



Department
for Environment
Food & Rural Affairs

UK Report on measures for 2021 exceedance of the Target Value for Nickel

December 2023



Llywodraeth Cymru
Welsh Government



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1. Introduction

The UK and Welsh Governments ('Government') recognise the impact that poor air quality can have on human health and the environment. Tackling air pollution is a priority. 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, towns and villages are welcoming places for people to live and work now and in the future, and for our prosperity. In 2023, the UK Government produced a new Environmental Improvement Plan for England. In August 2020, the Welsh Government published their Clean Air Plan, Healthy Air, Healthy Wales. These documents set out how Government will work towards our international targets to significantly reduce damaging emissions.

Improving air quality can reduce both the short-term and long-term effects on people's health. This particularly benefits those who may find their conditions are made worse through exposure to air pollution. For example, people with heart or lung conditions or breathing problems, as well as reducing longer term impacts on everyone.

1.1 This document

This report provides an overview of the measures being taken to address the exceedances of the pollutant nickel (Ni) in the United Kingdom (UK) for the compliance year 2021, including updates on the measures for exceedances in the compliance years 2013, 2014, 2015, 2016, 2017, 2018, 2019 and 2020¹, as reported in September 2014, 2015, 2016, 2017, 2018, 2019, 2020 and 2021 respectively. No exceedances were reported for the year 2017, an overview report on measures for Ni was, however, still prepared.

Defra also publish an annual *Air Pollution in the UK* report alongside the compliance assessment submission which can be found here: <http://uk-air.defra.gov.uk/library/annualreport/index>. More detailed information on these exceedances and measures being taken to address them can be found in the individual zonal reports provided as an Annex to this document.

¹ <https://uk-air.defra.gov.uk/library/bap-nickel-measures>

Copies of previous annual air quality submissions can be found on UK-AIR, [Air quality compliance xml files - Defra, UK](#).

1.2 Background and Context

The Air Quality Standards Regulations 2010² aims to improve and maintain air quality by setting target values for the concentration in ambient air of metals cadmium, arsenic, and nickel and for benzo[a]pyrene. The target value (TV) for nickel is an annual mean concentration of 20 nanograms (one billionth of a gram (10⁻⁹)) per cubic metre (m⁻³) in ambient air or lower. The regulation requires the UK to report on measures in place to address the exceedance of the TV and that all reasonable measures that do not entail disproportionate cost should be taken to ensure this target is not exceeded.

About Nickel

Nickel is a toxic metallic element found in ambient air as a result of releases from oil and coal combustion, metal processes, manufacturing, and other sources. The main source of emissions to air of nickel in the UK is the combustion of heavy fuel oil and solid fuels derived from petroleum.

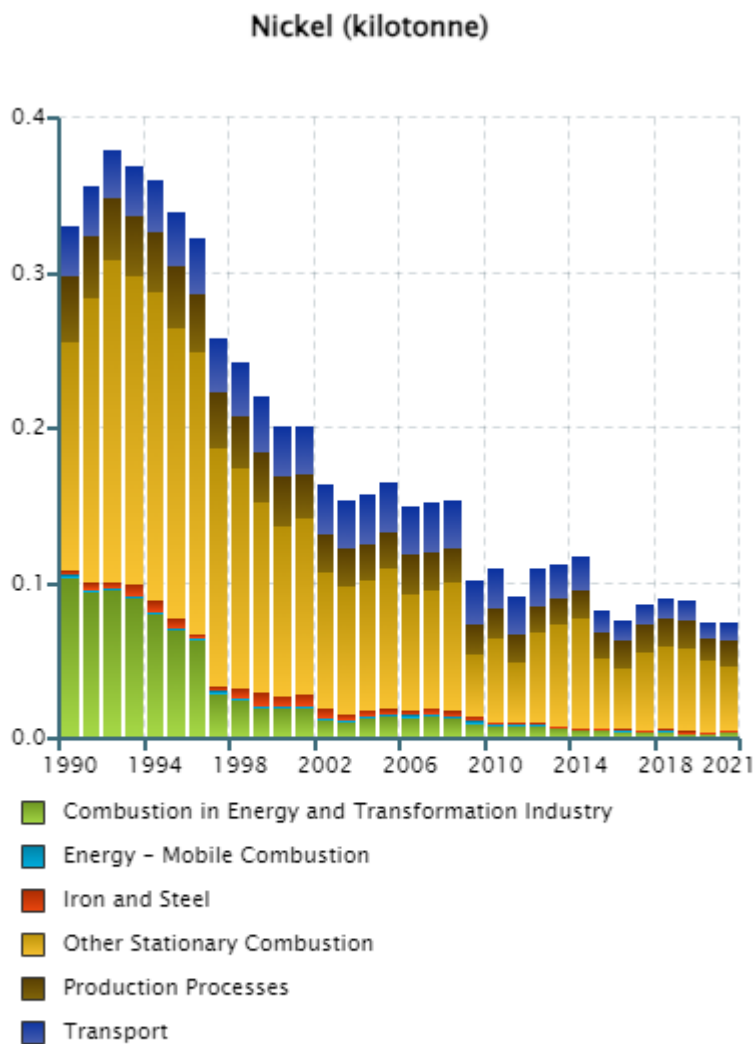
Nickel compounds are human carcinogens by inhalation exposure. They can cause irritation to the nose and sinuses and allergic responses and can lead to the loss of the sense of smell. Long-term exposure may lead to respiratory diseases and cancers³. Nickel can also pollute soil and water, thus having environmental impacts as well as impacts on human health.

