BRIEFING - JUNE 2024

Can living near an airport make you ill?

Aviation’s health effects on populations near airports

Summary

Aviation emissions are a climate concern, and also have a serious impact on air quality. Yet, this issue has not received much attention from regulators or the aviation industry.

When jet fuel is burnt, it releases particulate matter (PM) of different sizes, including ultrafine particles (UFPs), tiny particles below the size of 100 nanometre in diameter - approximately 1000 times smaller than a human hair. Despite growing evidence that **UFP exposure can contribute to respiratory symptoms, heart rate variability, blood pressure problems and have long-term effects on mortality[1],** this pollutant remains largely under researched and unregulated. Transport & Environment's new piece of research explores the link between UFPs and health, for people living near airports.

The study **provides a first estimate of the health effects caused by aviation-related UFPs in Europe**, by summarizing the available scientific evidence, and extrapolating data from the Amsterdam Schiphol Airport area to the main European airports. The analysis estimates that **a total of 280,000 cases of high blood pressure, 330,000 cases of diabetes, and 18,000 cases of dementia may be linked to UFP emissions among the 51,5 million people living around the 32 busiest airports in Europe.**

The study also assesses the correlation between jet fuel quality, UFP emissions and health impact. **The amount of UFPs emitted from flights depends strongly on the composition of aviation fuel.** The study estimates that the use of a 100% hydrotreated jet fuel with very low sulphur and aromatics, which can reduce up to 70% of the number of UFP emissions, would also reduce the associated health impacts by 70%.

To reduce aviation's UFP emissions, and thus improve air quality and mitigate the adverse health impacts, T&E recommends the following measures:

- Address exponential increase in air traffic and air pollution by banning further expansion of airport infrastructure, introduction of flight caps, promoting shift to rail, reducing business travel and targeted taxation of the aviation sector.
- Install sampling points in and around airports in Member States to better quantify UFPs concentration levels with a view of introducing target values for UFP concentrations in next review of the Ambient Air Quality Directive.
- Create an EU jet fuel standard with a progressive reduction of aromatics and sulphur content which will prepare the ecosystem for 0-aromatic, 0-sulphur SAF.

[1] WHO. (2021). Global air quality guidelines

1. Introduction

Besides carbon dioxide (CO_2), planes also emit other gases, such as nitrogen oxides (NOx), oxidised sulphur species and water vapour, and particulate matter (PM)[2]. These "non-CO_2 emissions" have a warming impact on climate, at least as significant as CO_2[3].

Non-CO_2 emissions also impact people's health, especially those living or working in the vicinity of busy airports. Aviation emissions contain a large amount of ultrafine particles (UFPs), a subset of PM emissions which can have a detrimental impact on health different from larger PM emissions[4]. Yet, no comprehensive study has been conducted at the European level on the potential link between aviation's UFP emissions and the increased risk of certain diseases, or the worsening of existing medical problems.

To address this gap, this report provides a first order estimate of the health impact of aviation's UFP emissions in Europe. The report utilizes UFP concentration levels around Amsterdam Schiphol Airport and the associated health effects in that area by the National Institute for Public Health and the Environment of the Netherlands (RIVM)[5], and extrapolates them to the population living within 20 kilometres of the 32 busiest airports in Europe (ranked on flight activity in 2019).

Thereafter, the analysis quantifies the reduction of air pollution thanks to improved jet fuel quality, describes additional possible solutions to mitigate these adverse health effects, and provides policy recommendations to improve air quality around airports.

2. Aviation's impact on health

2.1 Overview

The World Health Organization (WHO) considers air pollution the greatest environmental risk to health in the world[6]. Aircraft contribute to air pollution through the emission of a wide range of pollutants, including particulate matter (PM), nitrogen oxides, carbon monoxides, hydrocarbons, volatile organic compounds, black carbon and

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[2] Particulate matter (PM): small particles below 10 micrometres in diameter.

[3] EASA (2020), Updated analysis of the non-CO2 climate impacts of aviation and potential policy measures pursuant to EU Emissions Trading System Directive Article 30(4)

[4] Schraufnagel, D. E. et al. (2020). The health effects of ultrafine particles

[5] RIVM (2022). Health effects of ultrafine particles from air traffic around Schiphol

[6] World Health Organization (2016). Ambient air pollution: a global assessment of exposure and burden of disease

sulphur dioxide. These may be linked to conditions such as respiratory problems, certain types of cancer and cardiovascular diseases[7].

