HEATHROW

IN A *Noisy* LEAGUE OF ITS OWN

With a 3rd runway back on the agenda this timely pamphlet assesses what can be done to cut noise for residents.

It explodes the myth that the noise climate has improved over the past 20 years

It concludes quieter planes and improved operational practices provide an historic opportunity to cut the noise from Heathrow....but only if there is no significant increase in flight numbers.

725,000 people live under the Heathrow flight paths; that is 28% of all people disturbed by aircraft noise right across Europe (1)

The league tables

Comparison with key airports in Europe

Airport	Population within the $55L_{den}$ contour
London Heathrow	725,500
Frankfurt	238,700
Paris Charles de Gaulle	170,000
Paris Orly	110,000
Brussels	49,700
Amsterdam	43,700
Madrid	43,300

Comparison with airports in UK

Airport	Designated by the DfT for noise purposes	Population Impact	Population as a percentage of the total number of people affected across the European Union
Heathrow	*	725,500	28.5%
Manchester		94,000	3.7%
Glasgow		63,600	2.5%
Birmingham		47,900	1.9%
Aberdeen		16,300	0.6%
Edinburgh		15,000	0.5%
London City		12,200	0.5%
Southampton		12,100	0.5%
Gatwick	*	11,900	0.5%
East Midlands		10,500	0.4%
Stansted	*	9,400	0.4%
Luton		8,600	0.3%
Leeds Bradford		8,400	0.3%
Newcastle		5,900	0.2%
Liverpool John Lennon		5,700	0.2%
	Totals	1,044,300	41.0%

Source: European Commission, CAA. Figures based on the populations affected by noise using the standard measure of 55 LDen- 2006 figures

Has the noise climate *really* improved?

At first sight, it would appear the noise climate at Heathrow has got better (2)

	Number of Aircraft Movements	Area of 57dBA contour	Population Affected
1998	441,200	163.7 (km2)	341,000
2011	480,906	108.8	243,300

However, things are not as simple as they seem.

There are four key flaws in the way noise annoyance is measured.

The 1990s saw quieter planes introduced

It also saw a big increase in flight numbers

It was the decade when complaints soared.

And HACAN membership grew like never before or since

The increase in flight numbers was the all-important factor

1. The noise is averaged out over a 16 hour period. Averaging out noise over a given period might work for a busy main road where traffic is fairly constant throughout the day but average measurements are not suitable for the more intermittent nature of aircraft noise. The averaging out of aircraft noise includes the quiet periods of the day and the quiet days of the year, so underestimates the noise people actually hear. It does not reflect the way people are disturbed by the noise.

2. The method used to average out the noise does not give enough weight to the number of planes flying overhead. It concentrates on the noise made by each individual aircraft. It assumes annoyance levels will remain the same if the number of aircraft operations are doubled so long as the individual aircraft noise levels are reduced (3). Under this system, one Concorde followed by 3 hours and 58 minutes of relief is said to be as disturbing as four hour's worth of non-stop noise from Boeing 757s at a rate of one every two minutes (3). Clearly not a reflection of reality!

3. The point at which people are said to become annoyed by the noise is unrealistic. It is claimed annoyance only sets in when the noise averages out at 57 decibels across the 16 hour period. This excludes places like Putney and Fulham! Not the real world!

1 Concorde followed by 3 hours and 58 minutes of relief is said to be as disturbing as four hour's worth of non-stop noise from Boeing 757s at a rate of one every 2 minutes!

4. The measurements do not cover the areas where noise has become a real problem over the past 18 years. They only include areas about 8.5 miles from Heathrow. Yet in 1995/6 the flight paths were extended so that aircraft noise became a real problem for areas 20 miles away. The front page picture is of Vauxhall, 17 miles from Heathrow, not of West London. The big change took place around 1995/6. Until then planes landing at Heathrow from the east joined their final approach path around Barnes. But in the mid-1990s the joining point was pushed much further east, effectively to the Southwark/Lewisham borders. It didn't mean that every plane joined that far out but a lot did. It resulted in areas between the new joining point and Barnes getting a stream of planes they never had before. A similar thing happened to the west of the airport.

