Department
for Environment
Food & Rural Affairs

Air Pollution in the UK 2020 - Compliance Assessment Summary

September 2021

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Executive Summary

The UK's Air Quality Standards Regulations require reporting of ambient air quality data on an annual basis. This is done via the UK-AIR website at http://uk-air.defra.gov.uk/ . These data are reported on behalf of Defra (the Department for Environment, Food and Rural Affairs) and the Devolved Administrations of Scotland, Wales and Northern Ireland.

This Compliance Assessment Summary has been prepared to accompany and summarise the UK's 2020 submission on air quality. It presents a summary of the UK's compliance with the Air Quality Standards Regulations, based on measurements from national air pollution monitoring networks and supplementary assessment (which includes air pollution modelling). It includes details of the exceedances of air quality limit values and target values reported in 2020, and a comparison with previous years since 2008.

This document is an extract from a larger report, '*Air Pollution in the UK 2020*', which, in addition to the compliance summary, also provides background information on the pollutants covered by the above Regulations and the UK Air Quality Strategy; their sources, effects, how they are measured and modelled in the UK, and details of their spatial distribution and changes over time. The pollutants covered in this report are:

- Nitrogen oxides (NO_X) comprising NO and NO_2
- PM_{10} and $PM_{2.5}$ particles
- Ozone (O_3)
- Sulphur dioxide (SO_2)
- Carbon Monoxide (CO)
- Benzene
- 1,3-Butadiene
- Metals: lead, cadmium, nickel and mercury, and the metalloid arsenic
- Polycyclic aromatic hydrocarbons (PAH).

For the purposes of air quality monitoring and assessment of compliance with the Air Quality Standards Regulations, the UK is divided into 43 zones. The 2020 results are summarised below:

- The UK met the limit value for hourly mean nitrogen dioxide (NO_2) in all 43 zones. 2020 is the first year in which the UK has achieved full compliance with the hourly mean limit value, which came into force in 2008.
- 38 zones met the limit value for annual mean NO_2, with only five zones exceeding.
- The UK's full compliance with the hourly mean NO_2 limit value, and low number of zones exceeding the annual mean limit value, is largely attributed to the Covid-19 lockdown restrictions which substantially reduced traffic activity on many roads.
- All non-agglomeration zones complied with the critical level for annual mean NO_X concentration, set for protection of vegetation. (This has been the case in all years from 2008 onwards).
- All zones met the limit value for daily mean concentration of PM_{10} particulate matter, without the need for subtraction of the contribution from natural sources.

- All zones met the limit value for annual mean concentration of PM_{10} particulate matter, without the need for subtraction of the contribution from natural sources.
- All zones met both limit values for annual mean concentration of $PM_{2.5}$ particulate matter: the Stage 1 limit value, which came into force on 1st January 2015, and the indicative Stage 2 limit value to be met by 2020.
- The UK has achieved its 2020 national exposure reduction target for $PM_{2.5}$, based on the Average Exposure Indicator (AEI) statistic.
- All zones met both the target values for ozone; the target value based on the maximum daily eight-hour mean, and the target value based on the AOT40 statistic.
- Three zones were compliant with the long-term objective for ozone, set for the protection of human health. This is based on the maximum daily eight-hour mean.
- 27 zones met the long-term objective for ozone, set for the protection of vegetation. This is based on the AOT40 statistic, which is explained in Section 4 and Section 5 of this report.
- All zones met the limit values for sulphur dioxide, carbon monoxide, benzene and lead.
- All zones met the target values for arsenic and cadmium.
- Four zones exceeded the target value for nickel.
- Three zones exceeded the target value for benzo[a]pyrene, as has been the case in the previous three years.

During 2020, the Covid-19 lockdown restrictions significantly reduced traffic activity on many UK roads, for much of the year. The data show this caused a substantial decrease in urban ambient NO_2 concentrations, which has contributed to the improved compliance with limit values for this pollutant.

The pandemic restrictions appear to have substantially increased compliance with the limit values for nitrogen dioxide in 2020 compared to 2019. This does not mean concentrations of other pollutants were unaffected: however, the UK was already fully compliant with the limit values for other pollutants (PM_{10}, $PM_{2.5}$, SO_2, CO, benzene and lead), and target values for ozone, arsenic and cadmium.

Ozone is also of particular interest in the context of the Covid-19 restrictions. This pollutant is removed from the air by reaction with nitric oxide (NO), which is a component of vehicle emissions, and the data suggest that traffic reductions may have allowed ozone concentrations in some urban areas to become higher than they otherwise would have. The UK met all target values for O_3 in 2020 as it has done for many years, but the number of zones exceeding the long-term objective for vegetation (16 zones) was relatively high compared with previous years.

For more information on air quality in the UK visit the Defra website at www.gov.uk/defra and the UK Air Quality websites at http://uk-air.defra.gov.uk/, http://www.scottishairquality.scot/, https://airquality.gov.wales and www.airqualityni.co.uk.

1 Introduction

A cleaner, healthier environment benefits people and the economy. Clean air is vital for people's health and the environment, essential for making sure our cities are welcoming places for people to live and work now and in the future, and for our prosperity. Improving air quality remains a key priority for the UK.

In the UK, concentrations of a range of pollutants in ambient air are regulated by the Air Quality Standards Regulations as follows:

- The Air Quality Standards Regulations 2010 in England (UK Government , 2010), and their December 2016 amendment (UK Government , 2016)
- The Air Quality Standards (Scotland) Regulations 2010 in Scotland (Scottish Government, 2010), and their December 2016 amendment (Scottish Government, 2016)
- The Air Quality Standards (Wales) Regulations 2010 in Wales (Welsh Government, 2010)
- The Air Quality Standards Regulations (Northern Ireland) 2010 (Department of Environment Northern Ireland, 2010) and their December 2016 amendment (DAERA, 2017)
- The Air Quality Standards Regulations (Gibraltar) and their December 2016 amendment (HM Government of Gibraltar, 2016)

These Regulations have their origins in the following European Union legislation:

- Directive 2008/50/EC of 21st May 2008, on Ambient Air Quality and Cleaner Air for Europe (European Parliament and Council of the European Union, 2008).
- Directive 2004/107/EC of 15th December 2004 (European Parliament and Council of the European, 2004).

