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THE VOICE OF UK AIRPORTS

AIRPORT OPERATORS ASSOCIATION

DECARBONISATION REPORT

FOREWORD

The climate emergency has not gone away during the pandemic and remains one of the pressing issues of our time. Weather extremes seen in recent years are expected to become a more regular occurrence, as the most recent report from the UN's Intergovernmental Panel on Climate Change (IPCC) warned. Now is the time for decisive action plans across every industry in every country to ensure the transition to net zero gets underway and is achieved.

This applies to aviation also: we know aviation emissions will increase if decisive steps are not taken. That is why in 2020, UK aviation committed to achieving net zero carbon emissions by 2050, through an international approach, working with governments around the world and through the UN.

The UK is well positioned to become one of the leaders in green aviation, including sustainable aviation fuels and electric flight, creating highly-skilled and well-paid jobs in the process. Industry cannot do this alone and the recent UK government consultation on how we achieve "jet zero" is a welcome step forward to defining the collaboration between aviation and government.

As members of the UK coalition Sustainable Aviation we know that the whole industry is working on steps towards achieving the aviation industry's part of our commitment to net zero. Naturally, the focus in politics and the media is on the flights themselves, which account for the majority of emissions in our sector. However, this is no reason for airports to ease off the pressure to decarbonise airport operations and put in place the necessary infrastructure and conditions for others, such as airlines and groundhandling companies, to do likewise.

This report sets out how airports are adapting to the need to reduce carbon emissions. It included what airports have already achieved and the further action they have planned to reduce emissions and achieve net zero.

Beyond airports, aviation will change in the coming years: alternative fuels will power more flights, aircraft will become more efficient and increasingly electrified, and precision satellite guidance will drive further efficiencies. UK airports stand ready to be at the forefront of that movement: ensuring the benefits of travel for people with relatives and friends abroad, businesses looking to trade and families wishing to go on holiday can continue without the adverse impacts on the climate.

We cannot do so alone, particularly after the pandemic and resulting travel restrictions have decimated airports' balance sheets and most, if not all, capital investment has been paused. The Jet Zero consultation has to be the start of a close partnership with UK Government, initially to bridge the funding gap that the pandemic has left in industry and more broadly to ensure that the UK gains a position of international leadership in what is, by definition, an international industry.

This is our chance to build back better, and we must seize it.

Karen Dee
Chief Executive

AVIATION AND AIRPORT EMISSIONS IN CONTEXT

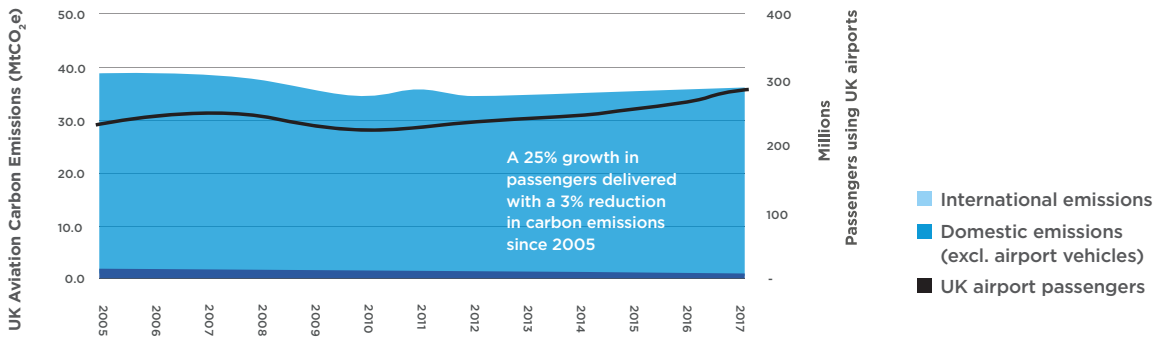
Aviation is an industry that is hard to decarbonise, but that has not halted progress. For example, airlines have spent over a trillion dollars since 2009 in more efficient aircraft and the industry is investing $15bn each year in development of more efficient technology.

Globally, carbon emissions from all sectors, including aviation, have risen by 60% since 1990. Across Europe and the UK, however, emissions have fallen, predominantly as a result of the rise of low-carbon energy generation.

Aviation emissions, while only representing a small proportion (around 2%) of the global total, have grown faster than the average across all sectors. Prior to the pandemic, UK aviation gross emissions accounted for 7% of total UK carbon emissions.[1] In 2017, the gross emissions from flights departing the UK were 37 MtCO2, up by 20 MtCO2 since 1990.

Over that period, passenger numbers nearly tripled as flying became ever more accessible: from 102.3m in 1990[2] to 284.6m in 2017. This huge growth in travel, which brought countless social and economic benefits, was achieved while reducing the per-passenger CO2 emissions: new aircraft and other efficiency improvements saw per-passenger emissions go down by 22% lower by 2019, compared to 1990. Furthermore, since 2005 UK aviation has decoupled growth in activity, such as numbers of people flying, from carbon emissions, due to significant fleet upgrades.

Changes in UK aviation carbon emissions and passengers since 2005



Source: Data from UK Government Greenhouse Gas statistics

[1] Committee on Climate Change, *'Net Zero' – The UK's contribution to stopping global warming* (2019)
[2] Department for Transport, *Jet Zero Consultation. A consultation on our strategy for net zero aviation* (2021), p. 22

In the UK, the aviation industry has come together in Sustainable Aviation (SA), a coalition of airlines, airports, aerospace manufacturers and air navigation service providers, to set out how UK aviation can achieve net zero in 2050. The Decarbonisation Road-Map focuses on aircraft emissions, where airports' role is predominantly focused on operational efficiencies to reduce fuel on the ground and in the airspace airports are responsible for.

Airports' action on emissions are, however, not limited to aircraft ground operations and airspace modernisation. To complement the SA Road-Map, this report looks at the emissions airports are responsible for or have influence over. These ground-based emissions are not counted towards international aviation emissions and are, therefore, already included in the UK's Carbon Budgets. This means airports' ground-based operations are included in the UK Government's net zero by 2050 commitment. In line with the global approach to international aviation and shipping emissions (IAS), IAS emissions were until recently not formally included in the Carbon Budgets, but the Budgets were set with headroom to account for those emissions. The UK Government has now announced that it will include IAS emissions starting from the 6th Carbon Budget (covering the period 2033-37.

Different emissions at airports

Greenhouse gas emissions are categorised into three groups or 'Scopes' by the most widely-used international accounting tool, the Greenhouse Gas (GHG) Protocol.

These scopes are:

- **Scope 1** – Direct emissions from fuel combusted in company-owned or -controlled facilities and vehicles, such as heating terminals, airside vehicles, etc.
- **Scope 2** – Indirect emissions from the generation of purchased electricity, steam, heat and cooling by the reporting company.
- **Scope 3** – All other upstream and downstream emissions in a company's value chain, such as flights taking off, travel to/from an airport (surface access), etc.

This report will focus on each of the three scopes in turn, setting out the areas where airports have already and are planning to take action.

While the majority of the focus in this report will be on greenhouse gas emissions, sustainability is wider than just climate action. Aviation noise is another critical area for local communities, as is adaptation to climate change, responsible use of resources and disposal of waste and local air quality. With Sustainable Aviation having done significant work on aviation noise and on air quality in recent years, these areas will not be covered again in this report. Where appropriate, waste management will be touched upon.

OVERVIEW: NET ZERO COMMITMENTS

As a whole, the UK aviation industry has committed to net zero by 2050. However, several individual airports have set earlier targets, which are summarised here.

Measuring the impact of emissions mitigations is vital to ensuring that we are all talking about the same issues in the same way as part of the debate on aviation's pathway to net zero. To this end, accreditation schemes are helpful ways to benchmark and provide external oversight on the progress.

Airport	Scope 1&2 net zero target date	Accreditation
Heathrow	mid-2030s	ACI
London Gatwick	before 2040	ACI
Manchester	2038	ACI
London Stansted	2038	ACI
London Luton	2040	ACI
Edinburgh	2030	ACI
Birmingham	2033	
Glasgow	mid-2030s	ACI
Bristol	2030	ACI
Belfast International	2050	ACI (pending)
Newcastle	2035	ACI
Liverpool	2040	ISO 50001
East Midlands	2038	ACI
London City	2050	ACI
Leeds Bradford	2030	ACI
Aberdeen	mid-2030s	ACI
Belfast City	2050	ACI
Southampton	mid-2030s	ACI
Cardiff	Under discussion	
London Southend	2027	ACI
Doncaster Sheffield	2030	
Exeter	2050	
Bournemouth	2050	
Norwich	2050	
Cornwall Airport Newquay	2030	ACI
Humberside	2050	
City of Derry	2035 (under discussion)	
Teesside	2035	
London Biggin Hill	2029	

ACI Airport Carbon Accreditation

Airports Council International (ACI) EUROPE initiated the Airport Carbon Accreditation scheme in 2008 and it has been a global scheme since 2014. It independently assesses and recognises the efforts of airports to manage and reduce their carbon emissions through 6 levels of certification: 'Mapping', 'Reduction', 'Optimisation', 'Neutrality', 'Transformation' and 'Transition'. These levels acknowledge that airports are at different stages in their journey towards comprehensive carbon management.