Out of all the different sources of air pollution, outdoor PM exposure alone is the fifth leading risk factor for death globally, accounting for 4.2 million deaths and over 103 million disability-adjusted life years lost[8].

Aviation is a primary source of PM pollution around airports. A significant share (14%) of aviation PM emissions occur during the relatively short landing and take-off cycle, and PM emitted by aircraft spread in a larger area surrounding airports[9] compared to road transport PM emissions.

Long term exposure to aviation PM emissions results in an estimated number of premature deaths between 14,000[10] and 21,200[11] every year, and may be related with cardiovascular issues and hospitalisation for asthma, respiratory, and heart conditions. Short term exposure can cause symptoms like coughing and difficulty breathing.

2.2 Focus on ultrafine particles

PM can be classified according to its size, which influences the particles' behaviour and their ability to penetrate human tissues: coarse particles (PM10), with a diameter between 2.5 and 10 microns; fine particles (PM2.5), between 100 nanometres and 2.5 microns; and ultrafine particles (UFP), with a diameter of less than 100 nanometres, or 1000 times smaller than the diameter of a human hair**.** UFPs, due to their smaller size, can penetrate deeper into the body, enter the bloodstream and reach internal organs, such as brain and placenta[12], posing unique health risks compared to larger PM.

The WHO and European legislation both recognise the significance of UFPs and the existing body of evidence on their effects on human health. The latest revision of the

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[7] Moreno-Rios, A.L. et al (2022).Sources characteristics, toxicity and control of ultrafine particles

[8] Murray, C. J. L. et al. (2020). Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study.

[9] UFP concentrations tend to follow a “rapid decay” spatial pattern with a decrease in concentration by at least 50% over a distance of 150 m away from the major roadway, with a gradual decay to the background thereafter over a distance of 500 m.
Austin E. et al.(2021) Distinct ultrafine particle profiles associated with aircraft and roadway traffic

[10] Yim, S. H. L. et al. (2015). Global, regional and local health impacts of civil aviation emissions.

[11] Sebastian D. Eastham, S. D. et al. (2024). Global impacts of aviation on air quality evaluated at high resolution

[12] Behlen, J. C. (2020). Gestational Exposure to Ultrafine Particles Reveals Sex- and Dose-Specific Changes in Offspring Birth Outcomes, Placental Morphology, and Gene Networks

EU's Ambient Air Quality Directive (AAQD)[13] requires the mandatory monitoring of UFPs, and airports are considered as air pollution hotspots, requiring careful attention by Member States. However, **no limits of UFP concentration are defined** neither by the WHO nor by the AAQD.

This study focuses on the health impact of ultrafine particles (UFPs) on people living near the 32 busiest European airports. Almost all PM emissions from aviation are UFPs, so studying their effects is essential to understand the health impact of the sector.[14]

