

STUDY

Requested by the PETI committee



Impact of aircraft noise pollution on residents of large cities



Policy Department for Citizens' Rights and Constitutional Affairs
Directorate-General for Internal Policies
PE 650.787- September 2020



Impact of aircraft noise pollution on residents of large cities

Abstract

This study, provided by the Policy Department for Citizens' Rights and Constitutional Affairs at the request of the Committee on Petitions, aims to provide a clear and simple overview to the non-expert reader, on the Impact of aircrafts noise pollution on residents of large cities, as well as to give recommendations addressed to the most relevant actors.

Noise is one of the most important problems linked to aviation. It can lead to health issues, as well as to negative social and economic effects. Examples of health issues produced by aviation are sleep disturbance, community annoyance, cardiovascular disease, and mental health problems.

This document was requested by the European Parliament's Committee on Petitions.

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Manuscript completed in January 2021
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LIST OF ABBREVIATIONS

ACI:	Airports Council International
APU:	Auxiliary Power Unit
ATC:	Air Traffic Control Service
BBI	Berlin Brandenburg International
CDO	Continuous Descent Operations
DALY:	Disability Adjusted Life Years
dB:	Decibel
DFS:	Deutsche Flugsicherung
EAER:	European Aviation Environmental Report
EEA:	European Environment Agency
EFTA:	European Free Trade Association
END:	Environmental Noise Directive
EPNdB:	Effective Perceived Noise Decibel
FBB:	Flughafen Berlin Brandenburg
GBAS:	Ground based Augmentation System
HYENA:	Hypertension and Exposure to Noise Near Airports
ICAO:	International Civil Aviation Organization
L_{Amax}:	Maximum Sound Level
L_{den}:	Day Evening Night Sound Pressure Level
L_{night}:	Night-time sound pressure level

Lva:	Level of Aircraft eValuation: the noise index for assessing noise around airports used in Italy, in dB(A)
NADP:	Noise Abatement Departure Procedures
NORAH:	Noise-Related Annoyance, Cognition and Health
NTK:	Noise and Track Keeping Systems
PAX:	Passenger
RAFIC:	Radar and Flight Information Capture
SEL:	Sound Exposure Level
SID:	Standard Instrument Departure
UN:	United Nations
WHO	World Health Organisation

EXECUTIVE SUMMARY

This study, based on concrete quantitative and qualitative evidence, aims to provide a clear and simple overview to the non-expert reader, on the impact of noise pollution on residents of large cities, with special regard to noise pollution from aircraft, as well as to give recommendations addressed to the most relevant actors.

Context

Noise is one of the most important problems linked to aviation. It can lead to health issues, as well as to negative social and economic effects. Examples of health issues produced by aviation are sleep disturbance, community annoyance, cardiovascular disease, and mental health problems.

The forecasts published by the European Aviation Environmental Report 2019¹, show an increase in air traffic, which would potentially increase the number of people exposed to noise produced by aviation activities. On the other hand, it is important to note that aircraft are becoming less and less noisy thanks to technological improvements. Thus, even with the expected increase of air traffic, the number of people affected by current aircraft noise levels could actually become lower in some future scenarios. Noise abatement procedures (for instance soundproofing for houses) can be used at airport level with the aim to reduce the noise exposure problem.

Assessment of noise issues in the European communities through petitions

This study focuses on five relevant petitions regarding aviation noise issues that have been used as source material for this study. Below, a summary of their analysis is provided.

Petition n° 0112/2015 Rome Ciampino airport

Ciampino is one of the two airports serving the city of Rome, together with Fiumicino. Both airports follow a familiar trend seen in large cities around Europe. The primary airport (in this case Fiumicino) is usually located at a significant distance from the city centre. The original (Ciampino) secondary airport is usually closer to the city and tends to handle more charter flights and low-cost operators.

This petition is primarily complaining about the proximity of the runway to the closest residential area. It calls for transparency and for assessing the impact of the increasing air traffic on the local inhabitant's health as well as for mitigation actions.

A rise in the number of flights in this airport has been observed². The increase of low-cost airline's movements over past decades can explain the strong attraction that Ciampino airport maintains. This situation may nevertheless change with the recent COVID-19 crisis since it is likely that low-cost companies will progressively limit short haul /domestic flights to focus on medium and long-haul flights.

¹ European Aviation Safety Agency, European Environment Agency, EUROCONTROL. (2019). European Aviation Environmental Report 2019.

² Assaeroporti. Associazione Italiana Gestori Aeroporti. (2020). Assaeroporti. Retrieved from <https://assaeroporti.com/statistiche/>

Petition n° 1645/2013 Berlin-Tegel Airport

This petition described the aviation noise issues suffered by the inhabitants of residential areas near to Berlin-Tegel Airport, who complain about its increasing number of flights during the last years³. In addition, residential areas are in the direct vicinity of the airport, which are affected by what seems to be aircraft attributable noise above 55 dB⁴.

In order to improve this situation, the airport already set mitigation measures⁵, such as: application forms available for noise insulation, entitlement of all residents affected by the airport to receive noise protection, relocation of aprons to reduce taxiing times or the placement of a noise barrier to neighbourly protect residential areas. Nevertheless, this situation is likely to cease, due to fact that the airport will probably close soon after the opening of new BER Airport.

Petition No 0622/2018 Budapest and Hungarian Airports

This petition indicated that the level of noise pollution in the vicinity of airports in Hungary is too high, claiming that the Hungarian government does not comply with its obligations under Directive 2002/49/EC relating to the assessment and management of environmental noise.

Budapest airport has submitted a designation of noise protection zones, as well as created a voluntary noise insulation programme. However, the situation is likely to worsen with a continuous increase of movements, since it is the only airport serving the city.

The COVID-19 crisis harshly impacted this airport since it is mainly focused on passenger flights. Consequently, the airport tries to attract freight traffic to avoid further drastic income loss and maintain its workforce.

Petition No 0193/2010 Liège Airport

The former military airport of Liege has experienced a decrease in passenger flights; however, the cargo flights did increase by a high percentage, as on average 140 of these movements were being handled per night⁶. Petitioners complain about noise from the air traffic during day but especially during night.

To address potential noise issues, Liege Airport already set a Balanced Approach. In addition, since 2010, Liege airport setup other mitigation actions⁷, such as: buying buildings in the surroundings of the airport, offering insulation options, providing access to compensations for noise exposure or neighbourhood access to the DIAPASON software, which shows aircraft trajectories and recorded noise pollution in real time. During the COVID-19 crisis, Liège Airport's movement is likely not to decrease, as it has been chosen to be one of the World Health Organization (WHO) hubs for medical supply distribution⁸.

³ Berlin Brandenburg Flughafen. (2020). Retrieved from <https://www.berlin-airport.de/en/press/publications/index.php/company/all>

⁴ Berlin Senate Department for Urban Development and Housing. (n.d.). Retrieved from <https://www.stadtentwicklung.berlin.de/umwelt/umweltatlas/ekb705.htm>

⁵ Berlin Brandenburg Flughafen. (2008). Retrieved from <https://www.berlin-airport.de/en/press/press-releases/2008/2008-01-21-noise-protection/index.php>

⁶ Liege Airport. (2020). www.liegeairport.com. Retrieved from <https://www.liegeairport.com/flexport/en/liege-airport/>

⁷ Liege Airport. (2020). www.liegeairport.com. Retrieved from Carte des zones de bruit : <https://www.liegeairport.com/flexport/fr/donnees-techniques/impact-sonore/>

⁸ RTBF. (2020, April 14). RTBF.be. Retrieved from https://www.rtbf.be/info/regions/detail_coronavirus-liege-airport-sera-un-hub-de-l-oms-pour-distribuer-le-materiel-medical-vital-press?id=10481472

Petition No 2671/2014 Cologne/Bonn Airport

This airport is important for both passenger and cargo flights, although the second has increased more importantly during recent years⁹. This petition complains about noise from aircraft in the area surrounding the airport and calls for the end of tax exemptions for air traffic, as well as the development of stricter legislation.

To address noise issue, the airport has, since the year of the petition, taken mitigation actions, such as a higher tax fee to airlines operating night flights and a programme for passive noise abatement.

While passenger operations at Cologne Bonn Airport ground almost to a complete halt because of the COVID-19 crisis, freight operations were running at full capacity, as it is an important logistics location.

Noise issues

It can be observed that where petitioners are complaining about various aspects of noise disturbance and calling for mitigation actions to be taken in general, the lack of communication about both regulatory framework and airports strategies are also mentioned. Petitioners are not clear about the impact that noise produces on health. They are also not aware if any actions have been taken to address noise health issues. In addition to that, the complexity of the regulatory framework organised in layers from international to local scale makes difficult to clearly identify: 1) interlocutors to address the complaint and 2) specific points on which a complaint can be made. It can be highlighted that petitions increase when the airport itself does not: 1) communicate about noise issues, 2) actively inform citizens about their actions addressing noise issue, or 3) does not engage in discussion with neighbourhood communities with a specific interlocutor.

All the petitions describe different aspects of noise disturbance. The most evident causes of nuisance in the petitions is the increase of air traffic/noise exposure over time. When mitigation actions are already in place, petitions often come with a relatively sudden increase of air traffic over relatively few years. This obviously comes with a sharp increase of noise disturbance.

Impact of noise on human health

During the last years, the increasing importance of environmental noise impact on health has led to the elaboration of several international research studies, which provide crucial remarks in this field.

Noise events produce annoyance, as well as other problems linked to long-term and regular exposure to high noise levels, such as auditory system deterioration, hearing loss, sleep disturbance, cardiovascular disease, and diminished learning capacity. Due to this situation, the EU requires major airports to report on the extent of aircraft noise levels and the number of people affected by them.

A 2011 WHO Report¹⁰, which studied the link between environmental noise (including that from road, railways and traffic) and diseases (such as cardiovascular disease, cognitive impairment in children, sleep disturbance and tinnitus), probably provides the most relevant proof of noise impact on human health.

Other studies have shown the effects of transportation noise on health. For instance, it has been shown that night-time noise from transportation produces both instantaneous and long-term health effects,

⁹ Cologne Bonn Airport. (2017). [www.cologne-bonn-airport.com](https://www.cologne-bonn-airport.com/uploads/tx_download/KBA_GeBer2017_web_EN.pdf). Retrieved from https://www.cologne-bonn-airport.com/uploads/tx_download/KBA_GeBer2017_web_EN.pdf

¹⁰ World Health Organisation. (2011). Burden of disease from environmental noise. Quantification of healthy life years lost in Europe. Retrieved from [www.who.int: https://www.who.int/quantifying_ehimpacts/publications/e94888.pdf?ua=1](https://www.who.int/quantifying_ehimpacts/publications/e94888.pdf?ua=1)

due to the alteration of sleep, leading to arousal and awakening¹¹. Also, there are results that suggest that high levels of aircraft noise are associated with an increased risk of stroke, coronary heart disease, and cardiovascular disease¹². Another important finding was obtained in the Hypertension and Exposure to Noise Near Airports (HYENA) study.¹³ In this research project it was found that excess risks of hypertension are related to long-term noise exposure, primarily for night-time aircraft noise and daily average road traffic noise

WHO Guidelines

The 2018 WHO Environmental Noise Guidelines for the European Region¹⁴, which also addressed aviation noise, firmly recommended reducing exposure to below 45 dB(A) for L_{den} ¹⁵ and 40 dB(A) for L_{night} . WHO also recommended using the DALY (Disability Adjusted Life Years) metric to quantify the deterioration of populations' health due to disease or by exposure to environmental factors.

ACI Response to WHO

ACI¹⁶-Europe responded to the publication of the 2018 WHO guidelines by publishing an Analysis Paper¹⁷, setting out the complexity of the subject and the scientific research needed to analyse it in a comprehensive manner, as well as the research gaps that still needed to be addressed.

The NORAH Study¹⁸ was stated by ACI to be the most recent, comprehensive, and authoritative study to date regarding health outcomes. This study indicates that aircraft noise has a strong impact on quality of life and is associated with highest levels of annoyance, which also depends on non-acoustic factors such as the ability of the person to handle noise or their attitude towards traffic. The study also highlighted the importance of subjective factors in the effects of noise disturbance on sleep.

Improving noise metrics

The implementation of the 2018 WHO guidelines might take some time, since there is a large gap between these advisory noise limits and the limits recommended by the International Civil Aviation Organisation (ICAO). The recommendation given by WHO to reduce exposure to below 45 dB(A) for L_{den} and 40 dB(A) for L_{night} can be a strong change to the methodology applied so far, as it is a big jump from 55 L_{den} and 40-45 L_{night} . For night noise especially, a relevant metric that quantifies the impact on health of residents living around the airport is the risk of awakening.

¹¹ Miedema, H., Passchier-Vermeer, W., & Vos, H. (2003). Elements for a position paper on night-time transportation noise and sleep disturbance. Delft.

¹² Hansell Anna L, Blangiardo Marta, Fortunato Lea, Floud Sarah, de Hoogh Kees, Fecht Daniela et al. Aircraft noise and cardiovascular disease near Heathrow airport in London: small area study BMJ 2013;347:f5432

¹³ Jarup L, Babisch W, Houthuijs D, Pershagen G, Katsouyanni K, Cadum E, Dudley ML, Savigny P, Seiffert I, Swart W, Breugelmans O, Bluhm G, Selander J, Haralabidis A, Dimakopoulou K, Sourtzi P, Velonakis M, Vigna-Taglianti F; HYENA study team. Hypertension and exposure to noise near airports: the HYENA study. Environ Health Perspect. 2008 Mar;116(3):329-33. doi: 10.1289/ehp.10775. Erratum in: Environ Health Perspect. 2008 Jun;116(6):A241. PMID: 18335099; PMCID: PMC2265027.

¹⁴ World Health Organization. (2018). Environmental Noise Guidelines for the European Region.

¹⁵ L_{den} : Day-Evening-Night Sound Pressure level

¹⁶ ACI: Airports Council International

¹⁷ Airports Council International Europe. (2018). Addressing the future of aviation noise. Retrieved from <https://www.aeroport.fr/uploads/documents/voir-l%27etude-sur-le-bruit.pdf?v12>

¹⁸ Forum flughafen & region. Umwelt - und nachbarschaftshaus. (2015). NORAH Noise Impact Study. Kelsterbach

There is the proposal to start giving more priority to other noise indicators (in particular frequency metrics) as well as calculating lower noise level contours to present noise exposure, which is a challenging modification considering the way noise effects have been studied until now.

Regulatory framework content

At international level, the Aircraft noise certification¹⁹, which establishes limits to aircraft noise depending on their weight and number of engines, is highly relevant. Newer and more stringent noise limits have managed to foster the development of quieter aircraft over the years. The ICAO Balanced Approach is also an important tool to address aircraft noise problems. It is based on 4 pillars: 1) Reduction of noise at source, 2) Planning and management, 3) Noise abatement operational procedures and 4) Operating restrictions. These pillars are complemented as well with the use of noise monitoring systems and community outreach.

At European level, international guidelines are applied adding restrictions in terms of technology used by the operator. It is forbidden to fly in the European Airspace with aircraft that are considered too noisy. Additionally, more detailed regulation is given to member states with respect to implementing ICAO's Balanced Approach regarding the application of noise operating restrictions.

Also, at the European level, the Environmental Noise Directive (2002/49/EC) aims to "define a common approach intended to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, led by the exposure to environmental noise". The Directive focuses on three areas: 1) Determination of exposure to environmental noise, 2) Availability of environmental noise information to the public and 3) Prevention and reduction of noise where necessary and preserving environmental noise quality where possible.

The regulation 598/2014 establishes rules on introducing noise-related operating restrictions at the European airports level. It follows the guidelines of the ICAO Balanced Approach about noise management and the rules defined apply to airports with more than 50,000 movements per year covering civil aircraft.

At the national level, each member state must transpose the EU regulations into its own legislation, defining a national noise framework law, a methodology to measure noise around airports, defining noise limits, etc.