Figure 1 shows the levels of nickel emissions in the UK and the main contributory sources. This shows that nickel emissions have reduced significantly since 1990. One of the largest contributions is from other stationary combustion which is dominated by combustion of liquid fuels and petroleum based solid fuels in industry, commercial and residential settings. While the contribution to the national total of emissions is large, these emissions are widely dispersed and do not cause any exceedances of the target value.

² [The Air Quality Standards Regulations 2010 \(legislation.gov.uk\)](#)

³ WHO AQG 2000, PHE Compendium of Chemical Hazards

Figure 1. Nickel emissions by sector (1990-2021)



UK Assessment

Assessment of levels of nickel in the UK with regards to the UK target value are made through a combination of fixed monitoring supplemented by modelling. There is a requirement to undertake monitoring at a fixed number of locations to assess key emissions sources, particularly near to large industrial emission sources. Undertaking modelling alongside monitoring enables the UK to calculate concentrations at locations where monitoring is not conducted providing a fuller picture of nickel concentrations across the UK. The air quality compliance assessment is carried out annually. The results are reported by 30th September each year, for the previous calendar year.

The 2021 compliance assessment reported that the UK exceeded the target value for nickel in two zones in Wales and two zones in England.

Reporting requirements for the exceedance of a target value

Where a target value is exceeded, appropriate authorities in the UK are required to specify the areas of exceedance and the sources contributing to it⁴.

Following an exceedance appropriate authorities in UK must submit a report detailing the measures already taken, ongoing or that will be taken, to reduce levels of this pollutant. Particularly those directed at the main emission sources in order to attain the target value. The Environmental Permitting Regulations (EPR) (England & Wales) aim to prevent or minimise pollution by placing stringent limits on emissions from industrial sources. It is required that all reasonable measures should be taken that do not entail disproportionate cost. The report must be submitted no later than 2 years after the end of the year in which the exceedance triggering the measure was observed (i.e. the end of 2023 for 2021 compliance year – see Table 1).

This report on nickel is the eighth such report that the UK has produced and updates the Report on Measures produced for the exceedances reported for 2013, 2014, 2015, 2016, 2018, 2019 and 2020¹. No exceedances were reported for the year 2017, an overview report on measures for Ni was, however, still prepared.

Table 1. Reporting timetable

| | |
|---------------------------------|---|
| Compliance year | “Year” (e.g. 2021) |
| Compliance assessment reporting | Sept 30 th “Year” +1 (e.g. 2022) |
| Report on Measures | Dec 31 st “Year” +2 (e.g. 2023) |

In the UK, the responsibility for meeting air quality target values is devolved to the national administrations in Scotland, Wales, and Northern Ireland. The Secretary of State for Environment, Food and Rural Affairs (Defra) is responsible for meeting the target values in England. Defra has co-ordinated the production of this report in conjunction with the Welsh Government.

