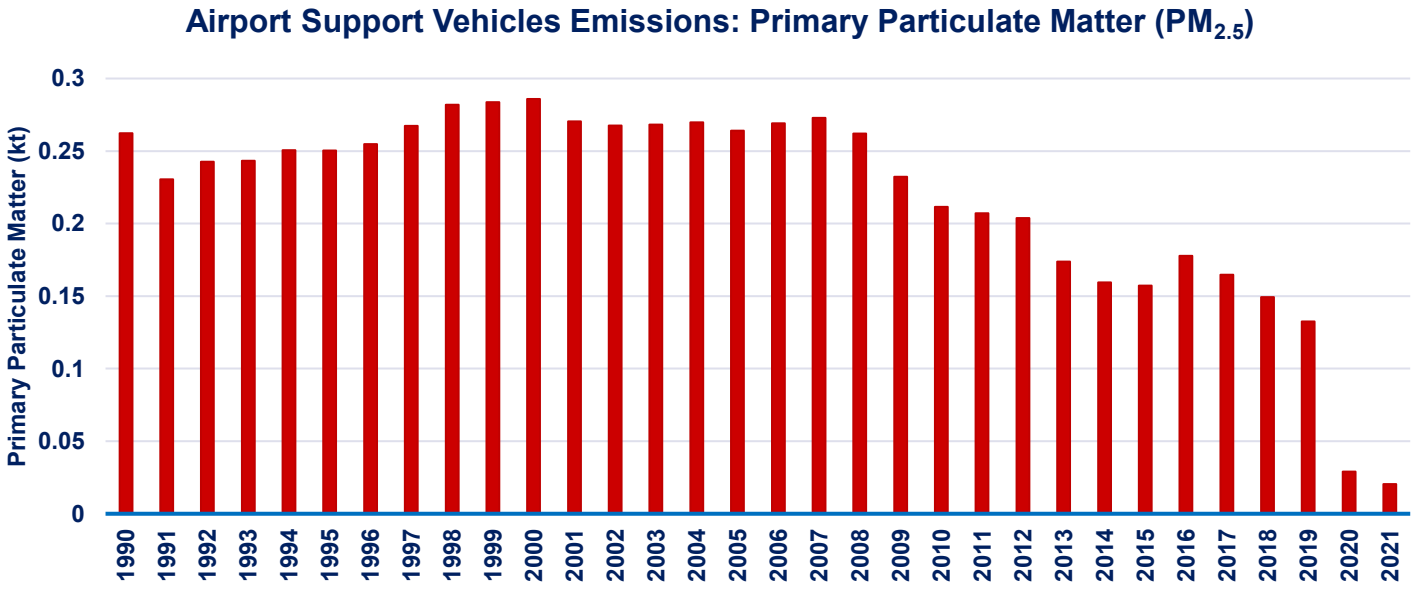
Image source: DEFRA Clean Air Strategy 2019

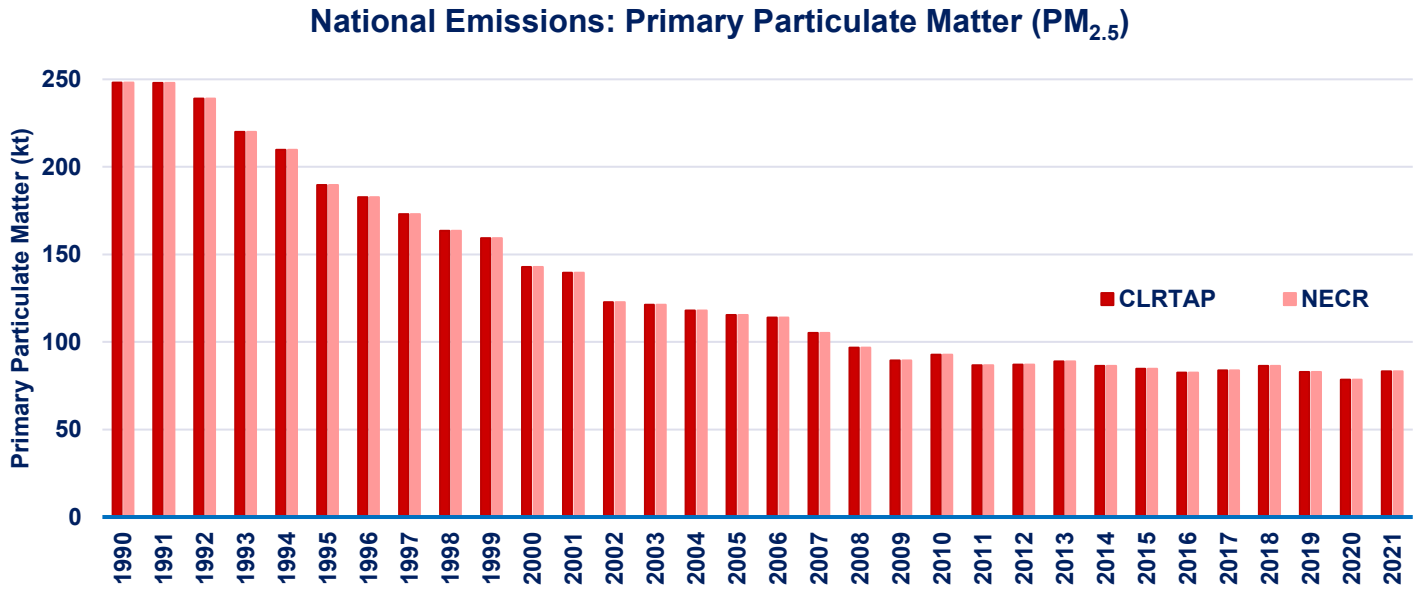
4.56 Particulate matter (PM) are solid particles or liquid droplets found in the air. It can come from natural sources such as pollen, sea spray and desert dust, as well as human made sources such as fires, vehicle exhausts, tyres and brakes. Particles emitted directly from these sources are called primary PM. Secondary PM is formed in the atmosphere through chemical reactions between other air pollutant gases such as nitrogen oxides (NO_X), ammonia (NH_3) and sulphur dioxide (SO_2). Particulates are classified according to size, either as PM_{10} which are particles that are less than or equal to 10 micrometres in diameter, or $PM_{2.5}$ which are particles that are less than or equal to 2.5 micrometres in diameter. $PM_{2.5}$ particles are 200 times smaller than a grain of sand.

4.57 PM is not a single pollutant; it is made up from a variety of chemical compounds and materials. Both PM, and the gases that can form it, can travel large distances and therefore impacts may occur far from the original source. Around 15% of UK PM comes from naturally occurring sources, up to a third from other European countries and around half from UK human-made sources.

4.58 Due to its size, PM can enter the lungs and bloodstream, allowing it to be transported around the body. PM can have short-term health impacts over a single day when concentrations are elevated, and long-term impacts from lower-level exposure over someone's life course. Effects are amplified in vulnerable







[84] Clean Air Strategy 2019 (publishing.service.gov.uk).

Ammonia (NH_3)