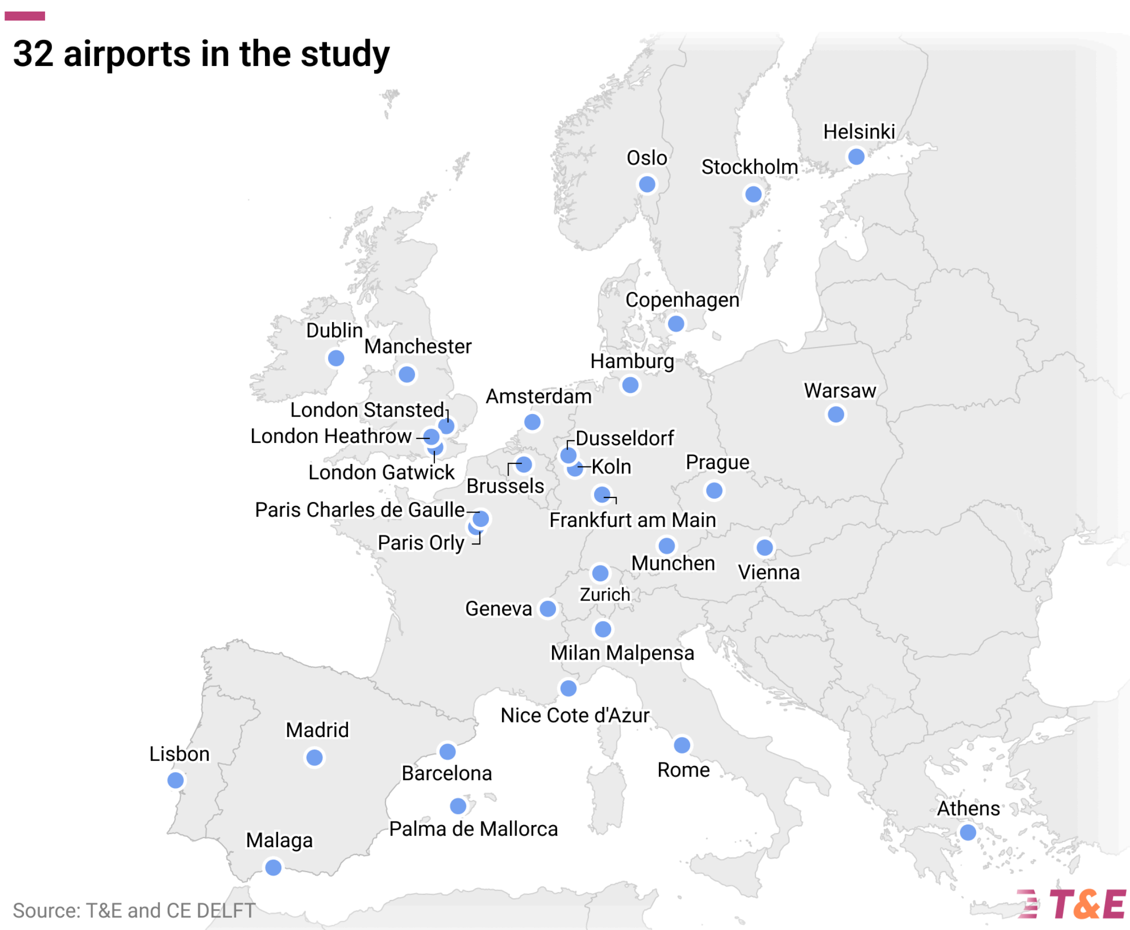

Figure 1. Map with the 32 airports in scope of the study

Although not covered by this study specifically, airport personnel working on the apron are some of the most exposed to these emissions, constituting an unquantified but serious risk to their health.

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[13] Commission, 'Proposal for a Directive of the European Parliament and of the Council on ambient air quality and cleaner air for Europe', COM(2022) 542 final

[14] WHO. (2021). Ambient (outdoor) air quality and health

3. Methodology

This report gathers the results from the RIVM's UFP study around Amsterdam Schiphol Airport, and extrapolates them to the 32 busiest European airports to obtain a first level estimate of the health effects of UFP exposure around those airports. The extrapolation assumes that UFP pollution grows linearly with air traffic, and that this pollution is spread evenly around each airport[15].

3.1 UFP health impacts around Amsterdam Schiphol Airport

The RIVM study evaluated the possible correlation between exposure to UFP pollution from Amsterdam Schiphol Airport and respiratory, cardiovascular, neurological and metabolic effects, psychological problems, and pregnancy outcomes.

First, researchers performed a series of measurements around Schiphol Airport to find out the levels of UFP concentrations due to air traffic in the airport surroundings. They found concentrations between 4000 to 30000 particles/cm^3 within 5 kilometres of the airport, 3000 to 6000 particles/cm^3 between 5 and 10 kilometres, and 1000 to 4000 particles/cm^3 between 10 and 20 kilometres. These estimates are aligned with recent measurement campaigns around Paris Charles de Gaulle[16] and Copenhagen airports[17]. UFP concentrations in city centres, including road traffic and other sources, can range between 3000 and 12000 particles/cm^3, highlighting the important contribution of airports to UFP pollution[18].

The RIVM study found strong associations between long-term exposure to UFPs and self-reported cases of diabetes, and with self-reported medication use for high blood pressure and dementia. It also found possible associations with early birth and small for gestational age-born children, with mortality due to Alzheimer, and probable relation with congenital abnormalities. Short-term exposure was also found to worsen existing respiratory problems and to increase the use of asthma medication.

