

# Heathrow Air Quality

Together towards sustainability

## Air quality at Heathrow Airport

### Q1 2014

#### Background

Heathrow Airport Ltd (HAL) has monitored air quality since 1993 at its site located near the northern runway (LHR2). It also monitors air quality at three other sites around the airport – Harlington, Longford (Green Gates) and Stanwell (Oaks Road). Fig. 4 shows the locations of these and air quality monitoring sites owned and operated by other parties within 2km of the Airport.

Large areas of London exceed the health-based air quality limit values set by the EU, due primarily to emissions from road traffic and from buildings and every London borough has declared at least one Air Quality Management Area (AQMA).

The main pollutants of concern are measured at all sites within 2km of the Airport – oxides of nitrogen ( $\text{NO}_x$  – made up of nitrogen dioxide and nitrous oxide) and particles (measured as  $\text{PM}_{10}$  and  $\text{PM}_{2.5}$ ). In addition, ozone ( $\text{O}_3$ ) is measured at Harlington.

Air quality management is a key priority for HAL and we will continue to work in partnership with our key stakeholders – especially local authorities and national government - to reduce emissions from all sources in the area in order to meet the EU limit values. Monitoring shows that concentrations of  $\text{NO}_2$  on the airport have fallen by 20% since 1993.

For more information, go to [www.heathrowairwatch.org.uk](http://www.heathrowairwatch.org.uk).

#### Headlines

Key information for air quality monitoring data for 2014 is:

- All monitoring data for Heathrow's four monitoring sites has been ratified for 2013.
- The annual mean for  $\text{NO}_2$  fell at two key AQ monitoring sites (Hillingdon M4 and Oxford Avenue) and may be below the EU limit value at Oxford Avenue for the first time since the site was installed in 2005 (see Fig. 1).
- There were three breaches of the daily average  $\text{PM}_{10}$  limit value (see Fig 3) – which is below the EU limit value of 35 breaches per year.
- Over 92% of aircraft movements were made by more modern aircraft - CAEP4 models or newer; the highest proportion recorded to date (see Fig. 5).
- Aircraft emissions are falling in line with our modelling expectations (see Fig 6).
- We have replaced our analysers which measure  $\text{NO}_x$  and  $\text{O}_3$  and will replace our particle analysers (for  $\text{PM}_{10}$  and  $\text{PM}_{2.5}$ ) in Q2 2014.

#### Measured concentrations

##### Local air quality

Nitrogen dioxide ( $\text{NO}_2$ ) and particles (measured as  $\text{PM}_{10}$  and  $\text{PM}_{2.5}$ ) are the pollutants of international concern because of their affect to human health.  $\text{NO}_2$  has the greatest extent of exceedence with large areas of London exceeding the annual average EU limit value, due mainly to emissions from road traffic and from buildings.

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Located on the western edge of London; close to two busy motorways, the Great Western mainline and local industries, Heathrow Airport is within an area of high air pollution, and the activities which take place at the Airport are just one source of local air pollution emissions, contributing between 25% at the Oaks Road site and 4% at the Hillingdon M4 site.

## Nitrogen dioxide (NO<sub>2</sub>) monitoring results (EU annual average limit value of 40µg/m<sup>3</sup> to be met by 2010)