⁴ The Air Quality (Miscellaneous Amendment and Revocation of Retained Direct EU Legislation) (EU Exit) Regulations 2018

2. Overview of Affected Zones

2.1 General information on zones

For the purposes of the compliance reporting against Air Quality Standards Regulations 2010, the UK is divided into 43 zones, termed agglomerations (large urban areas) and non-agglomeration zones (regional areas). There are 15 non-agglomeration zones (Non-AZ) and 28 agglomeration zones (AZ). The 15 non-agglomeration zones match:

1. The boundaries of England's former Government Offices for the Regions; and
2. The boundaries agreed by the Scottish Executive, Welsh Government, and Department for Agriculture, Environment and Rural Affairs in Northern Ireland.

An agglomeration is defined as any urban area with a population greater than 250,000.

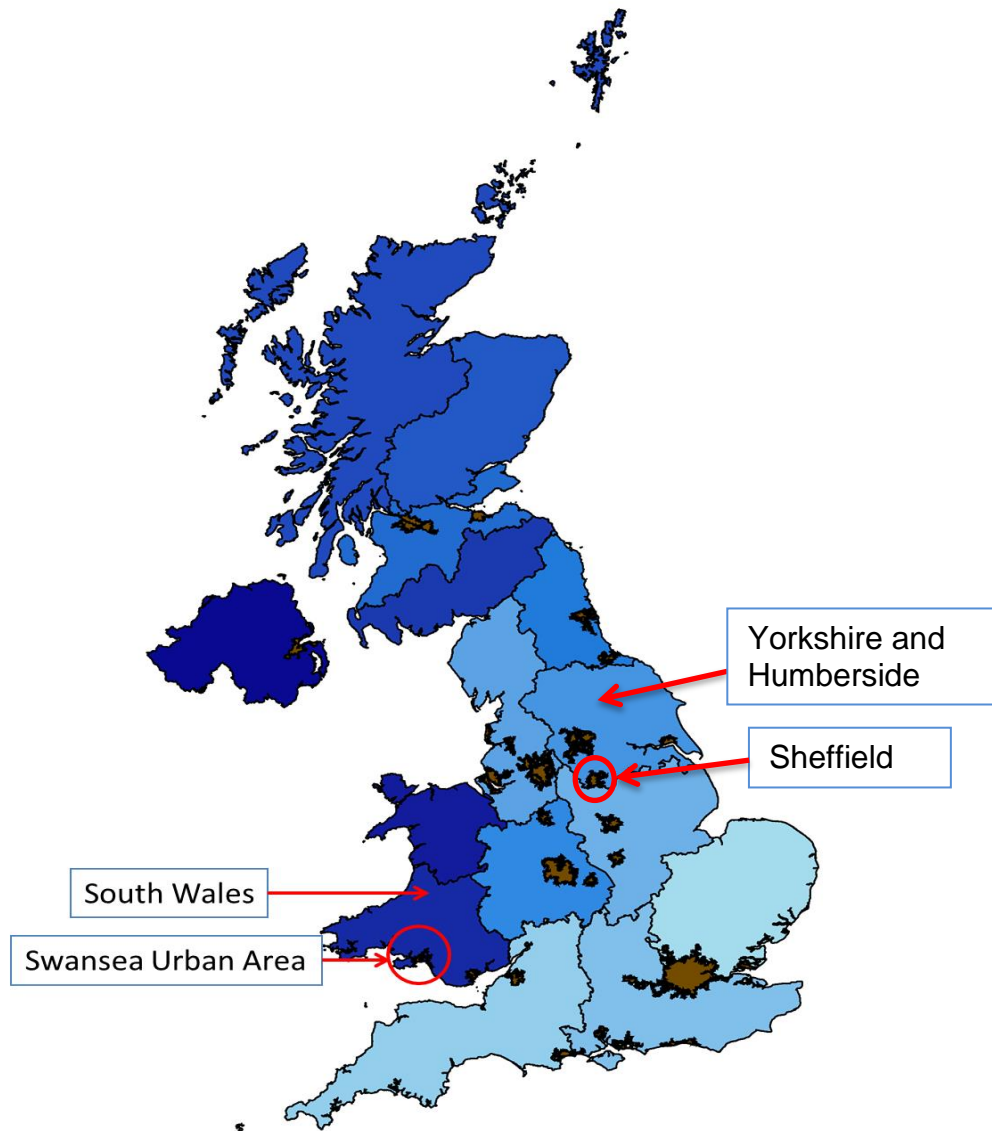
In 2021, four of the 43 zones in the UK were reported to have exceeded the target value for nickel (two non-agglomeration (non-AZ) and two agglomeration zones (AZ)). The affected zones were:

1. Sheffield Urban Area (UK0007) (AZ)
2. Swansea Urban Area (UK0027) (AZ);
3. Yorkshire and Humberside (UK0034) (Non-AZ);
4. South Wales (UK0041) (Non-AZ).