At airport level, more measures can be taken. Examples are the use of noise charges, management of the take-off and landing procedures or the implementation of Noise and Track Keeping systems (NTK), which provide a way to monitor and manage the noise generated from flights into and out of the airport.

Noise impact on socio-economic factors

There is some evidence that could suggest that poor people are exposed to higher noise levels than richer people because they can only afford cheaper houses closer to the airport. However, it is important to understand cause and effect and more studies are needed to identify whether there is a clear correlation between properties that are near an airport and low-income residential areas, as there are many (often conflicting) parameters to be considered. No evidence has been found in literature to prove that aircraft are redirected on purpose over poorer areas, even though it is clear, that around many airports there is vigorous debate about the specific routes aircraft are flying.

¹⁹ International Civil Aviation Organization. (2017). Annex 16 - Environmental Protection - Volume I - Aircraft Noise.

Exemplary practices at major European airports

In this section, some measures taken in Frankfurt and Vienna airport are commented, since they are examples of best-case studies in this field.

Frankfurt airport is continually active in reducing noise and has become a pioneer in active noise abatement procedures²⁰. Several techniques are being used or tested by the airport, focusing on the noise source, on aircraft operations and on residential areas. This airport has carried out active (like a noise respite model or Continuous Descent Operations) and passive (like soundproofing) noise abatement measures, as well as the implementation of noise monitoring program with stations and noise reports, an initiative to buy houses or provide compensations to properties that are flown below 350m, and the development of a good community engagement.

The airport of Vienna is considered a best practice case in terms of efforts on mediation and community engagement and it has developed different paths to dialogue with residents²¹. They have established several tools to foster the public participation and access to information: the “Neighbourhood Committee”, which provides communication with the local residents, the Dialogforum²², a non-profit organisation financed by the airport and functioning as an information and communication platform, the hotline “Umwelt und Luftfahrt”, or a thematic website (www.vie-umwelt.at). In addition to these tools to enhance mediation and community engagement, they have also worked on improving land use planning, noise mitigation and included night-time operating restrictions.

Another tool used to reduce noise level around an airport is the so called “League table” concept, developed by Heathrow Airport. Airlines are ranked based on their environmental performances. Airlines who ranked on top seem to be proud of their environmental performances²³ and in a world where sustainability is becoming more and more important this is an innovative way to promote airlines to new customers.

Conclusions

Noise has always been the major environmental issue in the field of aviation, primarily impacting residential communities close to airports. It can cause several health-related problems according to the World Health Organization, both in the short and long term, such as community annoyance, sleep deprivation, cardiovascular diseases, and mental health issues. Even though aircraft are becoming less and less noisy due to important technological improvements, the expected long-term increase in the number of flights (even after the COVID-19 pandemic) means that more effort from all stakeholders to reduce noise in the airport’s surrounding areas will be crucial. Usually, people living in residential areas around airports are the ones who get affected the most by aircraft noise and therefore they are also the ones who tend to complain more often and who call for quick solutions. The most common complaints are caused by increases in the number of flights, as well as night-time and low-altitude flights. There are many regulations at different levels addressing these issues. At international level, for instance, limits for take-off and landing phases are set, while at European level best available technologies are promoted, and at the National level, limits for perceived noise and other measures are set. Nonetheless,

²⁰ Mael, S. (2015, July 28). Frankfurt Airport pioneers active noise abatement. Retrieved from International Airport Review: <https://www.internationalairportreview.com/article/20017/frankfurt-airport-pioneers-active-noise-abatement/>

²¹ Vienna International Airport. (2020). Dialogue with residents. Retrieved from Vienna International Airport: https://www.viennaairport.com/en/company/flughafen_wien_ag/environment_sustainability/dialogue_with_residents

²² Dialog Forum. (n.d.). Dialog forum. Flughafen Wien. Retrieved from <https://www.dialogforum.at/>

²³ Oman Air. (2019, March 18). Oman Air. Retrieved from Press Releases: <https://www.omanair.com/es/en/about-us/press-releases/oman-air-ranks-first-heathrow-airports-fly-quiet-and-green-q4-2018-league>

this structure is quite complex and leads to difficulties for the citizens to ask for specific measures that need to be adopted. At airport level, measures to reduce the annoyance of people living in their vicinity are also being taken. Such is the case of some European airports that are investing in research and development projects to improve the noise situation in their surrounding areas. In order to decrease annoyance at the vicinity of airports, operational (such as forcing aircraft to follow specific paths during approaches or take-offs) or passive measures (like sound-proofing or buying houses that are frequently flown over at low altitudes) can be taken. Another important tool that can be used by airports to improve the noise situation is community engagement.

An important recommendation for Authorities is to improve the way they communicate with citizens, especially with the ones that most affected by aviation noise, which are the communities living close to airports. Information regarding the noise impact they receive, such as live information regarding flights and their measured noise levels, as well as the health consequences of noise should be provided.

Importance should be given to community engagement in all airports. This activity provides a way to reach people's problems, obtaining a better understanding of them and leading to more efficient solutions. Special attention should be given to poorer areas, which may not be the ones complaining the most, but which are usually the most affected by noise originated from all sources. It is also important to note that, since the current legislation is not always sufficient to prevent complaints from the population, proposals of increasing air traffic in sensitive locations should be taken with caution. It is also recommended that harmonized noise limits, in particular at European level, get established.

It would also be beneficial to enhance common strategies. When measures regarding aviation noise are adopted and result to be effective, their results should be shared, so more successful strategies could be developed by Member States, decreasing the number of people affected by dangerous noise levels and therefore improving the welfare of their citizens.

Finally, communication among airports and development of research activities could be beneficial to the future aviation noise management activities. An important research area would be the development of new noise impact metrics that better correlate with the health effects they produce.

1. INTRODUCTION

1.1. Report Structure

This study provides a clear and simple overview to the non-expert reader, on the ***Impact of noise pollution on residents of large cities, with special regard to noise pollution from aircraft.***

The study is based on existing available data, studies and analysis from various sources and documents from national and international institutions. It provides specific discussions of the issues outlined in the following sections:

- Assessment of noise issues in the European communities through petitions
- Summary of most recent scientific research on the impact of noise on human health
- Overview of aircraft noise restrictions and regulatory framework
- Investigation of any correlation between noise impact and socio-economic factors
- potential correlation between noise impact and socio-economic factors
- Overview of the best practices in big European urban areas

The study is based on concrete quantitative and qualitative evidence. It concludes with policy recommendations addressed to the most relevant actors.

1.2. Context

Noise is one of the most detrimental side effects of aviation. It can lead to negative effects on human health such as community annoyance, sleep disturbance, cardiovascular disease, and mental health problems. These problems can also cause a negative economic effect as they impact the productivity of workers and cause a burden on health care systems.

According to the European Aviation Environmental Report 2019²⁴ (hereinafter referred as EAER 2019), in 2017 3.2 million people were exposed to L_{den} ²⁵ levels higher than 45 dB and 1.4 million people to L_{night} ²⁶ levels above 40 dB around the 47 major European airports, where levels above L_{den} 45 dB and L_{night} 40 dB are respectively symptomatic of being highly annoyed or of sleep disturbance, according to WHO²⁷. For the same airports, it was also estimated that 1 million people were exposed every day to more than 50 aircraft noise events above 70 dB.

The expected growth of air traffic means that potentially more people risk being exposed to aircraft noise in future. In fact, air traffic is forecasted to increase in the next years, as a result of an increasing demand for air travel, as shown in Figure 1.1 from the EAER 2019.

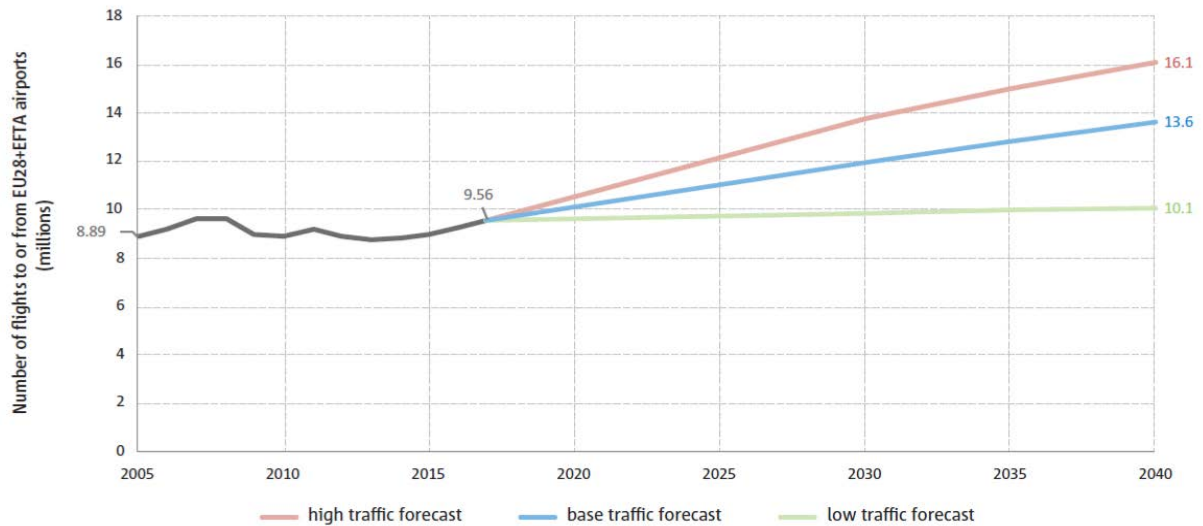
²⁴ [European Aviation Safety Agency, European Environment Agency, EUROCONTROL. \(2019\). European Aviation Environmental Report 2019.](#)

²⁵ L_{den} : Day-evening-night sound pressure level

²⁶ L_{night} : Night-time sound pressure level

²⁷ WHO: World Health Organization.

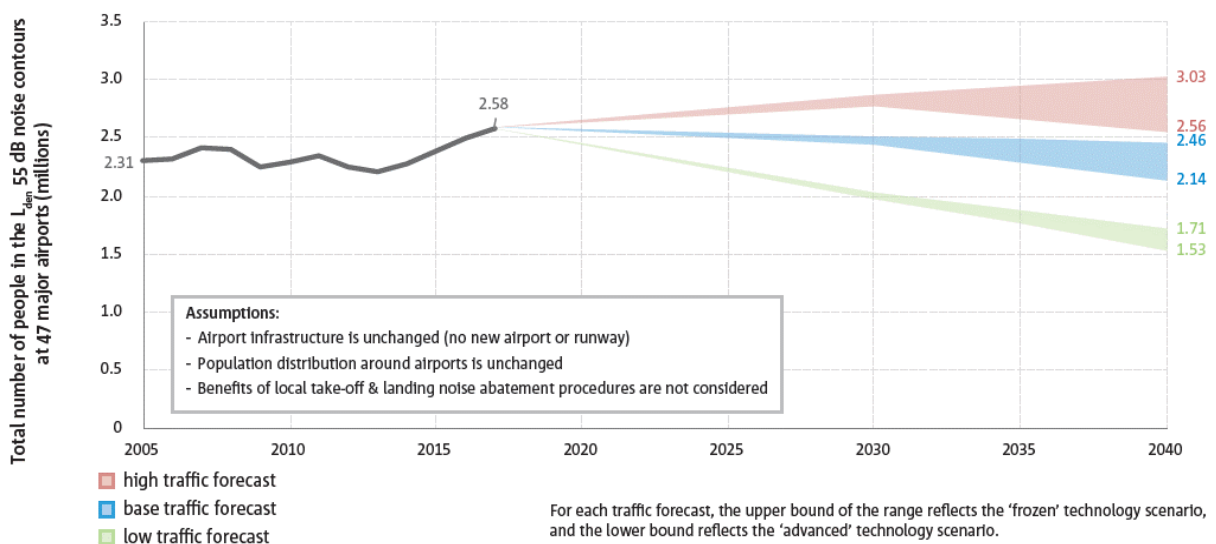
Figure 1.1 Expected increase of air traffic for 3 different scenarios (Image retrieved from [EAER 2019](#))



NOTE: At the time of writing (summer 2020), the COVID-19 pandemic has had a significant impact on the aviation sector and these forecasts are likely to be revised downwards in future.

Also, in recent years, aircraft have become significantly less noisy thanks to technological improvements (driven by international stringency standards). As mentioned in the EAER 2019 as an example, an Airbus A320 of the new generation (A320neo) is around 6 dB less noisy than the A320 old generation (A320ceo), currently the most popular aircraft in Europe. This means that 4 take-offs by an A320neo produce an approximately equivalent noise impact compared to one single take-off of an A320ceo in terms of L_{den} and L_{night} . For this reason, even if the traffic is expected to grow as currently predicted, the number of people expected to be exposed to current aircraft noise levels (as defined as living within the 55 L_{den} contour) could potentially be reduced in future under certain scenarios, as shown in Figure 1.2 from the EAER 2019.

Figure 1.2 Potential reduction of population impacted by aircraft noise (Image retrieved from [EAER 2019](#))



Local noise abatement procedures can also be applied at airport level to reduce the problem. This includes active measures to tackle the noise at the source, or passive measures, such as soundproofing

houses affected by aircraft noise. While some techniques are already applied at major airports, new techniques are currently being tested around Europe that may deliver solutions to alleviate this problem.

2. ASSESSMENT OF NOISE ISSUES IN THE EUROPEAN COMMUNITIES THROUGH PETITIONS

2.1. Petitions

As part of the source material used in this study, a selection of some relevant petitions was provided by the European Parliament. The analysis here seeks to understand the issues highlighted in the petitions and to offer commentary on their validity and how widespread such issues are. Where applicable, reference may also be made to best practice being applied at other airports, addressing these issues.

2.1.1. Petition n° 0112/2015 Rome Ciampino airport

Petition title: Pollution caused by air traffic to and from Ciampino airport in Rome		
Initiator Roberto Barcaroli, Italian citizen		Reference: 0112/2015
Declared admissible in 2015	Ciampino airport	Number of Signatories: 23
Short summary <ul style="list-style-type: none"> The petition protests against the pollution caused by Ciampino airport and its environmental impact, the affected area being home to more than 14,500 citizens. The airport's runway is said to be located just 150 metres away from residential housing and the take-off and landing routes reportedly cross over inhabited towns and sites of natural interest, including the Appian Way Regional Park. The airport's environmental impact is also alleged to have increased significantly over the past few years – indeed, while Ciampino ordinarily sees approximately one million passengers each year, that figure soared to five million in 2015. In this respect, the petitioner calls for an environmental impact assessment and a new strategic environmental assessment to be carried out, in addition to hearing the thoughts of the local population on the matter.²⁸ 		
Open/Closed open ¹	Recommendations/Conclusions <ul style="list-style-type: none"> After having monitored the situation, the commission asked the Italian authority to do a complete environmental impact assessment to evaluate the air traffic growth, taking into consideration in particular the environmental impact on the Appia Antica Regional Park and on the noise impact for the population living in the vicinity of the airport. Having reviewed that, the commission, considered that the project approval is still ongoing, did not find any violation in the European environmental directive. For this reason, the commission will not take any action regarding this petition. 	

This petition is primarily complaining about the proximity of the runway to the closest residential area, which is said to be only 150 meters away from the runway. This situation has worsened over years with

²⁸ European Parliament. (2015). Petitions European Parliament. Retrieved from Petition No 0112/2015 by Roberto Barcaroli (Italian) on pollution caused by air traffic to and from Ciampino airport in Rome : <https://petiport.secure.europarl.europa.eu/petitions/en/petition/content/0112%252F2015/html/Petition-No-0112%252F2015-by-Roberto-Barcaroli-%2528Italian%2529-on-pollution-caused-by-air-traffic-to-and-from-Ciampino-airport-in-Rome#petition-data>

the increase of movements on the airport. Residential areas are overflowed, and the citizens are suffering from the noise disturbance. The petition calls for transparency and for assessing the impact of the increasing air traffic on the local inhabitant's health. They also call for mitigation actions according to the conclusion of the risk assessment.

