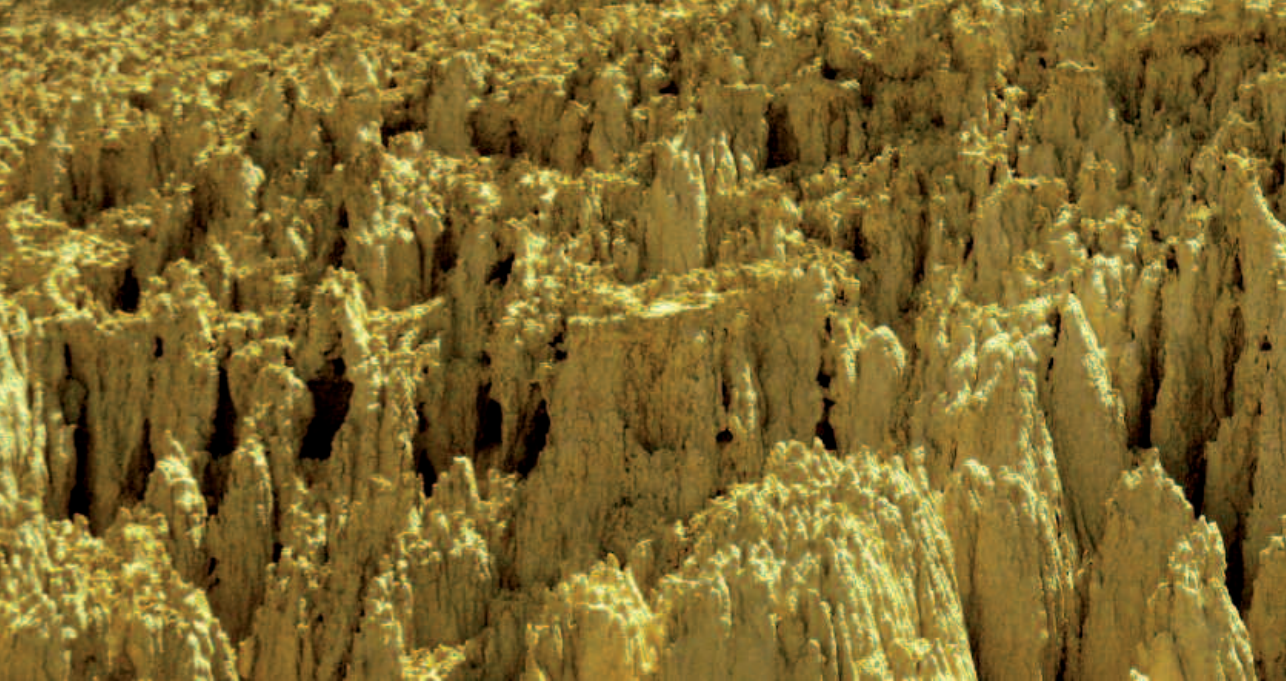
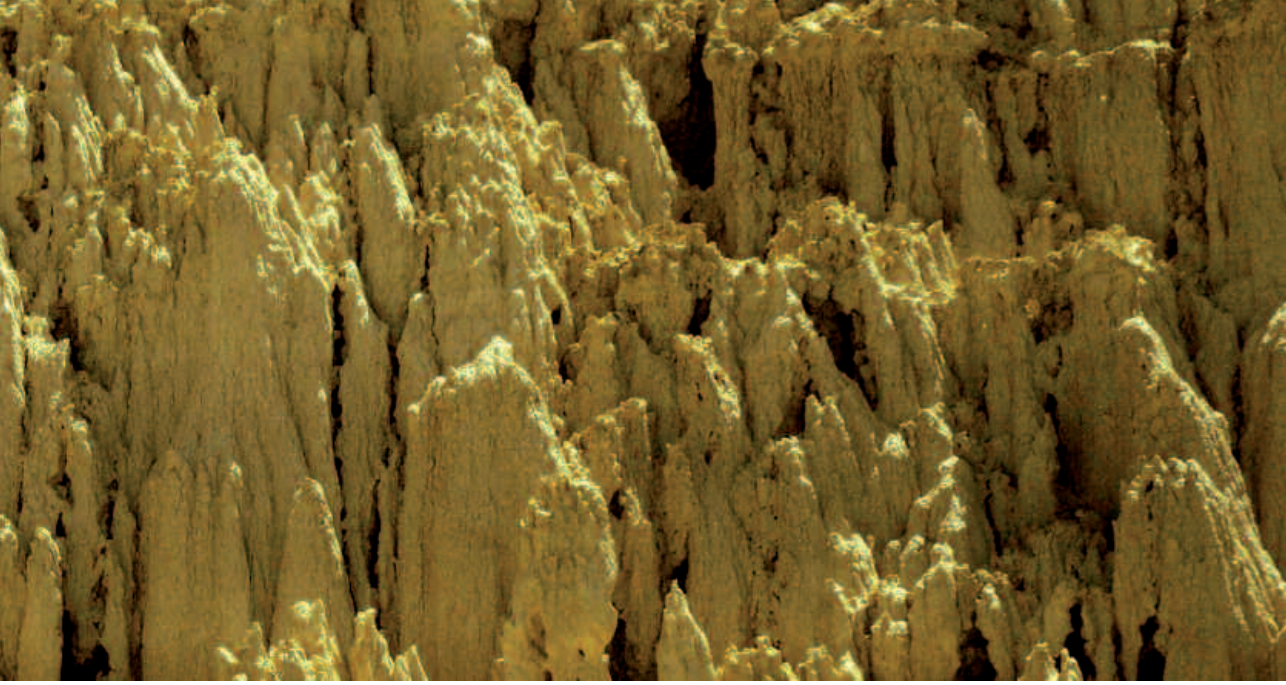




