

## Executive Summary

People are shunning air travel in parts of Europe, particularly Scandinavia, due to the emissions it generates. Numerous studies point to travel by plane as one of the most emissions intensive modes of travel. For context, aviation carbon dioxide emissions only account for ~2.5% of global emissions.

The number of airline passengers globally is expected to double to 8.2 billion by 2037<sup>1</sup>. Emissions from the aviation sector could more than double by 2050, if the sector does not respond. Governments and industry bodies are implementing policies, including emission reduction targets and aviation taxes, to try to stem the growth in emissions. Airlines and airports are also responding with offset programs and pledges towards carbon neutrality.

The Global Listed Infrastructure fund only invests in aviation through airports and not airlines. Airports globally form roughly 5% of aviation emissions, or roughly ~0.12%<sup>2</sup> of global emissions.

Numerous listed airports are pursuing energy efficiency, emissions reduction and offset programs to reduce their carbon footprint. Our investment process uses an environmental quality ranking that favours airports taking action towards becoming carbon neutral.

Given aviation is likely to remain an emissions intensive industry for the near future, your best bet to fly guilt-free is to fly with airlines that offer carbon offset programs and depart from airports that are on a journey towards carbon neutrality.

## Why are you ‘flight-shaming’ me?



Source: Uproxx.

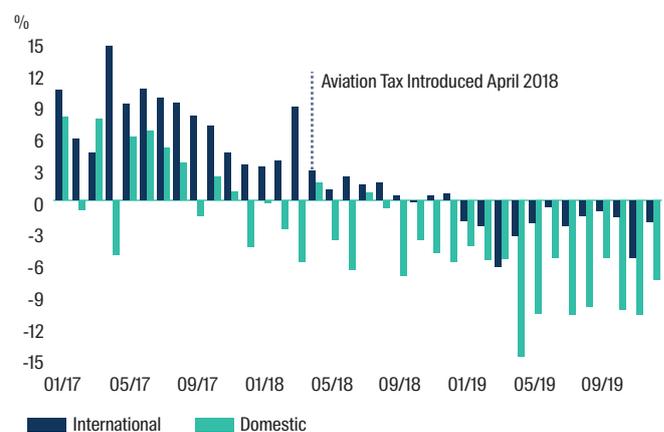
A new motion has been gaining traction in Sweden since the start of 2018, ‘flygskam’, which translates to ‘flight-shaming’. There is growing sentiment in parts of Europe to avoid air travel due to the emissions it generates. Instead, some Swedes are encouraging you to take the train instead, where you can participate in ‘tagskryt’ (train-bragging) on social media for making a more carbon conscious decision. In April 2018 and in response to the growing scrutiny towards aviation emissions, Sweden introduced an aviation tax of between ~6 and 39 euros per passenger to compensate for the emissions generated by flights.

<sup>1</sup> Source: IATA.

<sup>2</sup> Source: Airport Carbon Accreditation.

Both ‘flygskam’ and the Aviation Tax appear to be having a meaningful impact on plane travel, with 37% of Swedes interviewed in May 2019 by SJ (Sweden’s train operator), saying they choose trains instead of flights wherever possible, up from 20% only 18 months prior. Traffic data at Swedish airports also suggests that sentiment against air travel is building, with domestic passenger travel through Swedavia airports (the owner of the 10 busiest airports in Sweden) down 8.5% year-on-year in 2019<sup>3</sup>.

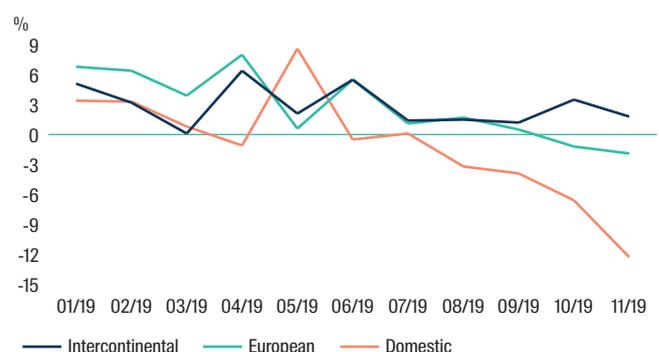
## Swedavia Airports – Total International & Domestic Passenger Growth (YoY %)



Source: Swedavia Traffic Reports.