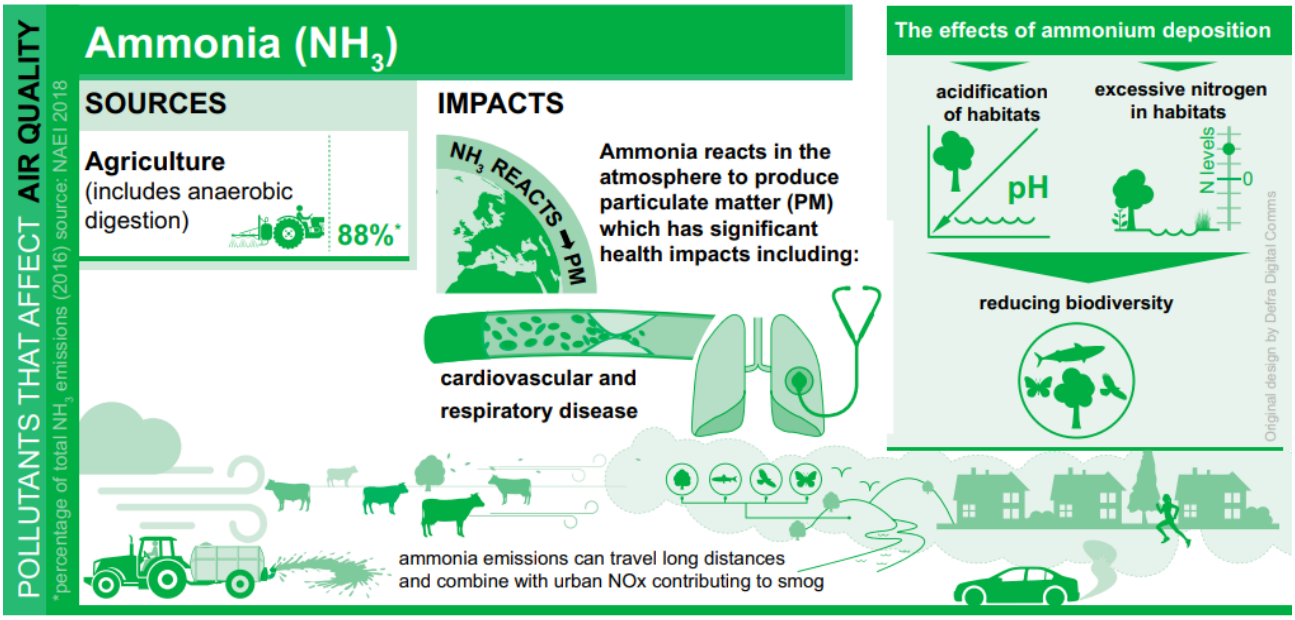


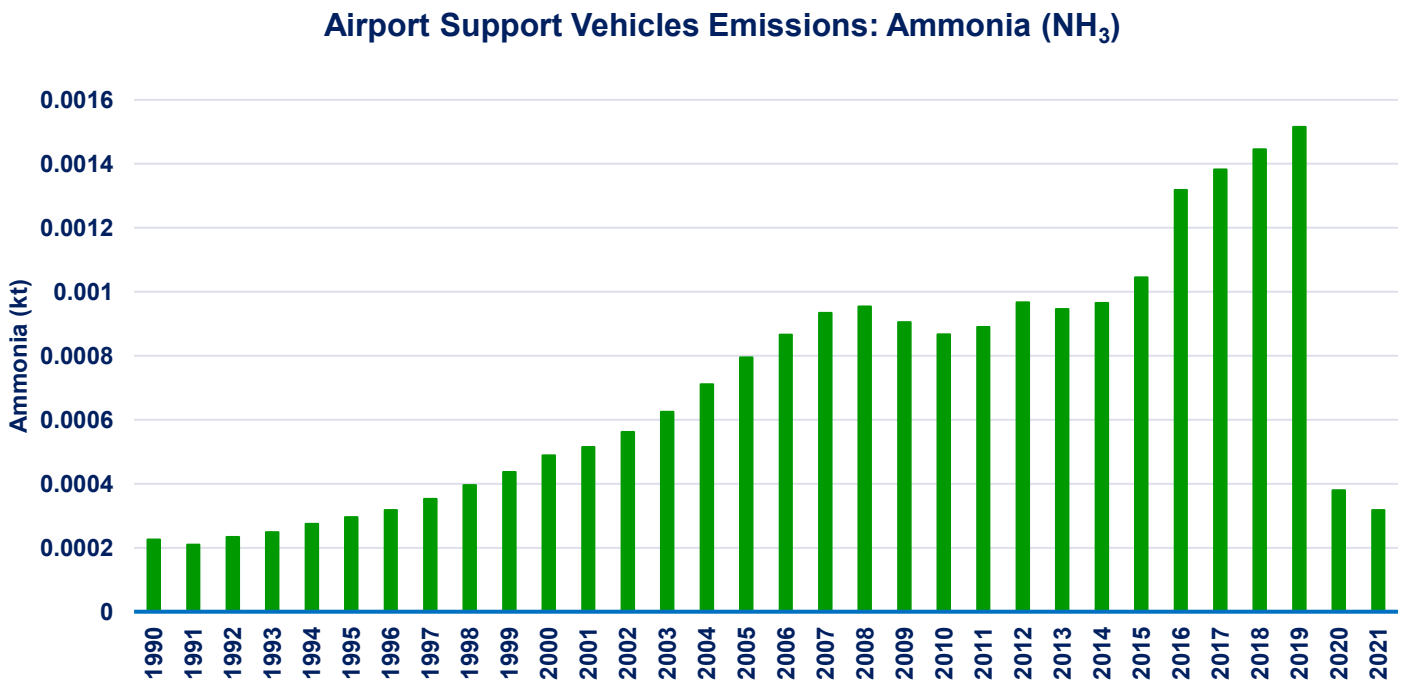
Image source: DEFRA Clean Air Strategy 2019

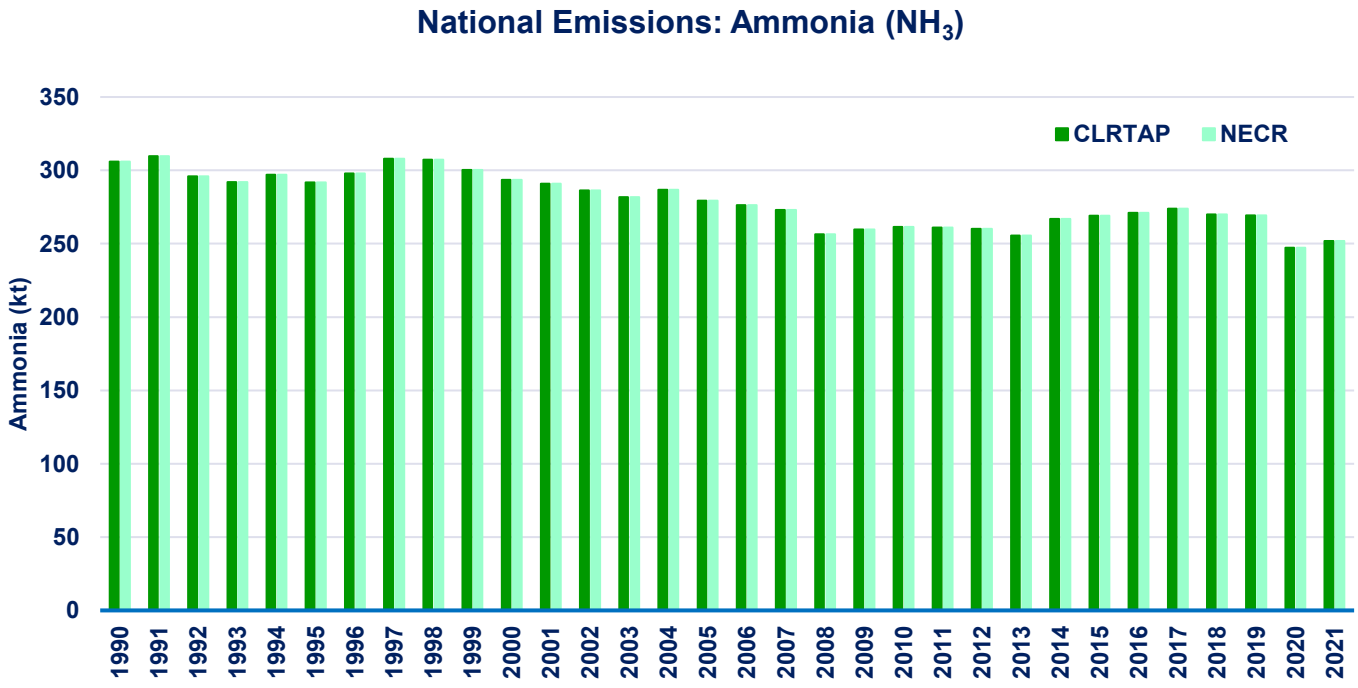
4.59 Ammonia (NH_3) is a gas that is emitted into the atmosphere, from where it is either converted into secondary PM, or deposited back onto land. Agriculture is the dominant source of NH_3 emissions and is emitted during storage and spreading of manures, slurries and fertilisers. After agriculture, the waste sector is the next most dominant source of NH_3 emissions. Remaining NH_3 emissions come from a mix of sources such as vehicles, human waste and industry.

4.60 The main concerns resulting from NH_3 emissions is its contribution to PM and the associated human health effects described above. NH_3 is converted into PM by mixing with nitrogen oxides and sulphur dioxide, producing ammonium compounds that turn into fine particulate matter. This PM is transported large distances and adds to the suspended background levels of particulates in the atmosphere. Public Health England attributed the 2014 London smog in part to agricultural NH_3 emissions.

4.61 NH_3 stays in the atmosphere for just a few hours as a gas but this extends to several days when converted into PM. In this form it can travel long distances before being deposited on land by rain or snow. When deposited on land NH_3 can cause significant impacts upon sensitive habitats, such as plants and wildlife.[85]

[85] Clean Air Strategy 2019 (publishing.service.gov.uk).


Airport Support Vehicles Emissions: Ammonia (NH_3)
Ammonia (kt)
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


National Emissions: Ammonia (NH_3)
Ammonia (kt)
CLRTAP
NECR
350
300
250
200
150
100
50
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

Non-Methane Volatile Organic Carbons

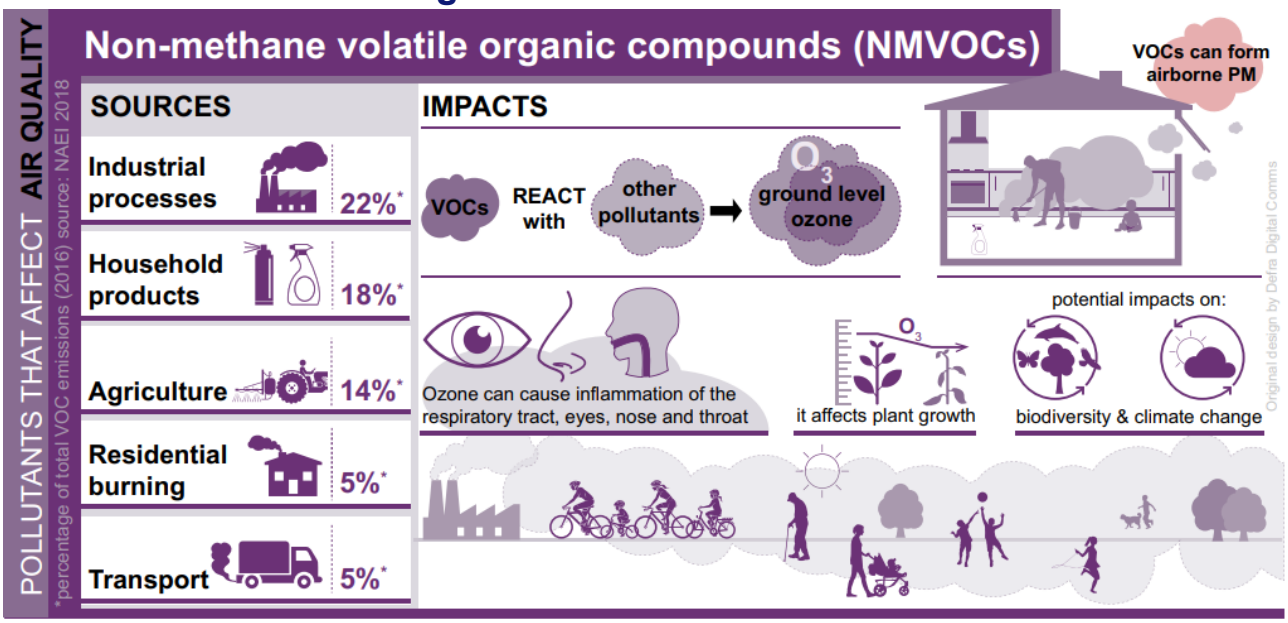


Image source: DEFRA Clean Air Strategy 2019

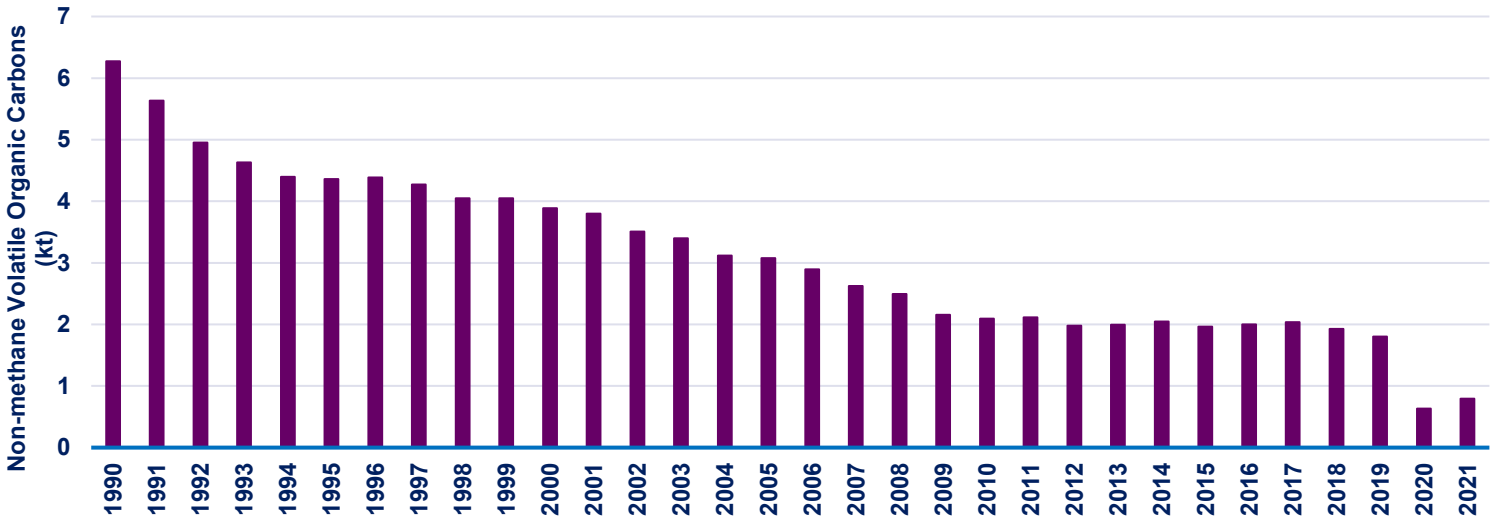
4.62 Non-methane volatile organic carbons (NMVOCs) are a large group of organic compounds which differ widely in their chemical composition but can display similar behaviours in the atmosphere. NMVOCs are emitted to the air through combustion, such as domestic burning and transport, as well as from industrial processes, household products and agriculture.