2. Indicators: themes and sectors

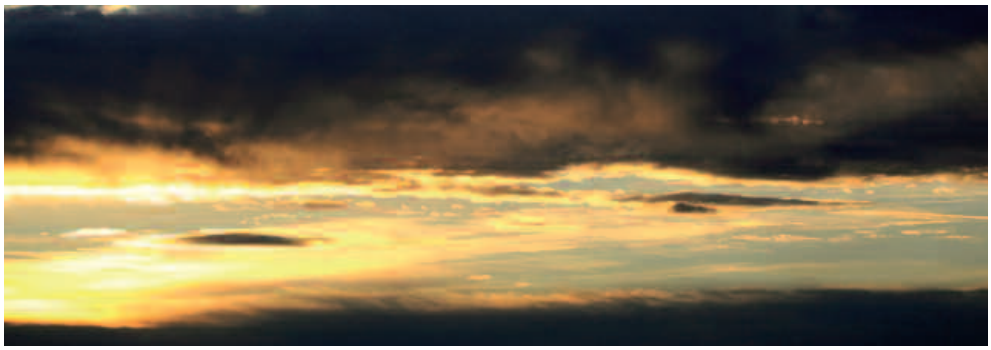
2.1 AIR

The Cancun summit held in December 2010, which laid the foundations on which to build an international climate change regime, was a major advance. The summit's outcome, backed by nearly all of the countries signed up to the United Nations Framework Convention on Climate Change (UNFCCC), signified a milestone as regards commitments to reduce GHG emissions and strengthened multilateral co-operation to resolve problems associated with climate change.

The definitive approved text serves as a reference for the two negotiation processes (Long Term Co-operative Action and the Kyoto Protocol) and seeks to make advances in the five areas of negotiation — mitigation, adaptation, finance, technology and deforestation and forest degradation. It also includes, for the first time, the environmental objective of keeping global warming to less than 2 ºC above pre-industrial levels, as well as including the possibility of revision in 2015.

Within the European context, the Europe 2020 Strategy incorporates the objective of reducing GHG emissions by at least 20% compared to 1990 levels, and by 30% if conditions permit, while promoting smart, sustainable and inclusive growth.

The fight against climate change centres on mitigation (halting GHG accumulation in the atmosphere by



reducing emissions and using sinks to capture already-emitted gases) and adaptation (minimising risk and impact and taking advantage of new environmental conditions whenever possible).