**Fig. 1 NO<sub>2</sub> annual average concentrations measured at selected sites around Heathrow Airport since 1995**

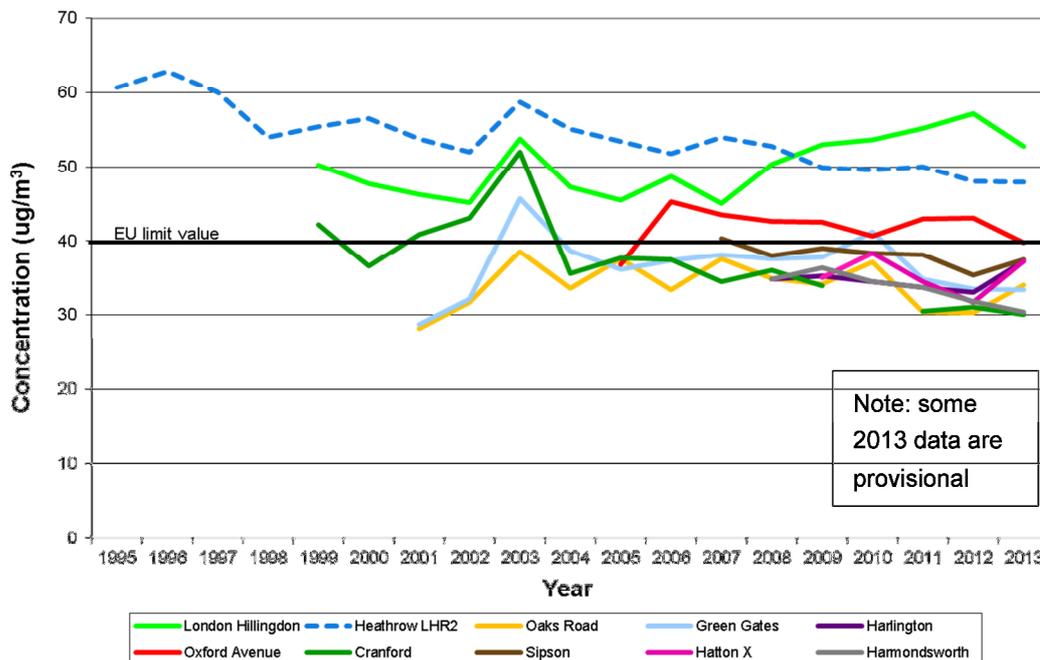


Fig. 1 presents annual average nitrogen dioxide (NO<sub>2</sub>) measurements at sites either on or close to the airport. Key information is:

- Oxford Avenue (red) is approximately 200m northeast of the airport boundary. Concentrations have exceeded the limit value since installation in 2005 and fluctuate from year to year. They were 43µg/m<sup>3</sup> in 2012, but were 39µg/m<sup>3</sup> in 2013 – just below the EU limit value. However, as data capture at this site was below 90%, we plan to use the 2014 results to assess concentrations fully against the EU limit value. Direct airport emissions are approximately 19% of measured NO<sub>x</sub> concentrations at this site, 6% is from airport-related road traffic, 18% is from non-airport traffic and 57% is from background sources.
- Two other sites exceeded the limit value:
  - London Hillingdon (light green) is mainly affected by emissions from traffic on the M4. Concentrations have decreased in 2013 to approximately 53µg/m<sup>3</sup> (57µg/m<sup>3</sup> in 2012). Direct airport emissions are approximately 4% of measured NO<sub>x</sub> concentrations at this site. A further 13% is from airport-related road traffic, 38% is from non-airport traffic and 45% is from background sources.

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- LHR2 (blue dotted line), located near the northern runway, has shown a 20% fall in concentrations since 1993, even though air transport movements have increased by 10%. Concentrations of  $48\mu\text{g}/\text{m}^3$  were recorded in 2013, which is similar to 2012. Direct airport emissions are approximately 30% of measured  $\text{NO}_x$  concentrations. A further 19% is from airport-related road traffic, 14% is from non-airport traffic and 37% is from background sources. The EU limit values are not applicable at LHR2.