Whilst the ‘flight-shaming’ movement appears to have originated in Scandinavia, there are some early signs that the movement may have also spread to Germany. In the later months of 2019, domestic aviation passenger growth turned strongly negative in Germany<sup>4</sup>. Whilst this dip could be partly blamed on the weaker economy or temporary industrial action, recent record-breaking heatwaves and abnormally low water levels in the Rhine River (that halted some ship movements and disrupted power production), have elevated climate change as one of the most public issues in the country.

## Germany Aviation Passenger Growth (YoY %)



Source: ADV, Bloomberg.

<sup>3</sup> Source: Swedavia.

<sup>4</sup> Source: ADV Aero.

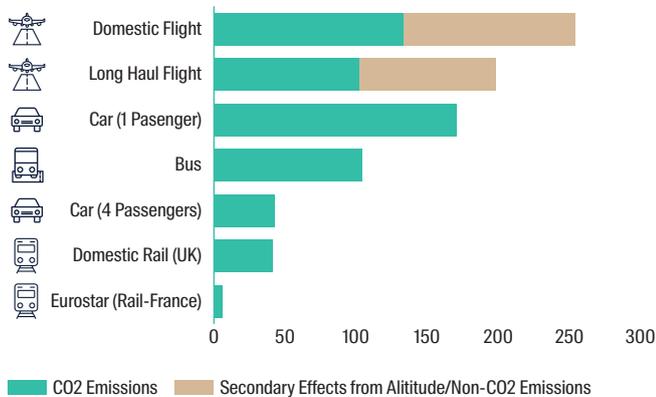
German rail operator Deutsche Bahn (DB) is positioning itself as the clean alternative to air travel, with approximately 60%<sup>5</sup> of the electricity driving their trains sourced from renewables. DB is also investing heavily in their rail network with an ambition to increase the number of long-distance passengers travelling on their network from 148 million in 2018 to ~260 million by 2040<sup>5</sup>.

A similar experience to what is occurring in Sweden and Germany could next move to Switzerland. The October 2019 national elections saw a large increase in votes towards environmental parties with the Greens and Green Liberals securing ~22% of votes (up from ~9% in 2015<sup>6</sup>) and signalling a strong shift in voter interest towards environmental concerns. An aviation tax is also under consideration and the national rail operator is investing heavily to improve connectivity to greater Europe.

## How much cleaner is it to travel by other modes of transport?

Travel by plane can offer substantial time and cost benefits over other modes of travel, particularly at long distances, but studies point to it as one of the most emissions intensive ways to travel.

### Emissions Per Passenger by Transport Mode (CO2 kg per 1,000 km)\*



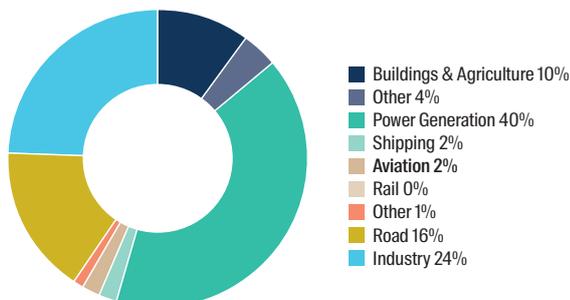
Source: BEIS / Defra Greenhouse Gas Conversion Factors 2019, First Sentier Investors.

\*It is worth noting that comparisons between transport modes rely on assumptions regarding fuel intensity, fuel type, electricity source (for trains), transport occupancy and other, that limit the accuracy of relative comparisons. In the diagram above, cars refer to an average diesel fuelled car.

## How big an impact does aviation have on global emissions?

According to the International Energy Agency (IEA), Transportation currently amounts to 22% of global emissions and aviation accounts for 11% of transportation emissions, this means aviation currently accounts for around 2.5% of global emissions. By contrast, road transportation (cars and trucks) account for 75% of global transport emissions, or the equivalent of ~16% of global emissions.

### Global Carbon Emissions by Industry\*



Source: International Energy Agency.

\*The figures above for aviation, only factor for direct carbon dioxide emissions from fuel burn and do not account for the secondary effects from altitude or non-carbon dioxide emissions. Numerous studies indicate that the warming effect of emissions at altitude (radiative forcing) and the other non-carbon dioxide emissions from planes can be equal to that if not more than carbon dioxide alone.