Life under the flight path

"I work at home, and during the days of heavy flight activity it is impossible to concentrate with the windows open. Clients are amazed to hear I am 20 miles from Heathrow and have to put up with such levels of noise. You can still hear the aircraft that has just passed at the same time as hearing the next one approaching. There is therefore not a single second of respite or calm in the day from the continual whine of approaching and departing aircraft".

Nick, Stockwell

Government has recognised the system is flawed

In its aviation policy framework, the Government has recognised that the existing system is flawed: "Average noise exposure contours are a well-established measure of annoyance and are important to show historic trends in total noise around airports. However, the Government recognises that people do not experience noise in an averaged manner and that the value of the LAeq indicator does not necessarily reflect all aspects of the perception of aircraft noise. For this reason we recommend that average noise contours should not be the only measure used when airports seek to explain how locations under flight paths are affected by aircraft noise" (4). It has asked the Airports Commission to do further work to assess noise metrics.

Are there *better* ways of measuring noise?

Is aircraft noise really a problem for people?
Since a lot of people can live with the noise it is sometimes thought that those who complain are exaggerating. However, the reality for many is that the noise is more than merely annoying. It is truly disturbing. (5)

- **The EU recommends something called the 55 Lden.** It calculates the average for three different periods: day, evening and night. It then weights them to allow for the lower background levels in the evening and at night. This results in 725,000 people under the Heathrow flight paths instead of 243,000 using the UK Government's method – still an underestimate but much closer to reality

- **Sydney has developed a different way of measuring noise annoyance**. It simply counts the number of planes expected to go over any property in one day and the likely noise of each aircraft as well as the number of hours that will be plane free.

- **Heathrow Airport is committed to producing annual Lden maps.** It is also working with HACAN to look at using the Sydney method in addition to the conventional one and of introducing colour-coded maps to explain noise more clearly.

In the recent consultation on the Government's new aviation policy, 57% of people opposed the continued use of the 57 db LAeq contour as the way of marking noise annoyance. Just 29% supported it.

Are there ways of *improving* the noise climate?

- **steeper approaches**

The angle at which planes come into land, known as the glideslope, can affect noise levels. At present most airports use a 3 degree glideslope. A steeper glideslope would mean planes would be higher longer, thus reducing the noise over more communities. At present the International Civil Aviation Organisation (IACO) is looking at the practicability of a 4 degree glideslope. Their trials have shown that 3.25 degree approaches are possible even for the largest aircraft but a 3.25 degree approach would only offer a small improvement.

- **continuous descent and departure (climb)**

A common technique to reduce noise used at some airports, including Heathrow, is Continuous Descent Approach (CDA). This is where planes aim for a smooth approach rather than the traditional step-by-step one which caused noise problems for communities in areas where aircraft were moving from a higher step to a lower one. Its critics argue it results in more noise in areas some considerable distance from the airport because, in order to achieve their smoother descent, aircraft are joining their final approach path further out than previously but, overall, it cuts noise. As would continuous climb on departure.

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- **dispersing the flights**

It has been Government policy to concentrate flights but the new Aviation Policy Framework, published in March, opens the door to dispersal: "The Government believes that, in most circumstances, it is desirable to concentrate aircraft along the fewest possible number of specified routes…however, in certain circumstances, such as where there is intensive use of certain routes, and following engagement with local communities, it may be appropriate to explore options for respite which share noise between communities on an equitable basis, provided this does not lead to significant numbers of people newly affected by noise." This is welcome. The alternative to some dispersal at Heathrow - with a plane up to one every 90 seconds - is the creation of noise ghettos. New technology means that planes will be able to be guided much more precisely as they land and take off. This opens the way for a greater sharing of flight paths, thus providing people with some respite from the noise.