**Fig. 2  $\text{NO}_2$  running annual average concentrations at selected sites since 1995**

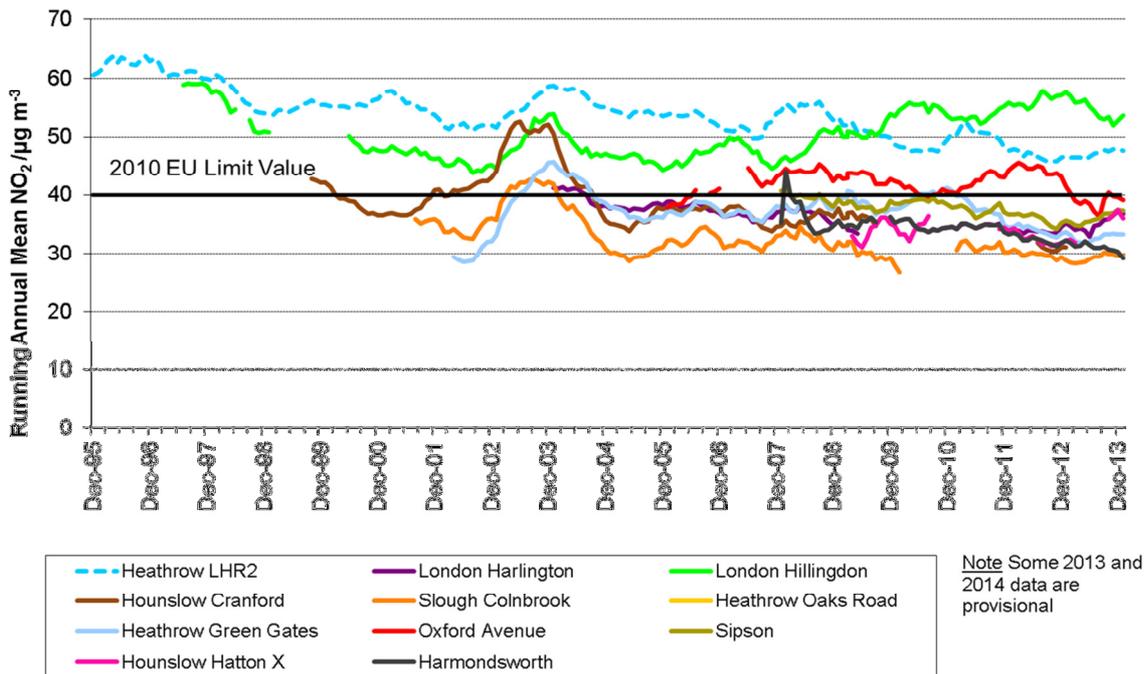
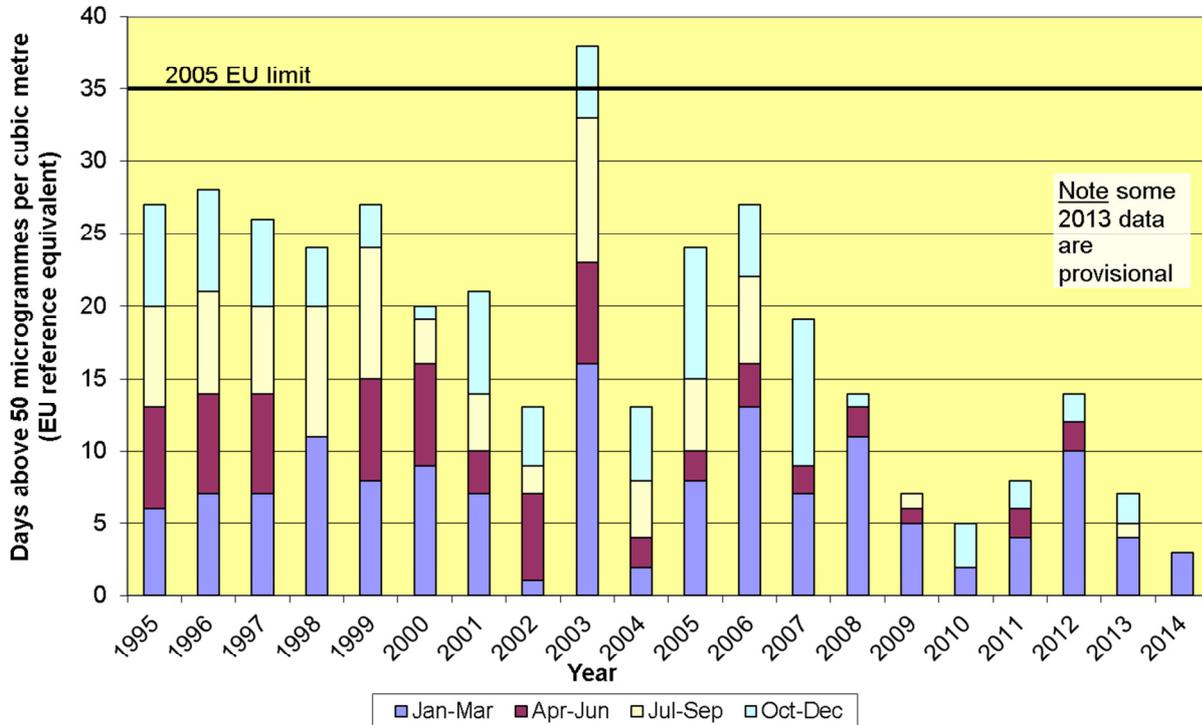


Fig. 2 shows the  $\text{NO}_2$  monitoring data expressed as running annual means, which allows us to track changes throughout the year. It shows concentrations fluctuate considerably but the trends shown in Fig. 1 are still noticeable.