<sup>5</sup> Source: Deutsche Bahn.

<sup>6</sup> Source: BBC.

Whilst the current emissions footprint from aviation appears small in comparison to other sectors, the outlook is problematic if there is no action to address the growing emissions from the sector.

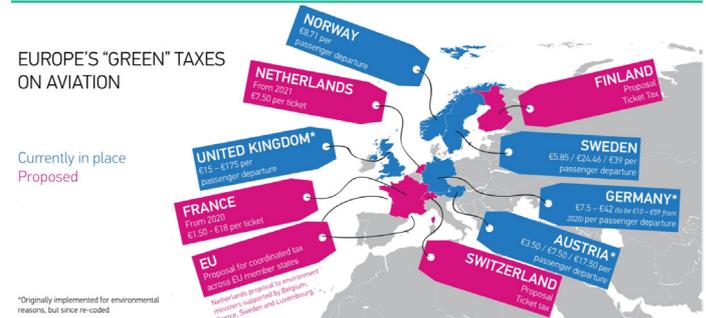
According to the International Air Transport Association (IATA), a trade organisation of 290 global airlines, the number of global air travellers is forecast to double to 8.2 billion by 2037, implying an annual global growth rate of 3.5% per annum. Based on other studies from the International Civil Aviation Organisation (ICAO), if the aviation industry were to take no mitigating actions, emissions from the sector would potentially more than double by 2050. Based on the outlook for emissions from aviation, both governments and the aviation industry are responding with a number of mitigation strategies.

## Aviation Taxes in Europe

Aviation taxes or Air Passenger Duties (APD) have existed for some time in countries such as the UK, Austria, Germany, Norway and Sweden. Aviation taxes are directed at penalising air travel due to the emissions it generates, but it also serves as a means for governments to raise revenue. The UK currently has the highest rates of aviation tax, with a long-haul premium departure tax as high as GBP172 per passenger. A number of other countries including Finland, France, Netherlands and Switzerland are planning to implement an Aviation Tax to curtail the emissions from the sector. The European Union is also considering a coordinated aviation tax regime to cover all countries in the union.

It is unclear whether the proceeds from these taxes will go towards offsetting emissions, investments in more efficient technologies or be used for other purposes.

### Aviation Taxes in Europe – Currently in Place & Proposed



Source: IAG.

## What else is being done to mitigate emissions?

The consensus amongst airlines and aviation industry bodies appears to be that Aviation Taxes are an ineffective measure and merely discourage air travel rather than improve the efficiency of air travel or offset emissions.