The Air Quality Standards Regulations set 'limit values', 'target values' and 'long-term objectives' for ambient concentrations of pollutants. These are explained below, as well as provisions regarding monitoring, and reporting of data.

Limit values are legally binding and must not be exceeded. They are set for individual pollutants and comprise a concentration value, an averaging period for the concentration value, a number of exceedances allowed (per year) and a date by which this must be achieved. Some pollutants have more than one limit value, for example relating to short-term average concentrations (such as the hourly mean) and long-term average concentrations (such as the annual mean).

Target values and **long-term objectives** are set for some pollutants and are configured in the same way as limit values. These are not legally binding, but the UK must take all necessary measures not entailing disproportionate costs to meet the target values and long-term objectives.

The Air Quality Standards Regulations include detailed provisions on the **monitoring and reporting** of air quality, including:

- The division of the UK into zones for the purposes of compliance reporting.
- The location and number of sampling points.
- The measurement methods to be used.
- Data quality objectives.
- Siting criteria each monitoring station must meet.
- Provision for reporting compliance.
- Provision of information to the public.

The Air Quality Standards Regulations require the UK to undertake air quality assessment and report the findings on an annual basis. The UK has statutory monitoring networks in place to meet the requirements of the above Regulations, with supplementary assessment (including air quality modelling) used to supplement the monitored data.

Further information on air quality in the UK can be found on Defra's online UK Air Information Resource (UK-AIR), at http://uk-air.defra.gov.uk/.

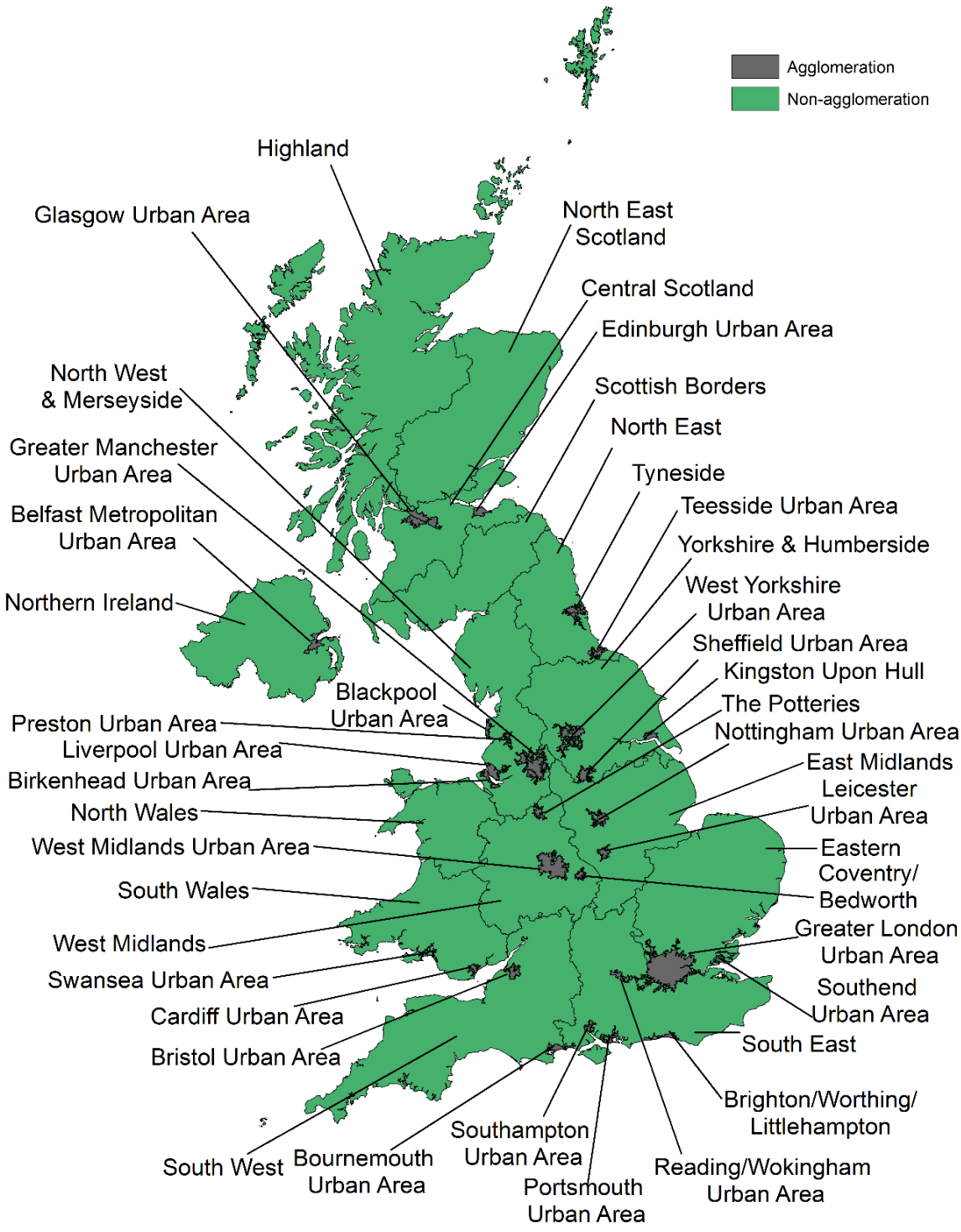
2 Definition of Zones

The UK is divided into 43 zones for air quality assessment. There are 28 agglomeration zones (large urban areas) and 15 non-agglomeration zones. Each zone has an identification code (**Table 2-1**). Zones are shown in **Figure 2-1**.