Spain's geographic position and socio-economic characteristics make it highly vulnerable to climate change. As a result, the global goal to reduce CO_2 emissions is a constant and consistent priority within the country's environmental policy. In this regard, Law 13/2010 of 5 July extended the general emissions trading scheme to

INDICADTOR	GOAL	TREND
Emissions of greenhouse gases	Reduce GHG emissions to comply with both Kyoto Protocol objectives and those laid down in the Sustainable Economy Law for sectors not subject to the European emissions trading scheme	In 2009, the downward trend in emissions begun in 2007 continued
Emissions of acidifying and eutrophying gases and tropospheric ozone precursors	Meet the objectives of the National Emissions Ceiling Directive by 2010	In 2009, the decrease in emissions was sustained, bringing Spain closer to the objectives established
Emissions of particulate matter	Meet the objectives of the National Emissions Ceiling Directive by 2010	In 2009, the downward trend in particulate emissions begun in 2008 continued
Regional background air quality for the protection of health and vegetation	Meet the objectives for ambient air quality set down in the legislation (recast by Directive 2008/50/EC of 21 May and RD 102/2011 of 28 January)	Mean concentration of mean annual ozone levels is nearing the 2010 target value

include aviation, and in December 2010 Law 40/2010 on geological storage of carbon was passed.

As regards GHGs, the Spanish Climate Change and Clean Energy Strategy (EECCEL) Horizon 2007–2012–2020 defines a series of actions intended to combat climate change. It refers to two key horizons — 2012 (when the Kyoto Protocol's first term ends) and 2020 (the reference year for the strategic objectives).

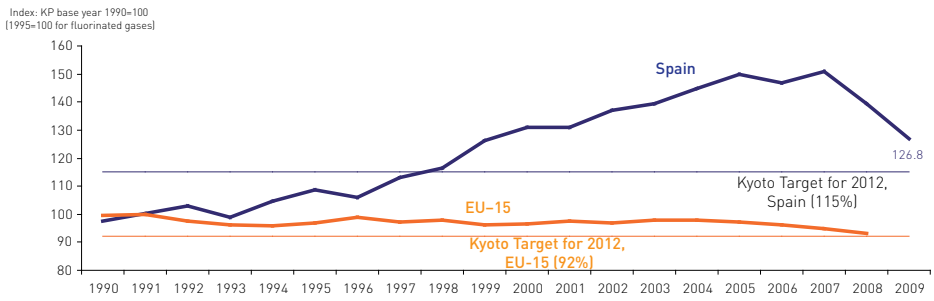
Meanwhile, the legal framework governing acidifying and eutrophying gases and tropospheric ozone precursors is provided by Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants. The National Emissions Reduction Programmes and their respective Action Plans propose specific measures and lines of action to reduce emissions by certain sectors.

Finally, it should be noted that overall air quality in Spanish towns and cities of over 50,000 inhabitants is analysed in the chapter on the urban environment, while this chapter offers information on regional background pollution at points far from pollutant sources.

Emissions of greenhouse gases

In 2009, GHG emissions decreased by 9.0%, exceeding the fall registered in 2008

TOTAL GREENHOUSE GAS EMISSIONS (CO_2 EQUIVALENT)



Source: EEA and MARM

GHG emissions between 1990 and 2009 were marked by sustained growth until 2007 (except in isolated years like 1993, 1996 and 2006) followed by sharp declines in 2008 and 2009 (7.6% and 9.0%, respectively). The Kyoto Protocol stipulates that over the five-year period from 2008–2012, emissions figures must be no higher than 15% above the 1990 level. Since approval (in 2006) of Spain's 2nd National Allocation Plan (2008-2012), the country looks likely to meet its Kyoto Protocol target, namely to keep overall GHG emissions at no more than 37% above base year level (1990).
This total is reached by adding together the 15% increase established by the Kyoto Protocol, an additional 2% attributable to removal by sinks, and acquisition of the equivalent of the remainder (less than 20%) in carbon credits via the Kyoto Protocol's flexibility mechanisms. After the decreases in recent years, in 2009 GHG emissions levels stood at 26.8% above the base year level.

In 2009, CO_2 was the largest contributor to GHG emissions (80.8%), followed by CH_4 and N_2O (9.9% and 7.1%, respectively). CO_2 emissions were also those that fell most drastically in 2009 (-11%).