Airport Carbon Accreditation is the only global, airport-specific carbon standard which relies on internationally recognised methodologies. It provides airports with a common framework for active carbon management with measurable goalposts. The programme is site-specific allowing flexibility to take account of national or local legal requirements, whilst ensuring that the methodology used is always robust.

ISO 50001

The International Organization for Standardisation (ISO) designed ISO 50001 to support organisations in all sectors with a practical way to improve energy use, through the development of an energy management system (EnMS).

ISO 50001 is based on the management system model of continual improvement also used for other well-known standards such as ISO 9001 or ISO 14001, enabling organisations to integrate energy management into their overall efforts to improve quality and environmental management.

ISO 50001 provides a framework to:

- Develop a policy for more efficient use of energy
- Fix targets and objectives to meet the policy
- Use data to better understand and make decisions about energy use
- Measure the results
- Review how well the policy works, and
- Continually improve energy management.

REDUCING ENERGY USE AT UK AIRPORTS

A first step in the journey to decarbonisation is reducing energy use.

Every process in the airport that uses some form of electricity or fuel can be made more efficient and the number of projects underway at airports cover the full breadth of the options. An important first step in that energy reduction journey is often measuring where energy is used and when. A number of airports are increasing energy metering across their sites as a first step to identify where the biggest gains can be made.

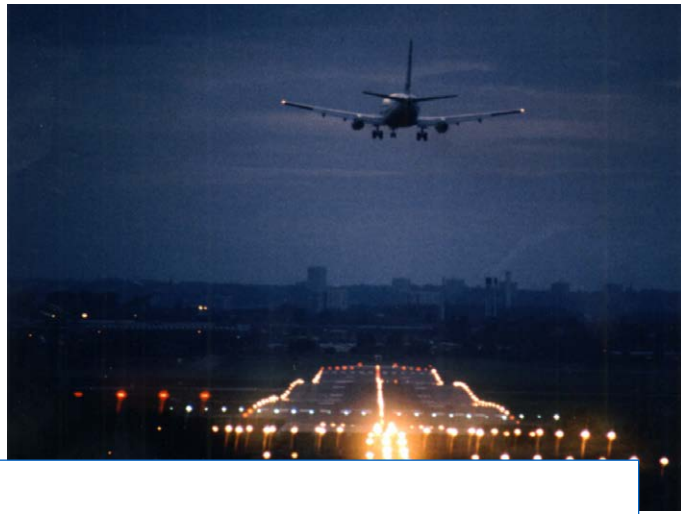
In terms of the concrete action, there are several areas where many airports are making progress:

- Reduce energy consumption from lighting: LED lights are replacing more energy-intensive lighting across airport operations. LEDs are lighting runways, airport aprons, car parks and terminals and are used in floodlights, advertising signage, etc. The savings can be significant: Bristol Airport's LED lighting programme is expected to save approximately 100 tCO2e each year.
- Increasing the energy efficiency of terminal buildings through a range of measures. For example, London City Airport has installed energy-reflecting windows to reduce heat gain. Heathrow Airport's Terminal 2 was the first airport terminal to achieve BREEAM certification and includes sustainability designs such as a roof that maximises natural light in the terminal
- Upgrading current heating and cooling solutions to more efficient ones: London Luton Airport carried out an extensive project to replace old inefficient boilers with new energy efficient versions while London City Airport installed eco-approved variable refrigerant volume (VRV or VRF) air conditioning units.
- Decarbonising ground power units: many ground power units at airports use diesel to generate electricity. This is in part because of regulatory requirements: the International Civil Aviation Organisation (ICAO) safety-related requirements set out how safe operations in poor visibility, for example when fog or low cloud means pilots cannot see the airport or their surroundings, should take place. This includes the provision of certain navigation aids, airfield lighting, and communications equipment such as radar and radio and that these must have reliable back-up power which can switched on at a moment's notice. For this safety-critical reason, a significant number of airports use generators as a primary power source for equipment such as runway lighting during periods of low visibility, with the National Grid as the back-up power source. Airports are now exploring and trialling the use of biofuel in generators, replacing generators with zero-emissions alternatives or using batteries.

Since 2016, Edinburgh Airport has invested more than £1m in energy saving projects. Projects include things like installing LED lighting across the terminal, making their lighting around 30% more efficient. The energy saving projects have reduced Edinburgh's energy usage by 4,165,000kWh in that time.

Edinburgh Airport
Where Scotland meets the world

Southampton Airport was the first UK airport to use LED lighting on aircraft stands and the first to install solar powered LED runway safety lighting. Operating 24/7, they store enough energy for 120 days' operation. LED lights are also being used in Southampton's terminal and car parks. The lights can operate for up to 100,000 hours (10 years) continuous usage, reducing energy consumption, maintenance costs and carbon emissions. Lighting controls in the car park also allow un-used lights to be switched off when they aren't required.



At Birmingham Airport, the period of low traffic volumes due to the pandemic were used to identify and implement energy saving opportunities concerning lighting on the airfield. The airport turned off High Mass Lighting at unused stands and reduced ground lighting wherever possible and replaced all observation lighting on taxiway Yankee with LEDs. The LEDs proved successful and a further roll-out of LED airfield lighting is planned. The dawn/dusk timings on all the High Mass Lighting have been altered to reduce the amount of time they come on to the minimum required. Finally, Birmingham's Air Traffic Control is able to use an eco-mode for runway ground lighting to minimise lighting when the runway is not in use and the airport is now looking to implement this across all airfield ground lighting.

SCOPE 1 EMISSIONS: DECARBONISING THE AIRPORT'S OWN OPERATIONS

Airports are complex operations: as infrastructure providers, the airport is often the basis for others to operate rather than operations by the airport themselves.

Many of the activities at an airport, from baggage handling to the flights themselves are undertaken by third parties, such as groundhandling companies and airlines. This means that the emissions under Scope 1 are more limited than someone might assume. This is not stopping airports from being ambitious in their efforts to decarbonise emissions where possible.

Renewable heat and cooling systems

The challenge is ensuring terminals and other airport buildings are heated in a sustainable way is a more significant challenge than renewable electricity. This is in line with the wider economy and society, with the Committee on Climate Change noting that decarbonising the UK's building stock (which accounted for 18% of UK emissions in 2019) remains a significant challenge where only limited progress has been made to date.[3] It is expected that gas-for-heating will remain widely used across the UK economy and society, and while this requires a UK-wide solution, airports are taking action to try and decarbonise heat and cooling systems where possible.

In the UK, Heathrow and Gatwick have started to generate onsite renewable heat. Heathrow operates a 10MW biomass boiler

Biomass boiler at Heathrow Airport

that supplies heat from a renewable source to terminals 2 and 5. The wood chip is from forestry waste sourced within 100 miles of the airport. Gatwick operates a 1MW capacity biomass drier and boiler which uses organic waste from airport operations to generate hot water and heat used to operate the airport's Materials Recycling Centre.

Several airports have a strategy to tackle renewable heat generation as part of their journey to net zero as well as concrete plans to decarbonise heat generation. For example, Heathrow Airport is considering its approach and has an aspiration to set the mid-2030s as its target for heat decarbonisation, subject to its regulated financial settlement. Bristol Airport has set

[3] Committee on Climate Change, Progress in reducing emissions: 2021 Report to Parliament (London: CCC, 2021), p. 111ff

a target date of 2030 for the removal of gas energy generation and using air source heat pumps instead. Aberdeen Airport, meanwhile, is focusing on ground source heat pumps as its alternative and London City Airport is considering water source heat pumps.

Decarbonising airport-owned vehicles

Anyone who looks out on to the airport apron from the terminal will have seen the many vehicles operating around the airfield. Only a small proportion of these vehicles will be owned by the airport: most will be operated by companies supporting the airlines that use the airport. These include the catering companies, fuel companies and groundhandlers. The emissions from most vehicles on the airport therefor fall under Scope 3, which is discussed below, and this section will look at the vehicles owned by the airport.

As electric and low-emission vehicles become more available, airports have started to trial and implement these vehicles in the airside environment. Currently, most airports will have a small but growing number of vehicles that are electric or hybrid. Some airports are trialling alternative fuels, such as a trial with HVO fuel at Edinburgh Airport, which could see a 90% reduction in carbon emissions compared to traditional fuels. All airports, however, plan to replace their fleets with low- or zero-emission vehicles in the coming years. One exception to this commitment is around fire and rescue service vehicles, which require high levels of resilience and safety. They can only be replaced when electric or low-carbon alternatives meet regulatory requirements, which may not be by the deadlines that some airports have set for vehicle fleet decarbonisation.