4.63 Outdoors, NMVOCs react with other air pollutants in the presence of sunlight to produce ground level ozone; however, NMVOC emissions can also form a significant component of indoor air pollution. A particularly important NMVOC is formaldehyde which can be released from furniture, building materials and kitchen cabinets. Formaldehyde can also be formed by chemical reactions between other NMVOCs present in the air and chemicals generated from combustion processes, such as smoking, heating, cooking or candle burning. At low concentrations, exposure to formaldehyde can cause irritation to the eyes and upper airways and is also classified as a human carcinogen.

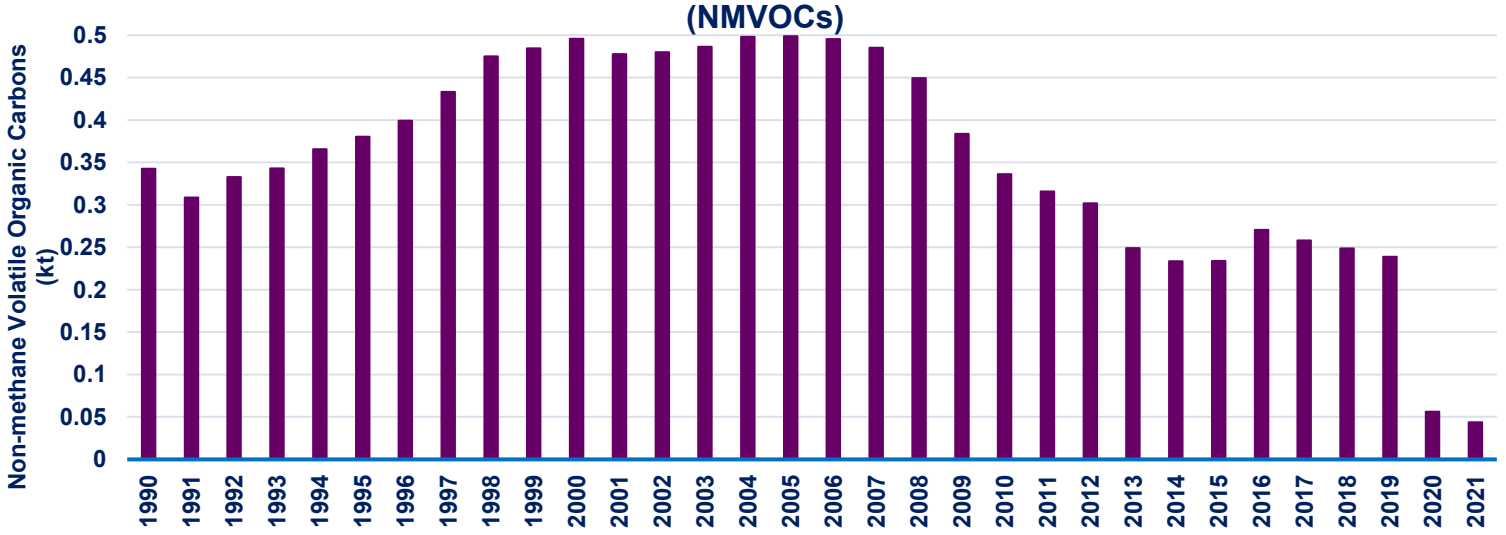
4.64 Other sources of NMVOCs include furnishings, carpets, upholstery, products for cleaning and polishing, air fresheners, and personal care products, such as fragrances, deodorants, and hair styling products.[86]

[86] Clean Air Strategy 2019 (publishing.service.gov.uk).

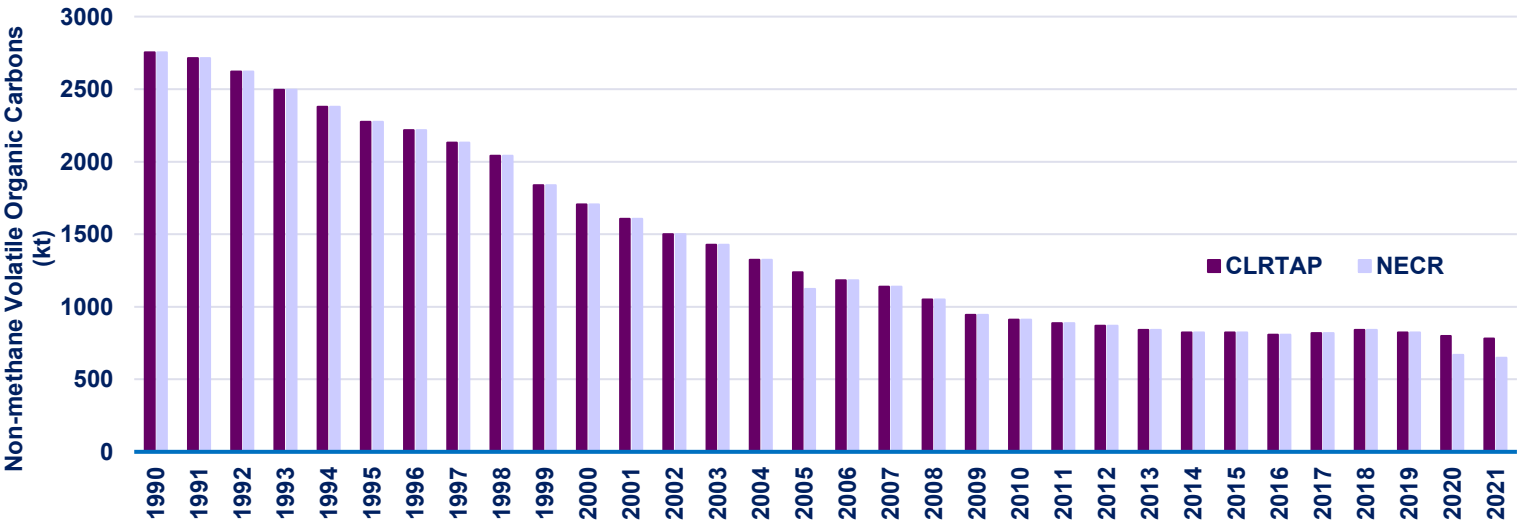
Aircraft Emissions: Non-methane Volatile Organic Carbons (NMVOCs)



Airport Support Vehicles Emissions: Non-methane Volatile Organic Carbons (NMVOCs)



National Emissions: Non-methane Volatile Organic Carbons (NMVOCs)



CHAPTER 5

Climate Change

5.1 This Chapter outlines the environmental protection measures in the UK relating to civil aviation and climate change.

5.2 Dependence upon fossil fuels has resulted in global surface temperatures rising by 1.1˚C above those recorded during the latter stages of the industrial revolution. Evidence suggests that these temperature rises, caused principally by the release of greenhouse gas emissions from human activities, have resulted in more weather and climate extremes leading to widespread impacts upon ecosystems and populations across the globe.[87]

5.3 Aviation has played a contributory role to climate change through its ongoing dependence on fossil fuels. This dependence, coupled with an upward trend in demand for air travel, continues to increase the industry's contribution to global temperature rise, potentially setting aviation to become one of the largest emitting sectors by 2050 if no action is taken.[88]

5.4 Industry recognises this threat and is proactively focusing on decarbonisation. Many airports and airlines are setting their own net zero targets through responsible management of their corporate activities. The sector is investing and introducing new operating models to improve engine efficiency, developing next generation propulsion systems and exploring the emission reduction potential of sustainable aviation fuels.

International Climate Change Measures

International Civil Aviation Organisation

5.5 As an ICAO member state, the UK has agreed to collaborate with other members to improve the level of environmental protection across many areas, one of which is climate change. ICAO is the UN body responsible for tackling international aviation's contribution to climate change through setting goals, standards and guidance. Since its 41st Assembly in 2022, ICAO now has short-, medium-, and long-term climate goals adopted in Assembly Resolution A41-21.[89] Measures to achieve these goals include its CO_2 emissions aeroplane

[87] IPCC, 2023: Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001.

[88] Sector-summary-Aviation.pdf (theccc.org.uk).

[89] Resolution A41-21: Consolidated statement of continuing ICAO policies and practices related to environmental protection — Climate change

certification standard and CORSIA, as well as extensive guidance to support member states in implementing operational efficiencies and policy to incentivise sustainable aviation fuels (SAF).

Volume III of Annex 16 to the Convention on International Civil Aviation

5.6 As the first global technology standard for CO_2 emissions for any sector, 2017 Volume III of Annex 16 to the Convention on International Civil Aviation was published with the aim of encouraging more fuel-efficient technologies in aeroplane design.

5.7 The CO_2 standard applies to subsonic jet and turboprop aeroplanes over 5,700 kg and 8,618 kg respectively that are new type designs from 2020. In addition, the CO_2 standard also applies to in-production aeroplanes from 2023 that are modified and meet specific change criteria, with a production cut-off in 2028. This means that any aircraft produced after 2028 must be built to a modified design that meets the CO_2 standard.

5.8 The CO_2 standard is based on fuel efficiency during the cruise phase of flight. In order to make the evaluation of fuel efficiency most relevant to day-to-day operations, three measurement points representing the gross mass of the aeroplane are used; high, medium and low, which are calculated as a function of maximum take-off mass. This is then applied to a metric which represents the distance travelled per unit of fuel, adjusted to represent the aeroplane size.[90]

5.9 This CO_2 standard increases the importance of fuel efficiency in the design process of an aeroplane type and positively impacts upon the industry's contribution to climate change. As explained in Chapter 2, in the UK the CAA is responsible for ensuring compliance against the CO_2 standard during the type-certification and airworthiness processes under UK Regulation (EU) No 748/2012.

Volume IV of Annex 16 to the Convention on International Civil Aviation

5.10 Volume IV of Annex 16 – Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) is a set of SARPS that, alongside extensive guidance material, form the 'CORSIA Package', a suite of ICAO documentation that requires and facilitates compliance with CORSIA. CORSIA is the world's first global market-based measure to address CO_2 emissions from any single sector. CORSIA was adopted into ICAO Assembly Resolution in 2016 and into Annex 16 in 2018. Monitoring and reporting of emissions under the scheme began in 2019 and offsetting is expected to begin in 2024, having been delayed by the COVID-19 pandemic.