The locations of these zones are indicated on the map shown in Figure 2. Of the four exceedances reported, one was monitored ([UK0027](#)) and three were modelled ([UK0007](#), [UK0034](#) and [UK0041](#)). There are detailed zonal reports for each of these exceedances.

The exceedances in both zones in Wales are attributed to emissions from the same industrial sources, which are located close to the zone boundary. The exceedances in the two zones in England are associated with industrial sources that are close to the zone boundary. The zonal reports provide a detailed breakdown of the affected area in each zone, including information about where the exceedance occurs, how it was assessed, information on sources of the exceedance and location maps.

Figure 2. Map of the UK showing location of zones and agglomerations exceeding the Nickel target value in 2021 (note: the arrows are for the purposes of labelling the zone and do not point to the location where the exceedance occurred – see zonal reports for more detail)



Map of the UK showing location of non-agglomeration zones (blue) and agglomeration zones (brown). Zones exceeding the nickel target value in 2021 are indicated.

Note: the arrows are for the purposes of labelling the zone and do not point to the location where the exceedance occurred – see zonal reports for more detail

2.2 Assessment details

The UK's annual assessment of compliance is based on a combination of information from the UK national monitoring network and the results of modelling assessments. The level of fixed monitoring is strictly defined by Air Quality Standards Regulations 2010. The use of models, alongside monitoring, allows for a reduction in the number of monitoring stations required and has the added benefits of enabling air quality to be assessed at locations without monitoring sites. Modelling also provides additional information on source apportionment (understanding which sources are the main contributors to the concentrations observed) and projections (predicting future concentrations) required for the development and implementation of air quality plans as well as this report on measures.

Monitoring

The combustion of fuel oils and petroleum coke in domestic, commercial, and industrial settings, nickel mining and refining, and municipal waste incineration are the main source of nickel emissions. Levels emitted will depend on the type of appliance, the efficiency of process and the level of emissions abatement that is in place. Large industrial sites where nickel is processed and refined are the most significant sources of industrial nickel emissions in the UK.

Monitoring situated near to large industrial sources is important for assessing the impact of industrial emissions on concentrations where there is relevant public exposure. In 2021 there were 23 monitoring sites measuring nickel concentrations in the UK. These monitors collect samples of particulate matter from the air (PM₁₀ – Particulate Matter of size fraction up to 10 microns). Samples are analysed to determine the concentrations. More information on the UK monitoring of metals covered by the Air Quality Standards Regulations 2010 can be found on UK-Air^{5,6}.

Modelling

The UK's modelling for compliance assessment is undertaken using a national-scale model known as Pollution Climate Mapping (PCM)⁷. PCM has been designed to assess compliance with environmental objectives at locations defined within UK Air Quality Standards Regulations 2010. Modelling is undertaken for 11 air pollutants each year, including nickel and completed each year in time for compliance assessment submission at the end of September. The model performs an annual

⁵ <http://uk-air.defra.gov.uk/library/annualreport/index>

⁶ <http://uk-air.defra.gov.uk/networks/network-info?view=metals>

⁷ <http://uk-air.defra.gov.uk/data/gis-mapping>

calculation covering the whole of the UK and outputs concentrations on a 1km square grid. These grid squares are assigned to each of the 43 zones and agglomerations for the purposes of assessing compliance status with respect to target values in the regulations.

Modelling calculates concentrations based on estimates of emissions of nickel from all known sources. The model calculates the background concentration of nickel from all area sources (e.g. domestic fuel use, commercial and traffic sources).

Large and small point sources (e.g. from industrial activity) are modelled separately and added to the background concentrations from all other sources.

Exceedance situations established either by national scale modelling or fixed monitoring are further examined using additional modelling (outside of the PCM model) carried out at a more detailed spatial resolution in order to understand the scope of the exceedance. Such assessments can help validate or refine the national scale PCM assessment.