One area where significant progress has been made is in electric bussing operations, both landside and airside. Birmingham and Glasgow airports were the first UK airports to introduce an all-electric fleet landside, which also improves air quality. Other airports, including Bristol and Heathrow, have increasing numbers of electric buses operating landside and airside.

Electric buses in operation at Birmingham, Bristol, Glasgow and Newcastle airports

London Gatwick Airport is working with West Sussex County Council (WSCC) and their consultants to examine the potential feasibility of re-using surplus heat produced at the local sewage works as a source of low carbon heat at the airport. This forms part of a wider study on the potential for district heating networks in Crawley and Manor Royal which WSCC commenced prior to the COVID-19 pandemic.

YOUR LONDON AIRPORT Gatwick

Solar panels at Birmingham Airport

SCOPE 2: DECARBONISING AIRPORT ENERGY CONSUMPTION

Renewable electricity

Decarbonising an airport's electricity usage is, thanks to great strides made decarbonising UK electricity generation, relatively straightforward. Airports either procure green electricity from an energy company or they participate in green energy projects.

Gatwick and Heathrow are the only two airports in the world to be members of RE100, a global initiative bringing together businesses driving the transition to 100% renewable electricity. Aberdeen, Belfast City, Bristol, London City and London Biggin Hill are among the UK airports who also procure 100% renewable electricity.

Moving to a green tariff is not the only action airports undertake to decarbonise their electricity supply. Many airports have renewable electricity generation on-site, or are a partner in a nearby project. This is predominantly solar photovoltaic energy generation, though some wind and energy-from-waste generation is also in use at UK airports.

Further electricity generation is planned: airports including Bristol, Gatwick, Liverpool and London Luton have ambitious targets for on-site energy generation.

London City Airport is working with Renewable Connections Developments to explore the potential for a floating solar array in the Royal Docks that could provide the airport and local customers with clean renewable energy in the future. The project has been backed by the Mayor of London's £1m Resilience Fund.

LONDON CITY AIRPORT

Newcastle International Airport has submitted a planning application for a major solar farm. If approved, the solar farm will be built in four phases between 2022 and 2035 on airport land. It will be capable of generating up to 16MW of electricity and will seek to provide 100% of the airport's electricity requirements. Plans also feature battery units to store excess energy for use during the evening or days with less sunshine.

Newcastle International Your Airport

Solar panels at Bristol, Heathrow and London Southend airports

Edinburgh Airport
Where Scotland meets the world

In a first for a Scottish airport, Edinburgh Airport will construct a solar farm on the airfield. The site will be approximately eleven-acres and construction is due to begin later this year before the site goes live in summer 2022. The project, part-funded by the Scottish Government, will see the solar farm constructed at the end the runway and it will generate around 26% of the airport's energy needs upon completion. The airport is currently finalising the process of appointing a contractor to deliver this Scottish first.

SCOPE 3: DECARBONISING OTHER COMPANIES' OPERATIONS IN AND AROUND THE AIRPORT

In scope 3, we can distinguish between emissions that the airport has some influence over, including staff commuting, waste processing, energy use by third parties on the airport site and passenger surface access, and emissions where the airport has limited influence, predominantly aeronautical emissions by aircraft taking off and landing at the airport.

Staff commuting

In common with other employers in the UK, airports have strategies in place to reduce the number of their teams that commute to the airport by private car. Initiatives include:

- Employee Car Sharing Scheme, which involves matching staff with others living in the same area and driving the same route to work.
- Encouraging public transport use: a number of airports have an on-site railway station and are also connecting to urban areas by bus. Employees can be encouraged to use public transport through staff discount schemes.
    - A significant challenge for airports is that not all public transport is aligned with the shift patterns of airport workers. Services may be limited during the night hours, limiting the options for staff to get to the airport out of peak travel hours. In a 2016 report on surface access, the AOA called on government to take better account of this need when tendering public transport contracts, such as rail franchises.
- Cycle to Work Scheme: several airports provide cycle storage lockers and showers available for staff use, and can be participants in HMRC's cycle2work enabling employees to hire/purchase a bike through their salary over a 12-month period.

To enable staff to travel with electric vehicles, airports are putting in place the necessary EV charging points, both for staff and for passengers using EVs.

LONDON CITY AIRPORT

As not all journeys can be done by public transport, cycling or walking, London City Airport has recently started offering a Car Benefit Scheme, in partnership with Tusker. Staff can use salary sacrifice in exchange for leasing a brand-new car, and there are incentives for acquiring more sustainable, hybrid or fully electric vehicles.

EV charging facilities at Heathrow Airport's passenger car parks

Passenger surface access

Improving surface access is an issue that has long been a focus and priority of airports. As set out in the AOA's report *Connecting the UK's economy: How better surface access to airports can boost growth*, surface access is a crucial enabler of aviation growth. By enlarging catchment areas, airports are better able to attract airlines and this boosts economic growth in their areas. That is why surface access improvement has been a long-standing ask of the AOA to the UK and devolved governments.

Airports have traditionally favoured public transport improvements in efforts to improve their surface access. These can bring significant volumes of people to the airport while minimising the impact on local roads, in terms of congestion, air quality and also carbon emissions. Several UK airports have existing rail and tram links, while others have been promoting schemes to extend (light) rail access. Unfortunately, the complexity of local transport planning and investment in relation to airports has seen many schemes fail to come to fruition, such as the light rail proposals at Glasgow and Bristol airports.

Where necessary, airports are working to decarbonise fuel-powered public transport, such as buses. This involves putting the right infrastructure in place, such as hydrogen or electric charging points, and working with other transport providers to encourage the shift towards low-carbon or zero-carbon alternatives. For those travelling by car to the airport, airports are putting in place the charging infrastructure necessary to enable passengers to make these journeys in EVs.

The Gatwick Express at Gatwick Airport train station

Where public transport is available, airports promote these travel options to passengers. This includes through the use of drop-off charges at the airport, to reduce emissions on the airport forecourt and improve air quality. Modal share at airports varies depending on how well-connected the airport is, with London City Airport achieving the highest share of public transport at 69% in 2018. Airports' surface access strategies set out how they will increase that modal share.

Other emissions

Airports continue to look for opportunities to work with third-party providers to reduce emissions. For example, several airports operate consolidation centres, which receives deliveries destined for an airport from retailers' own suppliers. Goods from a number of suppliers are then consolidated into fewer airport deliveries. This can reduce deliveries journeys to the airport by up to 75%.

Aeronautical emissions

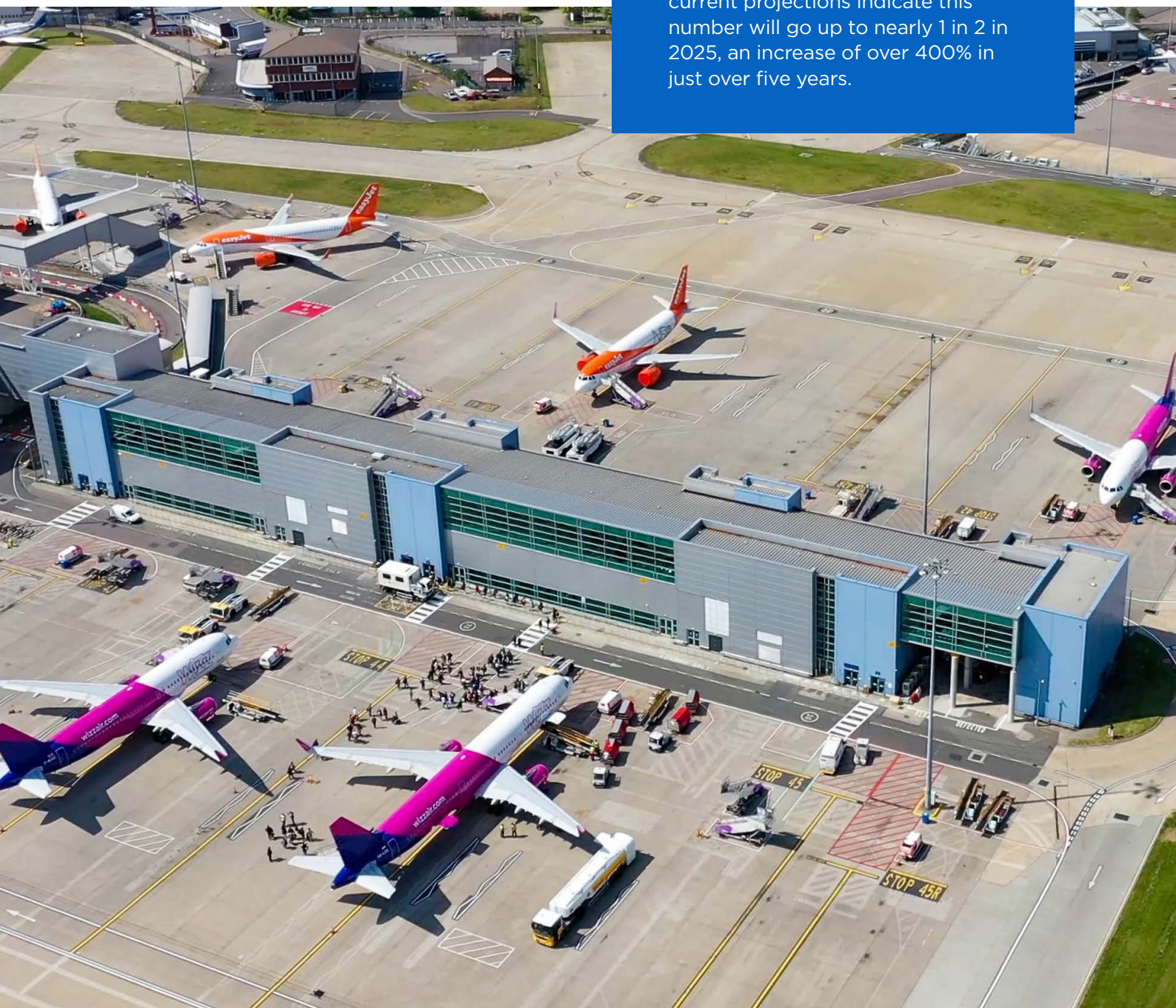
Greenhouse gas emissions by aircraft are, understandably, the area that first leaps to mind when considering the impact of aviation on the planet. As airports do not operate these directly, their role is focused on enabling lower emission through improvements both on the ground and in the air. This sometimes complements but can also conflict with other aviation impacts, such as the impact on aviation noise. The interdependencies here are important to reflect on, when considering sustainability at an airport.