5.11 Chapters 1 and 2 of Volume IV contain provisions for monitoring, reporting and verifying aeroplane operator CO_2 emissions from international flights. These are implemented into UK legislation through the Air Navigation (Carbon Offsetting

[90] Climate Change Technology Standards (icao.int).

and Reduction Scheme for International Aviation) Order 2021 (UK Statutory Instrument 2021 No. 543).[91]

5.12 Chapters 3 and 4 of Volume IV contain provisions for applying, calculating and meeting offsetting requirements under CORSIA. This includes which emissions units (offset credits) can be used and how offsetting requirements can be reduced through the use of CORSIA Eligible Fuels.

Long-term Global Aspirational Goal

5.13 At the 41st ICAO Assembly in 2022, ICAO Member States adopted a long-term global aspirational goal (LTAG) for international aviation to reach net zero carbon emissions by 2050. Adoption of the goal was underpinned by work of CAEP, which set out three scenarios for emission reductions based on technology, operations, and fuels. The scenarios range from 'high readiness/attainability and low aspiration' to 'low readiness/attainability and high aspiration'. Scenarios were analysed to understand the impacts on CO_2 emissions, costs and investments, and considered implications for aviation growth, noise, and air quality. According to the scenarios, possible CO_2 emissions reductions for 2050 could be between 39% to 87% compared to a 'frozen technology' scenario[92], with a contribution from sustainable fuels that ranges from 15% to 55%. The 'frozen technology' scenario is identical to the CAEP/12 Trends baseline scenario. This scenario is based on fleet technology frozen at 2018 and includes the benefits of fleet renewal, where airlines are make substantial investments towards the acquisition of new aircraft.[93]

5.14 At the third ICAO Conference on Aviation and Alternative Fuels in November 2023, ICAO adopted a new Global Framework for sustainable aviation fuels (SAF), lower carbon aviation fuels (LCAFs) and other aviation cleaner energies. To support the achievement of the LTAG, ICAO and its Member States agreed to 'strive to achieve a collective global aspirational vision to reduce CO_2 emissions in international aviation by 5% by 2030 through the use of SAF, LCAF and other aviation cleaner energies (compared to zero cleaner energy use)'.[94]

Intergovernmental Panel on Climate Change

5.15 The Intergovernmental Panel on Climate Change (IPCC) is a scientific body of the UN. It was created in 1988 by the World Meteorological Organization and the United Nations Environment Programme. It is the UN body for assessing the science of climate change. The IPCC provides policy makers with regular scientific assessments on climate change, its implications, and potential future

[91] https://www.legislation.gov.uk/uksi/2021/534/contents/made

[92] Technology frozen at 2018.

[93] Report on the feasibility of a long-term aspirational goal for international civil aviation CO_2 emissions reductions en.pdf (icao.int)

[94] ICAO Global Framework on Aviation Cleaner Energies_24Nov2023.pdf

risks. It also provides options for adaptation and mitigation. These reports are relevant to policy, but they are politically neutral and not prescriptive.

5.16 The UK Government fully supports the work of the IPCC. It regards the IPCC's assessments as the most authoritative view on the science of climate change. IPCC reports undergo an unparalleled, rigorous and transparent international preparation and peer-review process by scientific experts and governments before they are published. The governments of the IPCC's 195 member countries, which includes the UK, are involved in all major steps. This includes agreeing the scope of a report, nomination of experts as authors, reviewing the reports, and their final approval. IPCC assessments are highly influential. They informed the creation of the United Nations Framework Convention on Climate Change (UNFCCC), and the subsequent Kyoto Protocol. They drove the Paris Agreement's goal to limit temperature rises to well below 2°C and pursue efforts to limit the increase to 1.5°C, as well as underpinning the Glasgow Climate Pact agreed at COP26 (the 2021 United Nations Climate Change Conference) in November 2021. The 2018 IPCC Special Report on Global Warming of 1.5°C was a major influence on the UK's net zero 2050 target and led to net zero targets being set around the world.[95] As UN agencies, ICAO, IPCC and UNFCCC work closely together and ICAO contributes to the UNFCC process and Conference of the Parties (known as 'COP').

Paris Agreement

5.17 In 2015, 195 parties to the UNFCCC adopted the Paris Agreement. It is a legally binding, international treaty which entered into force in November 2016. Its overarching goal is to hold the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognising that this would significantly reduce the risks and impacts of climate change. Limiting global warming to 1.5°C or 2°C requires reducing global carbon dioxide emissions to at least net zero by around 2050 and 2070, respectively.[96]

5.18 Under the Paris Agreement, participating parties are required to submit a national climate action plan, known as a Nationally Determined Contribution (NDC). These are to be submitted every five years under Article 4 of the Paris Agreement. NDCs set targets for mitigating against greenhouse gas emissions that cause climate change and for adapting to climate impacts. NDCs conventionally exclude international aviation emissions, which are instead the responsibility of ICAO. At COP26 Parties resolved to pursue efforts to limit global temperature increase to 1.5°C and agreed to revisit and strengthen the 2030

[95] Climate change explained - GOV.UK (www.gov.uk).

[96] Climate change explained - GOV.UK (www.gov.uk).

targets in their NDCs as necessary to align with the Paris Agreement temperature goal.[97]

UK Climate Change Policy

UK: Nationally Determined Contribution

5.19 In December 2020, the UK communicated its NDC[98] to the UNFCCC in line with Article 4 of the Paris Agreement. In its NDC, the UK commits to reducing economy-wide greenhouse gas emissions by at least 68% by 2030, compared to 1990 levels. In light of COP26, the UK has revisited its NDC to ensure it is aligned with the Paris Agreement temperature goal, whilst exploring ways to strengthen it in line with best practice. This process involved analysis of a range of factors including the latest available science, expectations in the Paris Agreement and the Glasgow Climate Pact, the UK's existing 2050 net zero commitment, and energy security, as well as advice and evidence from the Climate Change Committee and other independent commentators.

5.20 The Department for Energy Security and Net Zero is responsible for the strategic oversight of the UK's international climate and energy policy, and for Government's domestic climate and energy policy. The Devolved Administrations[99] in Scotland, Wales and Northern Ireland have control over certain policy areas to deliver emissions reductions, while Government retains control over a number of other policy areas. The approach taken by each Government differs, drawing on the range of powers at their disposal.

Climate Change Act 2008

5.21 The Climate Change Act 2008[100] sets a framework for the UK to reduce greenhouse gas emissions and build capacity to adapt and strengthen resilience to climate risks.[101] The Climate Change Act 2008 originally committed the UK to cut its emissions by at least 80% below the 1990 baseline level by 2050. On 27 June 2019, this target was amended, committing the UK to a legally-binding target of net zero emissions by 2050, set on a whole-economy basis. The Climate Change Act 2008 introduced the requirement for carbon budgets for the UK, which cap emissions over successive five-year periods and must be set 12 years in advance. The first six carbon budgets cover the period from 2008-2037.

[97] United Kingdom of Great Britain and Northern Ireland's Nationally Determined Contribution (publishing.service.gov.uk).

[98] Information outlined in this section is derived from United Kingdom of Great Britain and Northern Ireland's Nationally Determined Contribution, unless referenced otherwise.

[99] The NDC also accounts for the Crown Dependencies and Overseas Territories however for the purpose of reporting under Article 87 of UK Regulation (EU) 2018/1139 these entities are not in scope of this report.

[100] Climate Change Act 2008 (legislation.gov.uk).

[101] Further information regarding climate change adaptation is detailed in Chapter 6 of this report.

5.22 The Climate Change Act 2008 also established the Climate Change Committee[102] (CCC) – the independent statutory body that advises Government and Devolved Administrations on climate change mitigation and adaptation, including emissions reduction targets. When providing advice, the CCC considers a wide range of factors including the UK's international obligations under the Paris Agreement and the UNFCCC.

5.23 In the UK, some policy areas important to climate policy are devolved (for example, agriculture and forestry, environment, and housing), while others (for example, aviation, energy supply and trade) remain reserved to Government. The Devolved Administrations in Scotland, Wales and Northern Ireland have their own climate framework laws and statutory emissions reduction targets. Government and the Devolved Administrations have established governance arrangements at ministerial and official level to co-ordinate the approach to meeting net zero. The climate change policy for each of the Devolved Administrations is as follows:

Scotland

5.24 Scotland has its own distinct framework of statutory climate change targets, set under the Climate Change (Scotland) Act 2009[103] and amended by the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019.[104] This legislation includes targets for Scotland to reach net zero greenhouse gas emissions by 2045, and interim targets of 75% and 90% reductions in emissions by 2030 and 2040 respectively, relative to a 1990-95 baseline. To help ensure delivery of the long-term targets, the Scottish framework also includes statutory annual targets for every year to net zero.

Wales

5.25 Emissions targets in Wales are set through the Environment (Wales) Act 2016.[105] In March 2021, the Senedd increased its ambition and formally committed Wales to achieving net zero emissions by 2050. Alongside the net zero target, the Environment (Wales) Act 2016 was updated to reflect the revised interim targets and the second and third carbon budgets, which are now set as:

- Carbon Budget 2 (2021-25): 37% average reduction (without the use of international offsets);
- Carbon Budget 3 (2026-30): 58% average reduction;
- 2030: 63% reduction • 2040: 89% reduction; and
- 2050: at least 100% reduction (net zero).

[102] Climate Change Committee (theccc.org.uk).

[103] Climate Change (Scotland) Act 2009 (legislation.gov.uk).

[104] Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 (legislation.gov.uk).

[105] Environment (Wales) Act 2016 (legislation.gov.uk).

Northern Ireland

5.26 The Climate Change Act (Northern Ireland) 2022[106] provides a basis for setting targets for the reduction of emissions in Northern Ireland. It includes a target of 100% reduction in emissions by 2050, against the 1990-95 baseline.

UK Net Zero Strategy

5.27 The UK's Net Zero Strategy,[107] published in 2021, sets out how the UK will deliver its Carbon Budgets 4, 5 and 6, the NDC, and how the UK will keep on track to achieve net zero greenhouse gas emissions by 2050. It includes policies and proposals to reduce emissions for each sector of the economy, and cross-cutting action to support the transition to net zero by 2050.

5.28 Underpinning the Net Zero Strategy, the UK has also published a range of sectoral strategies which support delivery of the NDC by 2030. One of these strategies, the Transport Decarbonisation Plan,[108] sets out the Government's plan to accelerating aviation decarbonisation and achieving net zero by 2050. This commitment is underpinned by the Government's 2022 Jet Zero Strategy,[109] which sets out the steps Government will take to reach net zero aviation emissions by 2050. Further information regarding the Jet Zero Strategy is presented in Chapter 6.