Table 2-1 UK Zones for Ambient Air Quality Reporting 2020

Zone	Zone code	Zone type
Greater London Urban Area	UK0001	Agglomeration
West Midlands Urban Area	UK0002	Agglomeration
Greater Manchester Urban Area	UK0003	Agglomeration
West Yorkshire Urban Area	UK0004	Agglomeration
Tyneside	UK0005	Agglomeration
Liverpool Urban Area	UK0006	Agglomeration
Sheffield Urban Area	UK0007	Agglomeration
Nottingham Urban Area	UK0008	Agglomeration
Bristol Urban Area	UK0009	Agglomeration
Brighton/Worthing/Littlehampton	UK0010	Agglomeration
Leicester Urban Area	UK0011	Agglomeration
Portsmouth Urban Area	UK0012	Agglomeration
Teesside Urban Area	UK0013	Agglomeration
The Potteries	UK0014	Agglomeration
Bournemouth Urban Area	UK0015	Agglomeration
Reading/Wokingham Urban Area	UK0016	Agglomeration
Coventry/Bedworth	UK0017	Agglomeration
Kingston upon Hull	UK0018	Agglomeration
Southampton Urban Area	UK0019	Agglomeration
Birkenhead Urban Area	UK0020	Agglomeration
Southend Urban Area	UK0021	Agglomeration
Blackpool Urban Area	UK0022	Agglomeration
Preston Urban Area	UK0023	Agglomeration
Glasgow Urban Area	UK0024	Agglomeration
Edinburgh Urban Area	UK0025	Agglomeration
Cardiff Urban Area	UK0026	Agglomeration
Swansea Urban Area	UK0027	Agglomeration
Belfast Metropolitan Urban Area	UK0028	Agglomeration
Eastern	UK0029	Non-agglomeration
South West	UK0030	Non-agglomeration
South East	UK0031	Non-agglomeration
East Midlands	UK0032	Non-agglomeration
North West & Merseyside	UK0033	Non-agglomeration
Yorkshire & Humberside	UK0034	Non-agglomeration
West Midlands	UK0035	Non-agglomeration
North East	UK0036	Non-agglomeration
Central Scotland	UK0037	Non-agglomeration
North East Scotland	UK0038	Non-agglomeration
Highland	UK0039	Non-agglomeration
Scottish Borders	UK0040	Non-agglomeration
South Wales	UK0041	Non-agglomeration
North Wales	UK0042	Non-agglomeration
Northern Ireland	UK0043	Non-agglomeration

Figure 2-1 UK Zones for Ambient Air Quality Reporting 2020



3 Air Quality Assessment for 2020

The air quality assessment for each pollutant is derived from a combination of measured pollutant concentrations and supplementary assessment (that is, modelling, UUNN NO_2 diffusion tube measurements or objective assessment). Where both measurements and supplementary assessment results are available, the assessment of compliance for each zone is based on the higher concentration of the two.

The air quality compliance assessment for each calendar year must be submitted to Defra by 30th September the following calendar year. The results of the air quality assessment for 2020 are summarised in the tables below. The tables have been completed as follows:

- Where all measurements were within the relevant limit values in 2020, the table shows this as 'OK'.
- In the above cases, where compliance was determined by supplementary assessment, this is indicated by '(s)', i.e. 'OK (s)'.
- Where locations were identified as exceeding a limit value, target value or long-term objective, this is identified as '>LV', '>TV' or '>LTO' as applicable.
- Where a non-compliance was determined by supplementary assessment, this is indicated by '(s)', as above.
- The abbreviation 'n/a' (not applicable) means that an assessment is not relevant for this zone, such as for the NO_X vegetation critical level in agglomeration zones.
- Zones that complied with the relevant limit values, targets or long-term objectives are shaded blue, while those that did not are shaded red. For ozone, zones that met the relevant target value but not the long-term objective are shaded purple.

There are no longer any zones where margins of tolerance apply.

Sulphur dioxide (SO_2): in 2020, all zones and agglomerations within the UK complied with the limit values for 1-hour mean and 24-hour mean SO_2 concentration, set for protection of human health.

All non-agglomeration zones within the UK also complied with the critical levels for annual mean and winter mean SO_2 concentration, set for protection of ecosystems (these are not applicable to built-up areas).

Carbon monoxide (CO), benzene and lead: all zones and agglomerations were compliant with the limit values for these three pollutants in 2020.

The 2020 compliance assessment for CO has been based on objective estimation, as explained in Defra's technical report on UK air quality assessment (Brookes, D. M. et al., 2020). This is underpinned by NAEI emission trends, AURN measurement trends and historical modelling assessments.

Nitrogen dioxide (NO_2): in 2020 not all zones and agglomerations were compliant with the limit values. The results of the air quality assessment for nitrogen dioxide for each zone are summarised in **Table 3-1**.

All zones and agglomerations were compliant with the 1-hour limit value (200 µg m^{-3}) in 2020, with none exceeding this limit value on more than the permitted 18 occasions. In recent years only a few zones (typically one or two) have exceeded this limit value, 2020 is the first year in which all zones have been compliant.

Thirty-eight zones met the annual mean limit value for NO_2 (40 µg m^{-3}) in 2020. The five that exceeded this limit value were:

- Greater London Urban Area
- West Midlands Urban Area
- Greater Manchester Urban Area
- Bristol Urban Area
- South Wales.

2020 saw a large reduction in the number of zones exceeding the annual mean limit value. For comparison, 33 zones exceeded in 2019. This large increase in the number of compliant zones is attributed to the reduced road traffic flows brought about by the Covid-19 pandemic lockdown restrictions.

All non-agglomeration zones within the UK complied with the critical level for annual mean NO_X concentration, set for protection of vegetation, as has been the case for many years.

As part of the 2017 UK plan for tackling roadside nitrogen dioxide concentrations (Defra, 2017), local authorities with exceedances of the annual mean nitrogen dioxide limit value have been required to develop local plans or studies to consider measures to achieve the statutory limit value within the shortest possible time. These studies or plans may include local scale modelling and/or monitoring data, and in some cases the local data presents different results to the national air quality assessment. Defra are working to develop and improve the national NO_2 compliance assessment to better reflect local level NO_2 concentrations. This includes establishing the UUNN to provide more local NO_2 measurement data.