## Particles monitoring results

(PM<sub>10</sub> - EU daily average limit value of 50µg/m<sup>3</sup> to be met by 2005 (35 breaches allowed))

**Fig. 3 PM<sub>10</sub> at LHR2 since 1995**



PM<sub>10</sub> is measured at all four of HAL’s monitoring sites. Concentrations measured at LHR2 are generally the highest and although the EU limit value does not apply at this site, results are presented in Fig. 3.

Only three exceedances of the EU limit value were recorded at LHR2 in Q1 2013 – similar to the number recorded in the same time period in 2012.

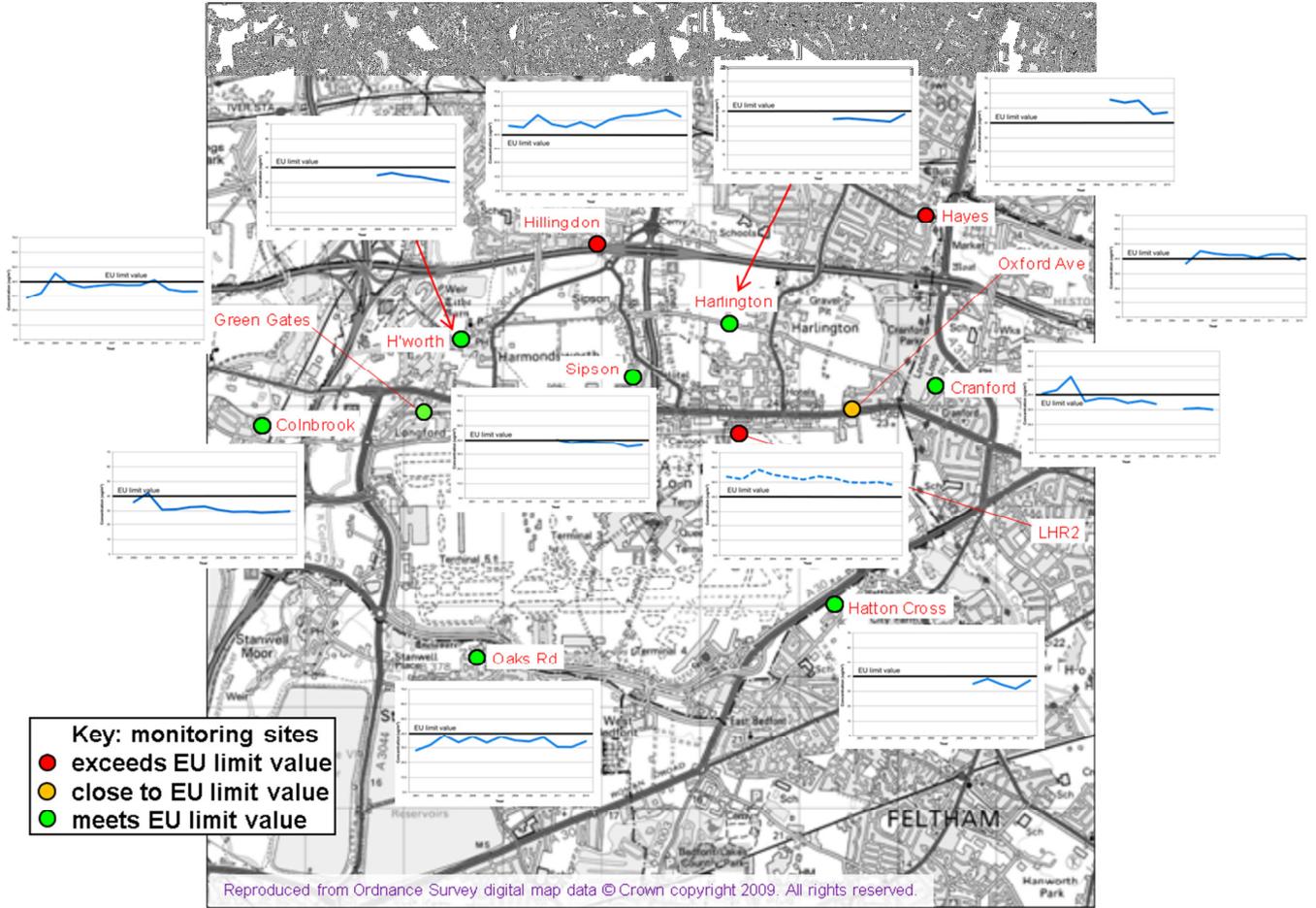
The EU limit value for PM<sub>10</sub> has been met at LHR2 in Q1 2003, when unfavourable weather conditions produced 38 breaches at LHR2 and affected sites throughout the UK.