In 2002, Ciampino airport only had 26,835 movements (web archive datitraffico Assaeroporti²⁹). The movements jumped to 52,649 movements in 2018. The number of movements has indeed doubled in six years, with only one runway (15/33). In addition, the airport is open from 4am until 12am (midnight). Ciampino has 38,963 inhabitants according to the Istituto nazionale di statistica (2019)³⁰ and the airport is in the direct vicinity of the city, as Figure 2.1 can attest. It can be clearly seen, according to the scale, that the runways are located at less than 200 meters from the residential area.

Figure 2.1 Ciampino Airport



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Map created using the Free and Open Source [QGIS](https://www.qgis.org/)

The situation of Ciampino Airport cannot be considered in isolation. It is one of 2 airports serving the city of Rome. It is the original airport serving Rome since 1916, and like many early developed airports that serve major European cities, it is located relatively close to the city centre. It is now Rome's secondary airport, with much of its business centred around low-cost carriers such as Ryanair and Wizz Air. Probably much of the attraction of the low-cost carriers to potential passengers, is the proximity of the airport to the city centre (17kms), whilst Rome Fiumicino Airport is 30km away from the city centre. So, there is clearly a trade-off between ease of access and potential impact on the surrounding population.

²⁹ Assaeroporti. Associazione Italiana Gestori Aeroporti. (2020). Assaeroporti. Retrieved from <https://assaeroporti.com/statistiche/>

³⁰ Istituto Nazionale di Statistica. (n.d.). Retrieved from <https://www.istat.it/en/>

Fiumicino is the biggest airport and has better transport facilities than Ciampino airport with a direct train line that brings passengers to Rome in 32min compared to 45min from Ciampino. Though Fiumicino airports opened in 1960 with the idea of deflecting movements from the over saturated Ciampino airport, the situation is that movements still doubled in six years.

Both airports follow a familiar trend seen in large cities around Europe. The primary (often newer) airport is usually located at a significant distance from the city centre. The original (and often smaller) secondary airport is usually quite close to the city centre and usually has traffic that is more charter flights and low-cost operators, which can be operated more independently compared with the logistics of a classical hub and spoke model which the major (national flag carriers) airlines adopt, with the implicit need to assure a larger network connectivity.

The increase of low-cost airline's movements over past decades can explain the strong attraction that this airport maintains. With the recent COVID-19 crisis, a different future for aviation may now emerge compared what anticipated only a few years ago. It is likely that low-cost companies will progressively limit short haul /domestic flights to focus on medium and long-haul flights. In an article in The Guardian, dated 01/05/2020, Ryan Air' CEO, Michael O'Leary, declared the momentary closure of a number of bases in Europe until air travel recovery, which could extend until 2022³¹. At the same time, Wizz Air, who was launching a new subsidiary when the Covid-19 crisis struck, (Wizz Air Abu Dhabi), will keep focusing on its development³². The Hungarian low-cost airline announced several cuts with a reduction of its workforce by 19%. Some actors in the airline sector also predict that, considering the global situation now, low prices would not necessarily suffice anymore to get passengers to fly again. Passengers need the guarantee that their health is being taken care of. Bill Franke, a budget airline backer, and chairman of Wizz Air since 2004, estimates that over time, the airlines' model will come back to the traditional fare models³³. In the meanwhile, several other legacy companies expressed their intention to reduce domestic flights and short haul. (Examples being Austrian Airlines³⁴ and Air France-KLM³⁵).

This aspect could turn the tables and decrease the appeal that Ciampino airport has for passengers.

2.1.2. Petition n° 1645/2013 Berlin-Tegel Airport

Petition Title: Noise nuisance and polluting emissions at Berlin-Tegel airport	
Initiator Monika Matalik	<i>Reference: 1645/2013</i>

³¹ Sweney, M. (2020, May 1). The Guardian. Retrieved from Ryanair to cut 3,000 jobs as coronavirus grounds flights: <https://www.theguardian.com/business/2020/may/01/ryanair-cut-jobs-coronavirus-grounds-flights-restructuring>

³² Air journal fr. (2020, April 17). Retrieved from chomage massif chez westjet et wizz air: <https://quebec.openjaw.com/2020/04/17/chomage-massif-chez-westjet-et-wizz-air/>

³³ Franke, B. (2020, May 9). Aero.uk Aviation news. Retrieved from Low air fares no panacea for Covid-19 crisis: <https://www.aero.uk/news-35324/Low-air-fares-no-panacea-for-Covid-19-crisis.html>

³⁴ Air Journal fr. (2020, April 22). Covid 19 austrian airlines va reduire sa flotte. Retrieved from <https://www.journal-aviation.com/actualites/44213-austrian-airlines-va-se-separer-du-quart-de-sa-flotte>

³⁵ Noëth, B. (2019, May 14). Aviation24.be. Retrieved from Air France to reduce short-haul capacity by 15% by end-2021; 465 staff made redundant but "no forced departures": <https://www.aviation24.be/airlines/air-france-klm-group/air-france/reduce-short-haul-capacity-15-end-2021-465-staff-made-redundant/>

Petition Title: Noise nuisance and polluting emissions at Berlin-Tegel airport		
Declared admissible in 2014	Berlin-Tegel	Number of Signatories on behalf of Bürgerinitiative Tegel-endlich-schliessen, supported by 4 co-signatories
<p>Short summary</p> <p>The petitioner protests about the intensive use being made of Berlin-Tegel airport. She says that, while the opening of the new airport at Berlin is delayed, Berlin-Tegel airport, which is located in the middle of the city, is being used increasingly intensively. As a result, residents of the surrounding districts are increasingly suffering from noise nuisance and air pollution. Yet no measures are being taken to alleviate their impact, because according to the authorities the airport will only be used so intensively for a limited period. The rules on noise, emissions and flying times are also being seriously breached. Another airport outside the city (Schönefeld) is actually being used less now, although measures have been taken there to protect residents against nuisance (insulating glazing, measurements of emissions, etc.). The petitioner demands that Schönefeld airport, which is currently under-used, be used more in order to reduce the pressure on Berlin-Tegel. She also calls for the equipment for the measurement of air pollution which has been removed to be reinstalled so that the pollution can be measured, and action taken as soon as the limits are exceeded. The petitioner points out that aircraft from Berlin-Tegel fly close over a water extraction area and that this may entail serious risks to the water supply in the event of an accident. The petitioner calls for action by the European Parliament to reduce traffic at Berlin-Tegel by at least 50% and increase the safety of residents by making more use of Berlin's other airports.³⁶</p>		
Open/Closed closed	Recommendations/Conclusions Following an individual complaint, the Commission has assessed the compliance of operation of the Tegel airport with EU law and has not identified any violation of EU rules. As regards compliance with Directive 2002/49/EC relating to the assessment and management of environmental noise, the Commission services will ensure, including through the ongoing EU PILOT procedure, that this directive is duly implemented.	

Petitioners are complaining about the increasingly intensive use of the airport causing inhabitants to suffer from the noise. Petitioners note that mitigations actions have already been taken (insulating glazing, measurements of emissions...) but are not enough and failed to subjugate the noise issue. They are calling for the reduction of airport traffic by at least 50%, on the base of 2014 total movements, movements would fall to 91,098 movements per year.

Berlin-Tegel was constructed in 1948. In 1996 the government announced the construction of the Berlin Brandenburg Airport (BER), planned to open in 2011. At the same time, it announced that Berlin-Tegel would be eventually closed with air traffic planned to shift to the new BER airport. In 2017, after several years of construction's delay, the government launched a referendum to ask Berliners whether Berlin-Tegel should remain open even after the opening of the BER airport. The result was positive

³⁶ European Parliament. (2013). Petitions. European Parliament. Retrieved from Petition 1645/2013, by Monika Matalik (German) on behalf of Bürgerinitiative Tegel-endlich-schliessen, supported by 4 co-signatories, on noise nuisance and polluting emissions at Berlin-Tegel airport

: <https://petiport.secure.europarl.europa.eu/petitions/en/petition/content/1645%252F2013/html/Petition-1645%252F2013%252C-by-Monika-Matalik-%2528German%2529-on-behalf-of-B%25C3%25BCrgerinitiative-Tegel-endlich-schliessen%252C-supported-by-4-co-signatories%2>

(majority of yes). The BER airport is finally expected to open the 31st of October 2020³⁷, but it is likely that the Berlin-Tegel closure will be announced a few weeks later.

In 2010, Berlin-Tegel airport had 158 570(FBB³⁸, 2010)³⁹. Four years later, this number had jumped to 182,197 movements (FBB, 2014) (29,000 more in 4 years). However, the increase slowed down with only 5,000 more movements in 2010 (FBB, 2018). The airport has two parallel runways and is open from 4am to 12pm. Figure 2.2 shows a view of Berlin-Tegel airport. It can be seen that on, the east side, residential areas are in the direct vicinity of the airport.

Figure 2.2 Berlin-Tegel Airport



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Map created using the Free and Open Source [QGIS](https://www.qgis.org/)

Noise contours in terms of L_{den} are published by the Senate Department for Urban Development and Housing in the Berlin-Tegel day and night noise assessment (2017)⁴⁰. For noise attributable to all the sources, The L_{den} 55 dB noise contour extends to about 30km in the runway's direction while the L_{den} 65 dB (red) noise contour extends to about 13km. Some residential areas such as Flakenhagener Feld, Haselhorst, Pankow, Heinersdorf, Stadtrandsiedlung Malchow, Malchow, Wartenberg, are located within what seems to be aircraft attributable noise above 55 dB.

³⁷ Berlin.de. (2019, November 29). Berlin.de The Official Website of Berlin. Retrieved from Airport BER to open on 31 October 2020: <https://www.berlin.de/en/news/5993203-5559700-airport-ber-to-open-on-31-october-2020.en.html>

³⁸ FBB: Flughafen Berlin Brandenburg

³⁹ Flughafen Berlin Brandenburg. (n.d.). *Flughafen Berlin Brandenburg*. Retrieved from Publications: <https://www.berlin-airport.de/en/press/publications/index.php/company/all>

⁴⁰ Berlin Senate Department for Urban Development and Housing. (n.d.). Retrieved from <https://www.stadtentwicklung.berlin.de/umwelt/umweltatlas/ekb705.htm>

The airport already set mitigation actions through the BBI⁴¹ noise protection program 2008⁴²:

- Application form for noise insulation measures
- Entitlement of all residents affected by the airport to receive noise protection and appropriate compensation for exposure to noise in gardens and external areas
- Relocating airports aprons (2008)⁴³ to reduce taxiing times
- Placement of a noise barrier up to 8 meters high to protect residential areas especially Cité Pasteur

During the COVID-19 crisis, while passenger air traffic has obviously drastically collapsed, cargo movements decreased by around 17% at the airport⁴⁴. Even taking account of the latest referendum in 2017, but also the lack of strong political statement about the definitive closure of Tegel Airport, the COVID-19 crisis has probably removed any doubt that the airport will close soon after the opening of the new BER Airport.

2.1.3. Petition No 0622/2018 Budapest and Hungarian Airports

Petition Title: Noise pollution in the vicinity of airports		
Initiator (of petition) M.L. (Hungarian)		Reference 0622/2018
Declared admissible in 2018	Budapest airport & Hungarian airports	Number of Signatories 153
The petitioner complains about the level of noise pollution in the vicinity of airports in Hungary, claiming that the Hungarian government does not comply with its obligations under Directive 2002/49/EC relating to the assessment and management of environmental noise (the Environmental Noise Directive – END), insofar as it did not set limit values for noise near airports. He also argues that the authorities did not make strategic noise mapping or action plans, did not organize public consultations in relation to the latter, as prescribed by the END, and failed to protect the health of people residing near airports. In addition, he points out that, as of August 2018, the flight paths were changed which increased noise pollution around the Budapest airport.		
Open/Closed open	Recommendations/Conclusions The Commission will assess the situation once information from the competent authorities is received.	

Budapest Airport is the only airport of Budapest and the biggest Hungarian airport. It has two runways and is in the XVIII district of Budapest.

⁴¹ BBI: Berlin Brandenburg International

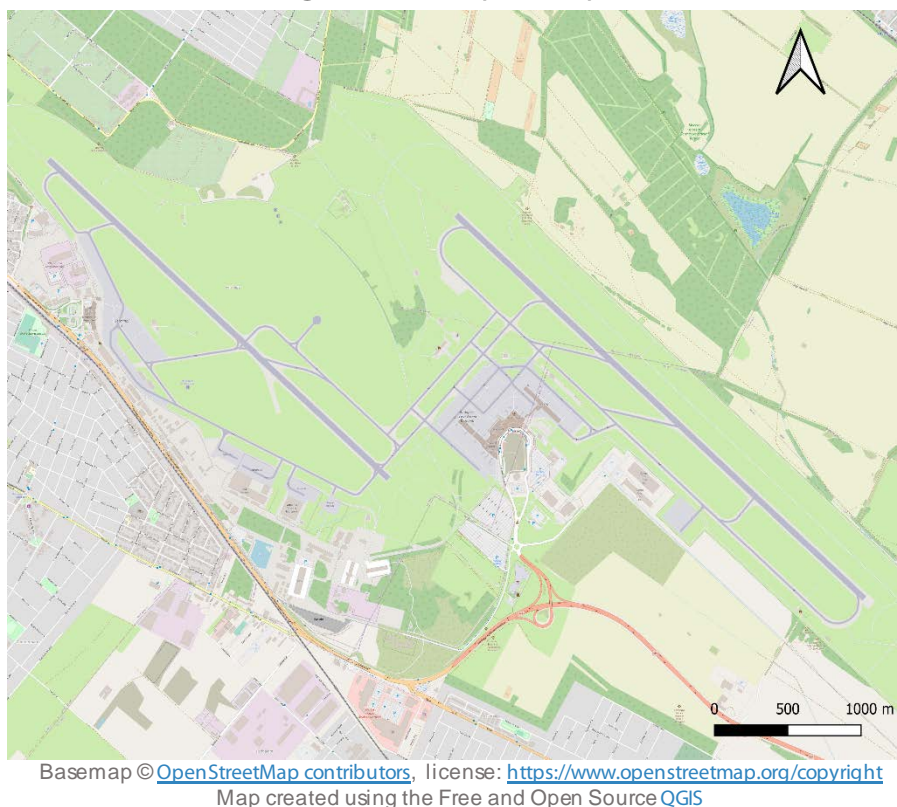
⁴² Berlin Brandenburg Flughafen. (2008). Retrieved from <https://www.berlin-airport.de/en/press/press-releases/2008/2008-01-21-noise-protection/index.php>

⁴³ [Tegel Airport: more space, improved noise control](#)

⁴⁴ Air-journal fr. (n.d.). Retrieved from COVID 19 le trafic secroule a berlin et pour sas scandinavian: <https://www.air-journal.fr/2017-04-21-sas-scandinavian-airlines-retourne-en-israel-5180465.html>

Day and night Noise contours for Budapest airport from 2012 to 2019 are published on the Budapest airport website ⁴⁵. From these images, it is visible how the noise exposure has increased over time for both night and day, as noise contours cover bigger areas.

Figure 2.3 Budapest Airport



According to the official Budapest Airport website⁴⁶, the designation of noise protection zones was submitted to the National Transport Authority Office for Air Transport in 2008. The same year, the airport launched a voluntary noise insulation programme that since that time has been extended to the cities of Üllö and Vecsés, but also to the districts XVIII and XVII of Budapest.

Considering that Budapest Airport is the only airport serving Budapest, the situation is likely to worsen, with a continuous increase of movements.