Additional information input into the finer scale models includes more detailed emissions source information (with up-to-date information on emission amount and release characteristics obtained from the process operators and regulators) and local meteorological data. Such assessments enable a more detailed assessment of the exceedance situation helping to establish the key sources and reasons behind an exceedance. Depending on the conclusions of such finer scale modelling, additional understanding may then be incorporated into the PCM model for future year assessments. Such fine scale assessments are only conducted where exceedance situations are identified.

During 2017 King's College London were commissioned to undertake an hourly measurement campaign to measure the concentrations of nickel and other metals in the Sheffield Tinsley area and provide further evidence on nickel sources in the area. This study identified sources to the south (Outokumpu) and northeast, plus additional sources to the west with a smaller contribution to nickel concentrations. Sources could be apportioned between point and fugitive type sources.

In 2021, the modelling for nickel in the exceedance area in Sheffield based on the emissions reported for Outokumpu was in good agreement with measurements.

Fine scale modelling for nickel in the vicinity of the exceedance areas in Swansea and South Wales showed good agreement with measured concentrations at nearby monitoring stations in 2021.

3. Measures

3.1 Overview of Measures

The UK has a number of measures that are being taken to address emissions of nickel from industrial sources.

Industrial Measures

Industrial emissions of nickel are regulated under the Environmental Permitting (England and Wales) Regulations (EPR) 2016, (as amended) and the Air Quality Standards Regulations 2010. The EPRs (and equivalent legislation in Scotland and Northern Ireland) transposed the IED into UK law, which aim to prevent or minimise pollution by placing stringent limits on emissions from industrial sources.

Various industrial facilities undertaking specific types of activity are required to use “Best Available Techniques” (BAT) to reduce emissions to air, water, and land. BAT means available techniques which are the best for preventing or minimising emissions and impacts on the environment. BAT is used to determine types of abatement, manufacturing and production technologies and methods that operators should put in place. The EPR requires regulators to issue environmental permits to operators of certain types of industrial installation - these installations must use BAT.

BAT Reference Documents (BRefs) containing associated emission limits are produced forming the basis of subsequent decisions containing BAT Conclusions. Once published, regulators are obliged by law to review permits and to implement new BAT either (i) within 4 years for existing installations or (ii) immediately for new installations.

The UK Government introduced secondary legislation under the EU (Withdrawal) Act 2018 to ensure the IED continues to operate; all existing EU BATCs from the review programme hitherto have been transposed into UK law.

The Non-Ferrous Metals sector, for example, was reviewed and a new BRef and BAT Conclusions were adopted in 2016. Environmental permits for existing installations (depending on the size and location of the plant, the regulator for these sites is either Natural Resources Wales (when in Wales), the Environment Agency (in England) or the relevant local authority) were subsequently revised by 2020 (with the exception of one Local Authority-regulated permit where a derogation application is still being determined).

A new autonomous air quality regime is being established to ensure that future UK BAT decisions are enforceable under national legislation.

4. Next steps

A further assessment was undertaken for the annual compliance assessment for 2022 and this was submitted in September 2023. For the 2022 assessment there were exceedances reported in three zones: Sheffield Urban Area, Yorkshire & Humberside, and South Wales. Comparisons of the results between the 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020 and 2021 can be seen here: <http://uk-air.defra.gov.uk/data/gis-mapping>. The next compliance assessment for levels of nickel in 2023 will be published in September 2024.

Zones in Wales

The Welsh Government has undertaken detailed assessments to help improve the confidence in the source apportionment and further confirmation/identification of the predominant sources, and to confirm the spatial extent of the exceedance.

Exceedances in both the South Wales (UK0041) and Swansea (UK0027) zones in 2021 can generally be attributed to emissions from the Wall Colmonoy site.

Significant work was undertaken by the regulator and site operator to understand and rectify the increase in emissions during 2018. Ambient monitoring data and internal nickel monitoring results were used to try to identify possible areas for improvement. An action tracker was used to identify, prioritise, and track possible improvements and a comprehensive programme of maintenance and improvement activities was carried out. It is believed that these interventions have had a significant impact on nickel concentrations in the area. The Welsh Government continues to work with regulators and operators in pursuit of compliance with the TV.