It is not unusual for daily mean PM<sub>10</sub> levels to exceed 50µg/m<sup>3</sup>, though the EU limit value allows 35 exceedances (equal to 35 days) per year before the limit value is breached.

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Fig. 4. Nitrogen dioxide monitoring sites and annual mean measurements since 2001

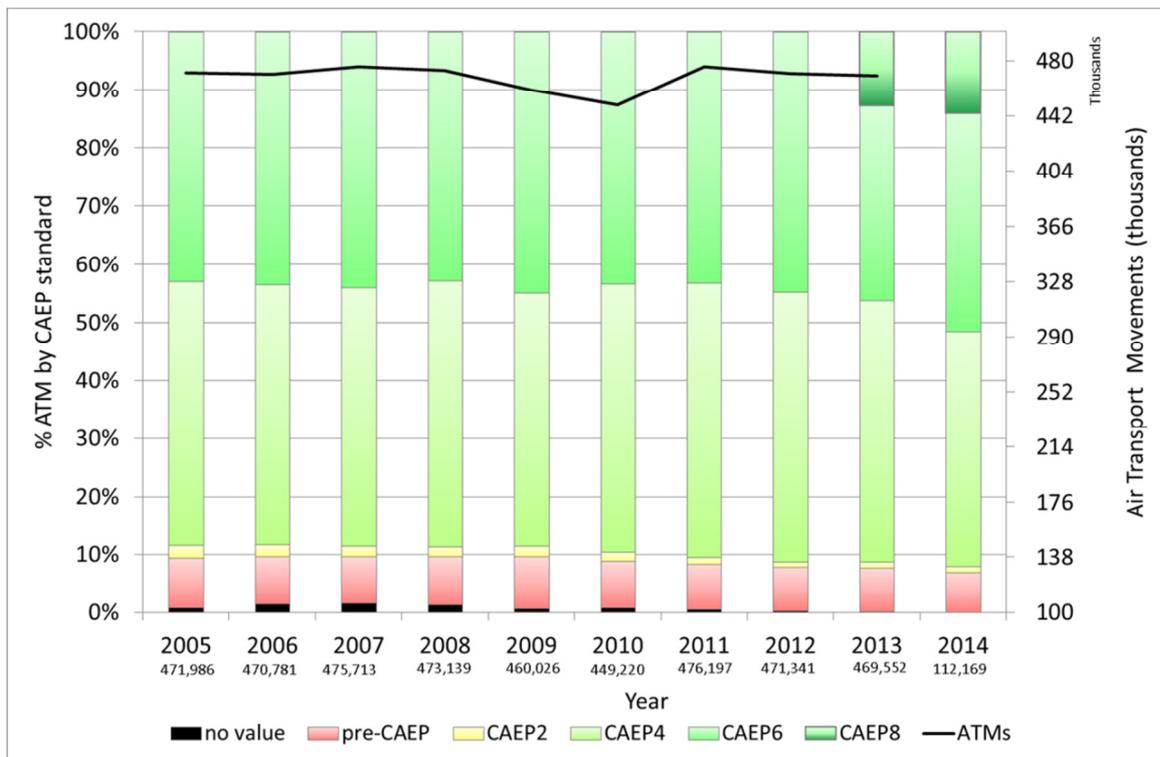


## CAEP value of air traffic movements

Through its Committee on Aviation Environmental Protection (CAEP), the International Civil Aviation Organization (ICAO) sets emissions standards for aircraft engines – including for NO<sub>x</sub>. CAEP8 is the latest standard and came into force in 2013.