COVID-19 crisis harshly impacted air traffic in Hungary, as everywhere, forbidding any non-citizen or non-permanent resident to land. Foreign visitors were also forbidden to land. Chief Commercial Officer, Kam Jandu, expects the airport business to go back to normal in calendar year 2022⁴⁷. During the crisis, the airport would handle 35 flights per week instead of 1,500 usually. As Budapest Airport is mainly focused on passenger (PAX) flights, the reduction of passengers also causes a drastic drain on the economic viability of the airport, where all the restaurants, shops or car parks have been emptied. As a consequence, the airport tries to attract freight traffic to avoid further drastic income loss and maintain its workforce.

⁴⁵ Budapest Airport. (n.d.). Bud. Budapest Airport. Retrieved from Noise map: https://www.bud.hu/en/budapest_airport/responsibility/environmental_responsibility/noise_protection/noise_map

⁴⁶ Budapest Airport. (n.d.). Bud. Budapest Airport. Retrieved from <https://www.bud.hu/en>

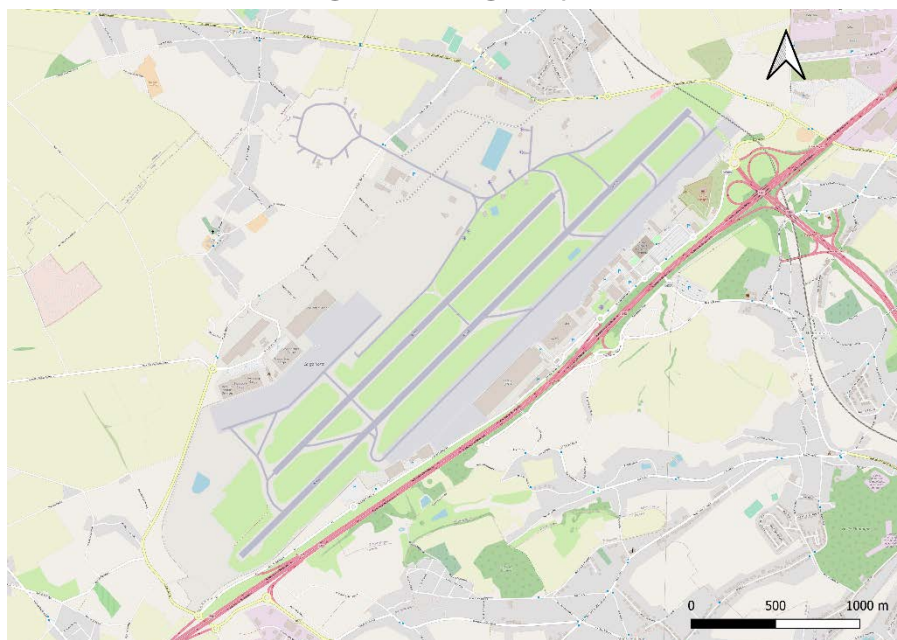
⁴⁷ Airport-business. (2020, April 14). Airport-business.com. Retrieved from Budapest Airport on COVID-19 crisis management: "Act swiftly, check the trends, be bold but be calm": <http://www.airport-business.com/2020/04/budapest-airport-covid-19-crisis-management-act-swiftly-check-trends-bold-calm/>

2.1.4. Petition No 0193/2010 Liège Airport

Petition Title: Aircraft noise from air traffic into and out of Liège airport		
Initiator (of petition) Klaus-Dieter Goebbels (German)		Reference 0193/2010
Date submitted: 2010	Airport: Liège airport	Number of Signatories One
The petitioner, who lives near the Belgian-German border, protests at the nightly air traffic into and out of Liège airport and the resulting noise. He has already complained to the authorities in the German Land of North Rhine-Westphalia and to the German Air Safety Agency DFS, which has since informed him that it is unable to find any grounds for taking action. The petitioner therefore asks the European Parliament to launch proceedings on his behalf against the competent authorities about this unacceptable situation		
closed	Recommendations/Conclusions Declare admissible; Send petitioner, for information, Written Question 4470/08 on Health risks caused by aircraft noise, and the Commission's answer given on 6 October 2008; Close	

The petitioner is a German citizen, living in the Belgium/German border in the city of Aachen, Germany, at around 50km from the Liège airport. The petitioner complains about Liège Airport's air traffic (2010). Petitioners complain about noise from the air traffic during day but especially during night, that is qualified as "unbearable". Petitioners are calling for the elevation of the flight route above their residential area. Considering that the Airport is operating 24h/7 and the distance between Liege Airport and the petitioner's house, this is likely to be often flown over by aircraft coming from or going to Liège Airport. Noise night exposure is more sensitive than daily one and is stated to be detrimental beyond 40 dB.

Figure 2.4 Liège Airport



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A former military airport, Liege airport has been converted into a civilian one in 1990 with the creation of La Société de Développement et de Promotion de l'Aéroport de Bierset. It has two runways and handled 48,515 movements at the date of the petitioner's request (2010). Compared to then, the airport now handles less movements, with roughly 9,000 movements less in 2019 (39,879⁴⁸) than in 2010. However, while the number of passengers handled decreased by 43% between 2010 (299,043) and 2019 (170,400), the cargo has increased by 1624%.

Indeed, Liege Airport took advantage of the saturated Amsterdam Airport's freight traffic to expand its business. In 2010, the tons of cargo handled were only of 52,311 t whereas they handled 90 047.4 t in 2019. Open 24/7, this evolution toward a full cargo strategy led Liege Airport to be one of the biggest cargo hubs in Europe climbing to the 8th position in 2016⁴⁹. The airport handles on average 140 cargo flights per night⁵⁰.

To address potential noise issues, Liege Airport already set a Balanced Approach. In addition, since 2010, Liege airport setup other mitigation actions (2018)⁵¹:

- 1585 building bought
- 143 buildings in acquisition
- Insulation options offered to 5 451 buildings
- A free access to the neighbourhood to information about possible compensations for noise exposure

⁴⁸ Mobilité et Transports. Belgium. (2020). [Mobilit.belgium.be](https://mobilit.belgium.be/fr/transport_aerien/aerports_et_aerodromes/statistiques). Retrieved from Données statistiques des aéroports: https://mobilit.belgium.be/fr/transport_aerien/aerports_et_aerodromes/statistiques

⁴⁹ Wallonia.be. (2017, January 10). Wallonia.be. Retrieved from Liege Airport, 8th cargo airport in Europe: <http://www.wallonia.be/en/news/liege-airport-8th-cargo-airport-europe>

⁵⁰ Liege Airport. (2020). [www.liegeairport.com](https://www.liegeairport.com/flexport/en/liege-airport/). Retrieved from <https://www.liegeairport.com/flexport/en/liege-airport/>

⁵¹ Liege Airport. (2020). [www.liegeairport.com](https://www.liegeairport.com/flexport/fr/donnees-techniques/impact-sonore/). Retrieved from Carte des zones de bruit : <https://www.liegeairport.com/flexport/fr/donnees-techniques/impact-sonore/>

- Neighbourhood access to the DIAPASON software, that shows aircraft trajectories and recorded noise pollution in real time.

During the COVID-19 crisis, Liège Airport's movement is likely not to decrease, as it has been chosen (14/04/2020) to be one of the World Health Organization (WHO) hubs for medical supply distribution⁵². The airport's cargo handling companies have recently been hiring more people to cope with the increase of cargos.

2.1.5. Petition No 2671/2014 Cologne/Bonn Airport

Petition Title: Aircraft noise from the Cologne/Bonn Airport (Germany)		
Initiator (of petition): Petra Hemptenmacher		Reference: 2671/2014
Declared admissible in 2015	Cologne/Bonn	Number of Signatories: One
Short summary <p>The petitioner complains about noise from aircraft in the area surrounding the Cologne/Bonn (Köln/Bonn) airport. According to the petitioner, every day 400,000 people living near the airport suffer harmful consequences from the aircraft movements which take place 24 hours a day. The noise level involved is clearly above the standards set by the WHO and approximately 120,000 citizens are at a significantly increased risk of developing high blood pressure and cardiovascular diseases, resulting in very high medical expenses and death rates. The petitioner claims that the EUR 1 million profit for the airport leads to EUR 3 million extra healthcare expenses. Air traffic should also be curbed in order to protect the climate, as, according to the petitioner, air traffic is one of the most harmful forms of transport for the climate, while the aviation sector does not contribute towards the costs of healthcare. It is partly for this reason that there should be an end to the tax exemption which this sector enjoys (e.g. tax-free kerosene). The petitioner also believes that the billions of euros in direct and indirect subsidies which the aviation sector receives could be spent more usefully on solving the (youth) unemployment problem. The petitioner asks the European Parliament to focus on aviation legislation which will benefit citizens and to support the 'Taming Aviation' petition (2482/2014).</p>		
Open/Closed closed	Recommendations/Conclusions Not available	

Presented by Petra Hemptenmacher (German), about aircraft noise from Cologne/Bonn airport (Germany), the complaint is about the suffering of 400,000 people in the airport's neighbourhood, caused by noise pollution. Considering noise levels being above the WHO standards, and that the money gained thanks to the airport's development is threetime less than the money spent by the state to cover health problems due to aviation, petitioners are calling for:

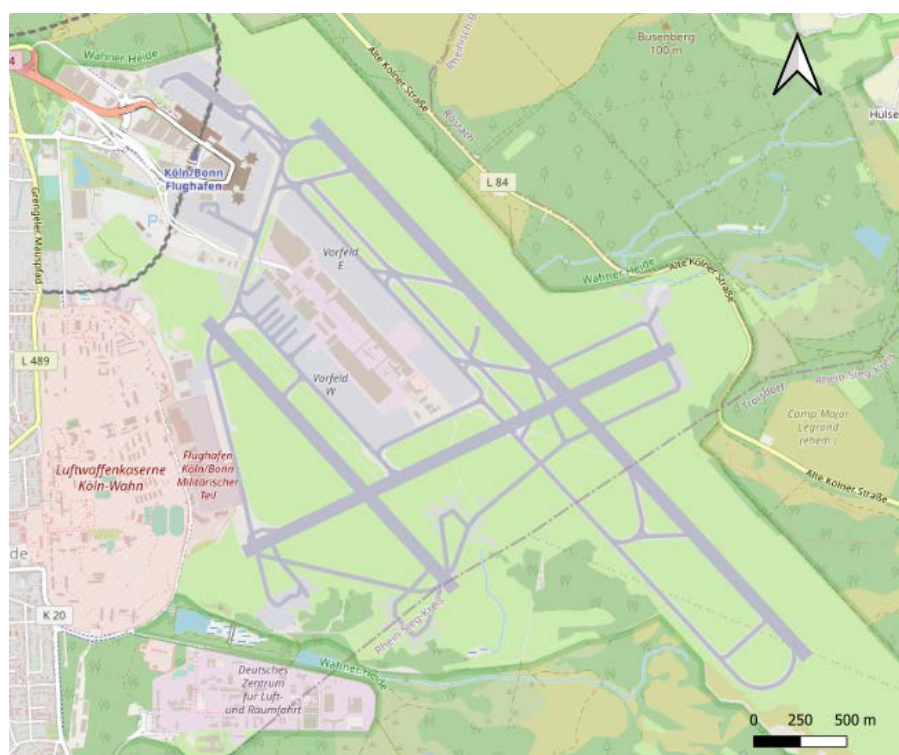
- The end of tax exemption
- A legislation going in the "Taming aviation" petition's direction

Cologne/Bonn airport, depicted in figure 2.5, is located at 12km from Cologne and 16km from Bonn. It is the only airport that serves Cologne and Bonn with passenger and freight. The airport has 3 runways,

⁵² RTBF. (2020, April 14). RTBF.be. Retrieved from https://www.rtbf.be/info/regions/detail_coronavirus-liege-airport-sera-un-hub-de-l-oms-pour-distribuer-le-materiel-medical-vital-press?id=10481472

two parallel and one cross wind. The number of movements jumped from 120,400 movements in 2013 to 141,300 movements in 2017. Located in the European “golden triangle”, cargo and freight are both important businesses for the airport. According to the 2017 Annual Report⁵³, Köln Bonn airport has seen the cargo sector increase even more than passenger, with a rise of 7% in 2017. This increase is explained by the increase of online shipping and the three leaders of cargo transportation FedEx, DHL, UPS that are operating at this airport. The Airport has received an award from Air Cargo World for their performance, customer service, infrastructure, and handling quality.

Figure 2.5 Cologne/Bonn Airport



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Map created using the Free and Open Source [QGIS](https://www.qgis.org/)

To address noise issue, the airport has, since the year of the petition, taken mitigation actions. A higher (+20% in 2015 for B737 and A319) tax fee is applied to airlines operating night flights (from 22:00 to 6:00). It should be noted that the higher tax is only applicable to PAX flights, and does not affect cargo flights.

In addition, since 1991, a programme for passive noise abatement had been introduced and is still in place, including installation of sound-proof windows and ventilators in bedrooms.

While passenger operations at Cologne Bonn Airport ground almost to a complete halt as a result of the COVID-19 crisis, freight operations were running at full capacity. As an important logistics location, the airport played key role in ensuring that both people and companies in the region are supplied with the goods they need. In addition to the three major cargo airlines – UPS, FedEx and DHL – further air cargo carriers are also strengthening their presence at Cologne/Bonn. As well as industrial goods, cargo aircraft are carrying medical supplies and equipment for hospitals. The proportion of food supplies is also high.

⁵³ Cologne Bonn Airport. (2017). [www.cologne-bonn-airport.com](https://www.cologne-bonn-airport.com/uploads/tx_download/KBA_GeBer2017_web_EN.pdf). Retrieved from https://www.cologne-bonn-airport.com/uploads/tx_download/KBA_GeBer2017_web_EN.pdf

“As a key component in the logistics chain, we currently bear a huge responsibility – as a hub for important supplies, our freight business is currently operating 24 hours a day, 7 days a week at full capacity,” says Johan Vanneste, CEO of Flughafen Köln/Bonn GmbH. “It is becoming clear how important it is that we, as one of the biggest freight airports in Europe, remain fully operational in these times of crisis. Our authorisation to operate night flights is also particularly relevant in this context. Our employees are highly motivated and are working as a team to ensure that we can get through these difficult times together. We owe them a great debt of thanks.”

2.2. Noise issues

Table 2.1 summarizes and compares the petitions’ charges and their demands. Petitions are ordered according to the previous sub-section and are dated according to the date the Parliament declared the petition admissible. Cause of nuisances and claims are then compared.

On a general point of view, all these petitions are addressing a specific airport’s noise exposure. Petition No 0622/2018 on noise pollution in the vicinity of airports 2018 addresses to all other Hungarian airports as well as the Budapest airport.

It can be observed that where petitioners are complaining about various aspects of noise disturbance and calling for mitigation actions to be taken in general, the lack of communication about both regulatory framework and airports strategies are also mentioned. Petitioners are not clear about what impact noise has on health. They also do not know if any actions have been taken to address noise health issues. In addition to that, the complexity of the regulatory framework organised in layers from international to local scale makes difficult to clearly identify 1) interlocutors to address the complaint and 2) specific points on which a complaint can be made. It can be highlighted that petitions increase when the airport itself does not: 1) communicate about noise issues, 2) actively inform citizens about their actions addressing noise issue, or 3) does not engage in discussion with neighbourhood communities with a specific interlocutor identified.

All the petitions are about different aspects of noise disturbance. The most evident cause of nuisance in the petitions is the increase of air traffic/noise exposure over time. When mitigation actions are already in place, petitions often come with a relatively sudden increase of air traffic over relatively few years. This obviously comes with a sharp increase of noise disturbance.

Table 2-1 Comparison of the petitions

Petition	year	Airport	Cause of nuisances				Calling for			
			Increase of air traffic/noise exposure	Proximity of runways (LTO)	Flight level above residential area	Transparency on health effects	Reduction of air traffic	Prohibition of tax relief	Elevation of flight level above residential area	Mitigation actions
2.1.1	2015	Ciampino	X	X	X				X	
2.1.2	2014	Berlin-Tegel	X				X			
2.1.3	2018	Budapest	X						X	
2.1.4	2010	Liège			X			X		
2.1.5	2015	Cologne/Bonn				X	X	X		

All the five petitions described in the previous sub-sections are dating from 2010 to 2018 and some mitigations actions have been implemented since the petitions were first raised.