Table 3-1 Results of Air Quality Assessment for Nitrogen Dioxide in 2020

Zone	Zone code	NO_2 LV for health (1hr mean)	NO_2 LV for health (annual mean)	NO_x critical level for vegetation (ann. mean)
Greater London Urban Area	UK0001	OK	> LV	n/a
West Midlands Urban Area	UK0002	OK	> LV (s)	n/a
Greater Manchester Urban Area	UK0003	OK	> LV (s)	n/a
West Yorkshire Urban Area	UK0004	OK	OK	n/a
Tyneside	UK0005	OK	OK	n/a
Liverpool Urban Area	UK0006	OK	OK	n/a
Sheffield Urban Area	UK0007	OK	OK	n/a
Nottingham Urban Area	UK0008	OK	OK	n/a
Bristol Urban Area	UK0009	OK	> LV (s)	n/a
Brighton/Worthing/Littlehampton	UK0010	OK	OK	n/a
Leicester Urban Area	UK0011	OK	OK	n/a
Portsmouth Urban Area	UK0012	OK	OK	n/a
Teesside Urban Area	UK0013	OK	OK	n/a
The Potteries	UK0014	OK	OK	n/a
Bournemouth Urban Area	UK0015	OK	OK	n/a
Reading/Wokingham Urban Area	UK0016	OK	OK	n/a
Coventry/Bedworth	UK0017	OK	OK	n/a
Kingston upon Hull	UK0018	OK	OK	n/a
Southampton Urban Area	UK0019	OK	OK	n/a
Birkenhead Urban Area	UK0020	OK	OK	n/a
Southend Urban Area	UK0021	OK	OK	n/a
Blackpool Urban Area	UK0022	OK	OK	n/a
Preston Urban Area	UK0023	OK	OK	n/a
Glasgow Urban Area	UK0024	OK	OK	n/a
Edinburgh Urban Area	UK0025	OK	OK	n/a
Cardiff Urban Area	UK0026	OK	OK	n/a
Swansea Urban Area	UK0027	OK	OK	n/a
Belfast Urban Area	UK0028	OK	OK	n/a
Eastern	UK0029	OK	OK	OK
South West	UK0030	OK	OK	OK
South East	UK0031	OK	OK	OK
East Midlands	UK0032	OK	OK	OK
North West & Merseyside	UK0033	OK	OK	OK (s)
Yorkshire & Humberside	UK0034	OK	OK	OK (s)
West Midlands	UK0035	OK	OK	OK (s)
North East	UK0036	OK	OK	OK (s)
Central Scotland	UK0037	OK	OK	OK (s)
North East Scotland	UK0038	OK	OK	OK (s)
Highland	UK0039	OK	OK	OK (s)
Scottish Borders	UK0040	OK	OK	OK
South Wales	UK0041	OK	> LV	OK
North Wales	UK0042	OK	OK	OK
Northern Ireland	UK0043	OK	OK	OK (s)

LV = limit value, (s) indicates that the compliance or exceedance was determined by supplementary assessment.

Particulate Matter as PM_{10}: all zones and agglomerations were compliant with the annual mean limit value of 40 µg m^{-3} for PM_{10}. All zones and agglomerations were also compliant with the daily mean limit value of 50 µg m^{-3}, which must not be exceeded more than 35 times a year. The results of the air quality assessment for PM_{10} for each zone, with respect to the daily mean and annual mean limit values, are summarised in **Table 3-2**.

Under the Air Quality Standards Regulations, the UK is required to identify any exceedances of PM_{10} limit values which are due to natural sources (for example sea salt). Where this is the case, the exceedance does not count as non-compliance. Particulate matter from sea salt is modelled and has been used in the past to determine whether compliance with the limit values has been achieved after contribution from natural sources has been subtracted. However, in 2020 there were no modelled exceedances of either the 24-hr or annual mean limit values, so no subtraction of contribution from natural sources has been carried out.

Particulate Matter as $PM_{2.5}$: all zones met the Stage 1 limit value (25 µg m^{-3} to be achieved by 1st Jan 2015) which came into force on 1st January 2015, and the Stage 2 indicative limit value (20 µg m^{-3} which was to be achieved by 1st Jan 2020). Both limit values apply to the annual mean, based on the calendar year.

The results of the air quality assessment for $PM_{2.5}$ for each zone are summarised in **Table 3-3**. Subtraction of $PM_{2.5}$ contributions due to natural sources was not necessary for any zone.

Under the Air Quality Standards Regulations, the UK was required to achieve a national exposure reduction target for $PM_{2.5}$, over the period 2010 to 2020. This is based on the Average Exposure Indicator (AEI) statistic. The AEI for the UK is calculated as follows: the arithmetic mean $PM_{2.5}$ concentration at appropriate UK urban background sites only is calculated for three consecutive calendar years, and the mean of these values taken as the AEI.

The AEI for the reference year (2010) was used to determine the National Exposure Reduction Target (NERT), to be achieved by 2020. The UK's reference year AEI was 13 µg m^{-3}; on this basis, the Air Quality Standards Regulations set an exposure reduction target of 15%. This equates to reducing the AEI to 11 µg m^{-3} by 2020. (The detailed methodology and results of this calculation are presented in Defra's technical report on UK air quality assessment (Brookes, D. M. et al., 2020).)

Table 3-2 Results of Air Quality Assessment for PM_{10} in 2020

Zone	Zone code	PM_{10} LV (daily mean)	PM_{10} LV (annual mean)
Greater London Urban Area	UK0001	OK	OK
West Midlands Urban Area	UK0002	OK	OK
Greater Manchester Urban Area	UK0003	OK	OK
West Yorkshire Urban Area	UK0004	OK	OK
Tyneside	UK0005	OK	OK
Liverpool Urban Area	UK0006	OK	OK
Sheffield Urban Area	UK0007	OK	OK
Nottingham Urban Area	UK0008	OK	OK
Bristol Urban Area	UK0009	OK	OK
Brighton/Worthing/Littlehampton	UK0010	OK (s)	OK (s)
Leicester Urban Area	UK0011	OK	OK
Portsmouth Urban Area	UK0012	OK	OK
Teesside Urban Area	UK0013	OK	OK
The Potteries	UK0014	OK	OK
Bournemouth Urban Area	UK0015	OK (s)	OK (s)
Reading/Wokingham Urban Area	UK0016	OK	OK
Coventry/Bedworth	UK0017	OK	OK
Kingston upon Hull	UK0018	OK	OK
Southampton Urban Area	UK0019	OK	OK
Birkenhead Urban Area	UK0020	OK	OK
Southend Urban Area	UK0021	OK	OK
Blackpool Urban Area	UK0022	OK	OK
Preston Urban Area	UK0023	OK	OK
Glasgow Urban Area	UK0024	OK	OK
Edinburgh Urban Area	UK0025	OK	OK
Cardiff Urban Area	UK0026	OK	OK
Swansea Urban Area	UK0027	OK	OK
Belfast Metropolitan Urban Area	UK0028	OK	OK
Eastern	UK0029	OK	OK
South West	UK0030	OK	OK
South East	UK0031	OK	OK
East Midlands	UK0032	OK	OK
North West & Merseyside	UK0033	OK	OK
Yorkshire & Humberside	UK0034	OK	OK
West Midlands	UK0035	OK	OK
North East	UK0036	OK	OK
Central Scotland	UK0037	OK	OK
North East Scotland	UK0038	OK	OK
Highland	UK0039	OK	OK
Scottish Borders	UK0040	OK (s)	OK (s)
South Wales	UK0041	OK	OK
North Wales	UK0042	OK	OK
Northern Ireland	UK0043	OK	OK