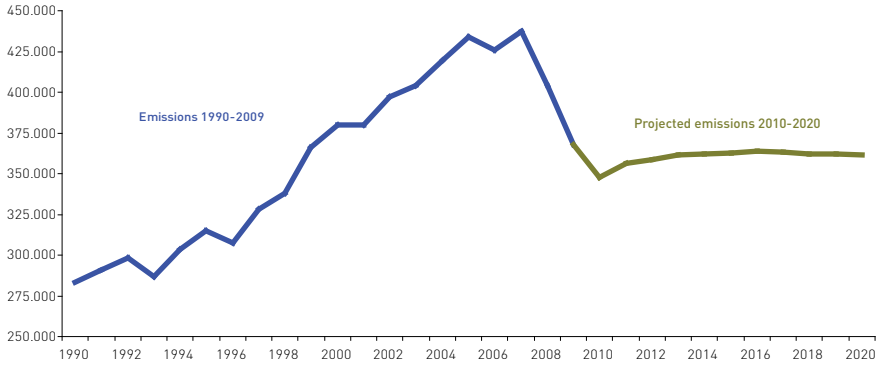
By economic sector, energy (including transport) and agriculture accounted for the highest GHG emissions in 2009 (77.0% and 10.5%, respectively). Meanwhile, the greatest drop in these emissions was registered in industrial processes (-15.3%).

In 2008, emissions per inhabitant in Spain continued to be among the lowest in the EU-27 — Spain recorded the ninth-lowest emissions level (8.96 tonnes of

CO_2-equivalent). Likewise, Spain had the eleventh-lowest emissions level per unit of GDP in 2008, with 0.373 kg of CO_2-equivalent/€. In both cases these values were below the 2007 levels. As regards total emissions, in 2008 Spain was responsible for 8.21% of the EU-27's emissions, contributing slightly less than in 2007 (8.71%).

The GHG emissions projections drawn up in accordance with the inventory for the 1990–2009 period (2011 edition) incorporate all of the measures approved to date, including the commitments set out in the Sustainable Economy Law (Articles 78.2 and 88) to ensure compliance with the GHG-reduction targets assumed by Spain under the current breakdown of the 2020 reduction target. These measures stipulate a collective 10% reduction on 2005 emissions levels in those sectors not subject to the European emissions trading scheme (diffuse sectors/non-ETS sectors).

INVENTORY 1990–2009 AND GHG EMISSIONS PROJECTIONS TO 2020 (kt CO_2-eq)
(EXCLUDING FLEXIBILITY MECHANISMS AND REMOVALS BY SINKS)



Source: MARM

NOTES

- This indicator presents total emissions of the six main greenhouse gases (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6), expressed jointly as CO_2 equivalent (index 1990=100 and 1995=100 for fluorinated gases).
  The Kyoto Protocol of the United Nations Framework Convention on Climate Change sets out developed countries' commitments to reduce emissions of these gases, regulates emissions trading among countries and establishes mechanisms to help less developed countries meet their emission reduction commitments. Within this framework, the EU has undertaken to reduce its greenhouse gas emissions by 8% in relation to 1990 levels within the period 2008–2012. Each EU member state has different obligations in relation to the Community's overall commitment to reduce emissions. Spain has to stabilise GHG emissions at 15% above 1990 levels.

- The figures are for gross emissions and exclude net sink (capture minus emissions) for "Land use, changes in land use and forestry".

- The figure taken as the reference value (base year) when examining the changes over time in aggregate emissions (without including emissions and absorption attributable to "Land use, changes in land use and forestry") is the officially approved value used to calculate the quantity allocated to Spain when evaluating its Kyoto commitments.

- Spain's national GHG emissions projections are calculated according to the guidelines provided by the Intergovernmental Panel on Climate Change (IPCC), Decision No 280/2004/EEC, the application provisions under Decision No 2005/166/EC, the recommendations of the EU Committee on Climate Change and the guidelines of the Geneva Convention.

- Decision No 406/209/EC establishes an emissions limit for 2020 for those sectors not included under Directive 2009/29/EC in the post-Kyoto period, as well as a route to compliance over 2013–2020 specifying the maximum levels for these sectors. The 2020 emissions limit for Spain is set at 90% of the emissions that in 2005 were attributable to sectors not included under Directive 2003/87/EC (Annex 2 of Decision No 406/209/EC, which establishes a 10% reduction for Spain in 2020 in relation to 2005).

SOURCES

- MARM, 2011. *Inventario de Gases de Efecto Invernadero de España. Años 1990–2009*. Directorate-General for Environmental Quality and Assessment.
- MARM, 2011. *Proyecciones de emisiones de contaminantes atmosféricos en España*. Directorate-General for Environmental Quality and Assessment.
- European Environment Agency, 2011. EEA greenhouse gas data viewer (on website).
- European Commission, 2010. Commission Communication: Europe 2020: A strategy for smart, sustainable and inclusive growth. COM(2010) 2020.