3. IMPACT OF NOISE ON HUMAN HEALTH

3.1. Noise impact on Human health

The impact of environmental noise on health has been growing in importance over the last few years. Nowadays, various international research studies are available that establish key observations on the health impacts from environmental noise.

Noise events not only cause annoyance, but long-term and consistent exposure to high noise levels also lead to auditory system deterioration, hearing loss, sleep disturbance, cardiovascular disease and diminished learning capacity. Widely adopted advice on the levels of aircraft noise where the onset of significant adverse impacts arise is available, and the EU requires major airports, to report on the extent of these and numbers of people affected.

The World Health Organisation (WHO) also undertake international research into this topic and from time to time publish new science on these impacts, which usually finds its way into international and ultimately national rules and legislation.

Perhaps the most important evidence on health impacts due to noise comes from WHO. A 2011 report⁵⁴ on the burden of disease from environmental noise evaluated the correlation between environmental noise, including that from road, railways and aircraft, with cardiovascular disease, cognitive impairment in children, sleep disturbance and tinnitus. This study showed that there is certainly growing evidence from epidemiological studies that noise does indeed impact health conditions. The data on the association between exposure to aircraft noise and hypertension, high blood pressure and ischaemic heart disease has increased during recent years. In particular for aircraft noise, because of its intensity, the location of the source, and its variability and unpredictability, is likely to have a greater effect on children's cognition and reading comprehension than for example, road traffic noise, which might be of a more constant intensity.

There have been other studies that have investigated the effects of transportation noise on health. For instance, it has been shown that, night-time noise from transportation produces both instantaneous and long-term health effects, due to the alteration of sleep, leading to arousal and awakening. The arousal involves neural and hormonal activity and may be reflected in cardiovascular changes and motor activity (motility).⁵⁵ Moreover, it was proved that insomnia, which can originate from the effects of noise at night coming from aircraft, has a negative effect on quality of life. It is linked to less work performance, memory and concentration problems, depression, obesity, cardiovascular disease, hypertension and to the increase of occupational accidents.⁵⁶ It was also found that aircraft noise during sleep results in increased probability of motility during these and events and increases the number of awakenings.⁵⁷

⁵⁴ World Health Organisation. (2011). Burden of disease from environmental noise. Quantification of healthy life years lost in Europe. Retrieved from [www.who.int: https://www.who.int/quantifying_ehimpacts/publications/e94888.pdf?ua=1](https://www.who.int/quantifying_ehimpacts/publications/e94888.pdf?ua=1)

⁵⁵ Miedema, H., Passchier-Vermeer, W., & Vos, H. (2003). Elements for a position paper on night-time transportation noise and sleep disturbance. Delft.

⁵⁶ [Health Council of the Netherlands. \(2004\). The Influence of Night-time Noise on Sleep and Health.](#)

⁵⁷ Passchier - Vermeer, W., Vos, H., Steenbekkers, J., van der Ploeg, F., & Groothuis-Oudshoorn, K. (2002). Sleep disturbance and aircraft noise exposure Exposure-effect relationships. Leiden.

Further evidence was found in a study near Heathrow Airport.⁵⁸ These results suggest that high levels of aircraft noise are associated with an increased risk of stroke, coronary heart disease, and cardiovascular disease. In this regard, a multi-airport retrospective study found a statistically significant association between exposure to aircraft noise and risk of hospitalization for cardiovascular diseases among older people living near airports.⁵⁹ Furthermore, night-time aircraft noise was found to increase the prevalence of prescriptions for antihypertensive and cardiovascular drugs, especially when prescribed combined and in conjunction with anxiolytic drugs.⁶⁰

Another important finding was obtained in the Hypertension and Exposure to Noise Near Airports (HYENA) study.⁶¹ In this research project it was found that excess risks of hypertension are related to long-term noise exposure, primarily for night-time aircraft noise and daily average road traffic noise. As a continuation study to this research project, it was observed that annoyance due to aircraft noise has increased throughout the recent years, and that the current EU prediction curve for aircraft noise annoyance should be modified.⁶²

3.2. WHO Guidelines

The 2018 WHO Environmental Noise Guidelines for the European Region⁶³, addressing the issue of aircraft noise, strongly recommended reducing exposure to below 45 dB(A) for L_{den} and 40 dB(A) for L_{night} . WHO also recommended using the DALY (Disability Adjusted Life Years) metric to quantify the deterioration of populations' health due to disease or by exposure to environmental factors. WHO estimates that the health deterioration coefficient (also called disability weight) for noise annoyance is about 0.02, and 0.07 for sleep disturbance, where the scale varies from 0 (undeteriorated health) to 1 (death).

Based on these recommendations, a February 2019 report by Bruitparif⁶⁴ evaluated the healthy life-years lost due to annoyance and sleep disturbance caused by transport noise from road, rail and aircraft within the densely populated zone of Ile-de-France. The study found that 375,000 people (3.7% of the population) in the densely populated zone of Ile-de-France are exposed to noise levels that exceed the regulatory limit value of 55 dB(A) using the L_{den} indicator. In terms of the health impact, aircraft noise is responsible for 18,718 disability-adjusted life-years lost every year within the densely populated zone

⁵⁸ Hansell Anna L, Blangiardo Marta, Fortunato Lea, Floud Sarah, de Hoogh Kees, Fecht Daniela et al. Aircraft noise and cardiovascular disease near Heathrow airport in London: small area study *BMJ* 2013; 347 :f5432

⁵⁹ Correia Andrew W, Peters Junenette L, Levy Jonathan I, Melly Steven, Dominici Francesca. Residential exposure to aircraft noise and hospital admissions for cardiovascular diseases: multi-airport retrospective study *BMJ* 2013; 347 :f5561

⁶⁰ Greiser, E., Greiser, C., & Jahnsen, K. (2007). Night-time aircraft noise increases prevalence of prescriptions of antihypertensive and cardiovascular drugs irrespective of social class—the Cologne-Bonn Airport study. *J Public Health*.

⁶¹ Jarup L, Babisch W, Houthuijs D, Pershagen G, Katsouyanni K, Cadum E, Dudley ML, Savigny P, Seiffert I, Swart W, Breugelmans O, Bluhm G, Selander J, Haralabidis A, Dimakopoulou K, Sourtzi P, Velonakis M, Vigna-Taglianti F; HYENA study team. Hypertension and exposure to noise near airports: the HYENA study. *Environ Health Perspect*. 2008 Mar; 116(3):329-33. doi: 10.1289/ehp.10775. Erratum in: *Environ Health Perspect*. 2008 Jun; 116(6):A241. PMID: 18335099; PMCID: PMC2265027.

⁶² Babisch W, Houthuijs D, Pershagen G, Cadum E, Katsouyanni K, Velonakis M, Dudley ML, Marohn HD, Swart W, Breugelmans O, Bluhm G, Selander J, Vigna-Taglianti F, Pisani S, Haralabidis A, Dimakopoulou K, Zachos I, Järup L; HYENA Consortium. Annoyance due to aircraft noise has increased over the years--results of the HYENA study. *Environ Int*. 2009 Nov; 35(8):1169-76. doi: 10.1016/j.envint.2009.07.012. Epub 2009 Aug 21. PMID: 19699524.

⁶³ [World Health Organization. \(2018\). Environmental Noise Guidelines for the European Region.](#)

⁶⁴ [Bruitparif. \(2019\). HEALTH IMPACT OF TRANSPORT NOISE IN THE DENSELY POPULATED ZONE OF ILE-DE-FRANCE REGION.](#)

of Ile-de-France, distributed between the DALYs lost due to annoyance (6,491 DALYs, or 35% of the total) and the DALYs lost due to sleep disturbance (12,227 DALYs, or 65% of the total).

A similar study to the one carried out by Bruitparif was performed for Brussels Capital Region (RBC) by Bruxelles Environnement in 2016.⁶⁵ In this report, the proportion of DALYs generated in RBC by the 224,000 aircraft movements from Brussels Airport in 2011 was larger than that of the Parisian region, which nevertheless has two international airports (Paris Charles de Gaulle and Paris-Orly), which together account for nearly 735,000 movements.

3.3. ACI response to WHO

ACI-Europe (the European industry trade association that represents over 500 European airports), responded to the publication of the 2018 WHO guidelines, by publishing an Analysis Paper⁶⁶, setting out the complexity of the subject and the sciences needed to analyse it in a comprehensive manner, as well as the research gaps that still need to be addressed.

3.3.1. The NORAH Study

The NORAH Study⁶⁷ was stated by ACI to be the most recent, comprehensive and authoritative study to date regarding the health outcomes.

The NORAH Study was conducted over nearly five years in the Rhine-Main Region in order to record effects of aircraft, road and rail traffic noise on residents in this region. The results were publicly presented in 2015 and summarized in the NORAH Knowledge No.14 document.

The study focused on the following subjects, Study on Quality on life, Study on Health Risks, Sleep Study, Blood pressure Study and Children's Study, and the following conclusions were given:

Aircraft noise has a strong impact on quality of life and is associated with the highest levels of annoyance, compared with road and rail traffic. However, non-acoustic factors contribute significantly to annoyance such as the ability of participant to handle noise, their attitude towards air traffic or their expectation of how the future flight operation would affect their residential situation.

Regarding Health Risks, aircraft noise was strongly identified in a correlation between traffic noise and the risk of depression, but the effects of road and rail traffic on chronic heart failure were more highlighted than those from aviation. Indeed, when only considering the long-term energy equivalent noise level, the highest risk for a weak heart came from rail noise, followed by road and aircraft noise. However, regarding depression, for an equivalent increase of 10 dB, the risk of a depressive episode increases by 8.9 percent for aircraft noise against respectively 4.1 and 3.9 percent for road and rail traffic. These results should be used with caution as for aircraft and rail noise, the risk drops again at very high noise levels.

The study highlighted the importance of subjective factors in the effects of noise disturbance on sleep. However, if people wake-up less at night since the introduction of night flight ban between 11 pm and 5am, they often feel less tired in the morning.

⁶⁵ [Bruxelles Environnement \(2016\). ÉVALUATION DES IMPACTS SANITAIRE ET ÉCONOMIQUE DU BRUIT DES TRANSPORTS EN RÉGION DE BRUXELLES-CAPITALE.](#)

⁶⁶ Airports Council International Europe. (2018). Addressing the future of aviation noise. Retrieved from <https://www.aeroport.fr/uploads/documents/voir-l%27etude-sur-le-bruit.pdf?v12>

⁶⁷ Forum flughafen & region. Umwelt - und nachbarschaftshaus. (2015). NORAH Noise Impact Study. Kelsterbach.

The study could not confirm with statistical certainty that chronic aircraft noise increases blood pressure.

Primary school children tend to learn to read more slowly in areas affected by aircraft noise. Lessons are being disturbed considerably in areas strongly subject to aircraft noise.

3.3.2. Non acoustic factors

ACI states in the same document that many airports face an increase in the number of noise complaints and reports of annoyance, while the number of people exposed to noise limits is going down. This allows them to conclude that noise annoyance cannot only be explained by objective noise levels, but that non-acoustic factors play an important role. According to Kroesen Maarten et al⁶⁸, acoustic factors represent 30 percent of the annoyance response of people.

3.3.3. Regulations

ACI develops its argument by detailing existing regulations and airport best practises examples.

3.4. Improving Noise Metrics

However, the implementation of the 2018 WHO guidelines might take a while to be adopted as there is a large gap between these advisory noise limits and the limits recommended by the International Civil Aviation Organisation (ICAO). The recommendation given by WHO to reduce exposure to below 45 dB(A) for L_{den} and 40 dB(A) for L_{night} can be a strong change to the methodology applied so far, as it is a big jump from 55 L_{den} and 40-45 L_{night} .

The Netherlands Health Council also stated⁶⁹ that limiting the SEL⁷⁰ inside the bedroom to less than the biological effect threshold levels was not a technically realistic option at the present time. Given that aircraft noise is mainly composed of low frequencies, sufficient soundproofing would require substantial thickness of insulating material.

Historically, the aviation industry did not pay too much attention to the health effects caused by their activity, although due to all the research carried out recently, this attitude has changed. Nowadays, the aviation industry has acknowledged the detrimental health impacts that aircraft noise can have on human health and has made efforts to actively tackle these issues.

For night noise especially, a relevant metric that quantifies the impact on health of residents living around the airport is the risk of awakening. The same Netherlands Health Council 2004 paper (above) on the influence of night time noise on sleep and health stated that *"At a given L_{night} value, the most unfavourable situation in terms of a particular direct biological effect of night-time noise is not, as might be supposed, one characterised by a few loud events per night. Rather, the worse-case scenario involves a number of noise events all of which are roughly 5 dBA above the threshold for the effect in question."*

Hence, depending on how L_{night} is regulated, the most effective option as of today would be to limit the number of night noise events, particularly for larger (and heavier) aircraft.

Traditional noise contour maps represent the area under a specific noise level. Hence larger noise contours do not necessarily represent more intense noise impacts, they are simply a reflection of

⁶⁸ Kroesen M, Molin EJ, van Wee B. Testing a theory of aircraft noise annoyance: a structural equation analysis. *J Acoust Soc Am*. 2008 Jun;123(6):4250-60. doi: 10.1121/1.2916589. PMID: 18537376.

⁶⁹ [Health Council of the Netherlands. \(2004\). The Influence of Night-time Noise on Sleep and Health.](#)

⁷⁰ Sound exposure level (SEL) is a logarithmic measure of the sound exposure of a sound relative to a reference value

increase or decrease in the area under a certain noise level. The size of the graphics and contours do not have a direct correlation with the density of people impacted and hence the total amount of annoyance to population caused. A better standardised method of representing this information graphically for easier comprehension should also be developed in the future.

Furthermore, the use of new metrics like Number of Events above a certain noise value are being pushed forward. As it is indicated in the WHO 2018 Environmental Noise Guidelines for the European Region *“There is additional uncertainty when characterizing exposure using the acoustical description of aircraft noise by means of L_{den} or L_{night} . Use of these average noise indicators may limit the ability to observe associations between exposure to aircraft noise and some health outcomes (such as awakening reactions); as such, noise indicators based on the number of events (such as the frequency distribution of LA_{max}) may be better suited. However, such indicators are not widely used”*.

There is, therefore, the proposal to start giving more priority to other noise indicators (in particular frequency metrics) as well as calculating lower noise level contours to present noise exposure, which is a challenging modification considering the way the noise effects have been studied until now.

4. REGULATORY FRAMEWORK CONTENT

This section provides an assessment of the legal situation for airport noise pollution and for air traffic and related measures to improve quality of life of citizens who live near the airports in the European Union.

Regulations regarding aircraft noise are defined at different levels which are described in the following sub-sections:

- International level (UN⁷¹/ICAO)
- European Union level
- National level
- Airport/Local level

4.1. International level

4.1.1. Aircraft noise certification (International Civil Aviation Organization, 2017)⁷²

During the certification process aircraft are also certified for noise. Aircraft noise is measured at 3 points:

- Take-off (6.5km from start of the roll)
- Side-line on the runway (450 m from the runway)
- Approach (2km from the runway threshold and 120m high)

For each of the 3 measurement points, a limit is agreed at ICAO level. These limits depend on the weight of the aircraft at the take-off and on the number of engines. The difference between the sum of the 3 limits and the 3 noise levels is called "Cumulative Noise Margin". During the years new noise limits have been decided, taking in to account the noise reduction achieved for individual aircraft due to technology improvements over time. For jets for example, the limits are referred to as Chapter 2, Chapter 3, Chapter 4 and Chapter 14. Depending on the year the type certificate is submitted, aircraft must comply with a limit:

- Chapter 2: Type certificate submitted before 6th October 1977
- Chapter 3: Type certificate submitted before 1st January 2006
- Chapter 4: Type certificate submitted before 31st December 2017
- Chapter 14: Type certificate submitted on or after 31st December 2017

Figure 4.1 from the EAER 2019 represents an overview of the improvement over time of aircraft noise performances in terms of Cumulative Noise Margin to Chapter 3. As visible from the chart, older aircraft have a cumulative margin to the limit lower with respect of newer aircraft. This means that, thanks to the technology improvements, newer aircraft are quieter. This improvement is visible in Figure 4.2, where the four different noise contours⁷³ represents the area exposed to a noise level greater than 80 dB for four 75-tonne aircraft marginally compliant with each standard during one landing and take-off. As visible from the figure, the area exposed to a noise level greater than 80 dB decreases if the aircraft meet the newest standards.