5.29 Each Devolved Administration has also published a plan outlining how it will reach net zero emissions under their respective legislation, as detailed in above. These plans are as follows:

Scotland

5.30 Under Scotland's statutory framework, a Climate Change Plan setting out policies and proposals to meet the emissions reduction targets, must be published at least every five years and prepared with reference to a set of statutory Just Transition and Climate Justice principles. In March 2021, the Scottish Government updated its Climate Change Plan[110] (which should be read alongside the original 2018 Plan),[111] setting out over 200 policies and proposals to cut greenhouse gas emissions across all sectors of the Scottish economy over the period to 2032. The updated Plan reflects the increase in target ambition from the Climate Change (Emissions Reductions Targets) (Scotland) Act 2019, in response to the global goals of the Paris Agreement. With respect to aviation,

[106] Climate Change Act (Northern Ireland) 2022 (legislation.gov.uk).

[107] Net Zero Strategy: Build Back Greener (publishing.service.gov.uk).

[108] Decarbonising Transport – A Better, Greener Britain (publishing.service.gov.uk).

[109] Jet Zero strategy: delivering net zero aviation by 2050 - GOV.UK (www.gov.uk).

[110] Securing a green recovery on a path to net zero: climate change plan 2018–2032 - update - gov.scot (www.gov.scot).

[111] Climate Change Plan: third report on proposals and policies 2018-2032 (RPP3) - gov.scot (www.gov.scot).

Scotland's policies include an aim to decarbonise scheduled flights within Scotland by 2040.

Wales

5.31 Under the Environment (Wales) Act 2016, each new administration is required to set out a plan containing policies and proposals to meet the carbon budget. The Welsh Government published Net Zero Wales,[112] in October 2021, covering Wales's second carbon budget period 2021–25. It contains 123 policies and proposals across all ministerial portfolios and looks beyond to start building the foundations for Wales's third carbon budget and 2030 target, as well as net zero by 2050. The plan focuses on the need to 'outperform' this second carbon budget of 37% average reduction in emissions, in line with the CCC's recommendation. This is because Wales' third carbon budget (2026–30) requires an average reduction of 58%, reflecting the huge step change Wales needs to make if its actions are to have enough time to take effect.

Northern Ireland

5.32 In October 2021, DEFRA launched a public consultation on a Green Growth Strategy for Northern Ireland.[113] The Green Growth Strategy is the Northern Ireland Executive's multi-decade strategy, balancing climate, environment and the economy in Northern Ireland. It sets out the long-term vision for tackling the climate crisis and is underpinned by the provisions of the Climate Change Act (Northern Ireland) 2022 with which it closely aligns. This longer-term Strategy will be delivered through a series of Climate Action Plans aligned to carbon budget periods, the first of which is to be developed by the end of 2023 and which will set out a series of policies and proposals to achieve the first carbon budget for the period 2023-2027. The Green Growth Strategy is currently awaiting sign off by the Northern Ireland Executive. Additionally, The Path to Net Zero[114] is Northern Ireland's current energy strategy and sets a long-term vision of net zero carbon and affordable energy for Northern Ireland by 2050.

CAA Regulatory Responsibilities

Aircraft CO_2 Emissions Certification

5.33 Article 9(2) of UK Regulation (EU) 2018/1139 brings into UK law the requirement for aircraft and their engines, propellers, parts, and non-installed equipment, to comply with, where applicable, the environmental protection requirements of Volume III of Annex 16 to the Convention on International Civil Aviation. This is

[112] Net Zero Wales | GOV.WALES.

[113] Consultation on the draft Green Growth Strategy for Northern Ireland | Department of Agriculture, Environment and Rural Affairs (daera-ni.gov.uk).

[114] Energy Strategy - Path to Net Zero Energy | Department for the Economy (economy-ni.gov.uk).

further ratified in UK Regulation (EU) No 748/2012, whereby the responsibility for ensuring compliance against the aforementioned environmental protection requirements for the issuance of a type-certificate,[115] and airworthiness certificate,[116] sits with the CAA. Further information regarding the specific certification Standards for Volume III of Annex 16 is detailed above

Airspace Change

5.34 The Transport Act 2000 and the Civil Aviation Authority (Air Navigation) Directions 2023 made underneath that Act establish the CAA as the UK airspace regulator responsible for making decisions related to changing the design of UK airspace. Section 70 of the Transport Act 2000 states that after maintaining a high standard of safety in the provision of air traffic services, the CAA must take account of any guidance on environmental objectives given to the CAA by the Secretary of State after the coming into force of this section when exercising its air navigation functions such as deciding on whether to approve changes to the design of UK airspace (among other factors). This guidance is issued under the Air Navigation Guidance 2017 which sets out the Government's key environmental objectives with respect to air navigation, and greenhouse gas emissions and climate change considerations form part of this. See Chapter 2 for further information regarding the CAA's duties with respect to its air navigation functions.

5.35 Consideration and assessment of the potential environmental impacts resulting from an airspace change proposal including greenhouse gas emissions is a necessary part of the CAA's decision making process, and also enables those who are affected by the proposed airspace change to better understand the impacts of the different design options being considered. In order to achieve this, the CAA requires change sponsors to provide an environmental assessment that evolves through the various stages of the airspace change process.

5.36 While developing and assessing the environmental impacts of airspace change design options, change sponsors must take into account the Air Navigation Guidance 2017, including the Government's environmental objectives and priorities as set out in that guidance.

UK Aviation Greenhouse Gas Emissions

5.37 This section outlines the latest greenhouse emissions estimates for the UK aviation industry. The data is published by the UK Government[117] and is used in international reporting tables which are submitted to the UNFCCC each year. The aviation greenhouse gas emissions accounted for within this data include carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), reported as

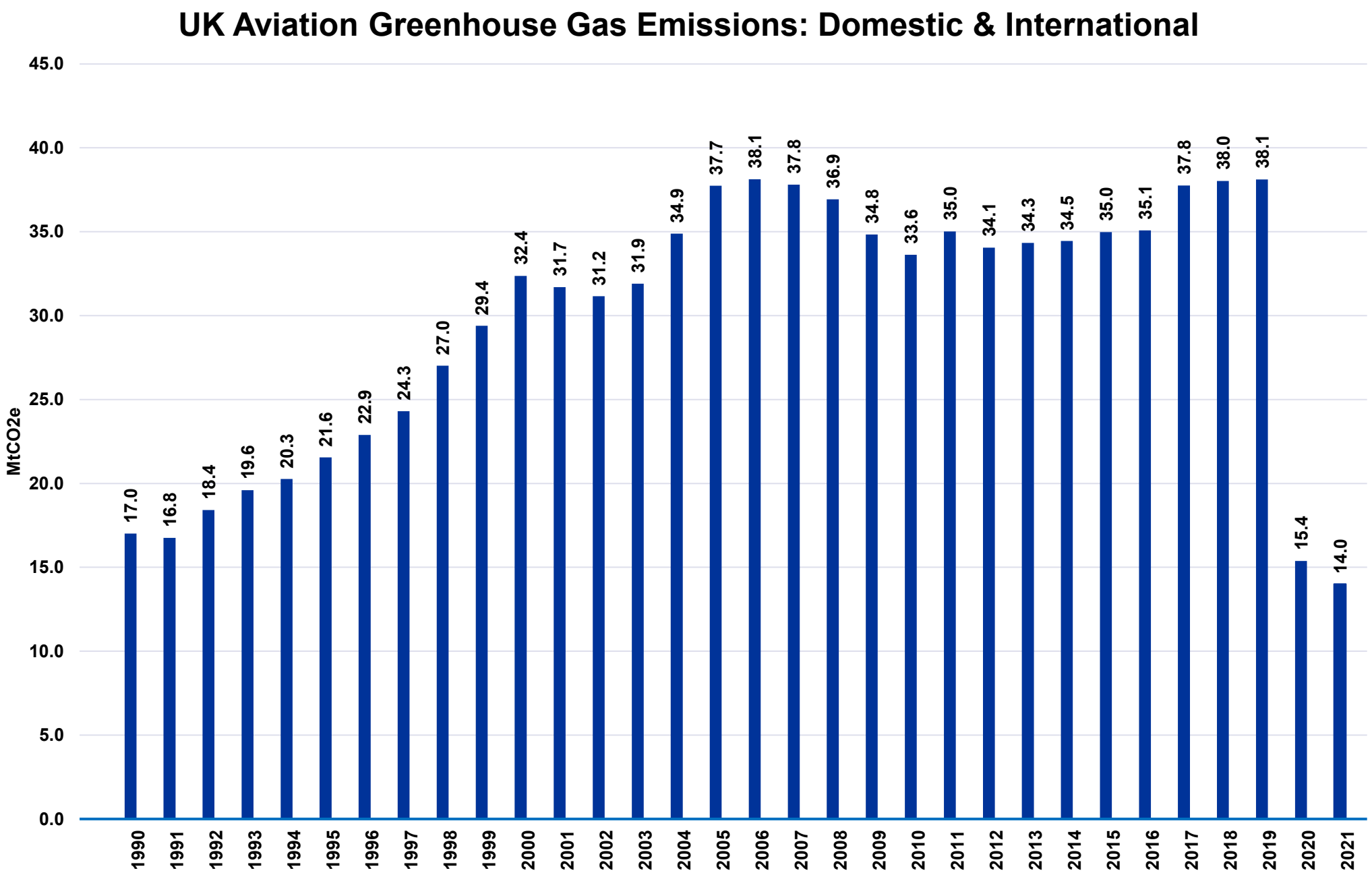
[115] Regulation (EU) No 748/2012 Annex I point 21.B.85.

[116] Regulation (EU) No 748/2012 Annex I point 21.A.173.

[117] final-greenhouse-gas-emissions-tables-2021.xlsx (live.com).

carbon dioxide equivalent (CO_2e).[118] The data presented in this section accounts for domestic flights within the UK and international flights departing the UK, in accordance with UNFCCC rules on the allocation of aviation greenhouse gas emissions to States.

[118]Metric measure used to compare various greenhouse gas emissions based on their global warming potential.


UK Aviation Greenhouse Gas Emissions: Domestic & International
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CHAPTER 6

The Future of Aviation: Environmental Protection

6.1 This Chapter sets out the changes currently underway within the aviation industry to enhance environmental protection. This includes outlining the strategies and roadmaps to achieving goals set by Government and industry, and the CAA's role in enabling safe and sustainable future flight.

6.2 There are currently two main measures under consideration to reduce aviation's carbon emissions:

1. Sustainable aviation fuels (SAF) - non-fossil based fuels which generate lower life cycle carbon dioxide emissions than conventional jet fuel.
2. Zero emission flight (ZEF) - flight by an aircraft that results in no carbon emissions at the engine exhaust. The industry is currently seeking to achieve ZEF through both small battery electric aircraft, already in use in the UK general aviation sector, and hydrogen, which is in the early stages of development globally for commercial aviation.

Jet Zero Council

6.3 Formed in 2020, the Jet Zero Council[119] (JZC) is a partnership between industry and Government that brings together senior leaders in aviation, aerospace, and academia to drive the development of new technologies and innovative ways to cut aviation emissions. The JZC will advise the Government on what is needed to drive forward its aims to deliver at least 10% SAF in the UK fuel mix by 2030 and zero emission transatlantic flight within a generation. This will be achieved by developing and industrialising zero emission aviation and aerospace technologies, establishing UK production facilities for SAF and commercialising the industry by driving down production costs, as well as developing a co-ordinated approach to the policy and regulatory framework needed to deliver net zero aviation by 2050.