LV = limit value, (s) indicates that the compliance or exceedance was determined by supplementary assessment.

Table 3-3 Results of Air Quality Assessment for $PM_{2.5}$ in 2020

Zone	Zone code	$PM_{2.5}$ Stage 1 limit value (annual mean, for 1st Jan 2015)	$PM_{2.5}$ Stage 2 limit value (annual mean, for 1st Jan 2020)
Greater London Urban Area	UK0001	OK	OK
West Midlands Urban Area	UK0002	OK	OK
Greater Manchester Urban Area	UK0003	OK	OK
West Yorkshire Urban Area	UK0004	OK	OK
Tyneside	UK0005	OK	OK
Liverpool Urban Area	UK0006	OK (s)	OK (s)
Sheffield Urban Area	UK0007	OK	OK
Nottingham Urban Area	UK0008	OK	OK
Bristol Urban Area	UK0009	OK	OK
Brighton/Worthing/Littlehampton	UK0010	OK	OK
Leicester Urban Area	UK0011	OK	OK
Portsmouth Urban Area	UK0012	OK (s)	OK (s)
Teesside Urban Area	UK0013	OK	OK
The Potteries	UK0014	OK	OK
Bournemouth Urban Area	UK0015	OK	OK
Reading/Wokingham Urban Area	UK0016	OK	OK
Coventry/Bedworth	UK0017	OK	OK
Kingston upon Hull	UK0018	OK	OK
Southampton Urban Area	UK0019	OK	OK
Birkenhead Urban Area	UK0020	OK	OK
Southend Urban Area	UK0021	OK	OK
Blackpool Urban Area	UK0022	OK	OK
Preston Urban Area	UK0023	OK	OK
Glasgow Urban Area	UK0024	OK	OK
Edinburgh Urban Area	UK0025	OK	OK
Cardiff Urban Area	UK0026	OK	OK
Swansea Urban Area	UK0027	OK	OK
Belfast Metropolitan Urban Area	UK0028	OK	OK
Eastern	UK0029	OK	OK
South West	UK0030	OK	OK
South East	UK0031	OK	OK
East Midlands	UK0032	OK	OK
North West & Merseyside	UK0033	OK	OK
Yorkshire & Humberside	UK0034	OK	OK
West Midlands	UK0035	OK	OK
North East	UK0036	OK	OK
Central Scotland	UK0037	OK	OK
North East Scotland	UK0038	OK	OK
Highland	UK0039	OK	OK
Scottish Borders	UK0040	OK (s)	OK (s)
South Wales	UK0041	OK	OK
North Wales	UK0042	OK	OK
Northern Ireland	UK0043	OK	OK

Subtraction of natural source contribution was not carried out for any zones in 2020.

LV = limit value, (s) indicates that the compliance or exceedance was determined by supplementary assessment.

The AEI for the reference year 2015 was set at 20 µg m^{-3} as an Exposure Concentration Obligation (ECO) in the Air Quality Standards Regulations. The UK met this obligation. There were no obligations or target values for the years *between* 2010, 2015 and 2020, but the running AEIs for these intervening years were used to give an indication of progress towards the 2020 target. The running AEI for 2020 was calculated as follows:

- 2018: 10 µg m^{-3}
- 2019: 10 µg m^{-3}
- 2020: 8 µg m^{-3}

The mean of these three values (to the nearest integer) is 9 µg m^{-3}. The AEI for 2020 itself is 8 µg m^{-3}. Thus, the UK has achieved the National Exposure Reduction Target (NERT), of reducing the AEI to below the 2020 exposure reduction target of 11 µg m^{-3} by 2020.

Ozone: all zones and agglomerations met the target values for health and for protection of vegetation. The results of the air quality assessment for ozone are summarised in **Table 3-4**.

For ozone (O_3), there is a target value based on the maximum daily 8-hour mean. All 43 zones and agglomerations were compliant with this target value. There is also a long-term objective for protection of human health, based on the maximum daily 8-hour mean. Only three of the 43 zones and agglomerations were compliant with the long-term objective (LTO) for health in 2020.

There is also a target value based on the AOT40 statistic. The AOT40 statistic (expressed in µg m^{-3}.hours) is the sum of the difference between hourly concentrations greater than 80 µg m^{-3} (= 40 ppb) and 80 µg m^{-3} over a given period using only the hourly mean values measured between 08:00 and 20:00 Central European Time each day. All 43 zones and agglomerations met the target value based on the AOT40 statistic. There is also a long-term objective, for protection of vegetation, based on this statistic; 16 zones and agglomerations exceeded this long-term objective for vegetation in 2020.

The UK met all target values for O_3 in 2020 as it has done for many years, but the number of zones exceeding the long-term objective for vegetation (16) was relatively high compared with most previous years.

Ozone concentrations – and hence the number of zones exceeding the LTOs - fluctuate from year to year as ozone is a transboundary pollutant and its formation is influenced by meteorological factors. However, as discussed in Section 6, the measurement data suggest O_3 concentrations in 2020 may have been affected by the Covid-19 restrictions. Ozone is removed from air by reaction with nitric oxide (NO) in vehicle emissions: the observed reductions in road traffic may have allowed ozone concentrations in some urban areas to become higher than they otherwise would have.