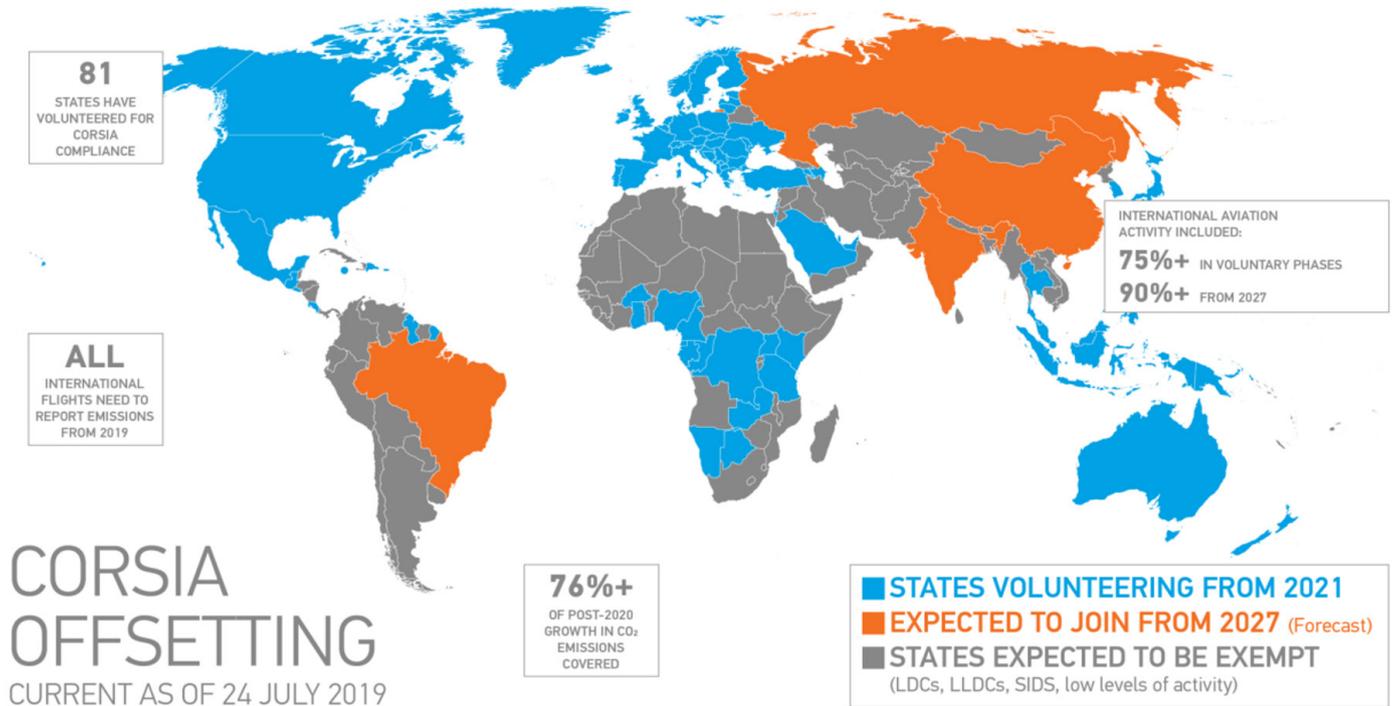
The aviation industry, coordinated by global industry bodies, is instead pursuing a four-pillar strategy to address its climate impact: 1) employing new technology, including the use of sustainable alternative fuels and new more efficient aircraft; 2) more efficient aircraft operations, including higher aircraft utilisation; 3) infrastructure improvements, including modernized air traffic management systems; and 4) a single Global Market-Based Measure (GMBM) for reporting and offsetting emissions.

According to the Air Transport Action Group (ATAG), each new generation of aircraft has double-digit fuel efficiency improvements, up to 20% more fuel efficient than the previous model. This has led to today's modern aircraft producing 80% less carbon dioxide per seat than the first jets introduced in the 1950s. Manufacturers invest roughly US\$15 billion per year in research into greater efficiency. In the future, we may be able to fly on electric or hybrid aircraft but the development of this technology is likely to take decades before it can replace current commercial aircraft.

Policies for improving the energy efficiency of aviation have also been initiated by a number of global agreements: for domestic aviation by the UNFCCC / Kyoto Protocol and for International aviation by the United Nations International Civil Aviation Organisation (ICAO). These policies are largely directed at setting standards for the emissions and energy efficiency of new aircraft. The ICAO has also implemented policies to curb the growth in CO2 emissions of international aviation.

The ICAO adopted the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). The aviation industry will initiate CORSIA in 2021, achieving carbon-neutral growth in volunteer states for international aviation from 2020. All developed ICAO member states will have to implement CORSIA from 2027, so this will require reporting CO2 emissions on an annual basis and offsetting any growth in international emissions via carbon offset programmes.

### CORSIA Global Offsetting Plan



IATA, the global industry body for airlines, has also set a 2050 target to reduce the aviation industry's emissions to half the 2005 level. The plan is ambitious and relies on a combination of sustainable aviation fuels, efficiency measures and new technologies, such as hybrid and electric aircraft to lower sector emissions.

### What are some recent initiatives from Airlines?

A number of airlines are also proactively addressing their climate impact by establishing carbon reduction or carbon neutrality targets. It will be interesting to observe if these initiatives attract 'carbon-conscious' passengers to the airlines over the coming years.

The large, UK-based low-cost carrier EasyJet is carbon offsetting all fuel-related flight emissions from the start of 2020. EasyJet will pay to participate in Gold Standard or Verified Carbon Standard (VCS) certified offset projects globally.

Carbon offset schemes allow individuals and companies to invest in environmental projects around the world to balance out their carbon footprint. The projects are usually based in developing countries and most commonly work to reduce future emissions. This can be done by installing clean technologies or by purchasing and voiding carbon credits from an emissions trading scheme. Other offset schemes work by soaking up carbon dioxide in 'carbon-sinks' directly from the air through the planting of trees. International Airlines Group (IAG), which owns UK airline British Airways, set an objective to be carbon neutral by 2050. British Airways will carbon offset all fuel-related, domestic flights from the beginning of this year.