All associations were corrected for exposure to other pollutants, such as nitrous oxides, PM2.5 and soot. Long term effects were also corrected for exposure to noise pollution.

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[15] Prevalent wind patterns can have an impact on the distribution of UFPs around airports. By assuming even spread of UFPs, health effects may be overestimated for populations upwind from airports and underestimated for those downwind from airports.

[16] Airparif - High level of ultrafine particles measured near an airport (in French)

[17] Danish National Center for the Environment and Energy - Large quantities of ultrafine particles from Copenhagen Airport (in Danish)

[18] Trechera, P. et al. (2023). Phenomenology of ultrafine particle concentrations and size distribution across urban Europe

3.2. Extrapolation to major European airports

To estimate the health conditions which may be linked to exposure to UFP from aviation, the UFP concentrations around the 32 airports in scope were estimated from the concentrations around Schiphol Airport. These concentrations were then overlapped with the population density around each airport, using population distribution data[19], to assess the amount of people exposed to different UFP concentration levels.

Subsequently, the increased health risks were estimated only for health effects that are strongly associated with UFP exposure according to the RIVM study: high blood pressure, dementia and diabetes (judging from self reports and medication use).

Finally, the number of people exposed to different UFP concentration levels was multiplied by the corresponding increased risks[20] of suffering the health conditions above. From this, the total number of cases for those health conditions was derived.

4. Health impacts of UFPs around major European airports

4.1. UFP emissions concentrations and exposed population

The study finds that 52 million people live within 20 kilometres of the 32 airports in scope, exposing them to increased health risks from UFPs. This population is then divided into three groups, depending on distance from the airport: 5 kilometres, 5-10 kilometres, and 10-20 kilometres.

The 3.8 million people living within 5 kilometres from the airports in scope are the most affected, with estimated average UFP concentrations of 5000 particles/cm^3, going up to 10.000 particles/cm^3 around airports like Paris Charles de Gaulle or London Heathrow.

In many cities, a correlation between people living near an airport and lower incomes can be found[21]. This shows once again that the most vulnerable in society are most affected by air pollution.

4.2. Increased health risks

The RIVM study quantified the increased risks of high blood pressure, diabetes and dementia due to exposure to aviation UFP pollution, compared to the average

[19] Schiavina, M. et al. (2019). GHS-POP R2019A - GHS population grid multitemporal (1975, 1990, 2000, 2015).

[20] The relative risks in the RIVM study for the population exposed to UFP pollution near Amsterdam Schiphol are assumed to be the same for any person exposed to the same level of UFP pollution around other airports.

[21] Simon M.C. et al. (2022). Sociodemographic Patterns of Exposure to Civil Aircraft Noise in the United States

population. The figure below shows the increased risks of those health conditions for the population in scope of the study.

The risks of suffering from diabetes and dementia are estimated to be more than 20% higher for people living within 5 kilometres from the airports analysed, whereas high blood pressure risk goes up by 7%.