Table 3-4 Results of Air Quality Assessment for Ozone in 2020

Zone	Zone code	O_3 TV and LTO for health (8hr mean)	O_3 TV and LTO for vegetation (AOT40)
Greater London Urban Area	UK0001	Met TV, > LTO	Met TV, > LTO
West Midlands Urban Area	UK0002	Met TV, > LTO	OK
Greater Manchester Urban Area	UK0003	Met TV, > LTO	OK
West Yorkshire Urban Area	UK0004	Met TV, > LTO	OK
Tyneside	UK0005	Met TV, > LTO (s)	OK
Liverpool Urban Area	UK0006	Met TV, > LTO (s)	OK
Sheffield Urban Area	UK0007	Met TV, > LTO	OK
Nottingham Urban Area	UK0008	Met TV, > LTO	OK
Bristol Urban Area	UK0009	Met TV, > LTO	Met TV, > LTO
Brighton/Worthing/Littlehampton	UK0010	Met TV, > LTO	Met TV, > LTO
Leicester Urban Area	UK0011	Met TV, > LTO	OK
Portsmouth Urban Area	UK0012	Met TV, > LTO (s)	Met TV, > LTO (s)
Teesside Urban Area	UK0013	Met TV, > LTO	OK
The Potteries	UK0014	Met TV, > LTO	OK
Bournemouth Urban Area	UK0015	Met TV, > LTO	Met TV, > LTO
Reading/Wokingham Urban Area	UK0016	Met TV, > LTO	Met TV, > LTO (s)
Coventry/Bedworth	UK0017	Met TV, > LTO	Met TV, > LTO (s)
Kingston upon Hull	UK0018	Met TV, > LTO	OK
Southampton Urban Area	UK0019	Met TV, > LTO	Met TV, > LTO (s)
Birkenhead Urban Area	UK0020	Met TV, > LTO	OK
Southend Urban Area	UK0021	Met TV, > LTO	Met TV, > LTO (s)
Blackpool Urban Area	UK0022	Met TV, > LTO	OK
Preston Urban Area	UK0023	Met TV, > LTO	OK
Glasgow Urban Area	UK0024	OK	OK
Edinburgh Urban Area	UK0025	OK	OK
Cardiff Urban Area	UK0026	Met TV, > LTO	Met TV, > LTO (s)
Swansea Urban Area	UK0027	Met TV, > LTO	OK
Belfast Metropolitan Urban Area	UK0028	Met TV, > LTO (s)	OK
Eastern	UK0029	Met TV, > LTO	Met TV, > LTO
South West	UK0030	Met TV, > LTO	Met TV, > LTO
South East	UK0031	Met TV, > LTO	Met TV, > LTO
East Midlands	UK0032	Met TV, > LTO	Met TV, > LTO
North West & Merseyside	UK0033	Met TV, > LTO	OK
Yorkshire & Humberside	UK0034	Met TV, > LTO	OK
West Midlands	UK0035	Met TV, > LTO	Met TV, > LTO
North East	UK0036	Met TV, > LTO	OK
Central Scotland	UK0037	Met TV, > LTO (s)	OK
North East Scotland	UK0038	OK (s)	OK
Highland	UK0039	Met TV, > LTO	OK
Scottish Borders	UK0040	Met TV, > LTO (s)	OK
South Wales	UK0041	Met TV, > LTO	Met TV, > LTO (s)
North Wales	UK0042	Met TV, > LTO	OK
Northern Ireland	UK0043	Met TV, > LTO	OK

TV = target value, LTO = long-term objective, (s) indicates that the compliance or exceedance was determined by supplementary assessment.

In 2020 there were 98 measured exceedances of the ozone population information threshold of 180 µg m^{-3} (at 23 sites), but no exceedances of the population warning threshold of 240 µg m^{-3}. The population information threshold exceedances are detailed in **Table 3-5**. All occurred in the afternoons and evenings of the following dates: 9th May, 24th – 25th June, 31st July and 8th -12th August, typically between 14:00 – 21:00.

Table 3-5 Measured Exceedances of the Ozone Information Threshold Value in 2020

Site name	Zone code	Number of 1-hour exceedances of information threshold	Maximum 1-hour concentration (µg m^{-3})
St Osyth	UK0029	15	217
Wicken Fen	UK0029	11	193
Sibton	UK0029	10	216
Lullington Heath	UK0031	9	205
London N. Kensington	UK0001	8	217
Norwich Lakenfields	UK0029	6	202
Weybourne	UK0029	5	207
Canterbury	UK0031	4	214
Reading New Town	UK0016	4	201
Rochester Stoke	UK0031	4	198
Yarner Wood	UK0030	4	201
London Haringey Priory Park South	UK0001	3	211
Northampton Spring Park	UK0032	3	188
London Bloomsbury	UK0001	2	188
Thurrock	UK0029	2	203
Aston Hill	UK0042	1	187
Bournemouth	UK0015	1	182
Chilbolton Observatory	UK0031	1	183
Leamington Spa	UK0035	1	182
Leeds Centre	UK0004	1	181
London Eltham	UK0001	1	188
London Harlington	UK0001	1	187
London Hillingdon	UK0001	1	181

Table 4-6 shows the exceedances of the ozone information threshold in the verified dataset.

The air quality assessment for arsenic (As), cadmium (Cd), nickel (Ni) and benzo[a]pyrene (B[a]P) are summarised in **Table 3-6**. All zones met target values for arsenic and cadmium, but some zones exceeded the target value for nickel or benzo[a]pyrene.