- **quieter aircraft**

Aircraft have become quieter over recent decades. Yet, during that period, complaints have gone up at Heathrow. This is because for most residents the benefits of the quieter aircraft have been off-set by the big increase in the number of planes. The industry group Sustainable Aviation, in its recent report **(2)**, argues that "aircraft and engine manufacturers have been aggressively researching low-noise technology for the past 50 years resulting in the dramatically reduced noise levels exhibited by aircraft now entering service. These aircraft typically output half the noise of the aircraft they are replacing, so air traffic movements can double without increasing the total noise output". But that statement skirts round the impact a doubling in the number of quieter aircraft numbers would have on residents. The science suggests that the noise climate for residents would not necessarily improve (**see appendix one**). The only way to *guarantee* an improved noise climate for people under the Heathrow flight paths would be to use quieter planes but with no increase in flight numbers

A resident writes: my dilemma – I want a break from the noise but not for others to suffer it

I'm not a typical child of the ghetto. I'm a middle-class working mother. But, in recent years, my middle-class area in South London has become a noise ghetto – a plane coming over every 90 seconds virtually throughout the day. Constant. I pray for an east wind or an Icelandic volcano! I want respite from the noise. For it just to go somewhere else. But then I take the tube just a few stops further south and it's blissfully quiet. I'm told they get some take-offs when an east wind is blowing (about 27% of the year) but can I ask them to share my 90 second landings and see their lives turned upside down, as mine was? I think not. We can't cover the whole of London and the Home Counties with aircraft. We cannot let Heathrow, the city state on the edge of our capital, dominate us like that. We must preserve our plane-free oases. After all, I may need to move there one day! I would go now, except it would mean removing the kids from school. But something must be done about the noise ghettos. Let's try all we can to share the noise out without ruining our oases. Some of my neighbours aren't bothered by the noise. I no longer invite them for coffee! Others hate it but feel nothing can be done. But something *has* to be done. Or else the ghetto will explode.

Conclusions

1. There are ways in which the noise can be reduced: quieter planes, well-designed respite periods, some dispersal and a range of operational procedures. And HACAN has worked with Heathrow Airport in trialling some of these measures and will continue to do so..

2. The unanswered question is the extent to which an increase in flights would negate these advantages. Residents' experiences of the past 30 years suggest it would. Is it worth the risk given the proven noise improvements that could be achieved without growth?

3. Quieter planes and improved operational practices provide an historic opportunity to cut the noise from Heathrow. It should not be put at risk by increasing the number flights using Heathrow.

References:

1. http://www.caa.co.uk/docs/589/CAA_InsightNote2_Aviation_Policy_For_The_Environment.pdf
2. The SA Noise Road-Map, A blueprint for managing noise from aviation sources *to 2050*, Sustainable Aviation, 2013
3. The Quiet Con, Hendin, HACAN, 2002
4. Aviation Policy Framework, Department for Transport, 2013
5. Why Noise Matters, Stewart et al, Earthscan, 2011

This pamphlet was written by John Stewart, chair of HACAN and author of *Why Noise Matters*, with technical assistance from Robert Silverstone. HACAN, representing residents under the Heathrow flight paths, can be contacted at 13 Stockwell Rd, London SW9 9AU, 020 7737 6641, info@hacan.org.uk www.hacan.org.uk July 2013

Appendix 1: The impact of quieter planes

Summary of some of the key technical literature

- **Noise pollution levels from individual aircraft have been reduced in the last decade or so, although the greatest change in noise came in the previous decades – compare current aircraft with those flying in the 1960s.**
- There have been big efforts to reduce the number of turbojet aircraft (by far the noisiest), as opposed to turbofan aircraft.
- Turbojet = all the air goes through the "hot" section of the engine such as fighter jets/Concorde, which require an afterburner for more power. Turbofan = majority of the air passes around the "hot" central section, classed as "cold" air. Turbofans are much quieter and constitute almost all engines today.
- Heathrow bans the use of turbojets except in emergency situations.

- **There is a target set by the EU that calls for a 65% reduction in aircraft annoyance by the middle of the century compared to the noise aircraft made in 2000. Rolls Royce say that to achieve this, there will need to be a step change in engine design together with alterations to air traffic control procedures, i.e. steeper glide paths.**
- The Silent Aircraft Initiative (SIA) research aims to produce conceptual designs for an aircraft whose noise would be almost imperceptible outside the perimeter of a daytime urban airport. This requires radically different aircraft and engine designs. The project is being carried out in partnership with the University of Cambridge and MIT as part of a Knowledge Integration Community of aerospace partners. It includes members from the airline industry, aircraft engine manufacturers, airport operators, policy makers and academics and even HACAN are an official partner!
- SIA is looking at developments which include locating the engines above the wings (so that the wings shield listeners on the ground instead of wings reflecting sound back down to ground), the use of acoustic liners to absorb sound within the engine itself, reducing engine fan speed, keeping the aircraft high for as long as possible (CDA glide path), keeping the engine power as low as possible and for as long as possible, and keeping the aircraft in a clean aerodynamic configuration for as long as possible to reduce airframe noise. All of these initiatives help improve fuel efficiency too.