6.4 The objectives of the JZC are to:

- Provide ministerial and senior industry leadership on efforts to deliver UK capabilities for net zero aviation.
- Identify and optimise the strategic, economic and international benefits of developing these industries in the UK and overcome the barriers industry face in achieving these goals.

[119] Information outlined in this section is derived from: Jet Zero Council – GOV.UK (www.gov.uk) unless referenced otherwise.

- Accelerate the design, manufacture, testing, certification, infrastructure and commercial operation of zero emission aircraft and aviation systems in the UK through sustained investment in applied research and development and fostering greater collaboration across sectors.
- Accelerate the delivery of SAF by supporting the investment in first-of-a-kind SAF plants, supporting research and development of new pathways, and driving down production costs through upscaling and innovation.
- Support grassroots innovation in these areas and make the UK the best place in the world to develop new aviation technology. Challenge existing approaches by involving disruptors and innovators in the dialogue.

6.5 The scope of the JZC is to advise on efforts to deliver net zero and zero emission aviation through UK production of ZEF and SAF, recognising the role of all current and future forms of commercial aviation in the technology pathway. Wider decarbonisation levers will be delivered through the Jet Zero Strategy, outlined in further detail in this section below.

Jet Zero Council Delivery Groups

6.6 To accelerate progress on the objectives of the JZC, Government has established focused delivery groups. The current JZC delivery groups are as follows:

Sustainable Aviation Fuels Delivery Group

6.7 The SAF Delivery Group[120] provides advice on how Government and industry can work together to develop UK production facilities and accelerate the delivery of SAF to market. Currently, it focuses on three areas:

- Development of a SAF mandate;
- Commercialisation of SAF; and
- Technologies and feedstocks required for SAF production.

6.8 The SAF Delivery Group supports the overall objective and purpose of the JZC by convening a wide range of experts to inform decision making and providing advice on how Government and industry can work together to deliver the UK's SAF commitments. These commitments include having at least 10% SAF in the UK jet fuel mix by 2030, and to see at least five commercial-scale SAF plants under construction in the UK by 2025.

[120] Jet Zero Council: Sustainable Aviation Fuels Delivery Group terms of reference - GOV.UK (www.gov.uk).

Zero Emission Flight Delivery Group

6.9 The purpose of the ZEF Delivery Group[121] is to put the UK in a leading position in the race to achieve ZEF, supporting the JZC to deliver on its objectives. To make this happen, the ZEF Delivery Group focuses on the following key areas:

- Development of zero carbon emission (ZCE) aircraft technologies;
- Infrastructure at airports and aerodromes to facilitate ZCE aircraft; and
- Regulations required to safely operate those aircraft and infrastructure.

6.10 The scope of the group is to provide a clear focus but is not designed to inhibit working with related sectors and Government or industry initiatives. The priorities of the ZEF Delivery Group are to focus on those areas which will have the greatest impact on zero emission aviation and UK growth.

6.11 The ZEF Delivery Group and SAF Delivery Group are also working on a number of joint workstreams which include international coordination, addressing non-CO_2, and increasing awareness.

Jet Zero Strategy

6.12 If aviation continues to grow at current rates the sector is expected to become one of the largest emitting sectors of greenhouse gas emissions by 2050. To mitigate against this, in July 2022 the UK Government launched the Jet Zero Strategy[122] which outlines the government's approach to delivering net zero aviation by 2050. It is known that decarbonising the aviation sector will not be an easy task and to enable delivery of the Jet Zero Strategy, Government is focusing on two key aspects:

- A strategic framework for delivery; and
- A trajectory against which progress can be measured.

Strategic Framework for Delivery

6.13 The first aspect relates to outlining a strategic framework for delivery which consists of three guiding principles, and six core policy measures. The guiding principles will frame the Government's approach to delivery of the Jet Zero Strategy, as follows:

- Taking an international leadership role;
- Delivered in partnership with stakeholders; and
- Maximising opportunities that transitioning to net zero will bring.

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[121] Jet Zero Council: Zero Emission Flight Delivery Group terms of reference - GOV.UK (www.gov.uk).

[122] Information outlined in this section is derived from: Jet Zero Strategy: jet-zero-strategy.pdf (publishing.service.gov.uk) unless referenced otherwise.

6.14 The six core policy measures are the key levers Government hold to reduce the climate impacts of aviation, both CO_2 and any non-CO_2 impacts. These measures include:

- increasing system efficiencies;
- SAF;
- ZEF;
- markets and removals;
- influencing consumers; and
- addressing non-CO_2 impacts.

2050 Trajectory

6.15 The second aspect relates to setting out an ambitious pathway to achieving net zero, which would result in emissions reducing over the short and longer term. Government is committed to achieving the 'High Ambition Scenario' which sees aviation emissions peak in 2019 at 38.2 $MtCO_2e$. In addition, Government has set in-sector interim targets out to 2050 in order to provide clear messaging on the need for progress from the sector, as well as providing clarity on the greenhouse gas removal (GGR) capacity required to meet net zero.[123]

6.16 In July 2023 the DfT published the Jet Zero Strategy One Year On which updated the High Ambition Scenario to reflect the latest macroeconomic conditions, including updating inputs on oil prices, gross domestic product and consumption growth, and foreign exchange rates. This resulted in less residual emissions compared to the amount reported in the original Jet Zero Strategy analysis.[124]

Policy Measures

6.17 In order to achieve the Jet Zero Strategy emissions reductions targets, the DfT has set policy focus areas across six core measures. The following section outlines each of the policy areas, including their strategic objectives and anticipated emissions reductions:

System Efficiencies

6.18 Improving system efficiency remains one of the key foundations of enabling the Jet Zero Strategy. System efficiencies are an important area for emissions reduction in themselves, and they also provide a more efficient environment in which future fuels and technologies are enabled and most efficiently used. However, whilst these future technologies are being developed there are

[123] Further detail regarding the assumptions behind the emissions reductions scenarios and in-sector interim targets can be viewed here: Jet Zero strategy: delivering net zero aviation by 2050 - GOV.UK (www.gov.uk).

[124] Jet Zero Strategy: one year on (publishing.service.gov.uk).

opportunities readily available today to reduce emissions. The areas in which efficiencies can be realised include airports, airspace and aircraft, and the sections below set out the policy objectives Government have committed to for each.

Airports

6.19 Airport operations are one of the areas where decarbonisation solutions are already being implemented, with more solutions being developed in the short to medium-term. This provides an opportunity for industry to showcase its commitment to achieving Jet Zero by accelerating the rollout of existing zero emissions solutions.

6.20 Many airports are already reporting their greenhouse gas emissions through the Airport Carbon Accreditation (ACA) scheme which was established by the Airports Council International in 2009. The ACA scheme is voluntary and is open to airports of all sizes, including general aviation and freight focused airports. There are six different levels of accreditation associated with the scheme and each level builds on the previous.

6.21 A total of 25 UK airports participate in the ACA scheme; 19 in England, four in Scotland and two in Northern Ireland. 12 of these airports are accredited at the Neutrality level or above.[125]

6.22 The Jet Zero Strategy includes the DfT's target for all airport ground operations in England to be zero emission by 2040 and in February 2023 the DfT published a call for evidence to seek views on how this could be achieved.[126]

Airspace

6.23 Government is supporting airspace modernisation efforts which aim to deliver quicker, quieter, and cleaner journeys and more capacity for those who use and are affected by UK airspace. Under the Civil Aviation Authority (Air Navigation) Directions 2023,[127] the Secretary of State has given the CAA the function to maintain and keep under review the Airspace Modernisation Strategy (AMS) and to consult the Secretary of State in relation to that AMS, including any current or future implementation plans associated with it. The CAA must also report to the Secretary of State annually on the delivery of the AMS.

6.24 The CAA published the AMS in December 2018, initially focusing on the period to 2024, replacing the Future Airspace Strategy. In 2023, a refreshed AMS was published which extended the focus of the AMS from 2024 out to 2040.[128] The AMS lays out the overall vision for airspace modernisation by setting out the ends (strategic objectives), ways (delivery elements) and means (delivery plans)

[125] Full list of participating airports can be found at: Airports & CO2 (airportcarbonaccreditation.org)

[126] 2040 zero emissions airport target - GOV.UK (www.gov.uk).

[127] The Civil Aviation Authority (Air Navigation) Directions 2023 (caa.co.uk).

[128] About the strategy | Civil Aviation Authority (caa.co.uk).

of modernising airspace. It is underpinned by four strategic objectives (or 'ends') to be achieved from airspace modernisation, one of which relates to environmental sustainability as an overarching principle applied through all airspace modernisation activities. Airspace modernisation should deliver the Government's key environmental objectives with respect to air navigation as set out in the Government's Air Navigation Guidance[129] and, in doing so, will take account of the interests of all stakeholders affected by the use of airspace.

6.25 The Government is supporting the CAA, together with the Airspace Change Organising Group, to ensure greenhouse gas emissions savings are realised as part of the wholescale changes to UK airspace through the AMS, and that these plans account for the introduction of zero emission aircraft. These structural changes are being undertaken as part of the Airspace Change Masterplan[130] which is a current implementation plan associated with the AMS. The purpose of the masterplan is to set out a single coordinated implementation plan for airspace changes in the UK up to 2040 to upgrade the UK's airspace and deliver the objectives of airspace modernisation at a strategic level, including unlocking environmental improvements and efficiencies.

Aircraft

6.26 The Jet Zero Strategy outlines a number of measures with regards to aircraft. These include consideration of whether a mechanism, either voluntary or mandatory, is required to avoid tankering where there is no practical reason to carry additional fuel.[131] It also sets out to ensure that the maximum potential is made for all flights, in addition to seeking further understanding and transparency on ghost flights so that unnecessary emissions can be avoided.

6.27 Government has committed to work with the Aerospace Technology Institute, industry and academia to establish a method for quantifying the potential emissions savings of future research and development projects for aircraft technology developments, so that the sustainability benefits for the aviation sector can be assessed, and funding of projects most likely to deliver clean growth can be prioritised.

6.28 Work through ICAO also forms part of the measures which aims to improve global fuel efficiency, through more stringent CO_2 certification standards, the setting of technology goals and guidance to states on implementing operational efficiencies.

Sustainable Aviation Fuels

6.29 The Government's strategic policy objectives in relation to SAF are to:

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[129] Air navigation guidance 2017 (publishing.service.gov.uk).

[130] Airspace Masterplan - Airspace Change Organising Group (ACOG).

[131] Tankering is a practice where aircraft uplift excess fuel at the origin airport so that little to no fuel is required at the destination airport for the next onward flight.