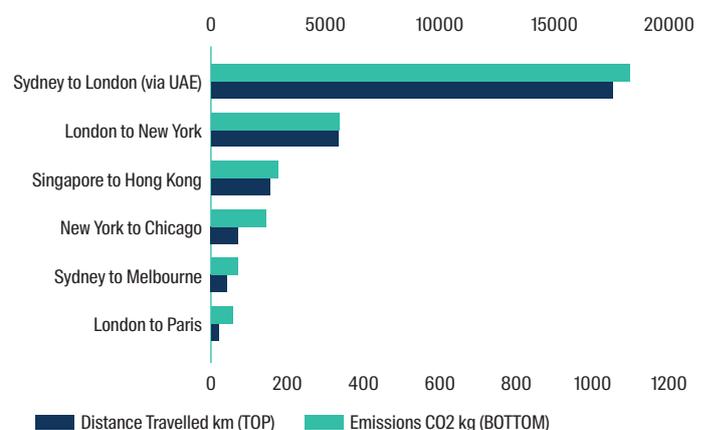
German Airline Lufthansa has made business related air travel for employees carbon neutral since 2019. The group also offers offset programs for travellers via their Compensaid platform.

It is expected over the coming years that a number of other airlines will introduce their own climate initiatives in response to customer demand.

### How emissions intensive is my flight?

The ICAO has developed a methodology to calculate the carbon dioxide emissions from air travel. Using the tool, the diagram below illustrates the emissions generated from some popular air travel routes.

#### Emissions Generated on Popular Routes (one-way per passenger CO2 kg)\*



Source: First Sentier Investors, ICAO Carbon Emissions Calculator.

\*This calculator only factors in the emissions related to fuel burn and does not include the effects of radiative forcing or other non-carbon dioxide emissions.

A trip from Sydney to London (via the United Arab Emirates) generates over one tonne of carbon dioxide per passenger based on the ICAO's calculator. If you were to adjust for the secondary effects of emissions at altitude and other emissions, that figure could likely more than double.

## How much would offsetting flights add to ticket prices?

Offsetting will form a large part of airlines' strategy to address climate change and the cost of these programmes will likely be passed onto customers through higher ticket prices.

The cost to offset one tonne of carbon varies globally by country and the offsetting project, but can range anywhere from AUD15 to as high as AUD40<sup>7</sup>. In Europe, the generally accepted price for one tonne of carbon is set by the European Emissions Trading Scheme (ETS), which currently prices one tonne of carbon at ~€24. Applying the European ETS price to offset the emissions of the popular routes discussed earlier, we can estimate the price impact to a standard one-way economy fare.

### Estimated Cost to Offset Fuel-Burn Emissions on Popular Routes (EUR)\*

Route	Estimated One-Way Ticket Cost (€)	Cost to Offset Emissions (€)	Offset Cost % of Ticket Price
London to Paris	57.0	1.4	2.4%
Sydney to Melbourne	75.0	1.7	2.3%
New York to Chicago	104.0	3.4	3.3%
Singapore to Hong Kong	120.5	4.2	3.5%
London to New York	330.0	8.0	2.4%
Sydney to London (via UAE)	397.5	26.3	6.6%

Source: First Sentier Investors, ICAO Carbon Emissions Calculator, Markets Insider, Skyscanner.

\*It should be noted that this does not include offsetting the secondary effects of non-CO2 emissions or the impact of radiative forcing. Some offset websites will quote a price that adjust for these effects, which is likely to cost more than double the figures above.

Applying the methodology above, estimates of the cost to offset the fuel-burn emissions of a flight range from roughly 2 – 7% of the original ticket price.

If airlines were to offset the emissions of all flights, it is likely that ticket prices would rise and that will likely make it less attractive to travel by plane.

## What could be the impact on Airports?

Airports are sensitive to changes in trends in air travel as they generate income from the number of passengers using their aeronautical assets (runway, terminal buildings, aprons etc.) and from the commercial activities surrounding these assets (duty free, speciality shops, food and beverage, car parks etc.)