- **The problem with sound is its perception as it is a subjective experience, not objective.**
- Our ears respond nonlinearly to sound, i.e. not in a pro-rata or proportionate way. If the sound energy is halved exactly, our ears do not perceive it as being exactly half as loud. That is why sound power is measured on a logarithmic scale – the decibel (dB). Where the axis on a graph will normally measures units linearly i.e. 1, 2, 3, 4 etc, the logarithmic equivalent will be 1, 10, 100, 1000 etc. thus it is increased by a factor of 10 each time, not 1.
- If 10 hairdryers are all running at once, when 5 of them are switched off, the sound energy is reduced by half, but we barely hear a reduction in noise. It is not until we switch off 9 of the 10 hairdryers that we actually notice any significant difference. The sound energy is reduced to just 10% of what it was, but the perception of the loudness to our ears will be halved. The point from this experiment is that it actually takes a lot of noise reduction of the engine and airframe to make any perceivable difference to humans on the ground. The current developments in technology, albeit in the right direction, are not noticeably significant to our overall perception which is why a technological step change in engine design will be needed.

- **Rolls Royce has pioneered the development of high bypass ratio engines which involve the increase in intake fan blade diameter.** These engines generate thrust with less noise by sucking in a greater volume of air and moving it through the engine more slowly and smoothly. Thus for the same power, the engine can be run at a slower speed to move the same volume of air without loss of power. Being able to reduce the fan rotation speed and hence air flow helps to reduce noise, although the real gain is in fuel efficiency as the engines are effectively running slower.
- Rolls Royce has also introduced absorbent panels inside the cowling around the fan which is used to soak up some of the noise energy which is converted into heat energy.
- Rolls Royce engines being developed for the new Airbus A350 are being designed with the fan blades perfectly aligned with a reduced air gap to the inside of the cowling. This helps to reduce noise produced from shock waves as the blade spin at supersonic speeds, i.e. 2700rpm = 900mph at blade tip (speed of sound in air = 768 mph).
- Open rotor engines were first tried in the 80s by Rolls Royce but had difficulty achieving the noise margins until contra-rotating blades were tried. Today, Rolls Royce says the technology almost there. There is EU funding for this R&D. These types of engines still need to overcome certification, integration into the airframe, reliability testing, acceptance by the public due to their weird appearance etc.

- Another innovation being developed is the Geared Turbofan. This is something Pratt and Witney (P&W) first attempted in 1998. This introduces a reduction gearbox between the main fan and the shaft ("hot" section). This allows the shaft to be run at lower rotational speed for the same fan blade speed, just as with geared car engines. This, P&W claim, makes this type of engine 10 – 15% more fuel efficient as well as substantially quieter. Some energy will be lost as heat in the gear mechanism and there will be the extra weight of the gear box, but this is offset by the reduction in weight by the reduction in turbine and compressor stages in the "hot" section. However, geared turbofans will be more expensive and have reliability implications too which will impact on long term maintenance costs, something airlines are not keen to pay for. Final versions of this type of engine are expected to be ready in 2013.
- Geared turbofans will save in the region of 2700 to 3000 tonnes of CO2 per aircraft per year and 50 to 55% NOx emissions, P&W claim.

- **50% of the overall noise comes not from the engines but from wind resistance over the flaps, spoilers, wings, and especially the landing gear.**

Summary

There is compelling evidence that all aircraft manufacturers are producing quieter engines. Developments in increasing the bypass ratio (by increasing intake fan blade diameter - commonly used on B777s and A380s) has reduced the noise of engines noticeably in recent years. However, the current progress in noise reduction is very slow, so much so, that it can often be difficult to tell from the ground if engines are getting quieter or not. A point will be reached, however, when conventional turbofan engines will no-longer be able to be made any quieter and no further progress will be made until a step change in technology is introduced.