Table 3-6 Results of Air Quality Assessment for As, Cd, Ni and B[a]P in 2020

Zone	Zone code	As TV	Cd TV	Ni TV	B[a]P TV
Greater London Urban Area	UK0001	OK	OK	OK	OK
West Midlands Urban Area	UK0002	OK (s)	OK (s)	OK (s)	OK
Greater Manchester Urban Area	UK0003	OK (s)	OK (s)	OK (s)	OK
West Yorkshire Urban Area	UK0004	OK (s)	OK (s)	OK (s)	OK
Tyneside	UK0005	OK (s)	OK (s)	OK (s)	OK
Liverpool Urban Area	UK0006	OK (s)	OK (s)	OK (s)	OK (s)
Sheffield Urban Area	UK0007	OK	OK	> TV (s)	OK
Nottingham Urban Area	UK0008	OK (s)	OK (s)	OK (s)	OK
Bristol Urban Area	UK0009	OK (s)	OK (s)	OK (s)	OK
Brighton/Worthing/Littlehampton	UK0010	OK (s)	OK (s)	OK (s)	OK (s)
Leicester Urban Area	UK0011	OK (s)	OK (s)	OK (s)	OK (s)
Portsmouth Urban Area	UK0012	OK (s)	OK (s)	OK (s)	OK (s)
Teesside Urban Area	UK0013	OK (s)	OK (s)	OK (s)	OK
The Potteries	UK0014	OK (s)	OK (s)	OK (s)	OK (s)
Bournemouth Urban Area	UK0015	OK (s)	OK (s)	OK (s)	OK (s)
Reading/Wokingham Urban Area	UK0016	OK (s)	OK (s)	OK (s)	OK (s)
Coventry/Bedworth	UK0017	OK (s)	OK (s)	OK (s)	OK (s)
Kingston upon Hull	UK0018	OK (s)	OK (s)	OK (s)	OK (s)
Southampton Urban Area	UK0019	OK (s)	OK (s)	OK (s)	OK (s)
Birkenhead Urban Area	UK0020	OK (s)	OK (s)	OK (s)	OK (s)
Southend Urban Area	UK0021	OK (s)	OK (s)	OK (s)	OK (s)
Blackpool Urban Area	UK0022	OK (s)	OK (s)	OK (s)	OK (s)
Preston Urban Area	UK0023	OK (s)	OK (s)	OK (s)	OK (s)
Glasgow Urban Area	UK0024	OK (s)	OK (s)	OK (s)	OK
Edinburgh Urban Area	UK0025	OK (s)	OK (s)	OK (s)	OK
Cardiff Urban Area	UK0026	OK (s)	OK (s)	OK (s)	OK
Swansea Urban Area	UK0027	OK	OK	> TV	> TV (s)
Belfast Urban Area	UK0028	OK	OK	OK	OK
Eastern	UK0029	OK	OK	OK	OK
South West	UK0030	OK	OK	OK	OK
South East	UK0031	OK	OK	OK	OK
East Midlands	UK0032	OK	OK	OK	OK
North West & Merseyside	UK0033	OK (s)	OK (s)	OK (s)	OK
Yorkshire & Humberside	UK0034	OK	OK	> TV (s)	> TV (s)
West Midlands	UK0035	OK	OK	OK	OK (s)
North East	UK0036	OK (s)	OK (s)	OK (s)	OK
Central Scotland	UK0037	OK	OK	OK	OK
North East Scotland	UK0038	OK (s)	OK (s)	OK (s)	OK (s)
Highland	UK0039	OK (s)	OK (s)	OK (s)	OK
Scottish Borders	UK0040	OK	OK	OK	OK (s)
South Wales	UK0041	OK	OK	> TV (s)	> TV (s)
North Wales	UK0042	OK (s)	OK (s)	OK (s)	OK (s)
Northern Ireland	UK0043	OK (s)	OK (s)	OK (s)	OK

TV = target value, (s) indicates that the compliance or exceedance was determined by supplementary assessment.

Concentrations of Ni exceeded the target value in Sheffield Urban Area, Swansea Urban Area, Yorkshire and Humberside and South Wales. These exceedances are attributed to

emissions from industrial sources. Concentrations of benzo[a]pyrene were above the target value in three zones; Yorkshire and Humberside, Swansea Urban Area and South Wales.

4 Comparison with Previous Years

This section provides information on non-compliances in previous years from 2008 onwards. (2008 is the year that the Air Quality Directive - which was subsequently transposed into UK legislation by the Air Quality Standards Regulations – came into force.)

For **SO_2, $PM_{2.5}$, lead, benzene and CO**, the UK has been compliant with Air Quality Standards Regulations limit values (apart from the $PM_{2.5}$ Stage 2 indicative limit value) in all years since 2008. For information on compliance with the 1st and 2nd Daughter Directives for all pollutants in earlier years, please see the 2012 or earlier reports in this series, which can be found here: https://uk-air.defra.gov.uk/library/annualreport/.

The UK has been compliant with the limit values for both **lead** and **CO** since 2003, and for **benzene** since 2007: these limit values are the same as those contained in the 1st and 2nd Daughter Directives, which the Air Quality Directive (and therefore the Air Quality Standards Regulations) superseded.

For nitrogen dioxide, **Table 4-1** summarises the results of the air quality assessment in years from 2008 to 2020. This table shows the numbers of zones exceeding the limit value (plus any agreed margin of tolerance, in cases where a time extension had been granted). The right-hand column contains notes on the effects of any time extensions, the last of which ended on 1st January 2015.

All non-agglomeration zones within the UK have complied with the critical level for annual mean NO_X concentration, set for protection of vegetation, in years 2008 onwards.

For PM_{10}, **Table 4-2** summarises the results of the air quality assessment in years from 2008 to 2020. There are notes in the right-hand column explaining the effects of the time extensions which were in place up to the end of 2011 for some zones.

For ozone, **Table 4-3** summarises annual exceedances of the target value for human health (based on the maximum daily 8-hour mean), the target value for protection of vegetation (based on the AOT40 statistic), and the two long-term objectives (LTOs) based on these two metrics.

Finally, for the pollutants formerly covered by the Fourth Daughter Directive - arsenic (As), cadmium (Cd), nickel (Ni) and benzo[a]pyrene (B[a]P) – **Table 4-4** summarises the numbers of zones with exceedances of target values in previous years.