⁷¹ UN: United Nations

⁷² International Civil Aviation Organization. (2017). Annex 16 - Environmental Protection - Volume I - Aircraft Noise.

⁷³ A Noise Contour is a line on a map that represents equal levels of noise exposure

Figure 4.1 Improvement over time of aircraft noise performance, in terms of cumulative margin to Chapter 3 limit (Image retrieved from [EAER 2019](#))

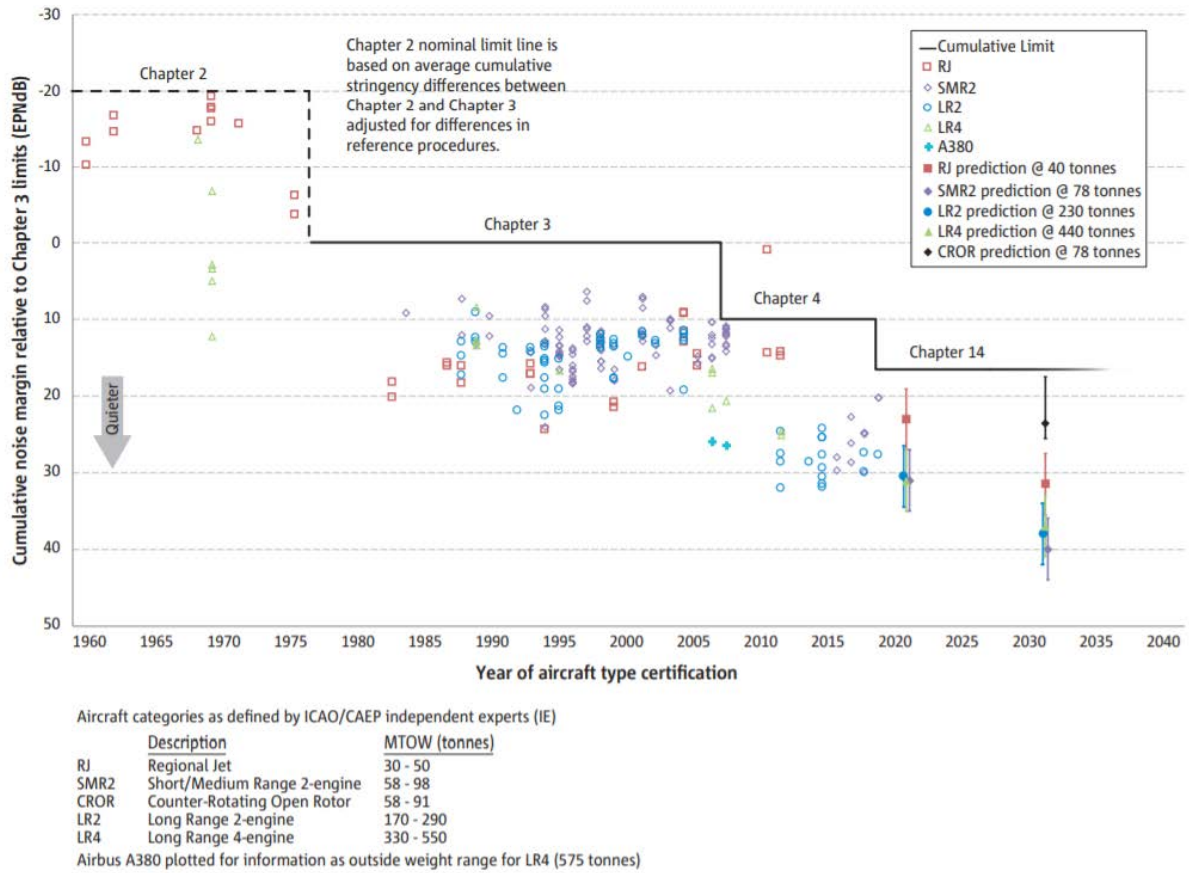
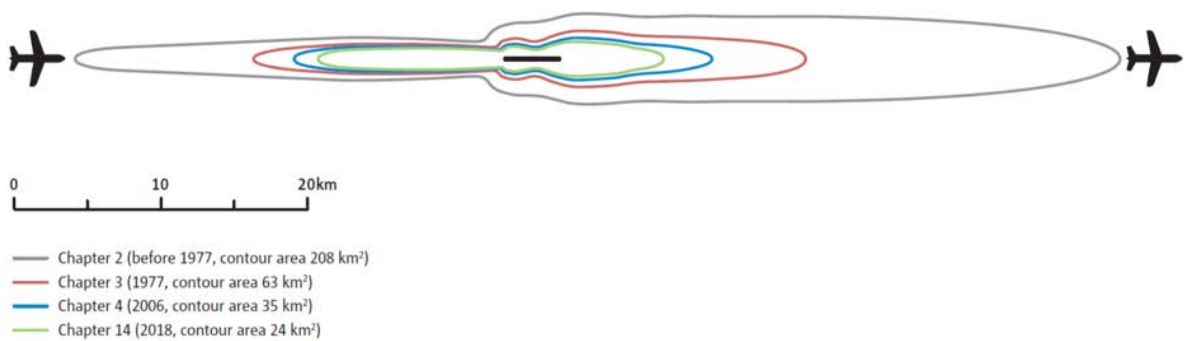


Figure 4.2 Take-off and landing 80 dB noise contours for different aircraft that meet the 4 different noise limits (Image retrieved from [EAER 2019](#))



4.1.2. Balanced Approach (ICAO Doc 9829 AN/451)⁷⁴

ICAO adopted the concept of “Balanced Approach” to identify the noise problems around airports and to propose different solutions. Technology improvements are helping to reduce aircraft noise, but more needs to be done to tackle the growing traffic.

Noise problems are causing operational limitations at airport level and opposition to the construction of new airports or to the expansion of existing ones. For these reasons, a common approach is necessary to avoid uncoordinated policies that could lead to negative outcomes.

The idea of the Balanced approach is to address aircraft noise problem at individual airports in the most environmentally and economically responsible way. The balanced approach corresponds to a list of principles that can help airports to improve their management of the ground noise impacts. As represented in Figure 4.3, the Balanced Approach has four pillars:

1. **Reduction of noise at source:** It is limited to adoption of noise certification standards -> ICAO responsibility
2. **Planning and management:** Zoning of areas around airports according to the noise level, allow only certain activities inside these boundaries -> Responsibility of local and municipal governments
3. **Noise abatement operational procedures:** They modify aircraft operations (Use of specific runways, respite periods, preferential routes ecc.) to reduce noise. These are the most effective measures
4. **Operating restrictions:** These include phase-out of certain aircraft type, curfews, use of APU⁷⁵ restriction. Restrictions can have an economic impact, so it is recommended to use them only when the other measures are not effective

Figure 4.3 Balanced Approach 4 pillars (Image retrieved from [EAER 2019](#))



Other strategies to reduce noise advised by the Balanced Approach are the use of noise monitoring systems and the community outreach.

Each airport should identify what are the main causes of noise problems and set noise objectives to be achieved. If there is any difference between the objectives and the evolution of the noise problem, then

⁷⁴ International Civil Aviation Organization. (n.d.). ICAO Environment. Retrieved from Aircraft Noise: <https://www.icao.int/environmental-protection/Pages/noise.aspx>

⁷⁵ APU: Auxiliary Power Unit

a problem exists. In the document it is also stated that Airports might have different problems regarding noise pollution, different ways to assess it and different objectives.

ICAO also defined the guidelines to assess noise around airports, stating that a good metric is the number of people affected by more than a specified noise index. A reduction of the number of people following the application of noise abatement measures should also be considered really carefully, as it could happen that more flights (and more noise) would be concentrated on a minority of people.

4.2. European level

At European level, international guidelines are applied adding restrictions in terms of technology used by the operator. It is forbidden to fly in the European Airspace with aircraft that are considered too noisy. Additionally, more detailed regulation is given to member states with respect to implementing ICAO's Balanced Approach, in particular, in applying noise operating restrictions.

Regarding regulations about citizens' noise exposure, Member States are obliged to assess noise levels from major sources, inform the public and find solutions to reduce noise. European Union does not set limit values⁷⁶, but many Member States have national noise limits decided with scientific studies on the health problems caused by exposure to excessive noise levels. As mentioned by the European Environment Agency in the same report, Member States' limit values do not reflect WHO guidelines and they are in general higher than the recommended values.

4.2.1. European Environmental Noise Directive⁷⁷

The European Environmental Noise Directive (2002/49/EC) aims to "define a common approach intended to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, due to the exposure to environmental noise".

The directive focuses on three areas:

1. Determination of exposure to environmental noise
2. Availability of environmental noise information to the public
3. Preventing and reducing noise where necessary and preserving environmental noise quality where possible

The directive requires the member states to draw up every 5 years noise maps for major road, railways, major airports (>50,000 movements per year) and agglomerations. The indicators used are L_{den} and L_{night} , to assess the number of people annoyed (L_{den}) and sleep-disturbed (L_{night}). It is important to note that the directive does not set limit values and the measures to be taken in noise action plans remains under each member states responsibilities. The noise action plans are based on the strategic noise-mapping results and aim to prevent and reduce environmental noise where necessary, particularly where exposure levels can induce harmful effects on human health.

⁷⁶ European Environment Agency. (2020). Environmental noise in Europe — 2020. Luxembourg: Publications Office of the European Union: <https://www.eea.europa.eu/publications/environmental-noise-in-europe>.

⁷⁷ European Parliament. (2002, June 25). Eur-Lex. Retrieved from Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32002L0049>

4.2.2. Europe Ban on “Chapter 2” compliant aircraft⁷⁸

In Europe, jet aircraft with a Maximum Take-off Mass greater than 34,000kg or at least 19 seats must be at least Chapter 3 compliant from April 2002 (Directive 2002/30/EC). According to the Directive, few exemptions apply. Member states can only authorise Chapter 2 compliant aircraft in the cases of:

- Aeroplanes of historic interest
- Aeroplanes used by an operator of a Member State before 1st November 1989 under hire purchase or leasing contracts still in effect, and which in this context have been registered in a non-member state
- Aeroplanes leased to an operator of a non-Member state
- An aeroplane which replaces one which has been destroyed and which the operator is unable to replace by a comparable aeroplane available
- Aeroplanes powered by engines with a by-pass ratio of 2 or more

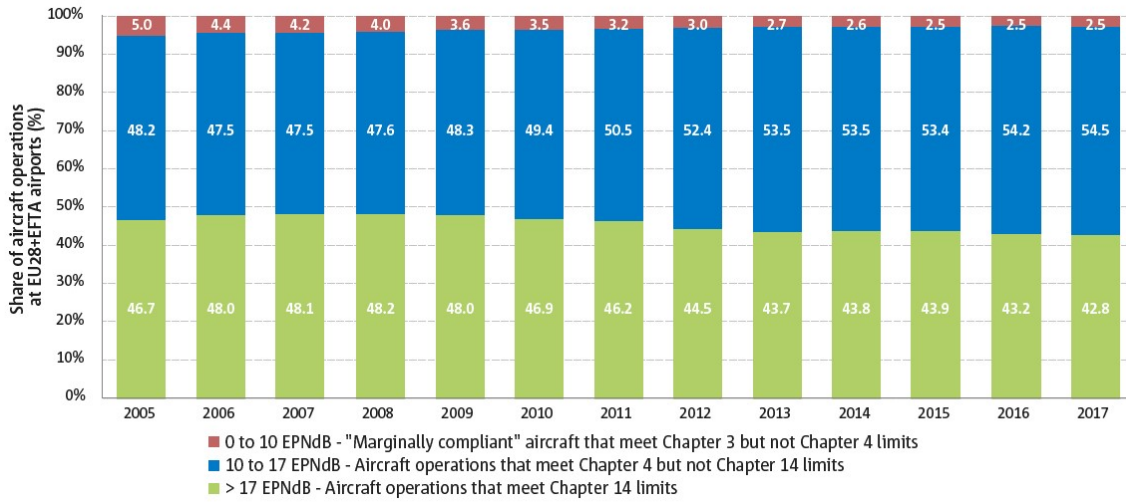
4.2.3. Regulation EU 598/2014

The regulation 598/2014 establishes rules on introducing noise-related operating restrictions at the European airports level to improve the noise environment. It follows the guidelines of the ICAO Balanced Approach to noise management and the rules defined apply to airports with more than 50,000 movements per year covering civil aircraft. No noise limits are defined at European level, but each member state has to define these thresholds. Decisions that may be applied are operating restrictions, such as limiting movements, setting noise limits, adopting a curfew during the night, and they must be based on independent data and approved by other member states and the European Commission. The directive introduces the obligation to monitor noise through monitoring stations and noise modelling. It demands technical cooperation between operators, ground handlers and air navigation services to study ways to mitigate noise. An innovative proposal put the attention on aircraft “marginally compliant” with Chapter 3 limit, proposing to ban all the operations with aircraft with a cumulative margin to the limit of less than 8 EPNdB⁷⁹ before 14 June 2020, and with a cumulative margin to the limit of less than 10 EPNdB after this date. As visible from Figure 4.4, the share of operations in the 27 European countries plus United Kingdom and the European Freedom Trade association (EFTA), composed by Iceland, Liechtenstein, Norway and Switzerland, is already a low number and it is decreasing every year.

⁷⁸ European Parliament. (2002, March 26). Eur-Lex. Retrieved from Directive 2002/30/EC of the European Parliament and of the Council of 26 March 2002 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Community airports (Text with EEA relevance): <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32002L0030>

⁷⁹ EPNdB: Effective Perceived Noise in Decibels

Figure 4.4 Share of EU28+EFTA operations by cumulative margin to Chapter 3 limits (Image retrieved from [EAER 2019](#))



4.3. National level rules

Each member state has to transpose the European union regulations into its own legislation. Governments decide which national authority is competent to define noise limits and implement the international and European guidelines with respect of noise management. A non-exhaustive list of what governments should decide includes:

- Introduce into the national legislation directives 2002/30/EC and 2002/49/EC
- Define a national noise framework law
- Define a methodology to measure noise around airports
- Define noise limits
- Define guidelines to reduce aircraft noise
- Passive acoustic requirements for buildings

Legislation could set a noise limit for a single take-off or a single approach and the usual metric used is L_{Amax}^{80} . Limits can also be designed in a different way. In Italy for example a metric is created to define what are the economic activities that can be done in areas around airports according to the noise level. The new metric takes in to account the 3 weeks with the higher number of movements and the Sound Exposure Level (SEL) of each movement. The newly created metric is called L_{va}^{81} and new noise contour maps are created. The following criteria apply:

Area	L_{va}	Constraints
Zone A	< 65 dB(A)	No constraints
Zone B	< 75 dB(A)	No residential area

⁸⁰ L_{Amax} : Maximum sound level. This is the maximum instantaneous sound level occurring during the measurement period.

⁸¹ Level of Aircraft eValuation: the noise index for assessing noise around airports used in Italy, in dB(A)

Area	Lva	Constraints
Zone C	> 75 dB(A)	Only activities linked to the airport
Other	< 60 dB(A)	No constraints

4.4. Airport level rules

Airports could also decide their own rules to tackle the noise problem, following the principles of the balanced approach or with rules that anticipated this regulation. In some airports for example it is forbidden to use reverse thrust (except for safety reasons), there are restrictions in the use of APUs or there could be penalties for tracks violations.