The 'flight-shaming' movement appears to be affecting air travel in Sweden and Germany and may spread to other regions in the future. As investors in listed airports, we are closely following this movement as it may adversely affect passenger volumes through listed European airport operators (Fraport in Germany, Zurich Airport in Switzerland, AENA in Spain, Aeroports de Paris in France) and other companies with global airport exposures (Atlantia, Vinci & Ferrovial).

If airline ticket prices were to increase because of offset programmes or aviation taxes, it is likely that less people will fly which will adversely affect the profitability of airports. What remains unclear is whether some customers will be happy to pay the additional cost to offset emissions in order to give them environmental peace of mind. This may counter the negative impact of 'flight-shaming'.

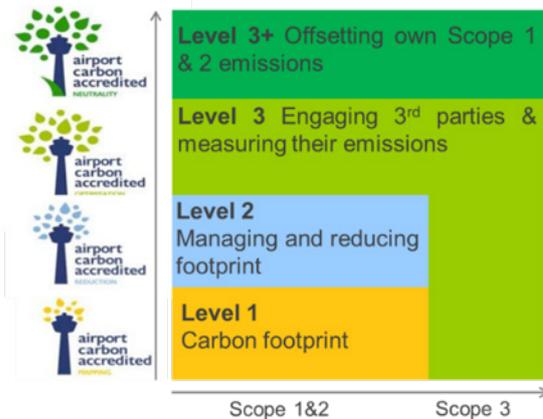
<sup>7</sup> Source: Greenfleet, Myclimate.org.

## How are Airports responsible for emissions?

Airports only account for ~5% of the air transport sector's total carbon emissions (equivalent to ~0.12% of global emissions), but are nonetheless responsible for emissions from a variety of sources. A figure attached at the end of this document by Airport Carbon Accreditation highlights the various sources of emissions at airports.

The Airport Carbon Accreditation (ACA) is the largest initiative to reduce carbon emissions at airports globally and now has 295 airports participating. The scheme maps a four stage journey towards carbon neutrality at airports: 1) mapping / carbon footprint measurement, 2) reduction in the airport operator's carbon footprint; 3) optimisation and engaging with others on the airport site to reduce their emissions; and 4) carbon neutrality and offsetting any residual emissions from the airport operator.

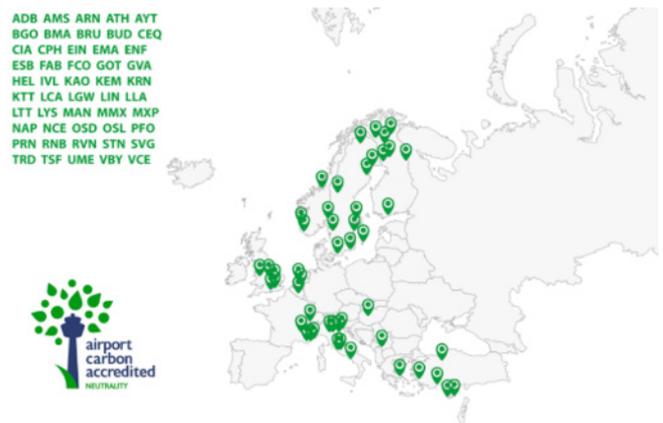
### Airport Carbon Accreditation – Levels of Compliance



Source: Airport Carbon Accreditation.

Since the scheme was implemented in 2009, airports participating have reduced emissions by roughly 1.4 million tonnes. Based on the scheme, there are now 62 carbon neutral airports globally<sup>8</sup>.

### Carbon Neutral Airports in Europe



Source: Airports Council International, Airport Carbon Accreditation. \*Note in late 2019 London City Airport was certified by ACA as a Carbon Neutral Airport.

## How are Airports reducing emissions?

Jet fuels that are part-blended with biofuels are increasingly becoming available at airports globally with the support of airlines. Swedish airports are pioneering the use of bio-fuels, with an ambition for five percent of all fuel used to be fossil free by 2025.

<sup>8</sup> Source: Airport Carbon Accreditation.

A number of airports are entering into long-term power purchase agreements with renewable energy providers to source clean energy. Sydney Airport for example entered into a power purchase agreement in 2018, which will see roughly 75% of its power needs sourced from the Crudine Ridge wind farm in regional Australia.

A growing number of airports are now seeking to become more energy independent and use sustainable energy sources such as wind, hydro and solar. Some airports have installed solar panels onto vacant roof spaces to supplement electricity generation. Listed airport operator, Auckland Airport has installed solar panels on top of the international terminal and office buildings to source renewable energy.