- Have a SAF mandate in place by 2025. The UK Government has proposed a SAF mandate to reduce emissions from the UK aviation fuel mix by the equivalent of at least 10% SAF use by 2030 and to support SAF investments within the UK. Full details of the SAF mandate, including the trajectories for SAF uptake in the UK to 2030 and beyond will be published in the Government response to the second SAF mandate consultation in due course.
- Work with the private sector to build a thriving domestic SAF industry, with a commitment to have at least five commercial-scale UK plants under construction by 2025. In support of this, the Government has made £135 million Advanced Fuels Fund (AFF) available to support the development of commercial scale SAF plants within the UK. The AFF has funded 13 UK SAF projects and once operational, these projects are expected to collectively produce over 700 kilo tonnes of SAF and reduce CO_2 emissions by 2.7 million tonnes each year. This competition drives the Government's ambition to see at least five commercial-scale SAF plants under construction in the UK by 2025.
- Work in partnership with industry and investors to build long term SAF supply. This work will include gathering a better understanding of the possible market failures and how any potential interventions, by industry or Government, should be targeted. The government has committed to design and implement a revenue certainty mechanism to support a UK SAF industry as soon as possible. The mechanism will provide revenue certainty for SAF products, supporting investor confidence in SAF projects by providing greater certainty on potential returns on investment.
- To establish a UK SAF Clearing House to support testing and qualification of new advanced fuels for aviation. The Clearing House will act as a central hub to co-ordinate testing and approvals of SAF, helping to remove barriers to new fuels coming to market. The UK SAF Clearing House was launched in November 2023, alongside an offer of £5.35 million of grant funding to support testing costs for eligible fuels.

Zero Emission Flight

6.30 The FlyZero project was an independent, government-funded initiative designed to assess the feasibility of ZEF.[132] The work confirmed the viability of using liquid hydrogen as an aviation fuel in long-haul flight, although it stressed the need for further research, particularly on the requirement to produce low carbon hydrogen at scale and to establish suitable ground infrastructure at airports, to handle these different types of fuel.

6.31 The Government's strategic policy objectives in relation to ZEF are as follows:

[132] The ATI's FlyZero project

- Grow UK share of the global aerospace manufacturing market as new forms of aircraft emerge.
- Facilitate collaboration between aviation, other transport modes and sectors of the economy on the adoption of hydrogen.
- Ensure parallel development of aircraft with the energy and ground infrastructure required for their operation.
- Ensure the aviation sector workforce is prepared for the introduction of new aircraft.
- Stimulate future innovation by promoting diversity and accessibility in the sector.
- Put in place the policy and regulatory system to enable zero emission aircraft to enter commercial service and deliver (the government's) aspiration of zero emission routes connecting different parts of the UK by 2030.

Markets and Removals

6.32 Successful carbon markets and investment in GGR technologies are vital for the aviation sector to meet the UK's net zero target. Carbon markets, where airline operators can obtain and surrender carbon allowances, are now well established and also have the potential to facilitate investment in GGR technologies through enabling the integration of negative emissions. Carbon markets can provide a mechanism for decarbonisation to occur where it is most cost-effective to do so and provide a useful price signal for investors. This will be especially beneficial for the aviation sector and other hard-to-abate sectors that are likely to have emissions by 2050.

6.33 The Jet Zero Strategy acknowledges, however, that there are also challenges in deploying and scaling up GGR technologies as well as building industry-wide support for their use. An international approach to carbon markets, for example by working through organisations such as ICAO, is required to help maximise value for money, maintain competitiveness and attract investment. The Government is committed to showing leadership in setting standards and targets to reduce carbon emissions but will engage purposefully with the aviation sector to ensure that targets and standards established by a markets and removals framework are achievable and properly costed. The Government's strategic policy objectives in relation to Markets and Removals include:

- Developing carbon markets that set a sustainable pathway towards decarbonisation and cover all aviation emissions.
- Continuing to explore options to develop robust negative emissions markets as mechanisms to allow hard-to-abate sectors such as aviation to balance residual emissions.

6.34 In support of these policy objectives, Government aims to have all legislation for ICAO's CORSIA in place in 2024. It will enforce the scheme robustly and encourage other states to do the same. Government will also enhance the effectiveness of the UK Emission Trading Scheme (UK ETS), in collaboration with the Devolved Administrations through the UK ETS Authority and is committed to maintaining the integrity of the UK ETS for aviation in supporting decarbonisation activities. CORSIA and the UK ETS are further explained below.

Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)

6.35 As detailed in Chapter 5, ICAO has developed a global framework, known as CORSIA.[133] For the first two phases Member State participation in CORSIA is voluntary and from 2027 onwards participation is mandatory, meaning all international flights will be subject to offsetting requirements, with some exemptions.[134] The monitoring, reporting and verification requirements of CORSIA are implemented into UK law through the Air Navigation (Carbon Offsetting and Reduction Scheme for International Aviation) Order 2021 (UK Statutory Instrument 2021 No. 543).[135]

Figure 6.1: CORSIA Emissions Baseline

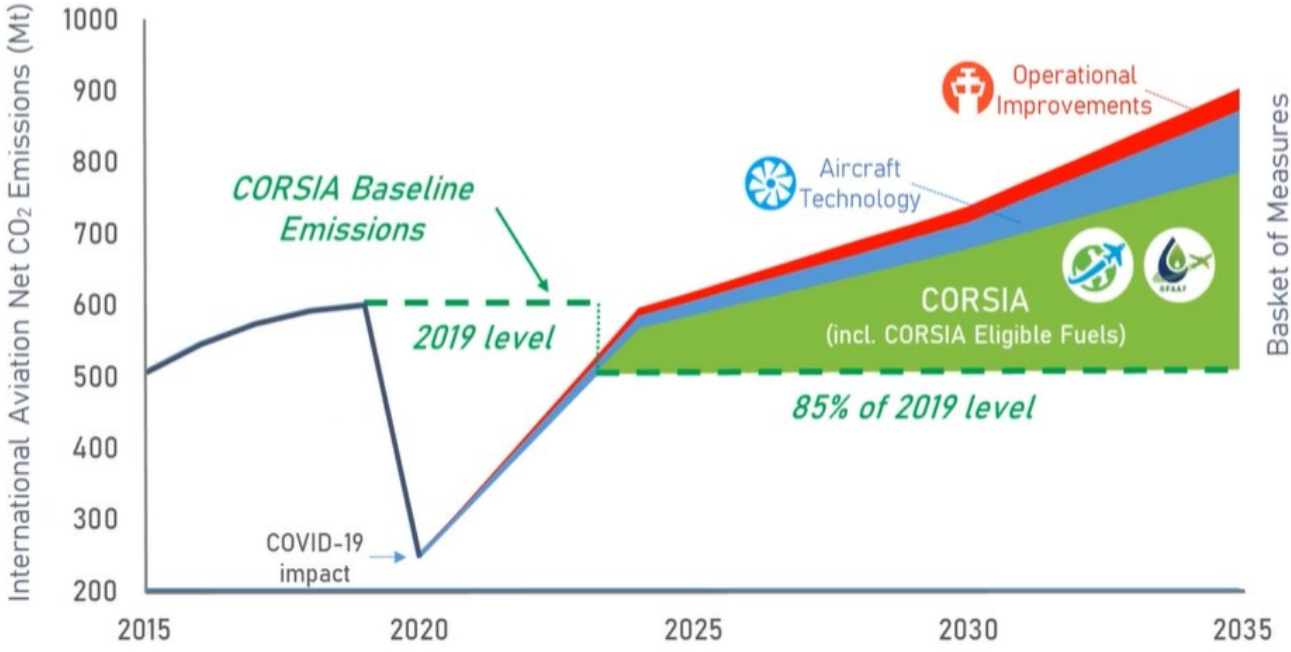

Image source: ICAO

UK Emissions Trading Scheme

6.36 From 1 January 2021, the UK Emissions Trading Scheme (UK ETS) replaced the UK's participation in the European Union Emissions Trading Scheme (EU

[133] Volume IV of Annex 16 to the Convention on International Civil Aviation
[134] See Volume IV of Annex 16 to the Convention on International Civil Aviation for exemptions.
[135] https://www.legislation.gov.uk/uksi/2021/534/contents/made

ETS).[136] The UK ETS uses a system of emissions allowances with each allowance being equivalent to one tonne of CO_2. This means that one UK ETS allowance allows an aircraft operator to emit one tonne of CO_2. The UK ETS for aviation applies to an aircraft operator that performs aviation activity above certain thresholds.

6.37 In the aviation policy sphere, the SAF mandate will sit alongside the UK ETS. Where use of SAF is reported on the UK ETS, it is zero rated and aircraft operators can claim a corresponding reduction in their UK ETS obligations. This is intended to help bridge the cost differential between SAF and conventional aviation fuel as the industry develops.

Influencing consumers

6.38 In its 2019 'Net Zero: the UK's contribution to stopping global warming' report, the Committee for Climate Change indicated that 67% of all measures, across all sectors, that would be required to meet the 2050 net zero target would need an element of behavioural change.[137] Aviation is no different, which is why one of the strategic policy focuses is influencing consumers to make more sustainable travel choices when flying and, as a consequence, encourage industry to decarbonise more quickly.

6.39 There is evidence that shows the public is concerned about climate change, including the CAA's Aviation Consumers Survey[138] and the DfT's public attitudes tracker,[139] with an increasing percentage of respondents agreeing or strongly agreeing that they would pay more for flight tickets to reduce the environmental impact of flying.

6.40 Industry is responding to these changes in the public's sentiment towards aviation and the environment. In the past three years there have been many organisations providing consumers with information about the carbon footprint of their flight at the point of searching and booking. However, there is no standard methodology for calculating this information. Several organisations internationally are starting to work together to align on a shared framework to collect, calculate and display flight emissions data.

6.41 The CAA published a Call for Evidence in January 2023 to gather stakeholder views on how this carbon footprint information should be calculated and how it should be presented.[140] Further research has also been commissioned by the DfT from the Behavioural Insights Team[141] and TRL[142] to explore what the

[136] The Greenhouse Gas Emissions Trading Scheme Order 2020 (legislation.gov.uk).

[137] Net Zero - The UK's contribution to stopping global warming - Climate Change Committee (theccc.org.uk).

[138] UK Aviation Consumer Survey | Civil Aviation Authority (caa.co.uk).

[139] Transport and transport technology: public attitudes tracker - GOV.UK (www.gov.uk).

[140] Consumer Environmental Information: Call for Evidence

[141] Who we are | The Behavioural Insights Team (bi.team).

[142] TRL | About Us.

information could look like, in order to be useful, easily comprehensible and visually engaging for consumers and thus contribute to encouraging more sustainable flight choices.

6.42 The outcome of the Call for Evidence, the research and a consultation on the CAA's proposed approach will be published in 2024.

Surface access

6.43 The flight is only one part of an aviation passenger's journey, so the right policies need to be in place to encourage passengers and employees to travel on sustainable modes of transport, to and from the airport, where possible. The DfT has committed to work with airports, other Government departments, local authorities and other interested bodies to improve surface access and consider how integrated service offerings can be developed with surface transport providers.