Many airports implement noise charges in order to make airlines reduce the total noise affecting their surroundings and the number of people affected by high noise levels, as well as to disincentivize the use of old and noisy aircraft and night flights. According to ICAO recommendations, any income from noise charges should be revenue-neutral for the airport and it should be used to fund noise alleviation or prevention measures. Each airport at which a noise problem is confirmed can decide the indicator to base their charges. As an example, Frankfurt airport is charging each aircraft type according to the average of the effectively measured noise level by Noise Monitoring Stations around the airport in the 3 previous years⁸². In Schiphol noise charges are determined on basis of noise certification, based on the total margin to Chapter 3 limit⁸³.

4.4.1. Regulatory Procedures for Take-off and Landing⁸⁴

After the take-off and before landing aircraft have to follow pre-defined routes with the scope of expediting the safe and efficient flow of traffic. These standard routes are called Standard Instrument Departure (SID) and Standard Terminal Arrival Route (STAR). These procedures are used to optimize the take-off and approach to balance terrain/obstacle avoidance, noise abatement and airspace management considerations. These routes connect the airport areas to the en-route airway system and vice versa. Aircraft must follow orders from ATC⁸⁵ before following a SID or a STAR. These routes are different according to the runway assigned and the origin or destination and can vary according to the weather. SIDs and STARs consist of a number of waypoints, climb profiles to follow and include instructions whether the pilot should cross specific points at higher or lower altitude. Noise abatement procedures, such as preferential routes, Continuous Descent Approach and noise abatement departure procedures (NADP⁸⁶), could also be used, proving that they don't compromise safety and that "ATC can accommodate the procedure with minimal or no impact to airport capacity or controller workload", according to ICAO recommendations.

⁸² [Airport charges: Infrastructure Costs - Fraport](#)

⁸³ [Airport charges and conditions 2019 - Schiphol](#)

⁸⁴ International Civil Aviation Organization. (n.d.). ICAO. Retrieved from SID/STAR Toolkit: https://www.icao.int/airnavigation/sidstar/Pages/SID_STAR-Toolkit.aspx

⁸⁵ ATC: Air Traffic Control Service

⁸⁶ Noise Abatement Departure Procedures

4.4.2. Noise Limiting Schemes and Responses

Competent authorities (often local governments) may set voluntary or regulated noise limits, applying to all noise sources under their jurisdiction.

The airport itself may declare voluntary noise limits as part of its commitment to engagement and transparency with the local community.

In order to manage the complexities, it is becoming more and more common in Europe now, for airports to procure and implement noise and track keeping systems (NTK) which provide, at varying levels of sophistication, a way to monitor and manage the noise generated from flights into and out of the airport.

Just by having an NTK system it is possible for an airport to claim that it is monitoring noise levels and distribution and thereby is in a position to manage aircraft noise to some degree and to better understand and respond to community concerns.

A NTK system may also be used to provide more specific responses to individual complaints relating to single flight events. It also allows more general statistical analysis of complaints distribution and the compilation of regular complaints and noise distribution reports.

With appropriate skills noise monitoring can be used to verify noise contour modelling results. NTK can also provide more accurate input data for modelling to account for local good practice, which standard assumptions will not account for.

Many airports use NTK to enforce maximum noise limits, to verify noise related charges and to enforce the accuracy of departure track-keeping, or arrival alignment (avoiding late turns etc).

There are presently no agreed international standards for noise penalties or acceptable track adherence.

The application of framework of penalties in conjunction with an NTK system, needs to be undertaken with great care and needs to take account of circumstances where abnormal noise is caused by circumstances beyond a pilot's control. It is also essential to ensure that only a small percentage of flights are penalised, that the penalties are proportionate, and that the airport does not profit from such penalties. The effective uses of the NTK system – and especially when used for enforcement - need to be collaboratively agreed with all stakeholders, or underpinned with specific regulation, otherwise it is likely to fail.

5. NOISE IMPACT AND SOCIO-ECONOMIC FACTORS

In this section, evidence is reviewed about whether there is any correlation between noise impact and socio-economic factors.

In the past years several studies have investigated the correlation between noise exposure and economic well-being, pointing out that noise pollution might differently affect people according to their social status (European Environment Agency, 2018⁸⁷). This includes not only aircraft noise, but also roads and train noise. In particular, the FBB (2018) reports that in Belgium, Denmark, France, Germany, Luxembourg and the Netherlands, the proportion of the population reporting noise from the street or from neighbours is higher among people at risk of poverty than the average for the whole population. However, the report also mentions that in many other places (for instance Switzerland and East European countries) this relationship was not found, meaning that socio-economic status cannot reliably be used to predict exposure to noise.

However, there does seem to be some evidence as to why poor people would be more affected by aircraft noise, when looking at the property values. For instance, there are strong evidence (Breidenbach et al., 2019; Trojanek et al., 2017⁹²) that houses are cheaper in areas overflowed by aircrafts at low altitude. Concomitantly, while rich and poor people are overflowed by the same amount of flights, rich people can afford to soundproof their houses. Many scientific studies (Ahlfeldt & Maennig, 2013⁸⁸; Breidenbach et al., 2019⁸⁹; Limlomwongse Suksmith & Nitivattananon, 2015⁹⁰; Papageorgiou, 2019⁹¹; Trojanek et al., 2017⁹²) both in Europe and in other continents found out that the price of houses is negatively affected by aircraft noise. According to a study conducted in the vicinity of Warsaw, single-family houses where the aircraft attributable noise level is higher than 65 dB are 13.77% cheaper than similar houses in the vicinity of the airport where noise level is below 55 dB. Same situation in Berlin, where rental prices around Berlin-Tegel airport started to increase after the government announced the construction of a new airport and consequently the Berlin-Tegel closure. Community property values started decreasing (by 2% to 4%) after the 2017 referendum results, revoking the airport's closure (Breidenbach et al., 2019), while air traffic continued to increase at Berlin-Tegel. However, the reduction in values were smaller than expected (other airports refer to 8% to 10% drop in property value), due to the strength of the rising real estate market in Berlin. Similar studies have been made in other continents.

However, cause and effect must be analysed very carefully before jumping to conclusions. It would seem logical that poor people tend to live where houses and rents are cheaper, however the economic impulse and the facility hub created by Airport's operations can also attract people for their business

⁸⁷ European Environment Agency. (2018). Unequal exposure and unequal impacts: social vulnerability. Luxembourg: Publications Office of the European Union. <https://www.eea.europa.eu/publications/unequal-exposure-and-unequal-impacts>

⁸⁸ Ahlfeldt, Gabriel, Maennig, Wolfgang and Richter, Felix, (2013), Urban Renewal after the Berlin Wall, No 4506, CESifo Working Paper Series, CESifo, <https://EconPapers.repec.org/RePEc:ces:ceswps:4506>.

⁸⁹ Breidenbach, Philipp & Cohen, Jeffrey P. & Schaffner, Sandra, 2019. "Continuation of air services at Berlin-Tegel and its effects on rental prices," Ruhr Economic Papers 822, RWI - Leibniz-Institut für Wirtschaftsforschung, Ruhr-University Bochum, TU Dortmund University, University of Duisburg-Essen. <<https://ideas.repec.org/p/zbw/rwirep/822.html>>

⁹⁰ Suksmith, Patcharin & Nitivattananon, Vilas. (2014). Aviation Impacts on Property Values and Management: The Case of Suvarnabhumi International Airport. IATSS Research. 39. 10.1016/j.iatssr.2014.07.001.

⁹¹ Leo Papageorgiou, 2019. "The Impact of the Heathrow Northwest Runway Announcement on Residential Property Prices in Greater London," ERES eres2019_97, European Real Estate Society (ERES) <https://ideas.repec.org/p/arz/wpaper/eres2019_97.html>

⁹² Trojanek, R.; Tanas, J.; Raslanas, S.; Banaitis, A. The Impact of Aircraft Noise on Housing Prices in Poznan. Sustainability 2017, 9, 2088.

development. Choosing to live in the vicinity of an airport is a way to ensure a good access to major transport hubs like train stations, highways and the airport itself, as it has been observed to a certain point in the vicinity of Suvarnabhumi Airport in Thailand (Limlomwongse Suksmith&Nitivattananon, 2015⁹⁰).

Superficially, it may seem that poor people are more likely to be exposed to higher noise levels than richer people because they can only afford cheaper houses or rent, which are often found around flight paths near an airport. Nonetheless more studies need to identify whether there is a clear correlation between properties that are near an airport and low-income residential areas, as there are many (often conflicting) parameters to be considered.

No evidence has been found in literature to prove that aircraft are redirected on purpose over poorer areas, even though it is clear, that around many airports there is vigorous debate about the specific routes that aircraft are flying. There is the anecdotal case of Barcelona (Spain), where people claim that aircraft trajectories are defined to avoid flying over areas where famous people and football players live and, according to the president of one Spanish airline, this was even preventing the expansion of Barcelona airport.

6. EXEMPLARY PRACTICES AT MAJOR EUROPEAN AIRPORTS

This section provides two case studies, considered as exemplary practice applying significant measures to reduce the population impacted by aircraft noise. Direct and indirect noise reduction measures, plus a strong engagement with local communities are crucial to make an airport sustainable.

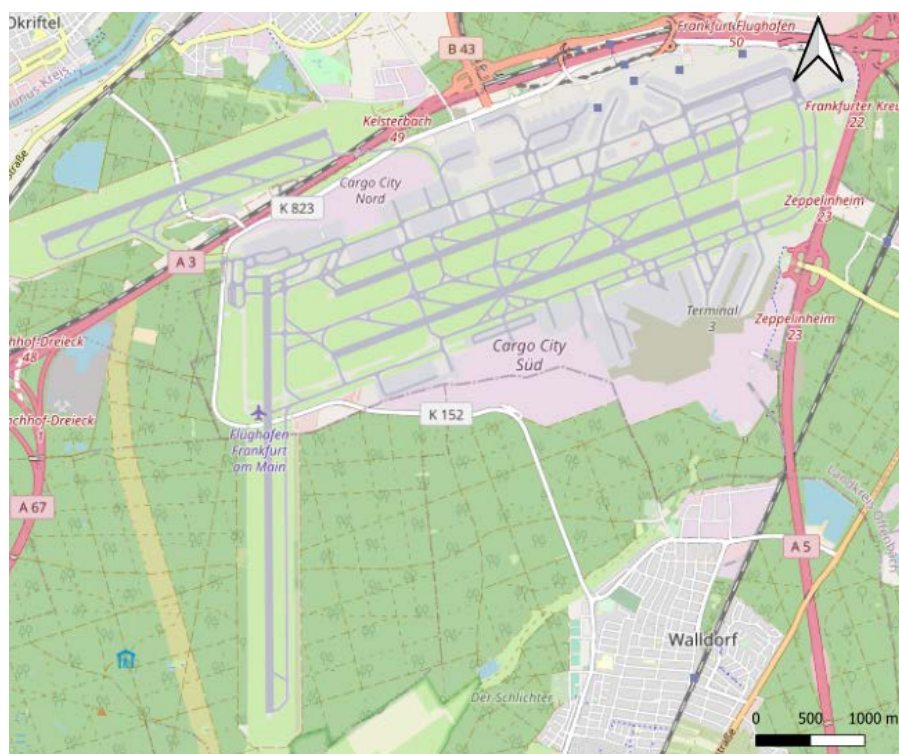
6.1. Frankfurt Airport

In 2018 Frankfurt airport was the 14th busiest airport in the world and the 4th in Europe, with more than 69 million passengers⁹³. According to the air traffic statistics, in 2018 there were 1,403 movements per day, 1 every 46 seconds in the 18 hours (from 05:00 to 23:00) in which the airport is open.

6.1.1. Runway System

The airport has 4 runways, three of which pointing east-west and the 4th pointing North-South. Runways use changes according to the wind direction and speed. In normal conditions, the two external runways among the 3 parallels should be used for landings, while the other two for take-offs. Given that on the left side of the airport there are residential areas adjacent to the airport itself, whenever it is possible the westerly direction is preferred for landings. On a yearly average, this direction is used around 70% of the times.

Figure 6.1 Runways system - Frankfurt airport



Basemap © [OpenStreetMap contributors](https://www.openstreetmap.org/), license: <https://www.openstreetmap.org/copyright>
Map created using the Free and Open Source [QGIS](https://www.qgis.org/)

6.1.2. Noise complaints

Many protests have been carried on since the planning of the third runway (the one pointing north-south) in 1973, which would have brought increasing in noise and cutting down of trees in the

⁹³ [Fraport AG. \(2019\). Frankfurt Airport Air Traffic Statistics 2018. Frankfurt on the Main: Fraport AG.](https://www.fraport.com/en/air-traffic-statistics/2018)

Frankfurt City forests. Protests were not successful, and the runway was built. In 1997, following plans to build the 4th runway, new protests arose. It was agreed that citizens should have participated in the planning of the runway and it was agreed to build a landing-only 2.8km shorter than the other 3, runway for smaller aircraft. In 2011 the first flight landed in the 4th runway and in 2012 the first noise-related protest occurred. According to *Airport Watch*, weekly protests are happening every week⁹⁴.

6.1.3. Noise management practices⁹⁵

The airport is highly active in reducing noise. In 2007 the first package of active noise abatement procedures for Frankfurt airport was signed by Fraport, the German state of Hesse, DFS Deutsche Flugsicherung, Lufthansa and the Regional Dialogue Forum (RDF) organisation. From an initial of 7 measures to tackle noise, this program has continuously expanded through the years, with measures that are already in place and others that are under development. With these measures, Frankfurt airport has become a pioneer in active noise abatement procedures⁹⁶. Several techniques are being used or tested by the airport, focusing on the noise source, on aircraft operations and on residential areas.

a. Active noise abatement

Active noise abatement measures aim to decrease noise directly at the source. Several techniques help to reduce noise emitted by the aircraft itself through modifications or by changing aircraft operations and by introducing a night ban

Ground Noise

Noise emitted on the ground is an important source of noise for those who live in the vicinity of the airport, for passengers and airport workers. The following techniques are already implemented by Frankfurt airport:

- Use of electrically driven aircraft tractors instead of moving on ground with main engines
- Noise-reducing screening wall used in test-run facilities
- Use stationary units instead of APUs
- Monitoring the use of reverse thrust

Flying higher

Flying higher allows to reduce noise at the ground. Frankfurt airport is a pioneer of these techniques and several procedures are currently used and tested at the airport to achieve this result. Some of them includes

- Improving departures procedures (limiting speed at certain point)
- Using of "Continuous Climb Operations" and "Continuous Descend Operations"
- Descend angle up to 3.2 degrees
- Ground based Augmentation System (GBAS): This technology improves satellite navigation and it allows to use other noise abatement procedures in all the runways

⁹⁴ Airportwatch. (2020). airportwatch.org.uk. Retrieved from Frankfurt airport. News about Frankfurt Airport: <https://www.airportwatch.org.uk/european-airports/frankfurt-airport/>

⁹⁵ Fraport. (2020). www.fraport.com. Retrieved from Noise abatement: <https://www.fraport.com/en/environment/noise-abatement.html>

⁹⁶ Mauel, S. (2015, July 28). Frankfurt Airport pioneers active noise abatement. Retrieved from International Airport Review: <https://www.internationalairportreview.com/article/20017/frankfurt-airport-pioneers-active-noise-abatement/>

- Steeper approach procedures (under development): Aircraft would be able to descend at 4.49° until 600 meters of altitude
- Point Merge Procedure (under development): Arrivals are put into funnel-type structures keeps aircraft at high altitudes until they are cleared to land with a CDO⁹⁷ technique

Noise respite model

No flights between 22:00 to 05:00 and from 23:00 to 06:00 for different areas to avoid sleep disturbance

Quieter aircraft

Frankfurt is promoting the use of quieter aircraft

- Fitting engines of Lufthansa's 737CEO with acoustic panels and withdrawal of them in the near future
- Modernization of fleets
- Modulation of noise related airport charges: The noisiest the aircraft, the more the airline pay. In this way, airlines are encouraged to use quiet aircraft

Flying around residential areas

- Increase use of westerly direction
- Avoid starting final approach over densely populated areas
- Plan to modify existing take-off trajectories

b. Passive Noise abatement

A "Passive Noise Protection Program" is also promoted to reduce noise levels within the buildings (eg. Soundproofing). With this program new measures are adopted thanks to extra budget from the Regional fund. The total budget is 150 million from the "Passive Noise Protection Program" and 265 to 2,570 million euros for the Regional Fund.

c. Noise Monitoring Stations

In order to minimize the noise around airports, flight noise is continuously monitored through monitoring stations since 1964. Now the aircraft noise measuring system is made up of 29 stationary measuring points and 3 mobile measuring containers. Noise levels, take-offs and approaches are continuously shown on an open-source website ("FRA.NoM"). Every month Fraport publishes a Noise report with type levels, fleet levels and excess for the airline companies and authorities and it is distributed only to airlines. Fraport also publishes a public report on aircraft noise with measuring results and many topics in relation to aircraft noise.

d. CASA program

In order to tackle the increase of noise expected due to the airport expansion, Frankfurt airport created the CASA program, a voluntary initiative by the airport who committed to buy houses (or compensate the owner) that are flown over below 350 meters, to compensate people who bought houses before the plan of the airport expansion. The overall cost of the program is over 100 million euros.