Encouraging airlines to use the cleanest and quietest aircraft

Through their landing charges, airports have the ability to vary the pricing structures to encourage the use of cleaner and quieter aircraft. The setting of these aeronautical charges is regulated by the Civil Aviation Authority at two airports, Heathrow and London Gatwick airports, as they are deemed to have significant market power under the EU's Airport Charges Directive, which has been retained in UK law following the UK's exit from the EU. At all other airports, the setting of aeronautical charges is a commercial negotiation between airport and airline without involvement of the CAA.

London Luton Airport

Being home to three of the most successful budget airlines, London Luton Airport has one of the youngest fleets in the UK. EasyJet, Wizz Air and Ryanair, which represent 94% of the airport's traffic, have strong focus on renewing their fleets to ensure efficient and sustainable operations. London Luton is working closely with its airline partners to increase the number of latest generation NEO and MAX aircraft which offers around 20% reduction in carbon emissions. Nearly one in ten of the aircrafts flying from Luton in 2019 were either NEO or MAX, and current projections indicate this number will go up to nearly 1 in 2 in 2025, an increase of over 400% in just over five years.



Reducing engine use on the ground

Aircraft use their engines for a number of reasons at on the ground at airports, including to taxi from the runway to the terminal building and they use the auxiliary power unit (APU) to generate electricity while on-stand for aircraft systems, including air conditioning. This is an inefficient use of the engines and generates greenhouse gases.

There are a number of ways that airports can enable airlines to reduce the use of their engines at the airport, to save fuel, reduce greenhouse gas emissions and improve air quality. These include:

- Providing electricity on-stand that aircraft can be plugged into: this is either fixed electrical ground power (directly from the airports' electricity grid) or through the use of ground-power units (GPUs). Where GPUs are used, trials are underway at some airports on using battery-powered GPUs as an alternative to diesel generators. Airports then work with airlines to encourage them to use the ground-power alternatives to the APU.
- While not required for smaller aircraft that are on their way again within 30-45 minutes, for wide-bodied aircraft that spend a longer time on stand, pre-conditioned air (PCA) can be a way to reduce the need to use the aircraft engines. At Heathrow Airport, a number of stands on Terminals 2 & 5 have a fixed PCA facility, while London Gatwick is trialling a mobile PCA unit.
- Through Sustainable Aviation's Departure and Arrivals Codes of Practice, the aviation industry has set out a number of ways to reduce engine use at the airport:
    - Aircraft engines are designed to provide the high levels of thrust required for power-intensive stages of flight, including take-off. This means that not all engines are needed to taxi on the ground. Depending on the aircraft type, either one or two engines can be shut down for taxiing before take-off and after landing, which is known as Reduced Engine Taxiing. This sees reductions of 20-40% of ground-based fuel burn and CO2 emissions, and 10-30% of NOx emissions depending on aircraft type and operator technique (some newer aircraft are more limited in their ability to use reduced engine taxing and further work is ongoing to look into the use of this technique, though these aircraft are more efficient generally in any event). To support reduced engine taxiing on departure, air navigation service provider NATS encourages air traffic controllers to give a five-minute warning of departure slot to enable flight crews to start the remaining engines.
    - NATS has worked with airport air traffic controllers and airlines to promote smooth taxiing and avoid unnecessary stop/starts. By providing early information so that pilots plan for expected ground routings, air traffic controllers help avoid unnecessary stops at taxiway junctions and as a result reduce fuel burn and emissions. Putting this in context, a Boeing 737-300 burns around 13kg of fuel per minute during ground taxiing while larger aircraft use between 20-60kg/min.
    - Airlines have implemented take-off procedures which reduce engine thrust settings to the level actually required to take off given the aircraft take-off weight, current weather conditions and the length of the runway available. This procedure was developed in the UK and is now a certified technique, built into aircraft flight management systems as standard. This tends to result in a small greenhouse gas emissions reduction and has benefits for air quality at and near-to the airport.
        - The impacts of this procedure on noise are complex, another factor airports have to take into account in their sustainability strategies. The reduction in power setting reduces noise close to the airport but means that an aircraft will be slightly lower along its flightpath. As a result, whilst the overall noise impact will reduce, the noise levels under the flightpath may be slightly increased.[4]

[4] Sustainable Aviation, *UK aviation and air quality* (London: Sustainable Aviation, 2017), p. 40

Airspace modernisation

Airspace is a crucial part of our transport infrastructure. It was designed in the 1960s and advances in aircraft technology since then have not been matched with corresponding modernisation of airspace management. Airports and NATS are working through the Airspace Change Organising Group (ACOG) to agree a masterplan for modernisation, to ensure people and goods can move more efficiently and reliably through our airspace. This process started pre-pandemic but it was paused during the height of the Covid-19 crisis and is being remobilised now with UK Government funding for the initial stage of modernisation.

Airspace modernisation is expected to deliver several benefits. These include improving the resilience of the network, both internationally and domestically, preventing rising delays and resulting in less congestion. It will also play a central role in decarbonising UK aviation: ahead of longer-term efforts to develop more fuel-efficient engines and the use of cleaner fuels, airspace modernisation will mean less airborne holding and fewer miles flown per aircraft. Upgrading airspace offers the potential to reduce aviation emissions by around 5% by 2050, while also accommodating a doubling of passenger numbers. Without a wholesale upgrade of UK airspace, CO2 emissions would be expected to rise by 8-12% per flight compared to current levels.

Airports are responsible for the airspace up to 3,000ft around the airport but there are significant interdependencies between greenhouse gas emissions and noise impacts. In the airspace that airports are responsible for, reducing noise impacts where possible is the priority in line with the Government's Airspace Strategy. This may mean that aircraft do not use the most efficient route from a decarbonisation perspective.

LONDON CITY AIRPORT Heathrow Making every journey better

New Aviation Propulsion Knowledge and Innovation Network (NAPKIN): NAPKIN is an Innovate UK Future Flight project modelling the introduction of zero emissions aircraft into sub-regional and UK domestic aviation. Participants include AOA members Heathrow and London City, as well as universities, aerospace companies and consultants. The project is organised around 5 core themes, taking a 'whole aviation system' approach:

- Aircraft requirements: developing a roadmap on technology improvements, including power generation, storage and propulsion
- Aircraft concepts: analysis of the characteristics for both small (8-18 seats) and larger aircraft (50-120 seats)
- Airport infrastructure: examining concept aircraft performance and operating constraints, including noise, airspace, ground operations and infrastructure requirements such as for re-fuelling.
- Impact on travel: airline behaviour and multimodal demand models to see how aircraft concepts and opearating constraints will affect trip characteristics and travel alternatives.
- Passenger, community and airline responses: end user attitudes and expectations and what the operational constraints and commercial opportunities may mean for uptake.

Alternative fuels

Sustainable aviation fuels are produced from a range of feedstocks, including ethanol, household and agricultural waste and waste industrial gases. Sustainable aviation fuels deliver up to 80% carbon reductions on a life-cycle basis for each litre of fuel used, compared to traditional jet fuel, and enable airlines to reduce their carbon emissions. They are known as "drop-in fuels", meaning that they require no modifications to existing aircraft, aircraft engines or airports' refuelling infrastructure.

The SA Decarbonisation Roadmap sets out that sustainable aviation fuels have the potential to start reducing UK aviation emissions in the mid-2020s and to reduce aviation emissions by at least 32% in 2050.