Airport capacity

6.44 One of the strategic objectives of the Jet Zero Strategy is to support growth in airport capacity where it is justified. However, an increase in airport capacity has potential to offset environmental benefits realised by advancements in aircraft technologies, airspace modernisation and other initiatives. This is acknowledged by Government.

6.45 In June 2018, the Airports National Policy Statement[143] set a need for increased airport capacity in the southeast of England by 2030. It set out the Government's preferred scheme to achieve this, a new northwest runway at Heathrow Airport, but was subject to legal challenge which was ultimately unsuccessful before he Supreme Court in 2020. Following a number of requests to review the policy statement, the Secretary of State confirmed in an open letter on 6 September 2021 that it was not appropriate to review it at that time. The Secretary of State set out that the question of whether or not to review the policy statement should be considered again once the Government's Jet Zero Strategy had been finalised, and that the timing of any re-consideration would need to have regard to the availability of long-term aviation demand forecasts.[144]

6.46 In June 2018 the Government also set out its approach to capacity at other airports in its 'Making best use of existing runways' policy, where it confirmed that it is supportive of airports beyond Heathrow making best use of their existing runways as long as they address the economic and environmental impacts and proposed mitigations.[145]

[143] Airports National Policy Statement - GOV.UK (www.gov.uk)

[144] Airports National Policy Statement: response to review requests - GOV.UK (www.gov.uk)

[145] Aviation strategy: making best use of existing runways - GOV.UK (www.gov.uk)

6.47 In December 2018, the Government published Aviation 2050, a Green Paper consulting on how it saw sustainable growth being delivered.[146] In May 2022, in the context of the unprecedented impacts that the COVID-19 pandemic had on the aviation sector, the DfT published Flightpath to the Future, a medium-term strategic framework for the sector in support of its vision for a modern, innovative and efficient sector over the following 10-years.[147]

6.48 In respect of airport capacity, Flightpath for the Future reiterates the Government's position that 'airport expansion has a key role to play in realising benefits for the UK through boosting our global connectivity and levelling up. We continue to be supportive of airport growth where it is justified, and our existing policy frameworks for airport planning provide a robust and balanced framework for airports to grow sustainably within our strict environmental criteria. They continue to have full effect, as a material consideration in decision-taking on applications for planning permission. The Government is clear that the expansion of any airport must meet its climate change obligations to be able to proceed.'[148]

6.49 In October 2021, alongside its Net Zero Strategy[149], the Government published its response to the report by the CCC 'Progress in Reducing Emissions'.[150] The CCC had recommended that the Government assess its airport capacity strategy in the context of Net Zero and any lasting impacts on demand from COVID-19, as part of the aviation strategy. The CCC had also recommended that there should be no net expansion of UK airport capacity unless the sector was on track to sufficiently outperform its net emissions trajectory and could accommodate the additional demand.

6.50 The Government's response stated that flying is a social and economic good, and one that it wholeheartedly supported as a key part of building a global Britain. The Government went on to say that it currently believed that the aviation sector, even if returning to a pre-COVID-19 demand trajectory, could achieve Jet Zero without the Government needing to intervene directly to limit aviation growth. DfT analysis for the Jet Zero Strategy showed that there are scenarios where net zero targets can be achieved by focusing on new fuels and technology, rather than capping demand, with knock-on economic and social benefits.[151]

Addressing non-CO_2 impacts

6.51 Much of the effort that is directed towards delivering the 2050 net zero target focuses on the reduction of CO_2 emissions, from all sectors, including aviation.

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[146] Aviation 2050 — the future of UK aviation - GOV.UK (www.gov.uk)

[147] Flightpath to the future: a strategic framework for the aviation sector - GOV.UK (www.gov.uk)

[148] ibid

[149] Net Zero Strategy: Build Back Greener - GOV.UK (www.gov.uk)

[150] Committee on Climate Change's 2021 progress report: government response - GOV.UK (www.gov.uk)

[151] Jet Zero strategy: delivering net zero aviation by 2050

However, aviation also has non-CO_2 effects which need to be better understood and addressed.

6.52 There is still uncertainty around the impact of non-CO_2 emissions which is being explored further by the JZC through a non-CO_2 Task and Finish Group.[152] In addition, the DfT, with the Natural Environment Research Council (NERC), has launched a £10 million funding competition for further research on aviation's non-CO_2 impacts on the climate.[153] Outlined below are the main policy objectives Government have committed to for non-CO_2 effects:[154]

- Evidence and data gathering on non-CO_2 impacts of using SAF blend flights, working with the scientific community and industry.
- Research on the potential mitigation of non-CO_2 impacts, working with atmospheric scientists, UKRI and also ICAO, from an international perspective.
- Consideration of potential inclusion of non-CO_2 impacts into the UK ETS.
- Work with the CCC to explore their potential methodology to monitor non-CO_2 impacts from aviation, including estimating and tracking.

Climate Change Adaptation

6.53 The effects of climate change are already being felt by the aviation industry, for example through flight delays caused by severe weather, extreme heat melting runways or the increased frequency and severity of turbulence. The IPCC predicts that the occurrence of extreme weather events is set to increase, even at 1.5˚C of global warming.[155] This increases the importance of having in place effective adaptation measures to mitigate against the impacts of climate change as far as possible. DEFRA is the lead department for domestic climate change adaptation, although actions and policies are implemented across Government.

Climate Change Act 2008

6.54 The Climate Change Act 2008 sets out the policy framework to ensure that the UK adapts to climate change, as well as reducing its domestic emissions. The framework includes commitments to produce a UK Climate Change Risk Assessment to identify climate risks, followed by a National Adaptation Programme to address the risks identified, every five years.

6.55 To ensure essential services and infrastructure are prepared for climate change, section 62 of the Climate Change Act 2008, known as the Adaptation Reporting

[152] Jet Zero Council: delivery group 2-year plan 2023 to 2024 (accessible version) - GOV.UK (www.gov.uk).

[153] Jet zero: aviation's non-CO2 impacts on the climate – UKRI.

[154] Jet Zero strategy: delivering net zero aviation by 2050 - GOV.UK (www.gov.uk).

[155] Chapter 11: Weather and Climate Extreme Events in a Changing Climate | Climate Change 2021: The Physical Science Basis (ipcc.ch).

Power (ARP), gives the Secretary of State for the Environment the power to direct reporting organisations (that is those with functions of a public nature or statutory undertakers) to produce reports detailing:

- the current and future projected impacts of climate change on their organisation;
- proposals for adapting to climate change; and
- an assessment of progress towards implementing the policies and proposals set out in previous reports.[156]

6.56 The provisions in Section 62 of the Climate Change Act 2008 give the Secretary of State for the Environment the power to mandate reporting, although this power has not previously been exercised. Instead, Government invites infrastructure providers and public bodies to report on a voluntary basis to ensure the process is flexible, responsive and proportionate. The ARP was introduced to help ensure reporting organisations are taking appropriate action to adapt to the future impacts of climate change. It helps do this both directly, through engaging organisations in reporting, and indirectly, through raising awareness, building capacity in organisations, and making examples of good practice publicly available. Under the five yearly cycle of the Climate Change Act 2008, the Government is required to set out and consult on its strategy for reporting. This strategy must be laid in Parliament alongside the National Adaptation Programme.[157]

6.57 Members of the aviation industry have previously submitted climate change adaptation reports under the ARP. These have included airports and air navigation service providers. The CAA has also previously submitted reports under the power and, as part of the CAA's Environmental Sustainability Strategy, has committed to contributing to future rounds of the ARP.

[156] Climate Change Act 2008, Section 62.

[157] Further information regarding the Government's role and powers with respect to climate change adaptation can be viewed here: Climate change adaptation: policy information - GOV.UK (www.gov.uk).

APPENDIX I

Noise Modelling Methodology

The CAA's Environmental Research and Consultancy Department (ERCD) modelled the noise exposure for each of the eight in-scope airports. These were: Birmingham, Edinburgh, Glasgow, London Gatwick, London Heathrow, London Luton, London Stansted, and Manchester. The models were developed from existing ERCD noise models where available and were proportionately adjusted to reflect local circumstances.

For Glasgow and London Luton airports, ERCD are not the retained noise modelling consultant and therefore no relevant existing noise model existed. For these two airports, ERCD developed the model using a combination of airport provided data and existing CAA data. These aircraft noise exposure models therefore do not meet the relevant requirements of CAP 2091[158] and are considered to be modelled to CAP 2091 Category E.[159] This is considered appropriate for this strategic aggregate assessment.

To minimise the effects of runway operating direction impacting changes in noise exposure, a long-term standardised modal split relevant to each individual airport was used, with the same modal split applied to each modelled year.

The population datasets used in this review were based on the 2011 Census updated to a given year supplied by CACI Limited.[160] The population exposed was calculated for those inside the 51dB $L_{Aeq,16h}$ daytime and 45dB $L_{Aeq,8h}$ night-time contours. Two approaches were used:

1. The population dataset representative of each year modelled (i.e. 2019 for 2019, 2020 for 2020); and
2. A 2019 population dataset applied to every year.

[158] CAP2091: CAA Policy on Minimum Standards for Noise Modelling.

[159] To inform future iterations of the UK Aviation Environmental Review, the CAA will review noise exposure models for Glasgow and London Luton airports to ensure compliance against the relevant requirements of CAP 2091.

[160] https://www.caci.co.uk/.

APPENDIX II

Abbreviations

ACA	Airport Carbon Accreditation
AEE	Assessment of Environmental Effects
AER 2023	UK Aviation Environmental Review 2023
AFF	Advanced Fuels Fund
AMS	Airspace Modernisation Strategy
ARP	Adaptation Reporting Power
CAA	Civil Aviation Authority
ERCD	The Environmental Research and Consultancy Department of the CAA
CAEP	Committee on Aviation Environmental Protection
CCC	The Climate Change Committee
CLRTAP	UN Convention on Long-Range Transboundary Air Pollutants
CO_2e	Carbon dioxide equivalent
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
dB	Decibels
dBA	A-weighted decibels
DEFRA	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EASA	European Union Aviation Safety Agency
ECAC	European Civil Aviation Conference
EIP	Environmental Improvement Plan
END	Environmental Noise Directive
EU	European Union
GGR	Greenhouse gas removal
HC	Hydrocarbons
ICAO	International Civil Aviation Organisation
ICCAN	Independent Commission on Civil Aviation Noise
IPCC	Intergovernmental Panel on Climate Change
JZC	Jet Zero Council
LCAFs	Lower carbon aviation fuels
LTAG	Long-term aspirational goal
LTO	Landing and take-off
NDC	Nationally Determined Contribution
NECR	National Emission Ceilings Regulations
NMVOC	Non-methane volatile organic carbons
nvPM	Non-volatile particulate matter
PM	Particulate matter
$PM_{2.5}$	Fine particulate matter
SAF	Sustainable aviation fuels
SARPs	Standards and Recommended Practices

UK AER	UK Aviation Environmental Review
UK ETS	UK Emissions Trading Scheme
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
ZCE	Zero carbon emission
ZEF	Zero emission flight