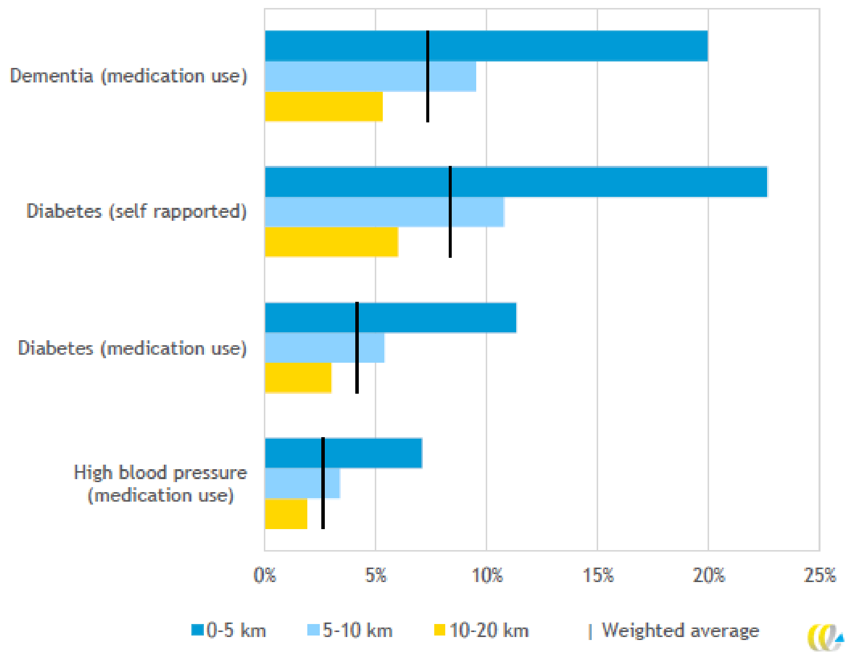

Figure 2. Increased risk of analysed health conditions due to UFP exposure

4.3. Health effects of UFPs around major European airports

The analysis estimates that **aviation UFPs may possibly be associated to 280,000 cases of high blood pressure, 330,000 cases of diabetes and 18,000 cases of dementia** around the 32 major European airports.

The two most important factors that influence the health impact of different airports are air traffic and population density around them. Paris Charles de Gaulle or London Heathrow are good examples of high estimated health impact due to a high volume of air traffic. Lisbon airport, on the other hand, also has a strong impact on the local population in spite of a relatively lower air traffic, due to its location, very close to Lisbon city centre and to other neighbouring populations. A more detailed breakdown of the results can be found in Annex 1.

Airport	Aircraft movements (x1000)	Population (x1000) per airport distance			
		0-5 km	5-10 km	10-20 km	0-20 km
Paris Orly	224	258	1181	4970	6410
Paris Charles de Gaulle	511	82	488	3425	3995
Madrid Adolfo Suarez	426	207	1082	2549	3837
London Heathrow	481	110	653	2732	3495
Barcelona El Prat	344	159	944	1656	2760
Lisbon	222	414	619	1181	2215
Warschaw Chopina	191	247	730	1163	2140
Brussels	223	112	579	1322	2013
Dusseldorf	226	169	452	1365	1986
Hamburg	155	208	592	1144	1945

Table 1. Population impacted for the top-10 most populous areas in the study. Full results can be found in Annex 1 (link)

It is important to note that only health conditions with a strong association with UFP exposure have been analysed. Conditions with possible or probable association with UFP exposure from the RIVM or other research, such as early birth or congenital abnormalities, are not considered in this study. This means that **the health impact of UFPs around major European airports is likely bigger than estimated by this analysis**.

The impact of other pollutants, and the effect on other exposed populations, particularly airport workers and populations around smaller airports, add as well to the health impact of aviation.

5. Mitigation of air pollution around airports through modified jet fuel composition

Aviation emissions depend upon a variety of factors, including jet fuel composition, engine and aircraft technology, engine thrust settings or ground operations. Out of those factors, the study analyzes the role of jet fuel composition on engine emissions, and how improvements in jet fuel quality can play an essential role in mitigating air pollution.

5.1 Impact of jet fuel composition on aviation emissions

Jet fuel consists of a mix of many different types of molecules, made mostly of carbon and hydrogen, plus some impurities. The composition of jet fuel is closely linked to the mass and number of PM emissions that an aircraft engine releases.

Aromatic compounds[22] are hydrocarbon molecules usually present in jet fuel. These compounds, especially polyaromatics (naphthalene), have poor combustion properties, so the aromatic content in jet fuel is related to non-volatile PM emissions.

The amount of sulphur in jet fuel also plays a critical role in aviation emissions, as it is directly related to the emissions of sulphur oxides and volatile PM.

5.1.1 Types and composition of different types of aviation fuels

Fossil jet fuel, produced from crude oil, represents more than 99% of aviation fuel used today. Jet fuel follows the ASTM D1655 specification, which sets maximum limits of 25% for aromatics, 3% for naphtahelene, and 3000 parts per million (ppm) for sulphur[23]. Its typical composition has an aromatics content ranging from 12 to 20%, naphthalene between 1 and 3%, and sulphur between 300 and 600 ppm.