IATA's recent commitment to net-zero carbon emissions by 2050 suggests that sustainable aviation fuels' contribution could be up to 65%.[5]

These fuels are market-ready: almost 200,000 flights worldwide have taken place using sustainable aviation fuels. UK airlines such as British Airways and Virgin Atlantic have been at the forefront of the efforts to bring sustainable aviation fuels to the UK, with the BA-supported plant being built by Velocys at Immingham in Lincolnshire likely to be the first UK sustainable aviation fuels plant. What is now needed for the scale-up of their use, is increasing production, which requires ongoing government support to de-risk the investment in these first-of-a-kind plant.

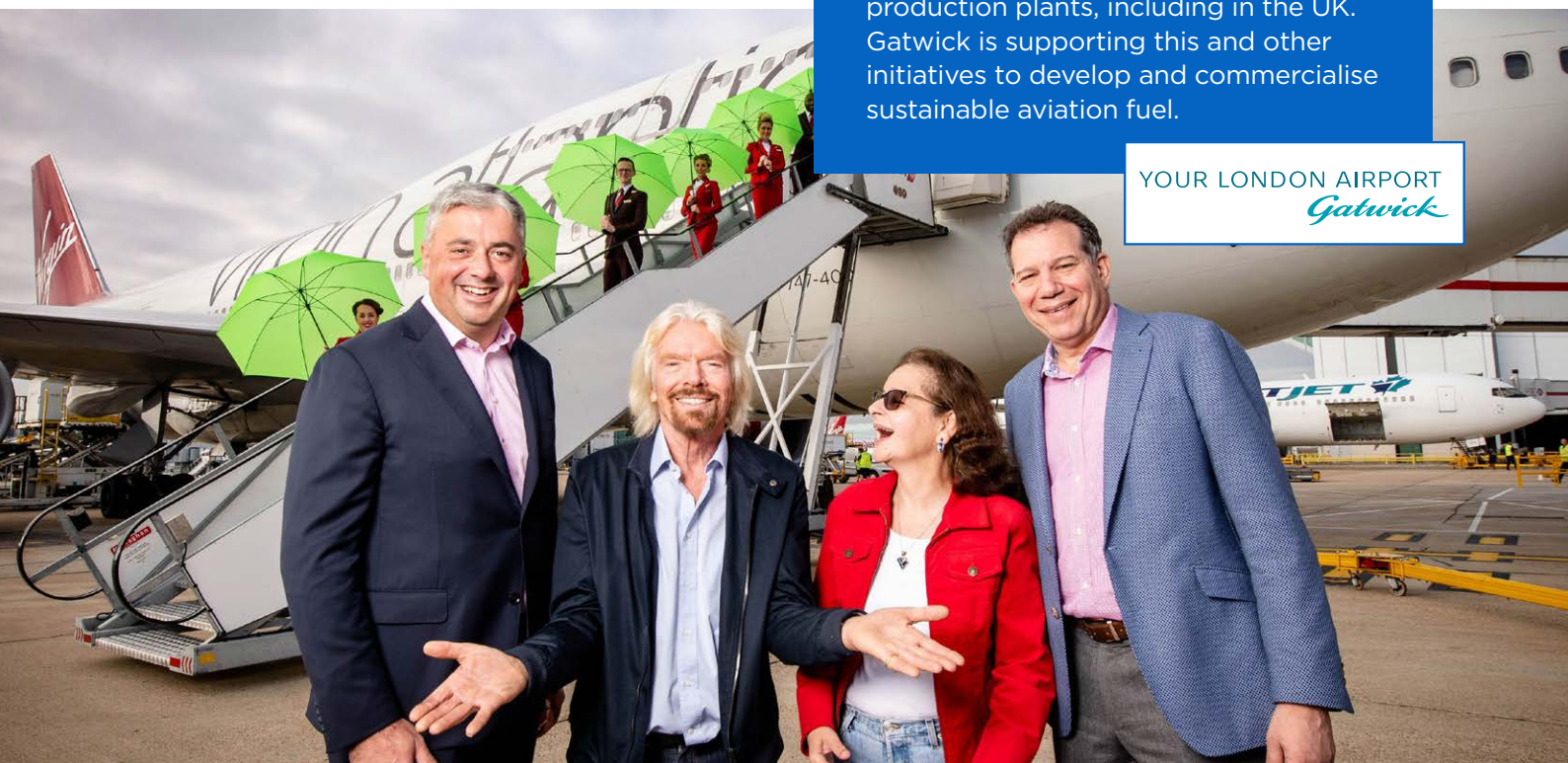
Independent work conducted by E4tech on behalf of Sustainable Aviation found that by 2037 there could be up to 14 SAF production facilities in the UK which would create 6,500 direct jobs and contribute £929 million annually to the UK economy. With export and overseas opportunities included, this grows to 13,600 jobs and £1.9 billion.

Airports are playing an advocacy role in support of the wider aviation industry's efforts to ensure the right conditions exist in the UK for sustainable aviation fuels to realise its potential. Heathrow Airport was the first major UK airport to successfully incorporate sustainable aviation fuel (SAF) into their main fuel supply and at London Biggin Hill, sustainable aviation fuels account for 34% of the fuel mix for aircraft.

Two other alternative fuel sources for aircraft are hydrogen and electricity (including for hybrid electric aircraft). As these are very much in development still, airports are involved in scoping exercises and trials to assess the impact of moving towards these fuels.

On 3 October 2018, London Gatwick Airport welcomed Virgin Atlantic's history-making flight VS16 from Orlando, the first commercial flight into the UK with fuel made partly from industrial waste gas emissions. In a process pioneered by LanzaTech, waste emissions are converted into ethanol alcohol which is blended with conventional jet fuel. LanzaTech says this delivers a reduction in greenhouse gas emissions of at least 65% compared with conventional jet fuel. LanzaTech's fuel is certified for up to 50% blending with conventional jet fuel, and LanzaTech wants to build several production plants, including in the UK. Gatwick is supporting this and other initiatives to develop and commercialise sustainable aviation fuel.

[5] IATA, Net-Zero Carbon Emissions by 2050 (4 October 2021) <https://www.iata.org/en/pressroom/2021-releases/2021-10-04-03/> [accessed 8 October 2021]



Electric flight trials at Cornwall and Exeter airports

Electrification of aircraft could play an important role in decarbonising transport and meeting the UK's net zero targets. The technology to deliver hybrid-electric planes and electric planes is under development and promises to provide a cost-effective alternative in the near future. Airports must start planning how they can strengthen their air-side electricity networks to enable charging of these planes and achieve sustainable aviation in the future.

Ampaire Ltd leads a UK-based consortium created to explore regional electric aviation transport solutions. In 2020, the team received £2.4 million from the UK Research and Innovation's (UKRI) £30 million Future Flight Challenge towards the consortium's £5 million 2ZERO programme. Consortium partners include Rolls-Royce Electrical, University of Nottingham, Loganair Ltd, Exeter and Devon Airports Ltd, Cornwall Airport Newquay, Heart of the Southwest Local Enterprise Partnership (HotSWLEP), and with UK Power Network Services as strategic supplier. In August 2021, Ampaire Ltd launched a series of successful demonstration flights of its hybrid electric Electric EEL aircraft between Exeter Airport and Cornwall Airport Newquay. The demonstration allowed the consortium to gather valuable data such as fuel savings, efficiency and noise to inform the next stage of the project.

Ampaire, UK Power Network Services Ltd and the airport partners Exeter and Cornwall have been working to research the requirement of ground electricity infrastructure to charge small hybrid-electric planes (up to 19 seats). This work includes analysing the following three solutions: a) charging the plane directly by connecting to the airport's private-wire electrical infrastructure, b) charging the plane via a battery on a trolley that could be pulled to a plane when needed, and c) swapping the batteries of the plane. This included developing cost scenarios for these options for a regional airport in the UK and evaluating how the ground electrical infrastructure could be scaled up to support future flights.

FlyZero: working to realise zero-carbon emission commercial aviation by 2030

FlyZero is a one-of-a-kind research project aiming to realise zero-carbon emission commercial aviation by the end of the decade in response to the urgent global challenge of decarbonising aviation. The twelve-month strategic research programme is backed by the UK Government and led by the Aerospace Technology Institute (ATI) to shape aviation's future so that the UK stands at the forefront of sustainable flight design, manufacture, technology and skills and thereby ensuring the UK's future competitiveness.

Carbon-free flight will require a step change in the design, development, manufacture and operation of commercial aircraft. With the right investment, new technologies have the potential to usher in a new era for aviation, akin to the advent of the jet age, bringing with it commercial opportunities for the UK aerospace industry that build on decades of expertise.