Fig. 5 shows the proportion of air transport movements (ATMs) at Heathrow based on their relationship to the CAEP NO<sub>x</sub> emissions standards. The number of ATMs for each year is presented below each bar as well as on the chart itself. The relative proportion of flights made by newer, cleaner aircraft (those defined as CAEP4 or better) in 2013 rose to its highest ever point; over 92%. The trend is expected to continue as airlines replace their older aircraft with newer, lower emission types and Heathrow’s NO<sub>x</sub> emissions landing charge encourages their use at our Airport.

**Fig. 5. - CAEP compliance of ATMs (air traffic movements) since 2005**



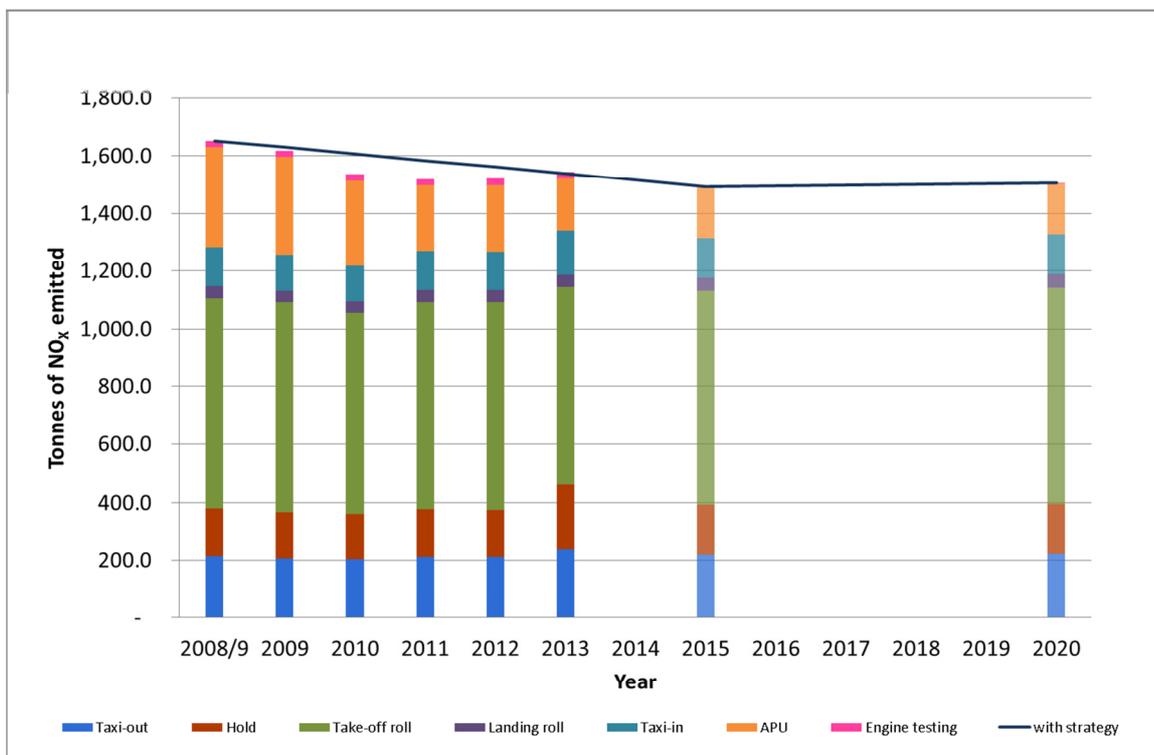
## 2013 aircraft emissions

Heathrow undertakes a full emissions inventory at least every five years to model emission from all airport sources. This activity is underway for 2013 and expected to be complete by autumn 2014. We have reassessed and updated the methodology and underlying assumptions and subsequent modelling from the last full emissions inventory of 2008/9 to reflect current airport operations. Specific components that have been reassessed include:

- Updating the departure and arrivals profiles for aircraft (from noise and track keeping data).
- Updating aircraft engine emissions factors.
- Revising the PSDH (Project for the Sustainable Development of Heathrow) methodology to calculate the effect of ambient conditions and forward speed on aircraft engine emissions.
- Updating aircraft taxiing and hold emissions calculations from data provided by NATS).
- Updating the spatial layout of the airport to revise the location of emission sources (e.g. eastern apron and Terminal 2 development).