Sustainable aviation fuels (SAFs) are produced from feedstocks which capture carbon from the atmosphere, reducing their carbon footprint. Most types of SAF are naturally low in aromatic compounds and sulphur, leading to a reduction in PM emissions, with positive effects on air quality. Although they are key to reducing the climate and air quality impacts of aviation. Nonetheless, they only represented 0.2% of jet fuel in 2023[24], and their production will take time to scale up - more than half of jet fuel in Europe may still be fossil well into the 2040s.

Before the scale up of SAFs, the composition of fossil jet fuel can be improved to reduce its air quality impacts, thanks to a set of refinery processes called hydrotreatment, which have been used for decades to reduce sulphur from road transport and maritime fuels[25]. Hydrotreatment can reduce sulphur and aromatics from jet fuel at an estimated cost of less than 0.05€/litre, with a hydrogen use below 10 kilograms per ton of fuel[26]. This hydrogen should be green to maximise the climate benefits of the fuel.

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[22] Aromatics contain at least one aromatic (benzene) ring, with polyaromatics containing more than one ring.
[23] ASTM D1655-21c - Standard Specification for Aviation Turbine Fuels
[24] IATA - Net Zero 2050: sustainable aviation fuels fact sheet
[25] Kokayeff, P. et al. (2014). Hydrotreating in Petroleum Processing.
[26] MathPro (2023). Techno-economic assessment of process routes for naphthalenes control in petroleum jet fuel

Info box : increased transport fuel quality and the aviation anomaly

The link between fuel quality and air pollution has been known for decades. European standards for road transport fuels were improved to reduce the maximum sulphur content, from 2000 ppm (diesel) and 500 ppm (petrol) in 1997 down to 10 ppm in 2009[27]. Similarly, the maximum sulphur content in the international standard for maritime fuels was reduced from 4.5% in 2011 to 0.5% in 2020[28].

The impact of sulphur in aviation fuels has also been analysed in the past. A study commissioned by EASA and published in 2010[29] found that reducing sulphur in jet fuel could reduce health impacts, with an estimated monetised benefit between 130-430 M€/year in Europe. This study did not take into account the benefits of a reduction in aromatics, which would add up to those of sulphur reduction.

However, the publication of the study did not lead to specific measures to reduce sulphur content in jet fuel, leaving millions of people exposed to avoidable health risks.

5.2 Estimated benefits of hydrotreated jet fuels and SAF

Hydrotreated jet fuels, due to a lower content of aromatics and sulphur, would reduce the number of UFP emissions and their associated health effects.

Hydrotreatment processes reduce first sulphur, then polyaromatics (naphthalene), and subsequently monoaromatics. Since sulphur is reduced very quickly, and naphthalene is more linked to PM emissions than monoaromatics, even fuels which undergo a light hydrotreatment process can have important benefits in terms of PM reduction[30].

Due to limited data on combustion tests of hydrotreated fuels, this study estimates its benefits using test results from combustion tests using blends of SAF and fossil jet fuel, which also contain less aromatics and sulphur than regular fossil jet fuel. One study found that PM emissions were progressively decreased with higher SAF blends, reducing more than 75% in particle numbers and 90% in particle mass for 100% SAF

[27] Directive 2003/17/EC of the European Parliament and of the Council of 3 March 2003 amending Directive 98/70/EC relating to the quality of petrol and diesel fuels
[28] MARPOL Annex VI - Regulations for the Prevention of Air Pollution from Ships
[29] EASA (2010). Reduction of sulphur limits in aviation fuel standards (SULPHUR).
[30] CE Delft (2022). Social costs and benefits of advanced aviation fuels.

compared to a fossil jet fuel baseline[31]. That study also confirmed that most PM emissions are smaller than 100 nanometers, falling within the UFP category.

Other ground based measurements of jet engine emissions showed similar results[32], confirming the emissions reductions of using SAF with low aromatics and sulphur.

It must be noted that, on top of jet fuel combustion, lubrication oils used in jet engines also contribute to PM emissions, with some studies estimating around 9% of particle mass coming from this source[33]. The analysis assumes that lubrication oils are also responsible for a 9% of particle numbers. The reduction in particle number emissions due to the use of SAF blends does not affect the PM emissions from lubrication oils. Consequently, the total reduction of PM emissions is of 70% for particle number and 80% of particle mass.