FlyZero brings together experts to study in detail the design and technological challenges, manufacturing demands, operational requirements and market opportunity of potential zero-carbon emission aircraft concepts. By creating these aircraft concepts alongside investigating industrial roadmaps and capabilities, the commercial and economic cases as well as wider sustainability considerations, FlyZero is setting out to demonstrate how the intensive development and early adoption of advanced technologies will enable us to realise zero-carbon emission commercial aviation by 2030.

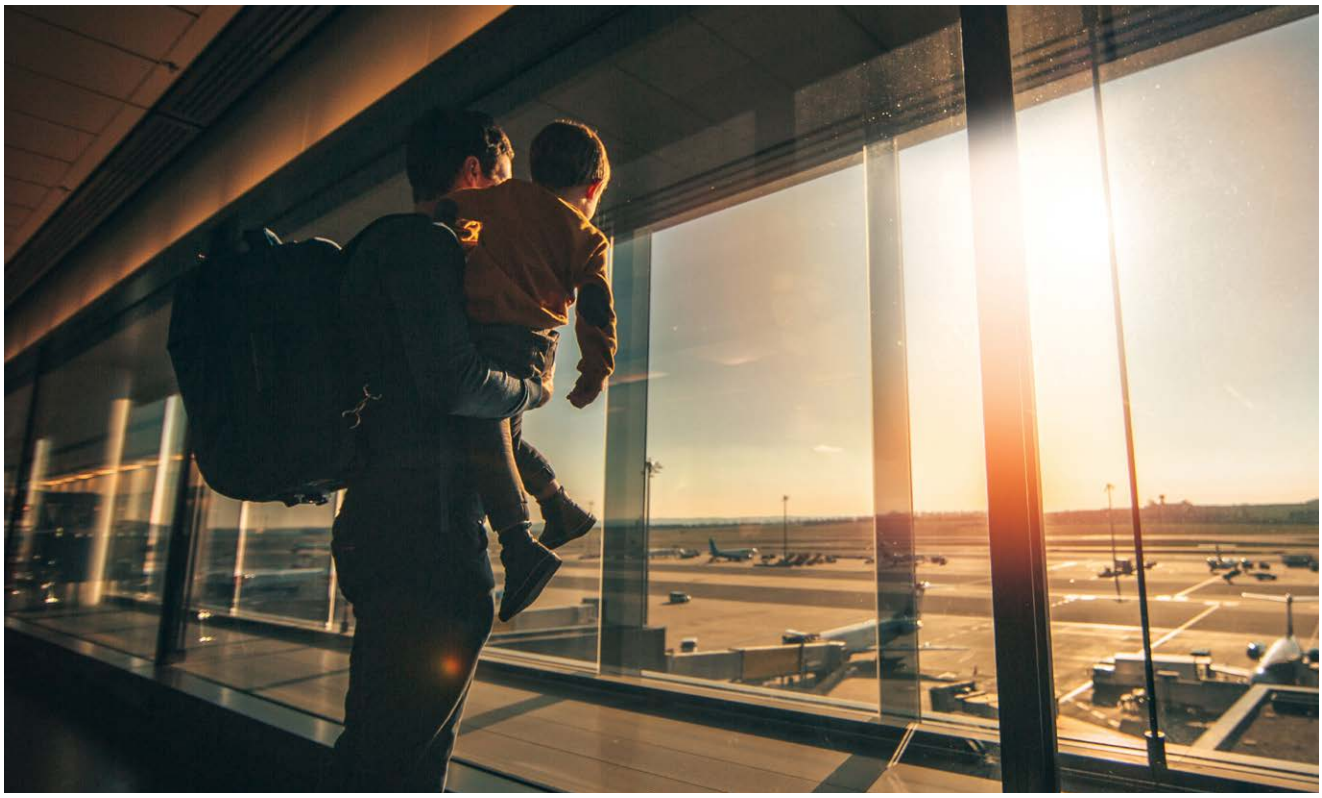
For example, FlyZero is working on three inter-linked studies to assess the full end-to-end hydrogen supply chain, including at airports. The first study focuses on the supply of hydrogen to an airport, considering their varying sizes, locations and hydrogen demand; overlaid with a range of national hydrogen growth and use scenarios. The second study focusses on airport infrastructure requirements, translating air traffic forecasts and hydrogen demand into the facilities required to operate, such as electrolysis, liquefaction and hydrogen storage. A third study completes the end-to-end hydrogen supply system, investigating the safe and efficient turnaround of aircraft using liquid hydrogen as a fuel. Together, these studies will enable to FlyZero team to better understand the feasibility and challenges faced by airports preparing for the introduction of a future hydrogen aircraft.

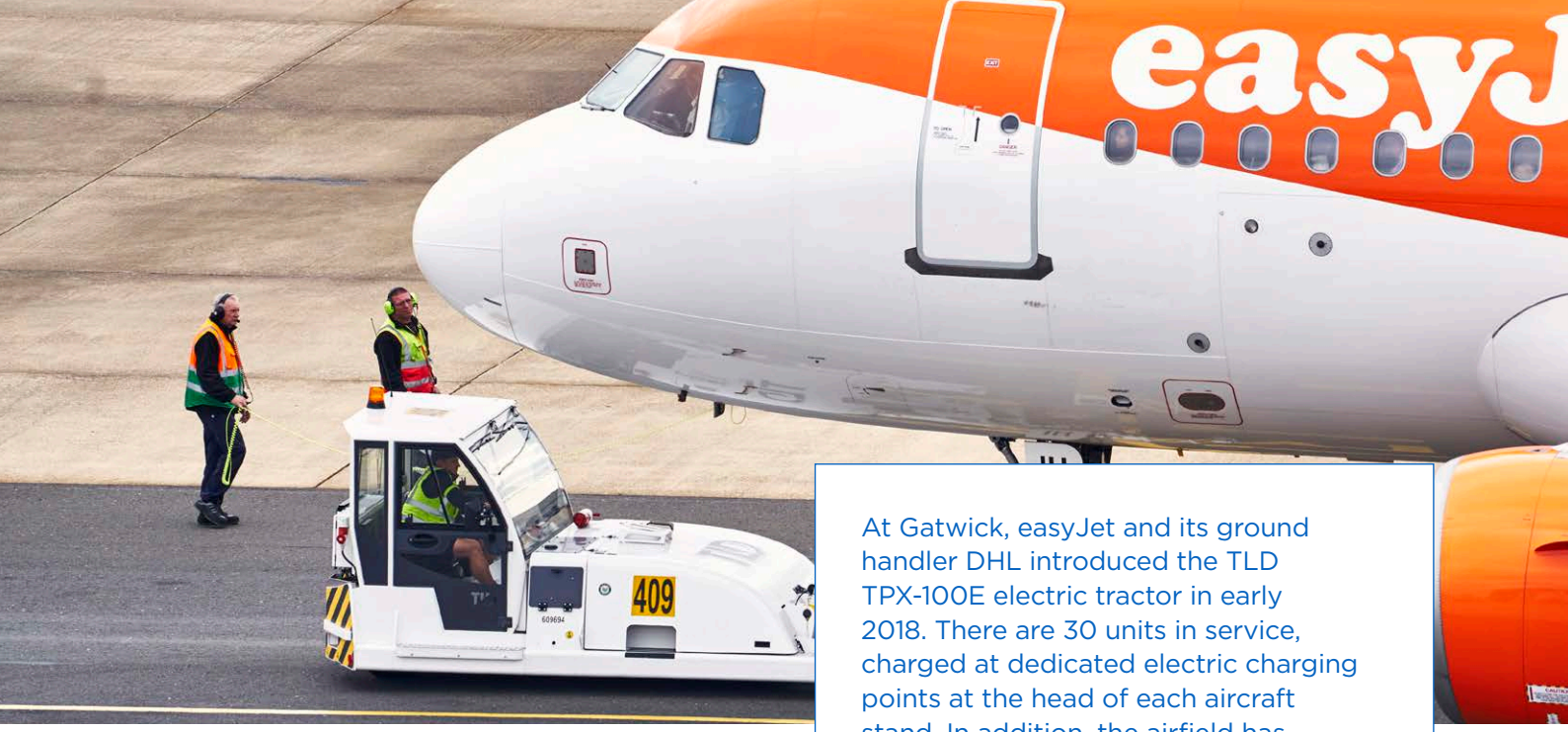
OXFORD — CAMBRIDGE ARC
UNIVERSITIES GROUP

As aviation decarbonises, several different fuel systems are expected to emerge to replace kerosene. With uncertainty regarding final fuel types, the Oxford to Cambridge Arc's Virtual Institute in Aviation (OCAVIA), an emerging research and development programme, is addressing the complex integration challenges of aircraft fuelled by batteries and hydrogen. OCAVIA, which includes London Luton Airport, will consider business models required, operational requirements and the considerable shifts in infrastructure development to accommodate battery charging, liquid and gaseous hydrogen storage and distribution, SAF integration and kerosene retirement in fully functioning environments.