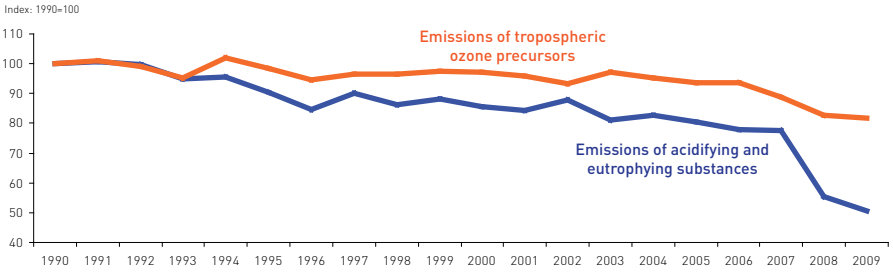
FURTHER INFORMATION

- **http://www.marm.es/es/calidad-y-evaluacion-ambiental/temas/sistema-espanol-de-inventario-sei-/**
- **http://www.eea.europa.eu/**

Emissions of acidifying and eutrophying gases and tropospheric ozone precursors

Emissions of acidifying and eutrophying gases and tropospheric ozone precursors continue to fall, although the latter decreased to a lesser extent

EMISSIONS OF ACIDIFYING AND EUTROPHYING SUBSTANCES AND TROPOSPHERIC OZONE PRECURSORS



Source: MARM

In 2009, emissions of acidifying and eutrophying gases (SO_2, NO_x and NH_3) and tropospheric ozone precursors (CO, NO_x, CH_4 and NMVOC) continued to decrease, though the downward trend was less pronounced than in 2008 (above all as regards ozone precursors).

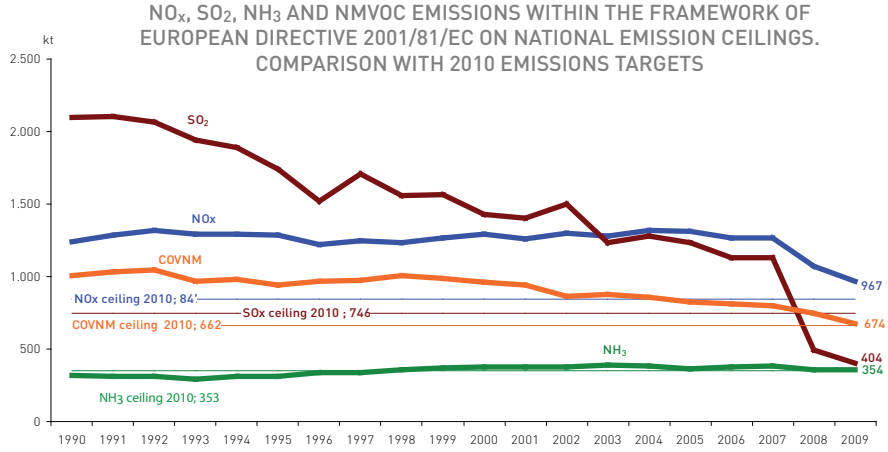
A review of the period from 1990 to 2009 reveals a strong drop (49.4%) in emissions of acidifying and eutrophying substances. The fall in emissions of tropospheric ozone precursors, while more moderate, was also significant (18.1%). The former fell by 8.8% on the previous year, while the latter fell by 1%.

The drop in emissions of acidifying and eutrophying substances was strongly conditioned by reductions in SO_2 (which fell by 80.2%), due mainly to the decline in combustion in energy and transformation industries. The fall in NO_x emissions, attributable to a reduction in emissions by road transport, also contributed to the downward trend. In contrast, the increase in agricultural NH_3 emissions (13.3%) between 1990 and 2009 counteracted the overall fall in acidifying and eutrophying gases. In the last year analysed, the three acidifying and eutrophying gases fell by 19.1%, 9.2% and 0.4% (SO_2, NO_x and NH_3, respectively).

As regards emissions of ozone precursors, the greatest drop was recorded in CO (51.6% between 1990 and 2009). It was accompanied by downturns of 16.8% for

NO_x and 13.7% for NMVOCs and by a rise of 35.6% in CH_4 emissions (generated by agriculture and waste treatment and incineration). However, the fall in 2009 was minimal due to increases in NMVOC and CH_4 emissions (5.2% and 1.1%, respectively).