As health risks from UFPs are related to the number of particles emitted, **using fuels with lower sulphur and aromatics such as SAF blends or hydrotreated fuels can reduce UFP health risks by up to 70%.**

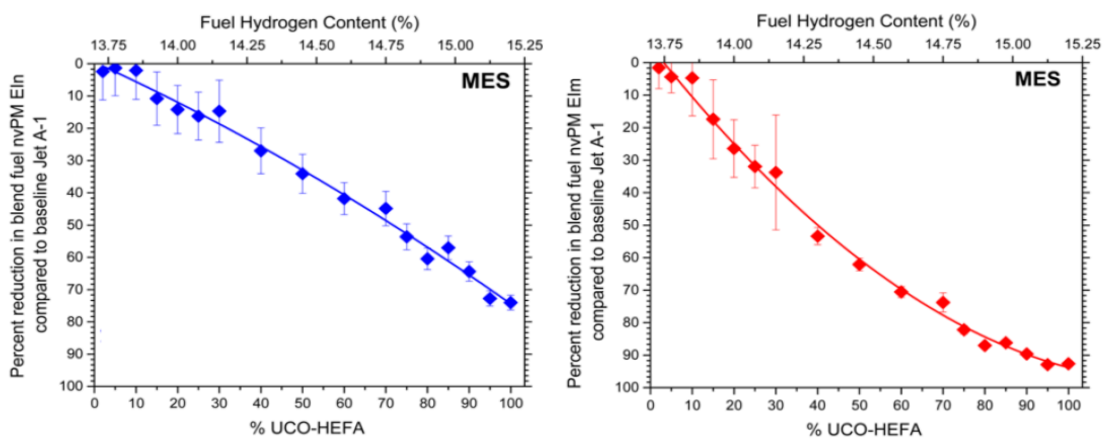

Figure 3. Non-volatile particulate matter emissions behaviour, in terms of number (left) and mass (right), for fuel blends with a varying proportion of SAF and jet fuel

[31] Lobo, P. et al. (2015). Evaluation of Non-volatile Particulate Matter Emission Characteristics of an Aircraft Auxiliary Power Unit with Varying Alternative Jet Fuel Blend Ratios

[32] Schripp, t. Et al. (2022). Aircraft engine particulate matter emissions from sustainable aviation fuels: Results from ground-based measurements during the NASA/DLR campaign ECLIF2/ND-MAX

[33] Ungeheuer, F. et al. (2022). Nucleation of jet engine oil vapours is a large source of aviation-related ultrafine particles.

6. Other measures to improve air quality around airports

On top of increased jet fuel quality, other measures can also be effective in tackling the air pollution in and around airports.

Due to a lack of systematic measurements and legal concentration level of UFPs, millions of people working at or living near airports are exposed to unknown levels of harmful air pollution. Measuring UFP levels at and around airports, and setting target values for this pollutant, are crucial to better understand and mitigate its health impact.

In the short term, limiting air traffic growth remains the most effective measure to curb aviation emissions and air pollution. Measures such as flight caps, or replacement of short haul flights by rail alternatives, can help keep air travel within reasonable limits. Stopping airport expansions is also key to make sure aviation does not keep growing its impact on climate and local populations.

Optimising airport ground operations[34] or more efficient jet engines can reduce emissions in and around airports, while future zero-emission aircraft may either reduce or almost eliminate aircraft tailpipe emissions[35].

7. Conclusions and policy recommendations

This study highlights how aviation emissions of gases and particulate matter (PM) not only affect climate, but also air quality, focusing on the effects of ultrafine particles (UFPs). Tens of millions of Europeans are exposed to increased health risks due to aviation UFPs.

Fortunately, reducing air traffic and improving jet fuel quality can mitigate the problem in the short term, with additional climate benefits. SAF with low aromatics and sulphur and other technological solutions could further reduce emissions in the mid to long term.

To reduce aviation's UFP emissions, and thus improve air quality and mitigate the adverse health impacts, T&E recommends the following measures:

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[34] Optimisation of airport ground operations comprises measures such as reducing taxiing times, single engine taxiing, limiting APU use or electrifying ground equipment.

[35] Hydrogen combustion engines will eliminate non-volatile PM emissions, but will still emit nitrous oxides. Hydrogen fuel cell propulsion will eliminate both nvPM and nitrous oxides emissions, whereas electric propulsion has zero exhaust emissions. These aircraft may still emit VOCs and volatile PM, e.g. from lubrication oils, and also dust from brakes and tyres.