Sustainable Aviation is one of the five economic priority areas identified under the oversight of the Arc's Economy Working Group, resulting in OCAVIA's creation. OCAVIA is overseen by an Industrial Advisory Group of airlines, airports, manufacturers and wider supply chain businesses and it ultimately reports into the Arc's Growth Board. The Arc includes Cranfield University, the UK's only research facility with an operational airport supported by digital facilities to model, simulate and evolve operational environments. It also houses state-of-the-art capabilities in related areas, such as skill developments, supply chain modelling and whole energy system modelling.

The Arc Universities Group: nine universities in the Arc working towards inclusive and sustainable economic growth in an area of designated national economic significance: www.arcuniversities.co.uk





At Gatwick, easyJet and its ground handler DHL introduced the TLD TPX-100E electric tractor in early 2018. There are 30 units in service, charged at dedicated electric charging points at the head of each aircraft stand. In addition, the airfield has over 200 charge-points for electric baggage carts, and 15 charge-points for operational cars and vans such as aircraft leader vehicles.

YOUR LONDON AIRPORT Gatwick

Decarbonising groundhandling operations

Many of the vehicles passengers see driving around the airfield will be vehicles operated by third parties, often groundhandling companies contracted by airlines, who load and unload both freight and luggage, refuel aircraft, ensure other supplies are restocked onboard and a legion other tasks involved in turning aircraft around so they are ready for their next journey.

Airports licence groundhandling companies to operate at airports and can, in some cases, encourage and mandate certain operating conditions. Encouraging the use of low- or zero-emissions vehicles as part of groundhandling operations is an important part of that. However, with groundhandling companies operating usually under severe cost pressures as a result of a very competitive market and tough contractual obligations between airlines and groundhandlers, there can be limited room for groundhandling companies to invest in the necessary equipment.

At London Luton Airport, the airport has introduced pooling of ground support equipment (GSE) with telematics to increase the efficiency of operation and reduce fuel consumption. This reduces the overall equipment used by ground handling companies at airports and the airport has invested in low- or zero-emission GSE. Over 20% of the airport's ground GSE is already electric and they're looking to increase this further. To put it into perspective, emissions from Luton's GSE are equivalent to all the emissions generated by the airport's scope 1 sources. Luton believes it is this show that it is essential to continue influencing its partners in Luton's path to Net Zero.

London Luton Airport

British Airways (BA), working with Heathrow Airport through its Clean Vehicles Partnership, has replaced its fleet of pushback tugs with zero-emission, remote-controlled aircraft pushback tugs for the entire short-haul operation in Terminal 5A. This made BA the first operator and Heathrow the first airport in the world to use multiple electric remote-control tugs on commercial flights.

Heathrow
Making every journey better

Bristol Airport and easyJet are working together to trial equipment and processes to decarbonise aircraft operations at airports and reduce waste. They will work with various expert associates and partners and, where successful, aim to roll out the outcomes of the trials across the easyJet network. Areas of work include:

- electric Ground Power Units
- sustainable aviation fuels
- electric passenger buses
- recycling and waste management
- employee carbon-saving initiatives
- supply chain carbon reductions
- aircraft continuous descent approaches
- zero-carbon emission aircraft turnarounds
- Airbus A320Neo aircraft deployment and fleet optimisation

Bristol Airport
Amazing journeys start here

Waste processing

Airports, those operating at airports and people using the airport generate waste. In their waste-management airports, airports look for opportunities to reduce waste, reuse or recycle waste or find alternative ways to manage the waste generated. As mentioned above, at London Gatwick Airport waste is used to generate heat. Other airports use waste generation in other innovate ways, such as at Birmingham Airport as detailed in the case study.

London Gatwick Airport collects discarded materials from around 2,000 bins across the airport every day. These bins are already separated into different categories, and then Gatwick undertake further sorting at Gatwick's on-site Recycling Facility to maximise reuse, recycling and recovery. Since 2016, this has meant that Gatwick achieved zero waste to landfill each year; and increased reuse/recycling from 52% in 2016 to 71% in 2019. This includes sending 60% of clothing discarded in bins to charity shops for resale (the remainder is recycled into fibres), along with discarded suitcases, umbrellas, pushchairs and sports equipment. All warehouse pallets and 95% of airfield and cargo pallets are returned to suppliers for reuse. All food scraps collected are converted into biofuel; while ash from the biomass boiler and from offsite recovery for electricity (using the remaining non-recyclable or reusable materials) is recycled into secondary aggregates for use in the construction industry.

YOUR LONDON AIRPORT Gatwick

Birmingham Airport

During the pandemic, Birmingham Airport has worked with the on-site shops and restaurants to reduce waste and benefit community projects through the donation of goods and foodstuffs to local charities. In May 2021, this amounted to 2.7 tonnes of goods worth an estimated £16,000. Items, including sweets, snacks, soft drinks, bottled water, gift sets, t-shirts, books, stationery, games, toys and travel accessories, and these were donated to support the work of three local charities: Unite4homeless, Birmingham Children's Hospital and Home Start.

JET ZERO: THE ROLE OF GOVERNMENT

As this report has demonstrated, airports have an ambitious vision to achieve net zero in their operations and support the decarbonisation of others operating on the airfield.

However, while industry can make significant progress on its own, there is a need for a clear partnership with government to drive innovation and speed up adoption of new technologies and opportunities.

In particular, the pandemic has had a devastating effect on the balance sheets of UK airports. With traffic decimated for much of the pandemic and a tentative recovery only just under way, airports have had to reduce their capital investment budgets and reduce expenditure across the board. It is expected that the financial recovery of airport revenues will lag the recovery of passenger numbers, as UK airports compete with European competitors for the return of routes, e.g. through discounting on airport charges. As Steer analysed for the AOA in 2020, non-aeronautical revenue (such as income from retail and car parking) will also be slow to recover, including due to the removal of VAT-free shopping airside (making the UK the only developed country without this offer to passengers).[6] With European airports having had significantly more financial support from their respective governments and able to expand their VAT-free sales to UK-bound travellers, this will make competing for airline routes more difficult for UK airports and that will impact airports' ability to invest.

The coming years cannot and must not be lost years in our journey to net zero. There is therefore a role for the UK and devolved governments to bridge the funding gap for sustainability initiatives.

Airspace modernisation

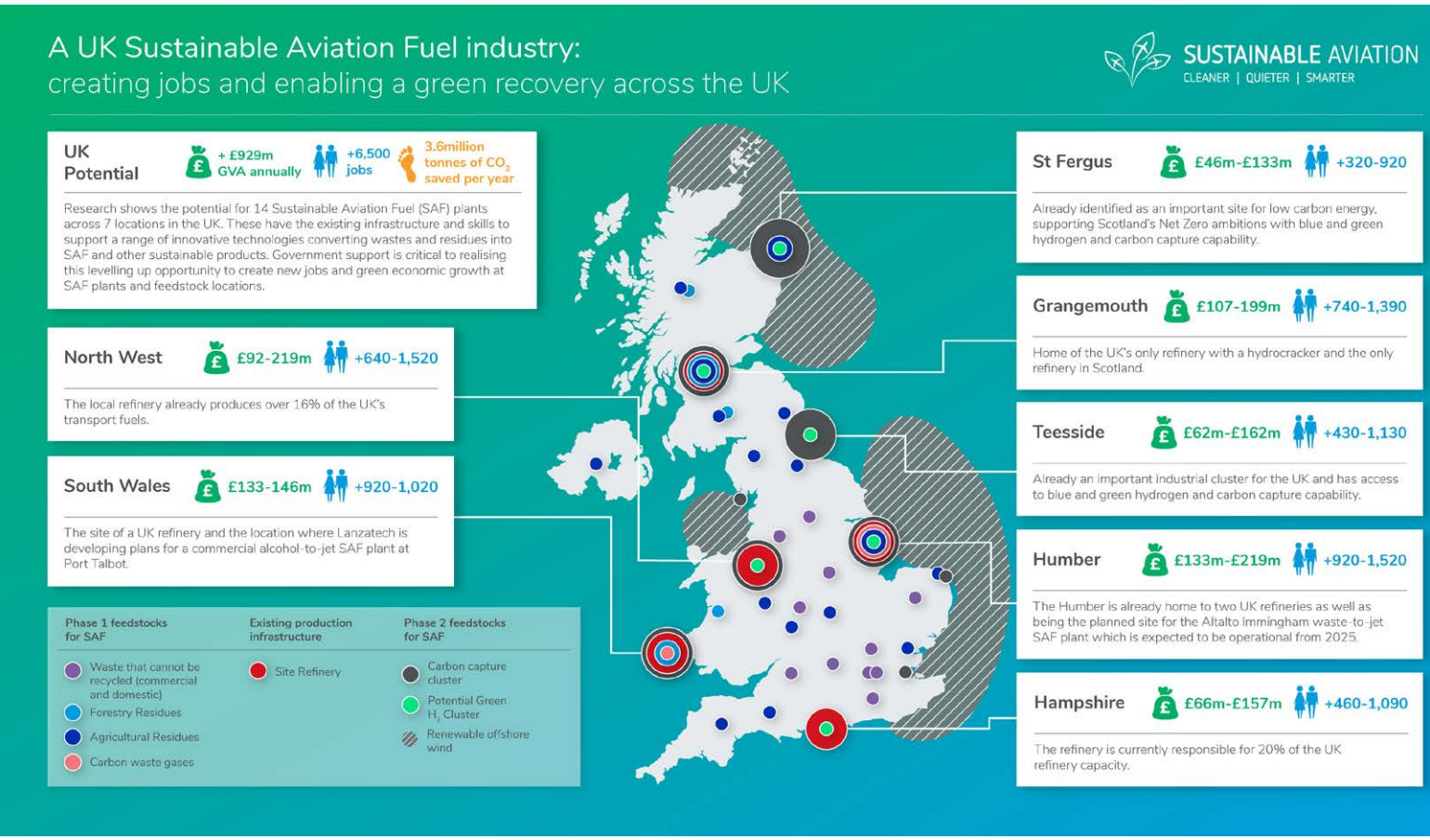
Upgrading UK airspace became Government policy in 2018 and in 2019, the Airspace Change Organising Group was set up to coordinate a masterplan for modernisation between airports and NATS. This work was paused during 2020 because of the pandemic, but it has now remobilised, in large part due to crucial UK Government funding for airports' work to reach the next stage, Stage 2, of the modernisation process.