Table 4-1 Non-Compliances with Limit Values for Nitrogen Dioxide, 2008-2020

Year	Zones Exceeding NO_2 LV for health (1hr mean)	Zones Exceeding NO_2 LV for health (annual mean)	Notes on Time Extensions
2008	3 zones (London, Glasgow, N.E. Scotland)	40 zones	-
2009	2 zones (London, Glasgow)	40 zones	-
2010	3 zones (London, Teesside, Glasgow)	40 zones	-
2011	3 zones (London, Glasgow, South East)	35 zones	*A further 5 zones exceeded the annual mean NO_2 LV in 2011 but were covered by time extensions and within the LV+ Margin of Tolerance (MOT), therefore compliant.*
2012	2 zones (London, South East)	34 zones	*A further 4 zones exceeded the annual mean NO_2 LV in 2012 but were covered by time extensions and within the LV+ MOT, therefore compliant.*
2013	1 zone (London)	31 zones	*A further 7 zones exceeded the annual mean NO_2 LV in 2013 but were covered by time extensions and within the LV+ MOT, therefore compliant.*
2014	2 zones (London, South Wales)	30 zones	*A further 8 zones exceeded the annual mean NO_2 LV in 2014 but were covered by time extensions and within the LV+ MOT, therefore compliant.*
2015	2 zones (London, South Wales)	37 zones	*2015 was the first year with no time extensions for NO_2: this is the reason for the apparent increase in zones exceeding between 2014 and 2015.*
2016	2 zones (London, South Wales)	37 zones	*No time extensions in place.*
2017	2 zones (London, South Wales)	37 zones	*No time extensions in place.*
2018	2 zones (London, South Wales)	36 zones	*No time extensions in place.*
2019	1 zone (South Wales)	33 zones	*No time extensions in place.*
2020	None	5 zones	*No time extensions in place.*

Table 4-2 Non-Compliances with the Limit Values for PM_{10}, 2008-2020

Year	PM_{10} LV (annual mean)	PM_{10} LV (daily mean)	Notes on Time Extensions and Subtraction of Natural contribution
2008	None	2 zones (1 zone after subtraction of natural contribution)	-
2009	None	3 zones (1 zone after subtraction of natural contribution)	-
2010	None	None (after subtraction of natural contribution)	*One zone exceeded the daily mean PM_{10} limit value more than the permitted 35 times in 2010, after subtraction of natural contribution. This zone was covered by a time extension and was within the LV+MOT so was therefore compliant.*
2011	None	None (after subtraction of natural contribution)	*One zone exceeded the daily mean PM_{10} limit value more than the permitted 35 times in 2011, after subtraction of natural contribution. This zone was covered by a time extension and was within the LV+MOT so was therefore compliant.*
2012	None	None (after subtraction of natural contribution. No time extension.)	-
2013	None	None (after subtraction of natural contribution. No time extension.)	-
2014	None	None (after subtraction of natural contribution. No time extension.)	-
2015	None	None (after subtraction of natural contribution. No time extension.)	-
2016	None	None	-
2017	None	None	-
2018	None	None	-
2019	None	None	-
2020	None	None	-

Table 4-3 Exceedances of Target Values for Ozone (Health) and Long-Term Objectives, 2008-2020

Year	8-Hour Mean Target Value	AOT40 Target Value	8-Hour Mean LTO	AOT40 LTO
2008	1 zone measured (Eastern)	None	43 zones	41 zones
2009	None	None	39 zones	10 zones
2010	None	None	41 zones	6 zones
2011	None	None	43 zones	3 zones
2012	None	None	41 zones	3 zones
2013	None	None	33 zones	8 zones
2014	None	None	32 zones	3 zones
2015	None	None	43 zones	1 zone
2016	None	None	42 zones	5 zones
2017	None	None	34 zones	None
2018	None	None	43 zones	38 zones
2019	None	None	43 zones	6 zones
2020	None	None	40 zones	16 zones

Table 4-4 Zones Exceeding Target Values for As, Cd, Ni and B[a]P, 2008-2020

Year	As	Cd	Ni	B[a]P
2008	None	None	2 (Swansea, South Wales)	6 (Yorks. & Humberside, Teesside, Northern Ireland, Swansea, South Wales, Belfast)
2009	None	None	2 (Swansea, South Wales)	6 (Yorks. & Humberside, Northern Ireland, Teesside, Swansea, North East, South Wales)
2010	None	None	2 (Swansea, South Wales)	8 (Yorks. & Humberside, Northern Ireland, Teesside, Belfast, W Midlands, North East, South Wales, North Wales.)
2011	None	None	2 (Swansea, South Wales)	7 (Yorks. & Humberside, N. Ireland, Teesside, Swansea, Belfast, North East, South Wales)
2012	None	None	2 (Swansea, South Wales)	8 (Yorks. & Humberside, Teesside, Swansea, Belfast, the North East, South Wales, North Wales, Northern Ireland.)
2013	None	None	2 (Swansea, South Wales)	6 (Yorks. & Humberside, Teesside, Swansea, East Midlands, North East, South Wales.)
2014	None	None	3 (Sheffield, Swansea, South Wales)	6 (Yorks. & Humberside, Teesside, Swansea, East Midlands, North East, and South Wales).
2015	None	None	2 (Swansea, South Wales)	5 (Yorks. & Humberside, Teesside, Swansea, the North East and South Wales).
2016	None	None	3 (Sheffield, Swansea, South Wales)	4 (Yorks. & Humberside, Swansea, South Wales and Northern Ireland).
2017	None	None	None	3 (Yorks. & Humberside, Swansea and South Wales)
2018	None	None	4 (Sheffield, Yorks. & Humberside, Swansea and South Wales)	3 (Yorks. & Humberside, Swansea and South Wales)
2019	None	None	4 (Sheffield, Yorks. & Humberside, Swansea and South Wales)	3 (Yorks. & Humberside, Swansea and South Wales)
2020	None	None	4 (Sheffield, Yorks. & Humberside, Swansea and South Wales)	3 (Yorks. & Humberside, Swansea and South Wales)

Additional information from the Devolved Administrations of Scotland, Wales and Northern Ireland can be found at:

- The Scottish Government Air Quality web page at http://www.scotland.gov.uk/Topics/Environment/waste-and-pollution/Pollution-1/16215
- The Welsh Government Environment and Climate Change web pages at https://gov.wales/environment-climate-change .
- The Northern Ireland Department of Agriculture, Environment and Rural Affairs (DAERA) web page at https://www.daera-ni.gov.uk/ .

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