### Rooftop Solar at Auckland Airport



Source: Auckland Airport.

Orly Airport (owned by listed operator Aeroports de Paris) in Paris and Keflavik Airport in Iceland are examples of airports that use geothermal energy to power their facilities.

There are numerous efficiency measures airports can pursue to further reduce emissions. One example includes installing ground based air conditioning systems to cool parked aircraft so that they can turn their engines off and reduce engine emissions. Some airports are also converting ground-based transport to electric or hybrid vehicles (including airports in Amsterdam, Bologna, Cork, Dublin, Frankfurt, Oslo, Zurich and others) and installing eco-efficient lighting in terminals (recent initiatives by listed Mexican airport groups OMAB and ASURB).

### Emissions Reduction Initiatives at selected Listed Airports

<b>Sydney Airport</b>	PPA with a wind farm for ~75% of energy requirements Green Bond with scaling pricing based on ESG initiatives
<b>Auckland Airport</b>	Replaced most of the lights in terminals with light-emitting diodes (LED) Installed solar panels on the international terminal and office buildings
<b>AENA</b>	Rolling out ground based electricity supply so planes do not need to use engines to generate electricity while parked
<b>Aeroports de Paris</b>	Orly Airport sources geothermal energy
<b>Fraport</b>	14% of Frankfurt Airport's vehicle fleet have an electric drive
<b>Flughafen Zuerich</b>	Installing EV charging stations in car parks Agreement to increase energy efficiency by 2% p.a. until 2030
<b>Airports of Thailand</b>	Suvarnabhumi Airport (Bangkok) offers an Electric Vehicle taxi service with charging infrastructure
<b>Beijing Airport</b>	Converting ground-based vehicles from fossil fuels to electric
<b>ASURB</b>	LEED sustainable building certification for Terminal 4 at Cancun Airport
<b>OMAB</b>	Light-emitting diode (LED) lighting for buildings, tracks & roadways. Efficient air conditioning systems in terminals

Source: Company Disclosures.

### Ground based Air-Conditioning Systems for Aircraft at Airports of Thailand



Source: Airports of Thailand.

Encouraged by the Airport Carbon Accreditation scheme, airports are also engaging with carbon-offset programmes to offset additional emissions that they are unable to reduce through other means.

### How does First Sentier Investors select Airports as Investments?

The Global Listed Infrastructure team uses an investment process favouring infrastructure assets that are making a positive environmental contribution, whether this be by reducing emissions, waste or by other means. We have integrated Responsible Investment principles and Environment, Social and Governance analysis into our investment process since the inception of the fund in 2007. Our analysis of airport environmental quality includes but is not limited to scope 1 & 2 emissions, UN sustainable development goals (SDGs), airport carbon accreditation status, the history of environmental controversies and positive environmental initiatives.

### Listed Airports Environmental Quality Indicator

Airport	Scope 1 + 2 Emissions per Passenger (kg CO2e)
<b>Zurich Airport</b>	0.86
<b>AENA (Spain)</b>	1.02
<b>Beijing Airport</b>	1.31
<b>Fraport (Frankfurt)</b>	1.33
<b>Airports of Thailand</b>	1.49
<b>OMAB (Mexico)</b>	1.88
<b>ASURB (Mexico)</b>	1.93
<b>Sydney Airport</b>	1.96

Source: Company Disclosures, Bloomberg, Airport Carbon Accreditation, First Sentier Investors.

We remain conscious of the 'flight-shaming' movement and its impact on airport passenger volumes. The price impacts from offsets and aviation taxes also serve as potential downside risks to airports going forward, but we recognise that the industry is proactively moving to mitigate emissions.