However, stage 2 is only the initial start of a long and complex airspace change programme, which involves several design and consultation phases with communities and airspace users. The initial government funding has been of great value, it is vital that the Government considers providing further funding to ensure full delivery of airspace modernisation by 2025 given the financial impacts of modernisation. There is also a role for Government to promote the overall need for modernisation and ensure communities understand how the local consultations fit in with wider efforts in aviation to reduce noise and emissions and that this is part of a global move through ICAO, EUROCONTROL and other organisations towards the next generation of air traffic control and airspace management, known as performance-based navigation.

Reducing emissions at airports

As we have set out in this report, airports are committed to sustainability and

[6] AOA, A UK Airport Recovery Plan, <https://www.aoa.org.uk/wp-content/uploads/2021/02/AOA-Airport-Recovery-Plan-1.pdf> (February 2021)



there are real opportunities to build back sustainably post-pandemic. In normal times, most of these would be (part-)funded by airports and the wider aviation industry but, as mentioned above, the Covid-19 pandemic has had a devastating impact on airports' balance sheets. That is why the AOA recommended in our UK Airport Recovery Plan[7] that the UK and devolved governments should step in and bridge the funding gap that is likely to arise in the coming years.

One recommendation in the AOA UK Airport Recovery Plan was that a Green Airports Fund be created. This could bridge the funding gap with grants for power infrastructure for aircraft, scrappage and conversion grants to grow low-emission or zero-emission airside vehicle fleets, renewable electricity and heat generation and other sustainability initiatives.

Longer term, further support for charging infrastructure for electric aircraft and/or hydrogen production/delivery would be required to facilitate infrastructure being ready for significant use of zero-emission flights. For electrical power, this would include addressing quantity of supply to the airport as well as charging infrastructure at it. Clarity would need to be given regarding the status for airports' carbon footprint of electricity supply for zero-emission planes prior to decarbonisation of electricity supply, anticipated for 2035.

Finally, in a number of areas, airports share the same challenges as the wider business community in their road to decarbonisation. This includes, for example, the common challenge of making heat generation more sustainable and net-zero compliant. A society-wide solution is needed on renewable heat generation, which airports would then fit in. This is why the AOA does not believe an airport-specific net-zero target date of 2040 for airports ahead of the rest of the economy, as proposed in the Government's Jet Zero consultation, is appropriate.

[7] AOA, A UK Airport Recovery Plan

The role of airports in decarbonising aircraft emissions

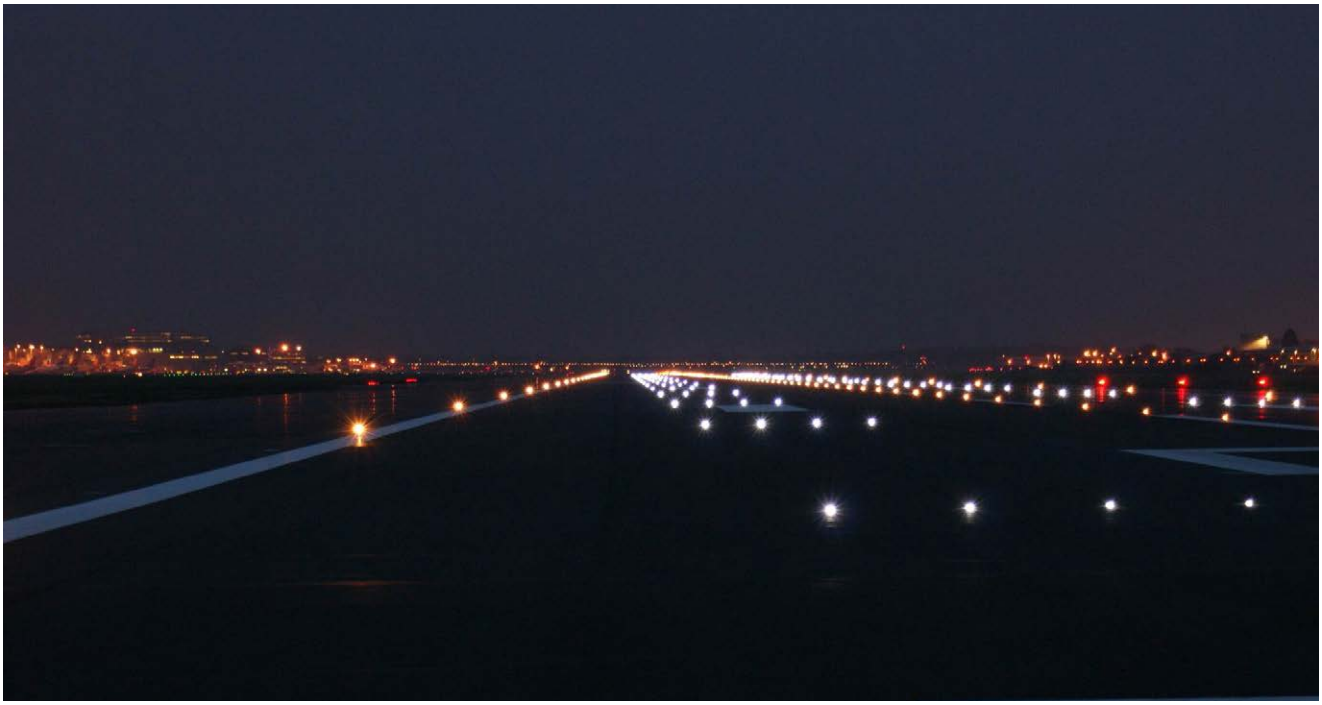
In the UK Government's Jet Zero consultation, there are several proposals included around airports incentivising reduction of aircraft emissions. These include, for example, a proposal to look at variation in slot regulations and landing charges to take account of environmental factors. As noted above, a number of airports already vary their charges to airlines based on the environmental performance (noise and/or emissions) of the aircraft used. While the setting of charges (other than at Heathrow and London Gatwick, where the CAA has a regulatory role) is a commercially negotiated agreement between airlines and airports, a clear framework on environmental pricing structures could be helpful so that, where differentiation is applied, it can act in a co-ordinated fashion to help promote change with UK aviation.

As regards including CO2 charging in the slots system, the AOA believes this should be addressed in the upcoming 18-month World Airport Slot Guidelines review first as this is likely to look at environmental drivers for efficiency. If then needed it can be looked at in the five-year Jet Zero review process. But compared to the importance of delivering the commercialisation of sustainable aviation fuels with government policies to de-risk initial investments, airspace modernisation, etc., CO2 slot charging is not a priority for next few years.

The role of taxation in aviation's road to net zero

Currently, Air Passenger Duty (APD) is a revenue-raising tool, based on the distance flown. It has no environmental credentials, as it does not take account of environmental performance of different aircraft, for example. It could, however, be changed to take better account of environmental impacts. The AOA believes there is a role for taxation in enabling the transition to net-zero aviation.

For example, a reduced APD rate could encourage the uptake of sustainable aviation fuels. When sustainable aviation fuels are available in sufficient quantities to be commercially viable, those flights operating with high levels of such fuels could benefit from lower APD rates, thus help offset the costs involved. Zero-emission flights could even be exempted from APD in future, incentivising the take-up of zero-emission technology as it becomes available for commercial use.



LED lights in operation at London Gatwick Airport

ABOUT THE AOA

The Airport Operators Association (AOA) is the trade association that represents UK airports. Its mission is to see UK airports grow sustainably. The AOA represents the views of UK airports to Government, Parliament and regulators to secure policy outcomes that help deliver its mission. It represents more than 50 UK airports in the UK.

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