⁹⁷ CDO: Continuous Descent Operations

e. Community engagement

Frankfurt airport is actively involved in keeping good relationship with local communities. In 2008 the "Forum Airport and Region" was created by the Regional Government together with air transport operators, with the aim of letting citizens participate in the dialogue about the development of the airport and the environmental burdens. In July 2009, a non-profit company is operating the "Environmental and Community Center", with the goal of informing citizens on noise, social and environmental monitoring data to improve the cooperation between the airport and the local communities.

6.2. Vienna International Airport

Vienna International Airport is the largest airport of the country and serves as a hub for Austrian Airlines and Eurowings Europe. Situated 18km southeast of the city of Vienna, the airport handled more than 27 million passengers in 2018.

Runway System

The airport features 2 runways, facing east-west and southeast-northwest. Runways use changes according to the wind direction and speed. The target agreement contains target values in terms of flights distribution, and the airport is monitoring the compliance with these values. However, for safety reasons, the airport ensures that aircraft take-off and land into the wind.

Figure 6.2 Vienna Airport



Basemap © [OpenStreetMap contributors](https://www.openstreetmap.org/contributors), license: <https://www.openstreetmap.org/copyright>
Map created using the Free and Open Source [QGIS](https://www.qgis.org/)

Noise Monitoring

At Vienna Airport, the noise generated by all starting and landing aircraft is measured by the FANOMOS system⁹⁸, that consists of 14 stationary and four mobile recording stations that monitor all flight movements based on the flight information data provided by AustroControl. The recorded flight tracks are used to map actual noise zones and is also used to monitor compliance with prescribed approach and departure paths. In addition, the captured noise data are linked to the flight path records of the RAFIC (Radar and Flight Information Capture) system, so the information can be used to optimise flight paths and to identify deviations from the paths and the aircraft which caused them.

Community outreach

The airport of Vienna is considered a best practice case in terms of efforts on mediation and community engagement and it has developed different paths to dialogue with residents⁹⁹.

One of the mediation and community engagement tools they have is the "Neighbourhood Committee", which provides communication with the local residents. This committee was established in 1989 and is composed of the airport managing director and the mayors and district heads of the surrounding neighbourhoods: Schwechat, Fischamend, Kleinneusiedl, Enzersdorf a.d. Fischa, Schwadorf, Grossenzersdorf and Rauchenwarth, Zwölfaxing and Himberg, and the districts of Donaustadt and Simmering.

Another way of dialogue is the Verein Dialogforum¹⁰⁰ (Dialogue Forum). This is a non-profit organisation financed by the airport and functioning as an information and communication platform. It continues the dialogue inaugurated during the mediation process that was made for the third runway project with 120 municipalities, the provinces of Vienna, Lower Austria and Burgenland, and citizens' action groups. Its members represent around 2 million people. The Vienna Airport mediation process and Verein Dialogforum Flughafen Wien are regarded worldwide as examples of best practice in open, fair and transparent public participation.

The Dialogforum monitors the compliance with the agreements concluded during the above-mentioned mediation process and deals with issues, questions and conflicts arising through the development of air traffic and enlargement of the airport. The mediation agreement handles several important topics, like the position of a possible third runway, night flight restrictions, noise caps, an environment fund and noise prevention programmes. The Forum discusses all these topics in order to reduce the nuisance from air traffic to a minimum. Municipalities and citizens had with it the possibility of putting in place actions that go much further than the measures indicated in the law. Furthermore, the Forum is continuously opened to all measures and ideas that may lead to decrease the negative effects of air traffic. The volunteer members work constructively to balance the legitimate and sometimes diverging interests of the aviation industry and the region.

In addition to the Mediation agreement, Vienna Airport has created the hotline Umwelt und Luftfahrt, which deals with environmental and aviation issues. They also have a website: www.vie-umwelt.at which provides comprehensive information about environmental issues. Furthermore, it provides information on flight movements on the individual runways, the results of the noise measurements, a section with environmental lexicon, publications, and e-mail contact links. The feedback obtained through the hotline or through email is used as input for the work done by the Dialogue Forum.

⁹⁸ https://www.viennaairport.com/en/company/flughafen_wien_ag/environment_sustainability/noise_management

⁹⁹ Vienna International Airport. (2020). Dialogue with residents. Retrieved from Vienna International Airport: https://www.viennaairport.com/en/company/flughafen_wien_ag/environment_sustainability/dialogue_with_residents

¹⁰⁰ Dialog Forum. (n.d.). Dialog forum. Flughafen Wien. Retrieved from <https://www.dialogforum.at/>

Vienna Airport has as well a visitor centre, the so called VISITAIR, in which information about the airport's functioning can be obtained. One of the sections of VISITAIR is the Sound Station, which explains the phenomenon of noise and provides technical information. It also has samples of different noises from different sources, so the visitors can experience the subjective nature of noise perception.

Night-time operating restrictions

Vienna Airport has night-time restrictions as well, since one of the points agreed during the mediation process of the third runway in Vienna Airport was the introduction of a limit on flight movements during night-time. Under this agreement the flight movements between 23:30 and 05:30 must be gradually decreased until a maximum of 3,000 flight movements per year (an average of four landings and four take-offs per night) when the third runway becomes operational. Additionally, the use of approach and departure paths is regulated during night hours, existing only restricted flight paths that can be used during those periods.

Land Use Planning and Noise Mitigation

In the case of Vienna Airport, the noise protection programme was largely extended in 2007 in response to the demands of the ARGE citizen's group in the Dialogforum and the mayors of neighbouring municipalities to include citizens who can expect relief under the three-runway system but still suffer under the two runway system. This programme extension is being paid by the Flughafen Wien environment fund. The noise protection programme has more strict thresholds than the standards, since it elaborates action plans at night for areas starting at 45 dB, while the Federal Ambient Noise Regulation states 55 dB.

The Flughafen Wien AG noise protection programme is designed to protect the health and wellbeing of the residents that live nearby the airport. For instance, for those households which have a permanent noise level of over 54 dB during the day and 45 dB at night, Vienna airport assumes from 50 to 100 % of the costs of the installation of soundproof windows and doors. Furthermore, in some cases the construction of winter gardens is also subsidised.

6.3. Heathrow's League Table concept¹⁰¹

A different technique used to reduce noise level around an airport is the so called "League table" concept, developed by Heathrow. The airport ranks airlines based on their environmental performances. The ranking is made available for the public and it is updated every quarter. The League Table score for each airline is calculated using 7 environmental metrics, two of them noise related (noise certification chapter and noise quota-count per seat and movement), two emissions related (NOx emissions standard and NOx emissions per seat and movement) and three operational: CDO violations, track keeping and late or early movement. Each airline is ranked for each indicator and the overall score is a number between 0 and 1,000. This score is calculated weighting each metric for a specific pre-defined weight. League Table encourages airlines to fly to this airport with the best aircraft available in their fleet and to operate in the most environmentally friendly way. In this way, Heathrow claims that it is helping the community by reducing the number of people exposed by high noise levels and high pollution levels, while on the other side a high position in the ranking could lead to long term financial saving for an airline, as some metrics, like Continuous Descend Approach procedures and Track deviations on departure, allow airlines to fly in the most efficient way. Airlines who ranked on top seem

¹⁰¹ London Heathrow Airports Limited. (2020). Heathrow Fly quiet and green. Retrieved from The League Table: <https://www.heathrowflyquietandgreen.com/q4-2019/>

to be proud of their environmental performances¹⁰² and in a world where sustainability is becoming more and more important this is an innovative way to promote airlines to new customers.

¹⁰² Oman Air. (2019, March 18). Oman Air. Retrieved from Press Releases: <https://www.omanair.com/es/en/about-us/press-releases/oman-air-ranks-first-heathrow-airports-fly-quiet-and-green-q4-2018-league>

7. CONCLUSIONS

Noise has always been aviation most detrimental environmental problem as, according to the World Health Organization, it can cause community annoyance and sleep deprivation in the short term and cardiovascular diseases and mental health problems in the long term. Technological improvement is helping making aircraft less noisy, but the growing demand of air traffic means that more effort should be made by all the stakeholders involved to reduce the noise levels around airports. People living in the vicinity of airports are the most affected by aircraft noise and tend to complain. Increase of air traffic, night and low altitude flights are the causes of nuisances that annoy people the most, who are calling for urgent actions to address the problem. Many regulations are addressing these problems with different measures taken at different levels, in particular setting limits for aircraft noise during take-off and landing phases at international level, forbidding too noisy aircraft, promoting the use of best available technologies and giving guidelines to Member States and airports on how to implement effective noise abatement procedures at European Level or setting noise limits for noise perceived plus other measures at national level. However, the complexity of this structure makes more complicated for citizens to ask for specific measures to be taken. In Europe, some airports are investing many resources in research and development activities with the aim of reducing annoyance for people living in the vicinity of their airport. Operational measures, such as forcing the aircraft to follow a specific path during approaches or take-offs, or passive measures, such as sound-proofing or buying houses that are flown over at low altitudes, are effective measures that contributes to reduce annoyance. Community engagement is another appreciate instrument that airports can explore to cooperate with local communities affected by aircraft noise to alleviate this problem.

As a consequence, it is recommended that authorities communicate better with citizens, in particular the ones living close to airports, regarding the noise impact they are experiencing, giving live information about aircraft flying at each moment and the measured noise level, as some airports are already doing, as well as consequences of the impact of noise on human health.

Community engagement should be enhanced in all the airports as it is an effective way to understand people's problems that could help to address the situation in the most efficient way. Attention should be given to poorer areas, where people may complain less but, according to several scientific studies, where people are most affected by noise from all the sources. Also, as the current regulation is not always effective to prevent complaints, more caution should be used when evaluating proposals of increasing air traffic in an already sensitive location. It is recommended that, given the sensitivity of the problem, more cooperation between Member States should be encouraged in order to adopt harmonized noise limits, particularly at European Level for which clear guidelines are currently missing.

Common strategies should also be enhanced. By sharing results of specific measures and best practices that were proven to be effective, a common and more successful strategy could be adopted by Member States with the benefit of increasing the well-being of their citizens, thus decreasing the number of people exposed to potentially dangerous noise levels.

And lastly, more communication between airports and cooperation in research activities, particularly to develop new noise impact metrics, that better correlate with known health effects, could also help to make the management of aircraft noise more effective in future.

7.1. Policy recommendations

In this subsection, some best-practice, and recommendations ideas regarding noise management at airports are provided:

- This may sound trivial, but each airport is different. Each will have their own specific location with different traffic conditions, weather, national legislation, stakeholders, and so on. Therefore, these characteristics will need to be carefully understood in order to identify the main causes of noise problems at that particular location. After this important background information is obtained, adequate noise objectives to solve the problem of the aviation noise impacts can be set.
- While each airport is different, it is beneficial to have a common methodological approach that will help to have coordinated policies. The ICAO Balanced Approach and its 4 pillars (reduction of noise at source, land-use planning and management, noise abatement operational procedures and operating restrictions) are key ways to address aircraft noise problems. This approach should be supplemented with the use of noise monitoring systems and community outreach.
- It is also important to note that operating restrictions are only recommended to be used when other measures have not been effective, since they can have an economic impact.
- Noise abatement procedures, like preferential routes, Continuous Descent Approach and Noise Abatement Departures can also be very useful to reduce noise impact and can be considered (of course as long as they do not compromise safety) depending on the characteristics of the noise problematic. Other measures such as noise respite models or passive ones, like soundproofing, can be considered and be useful.
- An important note regarding the study of the efficiency of noise abatement measures: reductions in the number of people affected by certain noise levels after taking noise abatement measures should be carefully considered, since there is the possibility that more flights would actually be concentrated on less people.
- Another measure is noise charges, which can be established to reduce the noise that aircraft produce in the airports' surroundings. As indicated by the ICAO recommendations, the income obtained from these noise charges should be employed to improve the noise situation at that airport.
- Fixing the lack of communication regarding regulatory framework and airport strategies should be a priority action for airports since it is a main part of the aviation noise problematic. Aerodromes should communicate about noise issues; actively inform citizens about the actions they take to address noise issues and should have an interlocutor for these matters. Specific websites or community engagement groups are also beneficial in this regard.
- A tool that can be of interest to airports to lead to reductions of noise levels around them is the "League table" concept, which ranks airlines depending on their environmental performance. These rankings provide an incentive for airlines to have lower environmental (and noise) impacts.
- Another important way to improve the understanding and therefore the management of noise impacts caused by aviation is the development and improvement of noise indicators. Particularly, frequency metrics are truly relevant, as well as the calculation of lower noise level contours to present noise exposure.
- Noise and Track Keeping Systems can be also be an especially useful tool for airports. They can serve as monitoring, as well as a source of useful data for noise modelling and as help to check the effectiveness of implemented noise management actions. A comment on this regard is that, when airports apply penalty frameworks in conjunction with NTK Systems, they should be applied with care, since some abnormal noise levels can be caused by circumstances that are out of a pilot's control. In addition, when NTK Systems are decided to be employed and in order to ensure their adequate functioning, they need to be agreed with all stakeholders or supported by specific regulation.

- Common strategies and effective noise management actions should be shared among Member States. That way, a successful network to foster the overall performance in this field would be obtained.
- To conclude, it is important to highlight that an adequate and efficient noise management plan will rely on a combination of different approaches. Like in the examples presented in this report, it will be crucial to take into account the particularities of each airport and its surrounding areas, to understand the causes of every noise problematic, and to propose adequate solutions with the support and agreement from the different stakeholders.

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This study, provided by the Policy Department for Citizens' Rights and Constitutional Affairs at the request of the Committee on Petitions, aims to provide a clear and simple overview to the non-expert reader, on the Impact of aircrafts noise pollution on residents of large cities, as well as to give recommendations addressed to the most relevant actors.

Noise is one of the most important problems linked to aviation. It can lead to health issues, as well as to negative social and economic effects. Examples of health issues produced by aviation are sleep disturbance, community annoyance, cardiovascular disease, and mental health problems.

PE 650.787

Print ISBN 978-92-846-6499-3 | doi:10.2861/584920 | QA-02-20-232-EN-C
PDF ISBN 978-92-846-6498-6 | doi: 10.2861/3570 | QA-02-20-232-EN-N