In addition to the full emissions inventory every five years, since 2009 HAL has commissioned an annual inventory of emissions from aircraft to assess how they change over time. More efficient taxiing, encouraging the use of cleaner aircraft and managing the use of APUs (auxiliary power units) on the airport all contributed to a fall of NO<sub>x</sub> emissions and are shown in Fig 6.

**Fig. 6. – Calculated Ground level aircraft emissions since 2008/09**



Key changes that affect 2013 aircraft emissions are:

- **Taxiing** – NATS' new taxi time monitoring tool was used for the first time. It uses electronic flight progress strips and is called EFPS. Its use provides a very accurate reflection of taxi times, including increases due to changes in airfield layout such as the building of T2 and resurfacing the southern runway. From 2014, NATS will use collaborative decision making (CDM) to assess the effect of reducing hold time before take-off on punctuality and emissions.
- **Cleaner aircraft**
  - The proportion of air transport movements made by modern aircraft, CAEP4 or newer, has increased to approximately 92% from 88.5% in 2008/9
  - An increasing proportion of flights are being made by A380 and B787, replacing older long-haul and short-haul aircraft respectively
- **Departure and arrival aircraft profiles** – new analysis shows that departing wide-bodied aircraft spend less time climbing to 1,000m, whereas narrow-bodied aircraft take slightly more time. On average, arriving aircraft spend a few seconds longer below 1,000m.

In 2013, air transport movements were approximately the same as in 2012 (471,938 compared to 471,341). Due to a mix of the new, updated methodology and changes to operations, NO<sub>x</sub> emissions have increased slightly compared to 2012. Even so, compared to 2008/9, emissions in 2013 have fallen by approximately 6.5%, or 108 tonnes.

PM<sub>10</sub> and PM<sub>2.5</sub> emissions from aircraft in 2013 have fallen by 1% (0.3 tonnes) and 1.7% (0.5 tonnes) respectively from 2008/9 levels.

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Further trends can be observed by looking at the relationship between emissions and aircraft type and also passenger numbers. Table 1 summarises these normalised data and shows:

- Air transport movements (ATMs) were slightly higher (approximately 0.1%) in 2013 than in 2011 (or within 1.8% of the ATM cap of 480,000).
- The proportion of flights by narrow bodied aircraft fell to approximately 64% of the total, but produced approximately 28% of total ground level NO<sub>x</sub>.
- Passenger loading increased by 2.8% – equating to an average of approximately 153 passengers per flight. This is an increasing trend at the airport.

NO<sub>x</sub> emissions per passenger fell again in 2013 to approximately 60 grams, whilst NO<sub>x</sub> emissions per aircraft movement increased slightly to 2.84kg; reflecting subtle changes to the aircraft fleet mix. The proportion of movements of wide bodied aircraft is increasing slowly at Heathrow, particularly of the A380, A330, B777 and B767.

**Table. 1 - Assessment of normalised annual NO<sub>x</sub> emissions**

	Year						
	2002	2008/9	2009	2010	2011	2012	2013
ATMs	466,554	470,029	466,393	460,546	476,197	471,341	471,938
Proportion of movements by narrow bodied aircraft (%)	72.8	65.0	65.1	65.7	65.9	65.3	63.8
Proportion of movements by wide bodied aircraft (%)	27.2	35.0	34.9	34.3	34.1	34.7	36.2
Ground level aircraft NO <sub>x</sub> emissions (tonnes)	1,662	1,652	1,618	1,536	1,518	1,520	1,544
Proportion of NO <sub>x</sub> emissions by narrow bodied aircraft (%)	33.9	28.1	27.9	28.1	29.0	27.5	27.9
Proportion of NO <sub>x</sub> emissions by wide bodied aircraft (%)	66.1	71.9	72.1	71.9	71.0	72.5	72.1
passengers (mppa)	63.01	65.93	66.04	65.88	69.43	70.05	72.33
passengers per movement	135.1	140.3	141.6	143.0	145.8	148.6	153.3
Ground level NO <sub>x</sub> emission per passenger (g/passenger) <sup>1</sup>	65.78	68.00	66.88	64.75	62.43	61.22	59.52
Ground level NO <sub>x</sub> emission per movement (kg/ATM) <sup>1</sup>	2.70	2.73	2.69	2.64	2.66	2.69	2.84

Note:

1. Excludes APU and engine testing emissions

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