Zones in England

There is population exceeding TV in Sheffield (7649) and in Yorkshire and Humberside (2154).

Work has been undertaken to better understand the emissions sources contributing to measured concentrations in the Sheffield exceedance area. Higher time resolution measurements at daily time resolution were undertaken to provide evidence to identify emissions sources contributing to nickel concentrations in the Tinsley area. The study identified sources to the south (likely Outokumpu) and unknown sources to the northeast and west of Tinsley. Those sources were subsequently identified as a mixture of industrial point sources and fugitive sources from a wide range of metal processing operations.

The regulator and the operators of industrial sites in the vicinity of the Tinsley area of Sheffield have continued to work closely to understand, assess and address the sources of nickel originating from their process.

Outokumpu, a stainless steelmaking site, has been identified as the single largest contribution for the Tinsley area. Previous studies have shown that nickel emissions from this site are predominantly emitted from stationary sources which are controlled working with Best Available Techniques (BAT) or beyond. The site uses a bag filter plant to abate particulate emissions and achieves levels that are typically well below the emission limit value (ELV) defined in their permit. To improve the performance of the bag plant and prevent any exceedance of the ELV, the following measures have been implemented during the last couple of years:

- An engineer has been appointed as reliability engineer to specifically work on the performance of the plant
- The maintenance shift has been increased
- A diagnostic system has been developed to optimise plant performance
- CapEx / Maintenance in the order of £700k to continuously improve the bag plant

Aside from primary sources, Outokumpu has targeted fugitive emissions which are estimated to be responsible for about 12% of the site's nickel emissions. Fugitive emissions from the raw materials stockyard have been identified as the biggest fugitive source. Abatement measures implemented include targeted dust suppression based on a dust forecaster which uses a three-day weather forecast.

Another potentially significant industrial contributor to the ambient nickel load in Tinsley is ELG Metals UK Limited, a stainless-steel scrap handling and processing plant. Most of the nickel arising from this site is believed to be fugitive emissions from scrap processing and cutting. ELG have made significant capital expenditures to reduce fugitive releases by upgrading their equipment and reducing the need to carry out cutting in the open. The company has also changed its business model resulting in a much-reduced amount of scrap coming into this site. Consequently, emissions resulting from scrap processing has also reduced accordingly.

The exceedance situation in Yorkshire and Humberside [Ni_UK0034_2021_1] shares common industrial sources with Sheffield agglomeration zone, and no additional sources of nickel have been identified for the exceedance situation in Yorkshire and Humberside. We will continue to investigate the undefined and scaled source contributions.

Defra convened with regulators monthly during 2022 to discuss the target value exceedances. The regulators are working closely with site operators to identify

sources, review implemented measures and agree on a proportional and coordinated plan to reduce emissions. To that effect, regular inspection visits have been scheduled to review the local measures plans.

Annex A: Zones

| Zone or agglomeration | Zone code | Link to zonal report |
|--------------------------|-----------|---|
| Sheffield Urban Area | UK0007 | https://uk-air.defra.gov.uk/assets/documents/reports/bap-nickel-measures/ni_sheffield_UK0007_report_onmeasures_2021.pdf |
| Swansea Urban Area | UK0027 | https://uk-air.defra.gov.uk/assets/documents/reports/bap-nickel-measures/ni_swansea_UK0027_report_onmeasures_2021.pdf |
| Yorkshire and Humberside | UK0034 | https://uk-air.defra.gov.uk/assets/documents/reports/bap-nickel-measures/ni_yorkshireandhumberside_UK0034_reportonmeasures_2021.pdf |
| South Wales | UK0041 | https://uk-air.defra.gov.uk/assets/documents/reports/bap-nickel-measures/ni_southwales_UK0041_reportonmeasures_2021.pdf |

Annex B: Acronyms

| | |
|---------|--|
| AQSR | Air Quality Standards Regulations |
| AZ | Agglomeration Zone |
| BAT | Best Available Techniques |
| BAT-AEL | BAT-associated emission limits |
| BREF | BAT Reference Documents |
| EPR | Environmental Permitting (England and Wales) Regulations |
| IED | Industrial Emissions Directive |
| Ni | Nickel |
| Non- AZ | Non- Agglomeration Zone |
| PCM | Pollution Climate Mapping |
| TV | Target Value |