- Address exponential increase in air traffic and air pollution by banning further expansion of airport infrastructure, introduction of flight caps, promoting shift to rail, reducing business travel and via targeted taxation of the aviation sector.
- Install sampling points in and around airports in Member States to better quantify UFPs concentration levels with a view of introducing target values for UFP concentrations in next review of the Ambient Air Quality Directive.
- Create an EU jet fuel standard with progressive reduction of aromatics and sulphur content which will prepare the ecosystem for 0-aromatic, 0-sulphur SAF.

Further information

Carlos López de la Osa

Aviation Technical Manager

carlos.lopez@transportenvironment.org

Mobile: +34 626053843

Krisztina Toth

Aviation Policy Manager

krisztina.toth@transportenvironment.org

Mobile: +32 490 51 07 63

Annex I. Population impacted per airport, and estimated number of health conditions per country

Airport	Aircraft movements (x1000)	Population (x1000) per airport distance			
		0-5 km	5-10 km	10-20 km	0-20 km
Paris Orly	224	258	1181	4970	6410
Paris Charles de Gaulle	511	82	488	3425	3995
Madrid Adolfo Suarez	426	207	1082	2549	3837
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Brussels	223	112	579	1322	2013
Dusseldorf	226	169	452	1365	1986
Hamburg	155	208	592	1144	1945
Amsterdam Schiphol	509	88	487	1198	1773
Koln	143	99	310	1355	1764
Frankfurt am Main	508	135	449	1172	1757
Manchester	201	101	379	1255	1735
Athens Eleftheros Venizelos	220	18	93	1507	1617
Prague Ruzyne	144	86	264	1037	1388
Zurich	243	102	404	788	1294
Dublin	239	127	373	780	1280
Helsinki Vantaa	194	81	272	786	1139
Copenhagen Kastrup	263	76	223	827	1126
Vienna Schewchat	282	14	49	944	1006
Milan Malpensa	234	46	212	651	909
Malaga Costa Del Sol	144	244	359	293	896
Nice Cote d'Azur	178	143	308	399	850
Geneva	146	225	316	244	785
Roma Fiumicino	311	20	103	585	708
London Gatwick	284	81	125	438	644
Palma de Mallorca	217	130	250	177	557

Munchen	417	24	66	246	336
London Standsted	195	21	62	199	282
Stockholm Arlanda	232	14	21	131	166
Oslo Gardermoen	253	16	24	67	107

Table 2. Population impacted for the 32 airports in the study

Country	**Aircraft movements for in scope airports (x1000)**	**Population (x1000) per airport distance**				**High blood pressure (from self report)**	**Diabetes cases (from self report)**	**Dementia (from medication use)**
		0-5 km	**5-10 km**	**10-20 km**	**0-20 km**			
Belgium	223	112	579	1322	2013	7055	7526	492
Czechia	144	86	264	1037	1388	4507	4825	203
Denmark	263	76	223	827	1126	4920	4415	410
Germany	1449	635	1870	5283	7788	49587	52691	1975
Ireland	239	127	373	780	1280	3541	7814	594
Greece	220	18	93	1507	1617	4705	6145	934
Spain	1132	740	2635	4675	8050	52205	64918	5339
France	914	483	1977	8794	11255	46836	66309	1441
Italy	545	66	315	1236	1617	7140	7280	276
Netherlands	509	88	487	1198	1773	12786	14740	246
Austria	282	14	49	944	1006	4181	3682	270

Poland	191	247	730	1163	2140	11504	11252	673
Portugal	222	414	619	1181	2215	15473	18615	1837
Finland	194	81	272	786	1139	5475	6097	928
Sweden	232	14	21	131	166	611	677	39
Norway	253	16	24	67	107	436	415	24
Switzerland	389	327	720	1031	2078	9428	11122	266
United Kingdom	1160	313	1219	4623	6155	40846	44165	2209
Total	**8560**	**3858**	**12468**	**36588**	**52914**	**281234**	**332687**	**18157**

Table 3. Population impacted and number of health conditions for the 32 airports in the study, grouped per country