The graph below shows the trend in emissions of pollutant substances included under Directive 2001/81/EC of 23 October on national emissions ceilings one year prior to the deadline for meeting the targets set in the Directive. It is evident that from 2008 onwards the targets set for SO_x have been met and that the targets for NH_3 and NMVOCs have almost been reached.



Source: MARM

The following table shows estimated emissions for 2010 based on national emissions projections in a scenario in which measures are implemented and indicates the distance from the ceiling established for each substance. These projections, based on the 1990–2009 inventory, cover the period from 2010–2020.

Pollutant	2010 emissions. Scenario with measures (t)	Ceiling (t)	Distance from ceiling in 2010 (%)
SO_x	363,059	746,000	-51.30%
NO_x	900,506	847,000	6.30%
NMVOCs	679,227	662,000	2.60%
NH_3	337,062	353,000	-4.50%

Source: MARM

NOTES

The graph for the indicator shows the changes in aggregate total annual emissions of acidifying and eutrophying substances (SO_2, NO_x and NH_3) and tropospheric ozone precursors (NO_x, NMVOCs, CO and CH_4) in relation to the base year 1990 (1990=100).

SNAP 11 group emissions (other sources and sinks) are not included for NMVOCs, nor are emissions pertaining to subgroups 10.01 and 10.02 (fertilised and unfertilised crops), corresponding to leaf biomass.

Emissions of acidifying and eutrophying gases are presented as acid equivalent (hydrogen ion-generating potential) and are aggregated using the following weighting factors: 31.25 acid equivalent/kg for SO_2 (2/64 acid equivalent/g), 21.74 acid equivalent/kg for NO_x, expressed as NO_2, (1/46 acid equivalent/g) and 58.82 acid equivalent/kg for NH_3 (1/17 acid equivalent/g). Emissions of tropospheric ozone precursors were estimated using the tropospheric ozone depleting potential (expressed as NMVOC equivalent). The following weighting factors were employed: 1.22 for NO_X, 1.00 for NMVOCs, 0.11 for CO, and 0.014 for CH_4.

The objective of Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001, on national emission ceilings for certain atmospheric pollutants, is to limit emissions of acidifying and eutrophying pollutants and ozone precursors in order to protect human health and the environment.

SOURCES

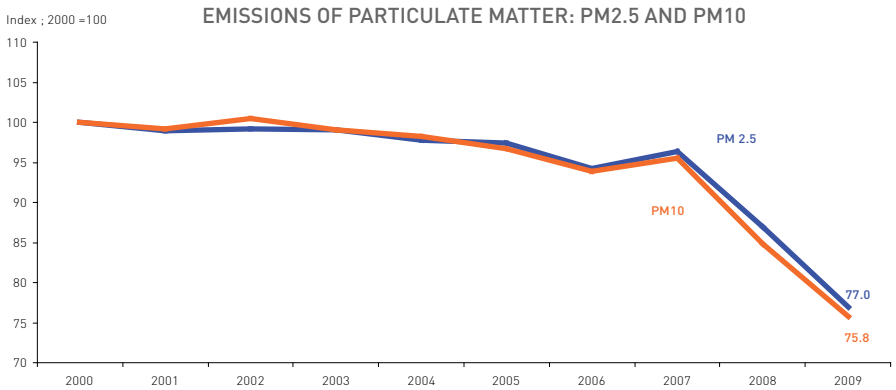
- MARM, 2011. *Inventario de Gases de Efecto Invernadero de España. Años 1990–2009*. Directorate-General for Environmental Quality and Assessment.
- MARM, 2011. *Inventario de Emisiones a la Atmósfera de España*. Ceilings Directive. 1990–2009 series. Directorate-General for Environmental Quality and Assessment.
- MARM, 2011. *Proyecciones de emisiones de contaminantes atmosféricos en España*. Directorate-General for Environmental Quality and Assessment.