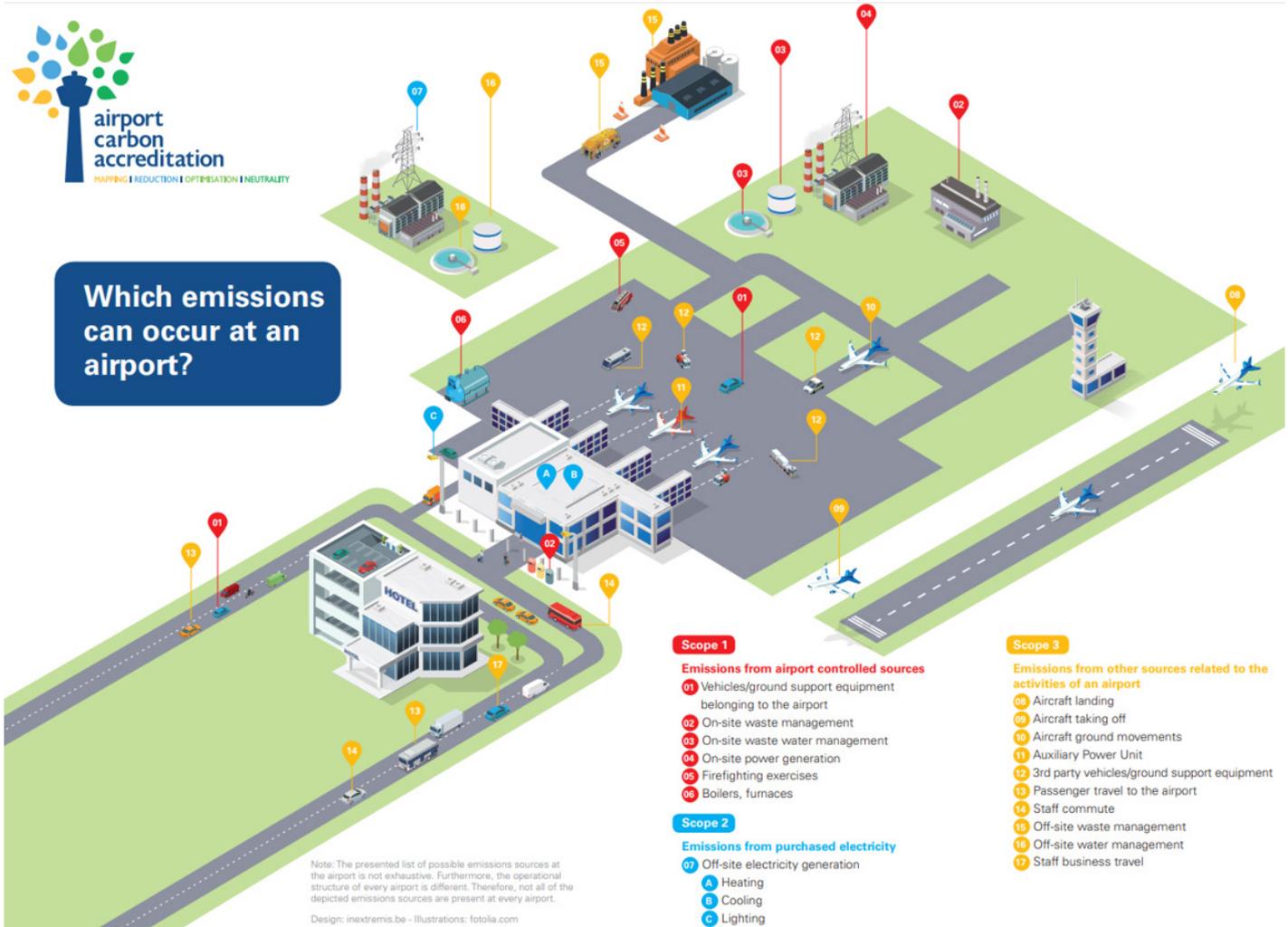
Airports are entrusted by their communities and stakeholders with a social license to operate. By proactively addressing their carbon footprint, airports are lowering the risk of any potential future backlash from their communities and stakeholders over emissions.

We are closely monitoring the journey the aviation industry is taking towards carbon neutrality in Europe where it is more progressed than other regions globally. We see opportunities to work collaboratively with airports in other regions towards carbon-neutrality and to share the experience from Europe.

Given we are investors in an array of infrastructure assets, if the 'flight-shaming' movement expands materially and at the expense of the airports, it may provide a boost to other listed infrastructure assets such as passenger rail (Japan Rail companies, Eurotunnel, CCR and Bangkok Expressway) and tollroad operators (Vinci, Atlantia and others).

Your best option to fly guilt-free is to opt for airports that are on a path towards carbon-neutrality and fly with airlines that are improving their efficiency and that integrate emission-offset programs.

## Potential Sources of Emissions at Airports



Source: Airport Carbon Accreditation.

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