FURTHER INFORMATION

- **http://www.marm.es/es/calidad-y-evaluacion-ambiental/temas/sistema-espanol-de-inventario-sei-/http://www.eea.europa.eu/**

Emissions of particulate matter

Emissions have fallen steeply since 2007



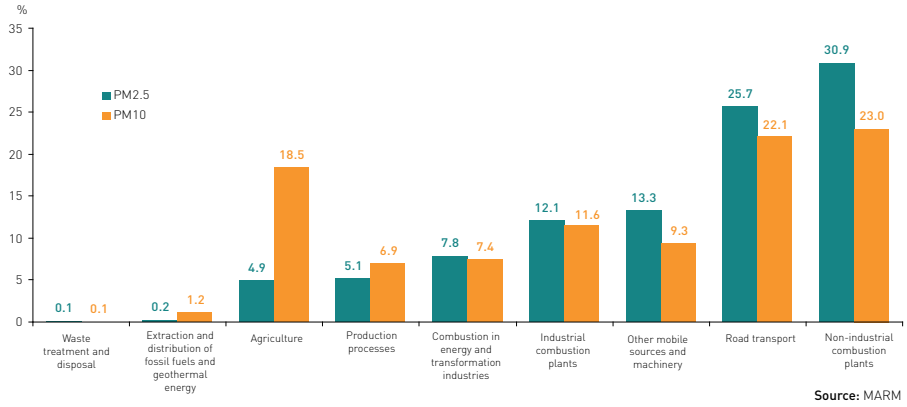
Source: MARM

Between 2000 and 2009, there was a very sharp decrease in emissions of primary particulate matter, with $PM_{2.5}$ falling by 23% and PM_{10} falling by 24%. The sectors recording the greatest emissions reductions were combustion in energy and transformation industries, transport, extraction and distribution of fossil fuels and geothermal energy. The waste treatment and disposal sector experienced no significant change, and therefore had very little influence on the general drop in emissions. Conversely, emissions reductions in the transport sector did have a considerable influence on the general trend due to both the magnitude of the decrease (24–30%) and to the size of the sector's contribution to overall emissions.

Over the same period, emissions from non-industrial combustion plants increased by around 1%, while emissions from agriculture increased by more than 4%, figures that naturally affected the overall emissions data.

Between 2008 and 2009, $PM_{2.5}$ emissions dropped by 11.5%, exceeding the 9.0% fall recorded between 2007 and 2008. Meanwhile, PM_{10} emissions dropped by 10.6% between 2008 and 2009, slightly less than the figure registered for 2007–2008 (11.2%). The last two years analysed witnessed the greatest drop recorded in the period under study, which had been characterised until then by slight isolated rises and falls in emissions of particulate matter.

BREAKDOWN OF PARTICULATE MATTER EMISSIONS BY SECTOR. 2009



Source: MARM

This downward trend is in line with the overall picture in Europe, where emissions of primary particulate matter (PM_{10}) fell by 21% overall between 1990 and 2008 across the EEA-32.

The most significant emissions reductions occurred in Estonia (-58%), the United Kingdom (-53%) and the Netherlands (-51%).

NOTES

- This indicator covers emissions of suspended primary particulate matter with an aerodynamic diameter less than or equal to 10 and 2.5 μm (PM_{10} and $PM_{2.5}$).
- The EU has not established specific limits for emissions of primary particulate matter, but it did put limits in place in 2010 for their precursors (NO_x, SO_x and NH_3) under the National Emission Ceilings Directive (Directive 2001/81/EC) and the Gothenburg Protocol to the Convention on Long-Range Transboundary Air Pollution (Council Decision 81/462/EEC of 11 June 1981).

SOURCES

- MARM, 2011. *Inventario de Gases de Efecto Invernadero de España. Años 1990–2009*. Directorate-General for Environmental Quality and Assessment.

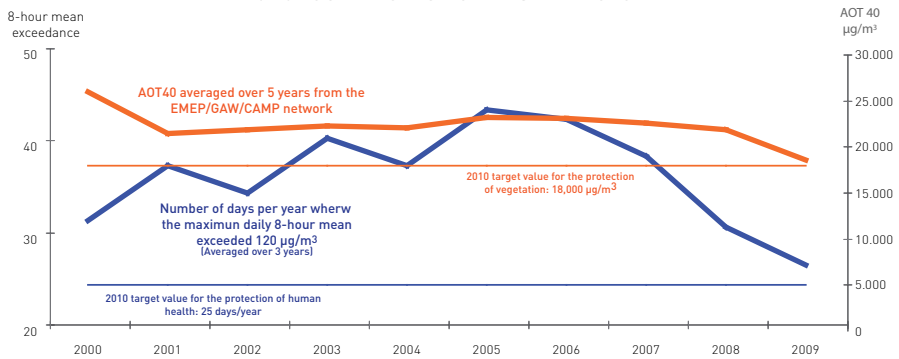
FURTHER INFORMATION

- **http://www.marm.es**
- **http://www.eea.europa.eu/**

Regional background air quality for the protection of health and vegetation

Mean concentration of annual mean background ozone is nearing the target value set for 2010

BACKGROUND POLLUTION IN SPAIN: OZONE



Source: MARM

Ozone pollution still constitutes one of Spain's main problems in terms of background pollution and the indicator shows that in 2009 levels were still above the targets stipulated by legislation. However, it is worth highlighting the drop in both mean values of AOT40 and in daily exceedances of the maximum 8-hour average, a trend that brings levels closer to the target for 2010.

Specifically, in 2009, the EMEP/GAW/CAMP Network recorded an average of 27 annual exceedances of the maximum 8-hour average of 120 µg/m^3, while in 2008 there were 31 exceedances, and in 2007, 39.

Likewise, the mean 5-year running average for AOT40 at rural background stations was 18,545 µg/m^3 in 2009 (21,910 µg/m^3 in 2008). The 2010 target value for the protection of vegetation is 18,000 µg/m^3.

As regards SO_2, NO_2 and PM_{10}, the Network averages of mean concentrations are still lower than the limits established by the legislation for each of these pollutants (since 2002 the SO_2 limit value for the protection of ecosystems has been 20 µg/m^3

(calendar year and winter); since 2002 the NO_x annual limit value for the protection of vegetation has been 30 µg/m^3; and since 2005 the PM_{10} annual limit value for the protection of health has been 40 µg/m^3). The trend for all these mean values is downward. Likewise, the highest mean values do not exceed the limit values either and therefore (excluding possible critical and/or extreme situations and circumstances) background pollution does not present a significant hazard.

NOTES

- The indicator assesses general background pollution in Spain. This is presented for each pollutant and year as the mean of the mean concentrations recorded at all of the stations on the EMEP/GAW/CAMP network, which supplies comprehensive data on background air pollution in Spain.
- AOT40 stands for Accumulation Over Threshold. This index is defined as the sum of the differences between hourly concentrations above 80 µg/m^3 (=40 parts per billion, or ppb) and 80 µg/m^3 over a given period (which, in the case of the protection of vegetation, is that comprising the months of May, June and July), using only 1-hour values measured between 8.00 and 20.00 each day, Central European Time (Royal Decree 1796/2003, which transposes Directive 2002/3/EC into Spanish law; both replaced by Royal Decree 102/2011 and Directive 2008/50/EC).
- In order to obtain the AOT40 figure from the 1-hour ozone concentrations at each of the stations covered, figures are taken for those years in which 90% or more of the available data are valid, corrected to standardise all at 100% of possible data. Averages are calculated over five years (running averages) or, in the absence of a complete consecutive series of annual AOT40 figures, a minimum 3-year average is used (Annex I of Royal Decree 1796/2003, which transposes Directive 2002/3/EC into Spanish law; both replaced by Royal Decree 102/2011 and Directive 2008/50/EC).
- The EMEP, established under the framework of the Geneva Convention, measures background air pollution. The Global Atmospheric Watch (GAW) is a project implemented by the World Meteorological Organization (WMO). The Comprehensive Atmospheric Monitoring Programme (CAMP) is fruit of the OSPAR Convention and is designed to identify the atmospheric inputs in the North-East Atlantic region and examine their impact on the marine environment. The EMEP/GAW/CAMP network, which seeks to meet the aims of the aforementioned programmes, monitors tropospheric levels of background air pollution and sedimentation on the Earth's surface in order to protect the environment.
- With the entry into force of the new Air Quality Directive (Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008), on ambient air quality and cleaner air for Europe, transposed by Royal Decree 102/2011, of 28 January, on improving air quality, current limit values for the protection of ecosystems against SO_2 and of vegetation against NO_x are now known as "critical levels for the protection of vegetation".
- Winter is considered the period running from October last year until March of the year in study. The calendar year goes from January the first until December 31st.

SOURCES

- MARM, 2011. Air Quality Database. Directorate-General for Environmental Quality and Assessment. MARM

FURTHER INFORMATION

- http://www.marm.es
- http://www.aemet.es/
- http://www.eea.europa.eu/