AIR POLLUTION

Definition

The indicator tracks the trends in anthropogenic emissions of acidifying substances, i.e. acidifying processes in the air. These substances include nitrogen oxides, ammonia, and sulphur dioxide, and their acidifying power is weighted by their acidifying potential.

The indicator also provides information on emissions by sectors: energy generation and transformation, road and other transport, industry (processes and energy), fugitive emissions, waste, agriculture and other.

Units

- kt (acidifying equivalent)

Policy relevance of the indicator

List of relevant policy documents

Action Plan for European Partnership, National Plan for approximation of the national legislation with European regulations specifying bylaws that need to be prepared has been adopted.

The National Environmental Action Plan (NEAP II) has been adopted. It contains the measures that need to be taken to improve the overall status of air quality, including the reduction of emissions of acidifying substances. The National Plan for Ambient Air Protection for the period 2012 to 2017, the National Programme for gradual air emissions reduction by 2020 aimed at air quality improvement in certain local self-government units (LSGUs) with action plans (pilot: City of Skopje) have been developed and capacity has been built in technical vehicles control at registration, annual technical inspections and control on roads.

All 8 Protocols to the Convention on Long-Range Transboundary Air Pollution (CLRTAP) have been ratified. With regard to the last three Protocols, on heavy metals, on POPs and Gothenburg Protocol, National Action Plan for Ratification and Implementation has been developed.

Inventory of Air Pollution by CORINAIR Methodology and reporting to UNECE and CLRTAP takes place on regular annual basis.

National Plan for POPs Emissions Abatement has been prepared.

Legal grounds

The Law on Ambient Air Quality establishes the legal grounds for adoption of a number of bylaws. Since its adoption in 2004, it has undergone several amendments. The following bylaws have been adopted so far: Decree on limit values of polluting substances in ambient air, Rulebook on criteria, methods and procedures for ambient air quality assessment, Rulebook on the methodology for inventory and determination of the levels of polluting substances emission in the atmosphere, Rulebook on the preparation of National Plan for Ambient Air Protection, Programme for Air Pollution Reduction and Quality Improvement and Action Plan for Air Protection, Rulebook on the quantities of pollutants emission ceilings, Rulebook on the limit values of permissible levels of emission and types of polluting substances, Rulebook on the methodology of ambient air quality monitoring, Rulebook on air quality information delivery, Rulebook on the manner, the form and the content of air cadastre management, Rulebook on the format and the content of forms for keeping the log of emission measurements, Decree determining the combustion plants required to undertake measures for ambient air protection against pollution.

Laws on ratification of the 8 Protocols to the Convention on Long-Range Transboundary Air Pollution have been adopted.

By means of endorsement method, 72 ISO and CEN standards in the area of air emissions and quality have been adopted.

Other legislation related to the regulation of air quality and air emissions includes the Law on Road Transport Safety, Law on Standardization, Rulebook on liquid fuels quality with national standards for liquid fuels quality, etc. The Law on Ambient Air Quality establishes the legal grounds for technical inspection at registration of non-road mobile sources of pollution to include compulsory regular control of the compliance with legal standards for emission level.

Key policy issue

What progress has been made in reducing acidifying substances emissions in the air?

Which different sectors and processes contribute to acidifying substances emissions?

Key message

In 2005, in the frames of the CORINAIR Programme, the Inventory of Air Emissions was established in the country, presenting emissions by individual sectors or activities, and in 2008 and 2010, respectively, updating was made for all SNAP sectors. Assessment was made for the period 2002 to 2010, which means that the trend presented has some uncertainty deriving from the use of emission factors contained in the Guidelines of the CORINAIR Methodology.

Sectors based on the CORINAIR Methodology and SNAP – selective nomenclature are given in the table below:

SNAP	
1	Combustion in energy and transformation industries (stationary sources)
2	Non-industrial combustion plants (stationary sources)
3	Combustion in manufacturing industry (stationary sources)
4	Production processes (stationary sources)
5	Extraction and distribution of fossil fuels and geothermal energy
6	Solvent and other product use
7	Road transport
8	Other mobile sources and machinery
9	Waste treatment and disposal
10	Agriculture
11	Nature

In the period 2002 to 2010, a varying trend in the emissions of certain acidifying substances was observed in the Republic of Macedonia, especially for SO_2 (decrease by around 18%) by 2010. The varying trend in the amounts of emissions in the air during this period was due mainly to the decreased number or/and closed production processes in metallurgy which used to be sources of pollution, considering the fact that the country was undergoing a period of development. With regard to nitrogen oxide emissions, however, there was almost no significant variations in the amounts and they remained at almost the same level between 2002 and 2010.

Electricity production remains the main source of pollution with SO2, mainly as a result of the poor quality (low calorific value) of fuels with high content of sulphur. These processes, together with the transport, are also the main sources of NOx emissions. Data on NH3 is rather limited and incomplete and thus it does not provide a clear picture of ammonia share and impact in the process of acidification.

So far, at country level, two key documents have been adopted, namely National Plan for Ambient Air Protection from 2012 to 2017 and National Programme for Emission Phasing-out by 2020. The implementation of these two documents should play significant role in the reduction of emissions of polluting substances with acidifying effect.

There are ongoing activities towards implementation of the system of integrated pollution prevention and control in accordance with the Law on Environment and Directive 2008/1/EC. Accordingly, the business facilities required to obtain A and B integrated permits, respectively, have been defined to specify the conditions for air pollution control and limit of their air emissions. So far, 28 A adjustment permits with adjustment plan have been issued. By introduction of this system, both emissions into and quality of the air are controlled, as is the possibility for reduction of acidifying substances emission into the air.

Figure 1. Total emission of acidifying substances

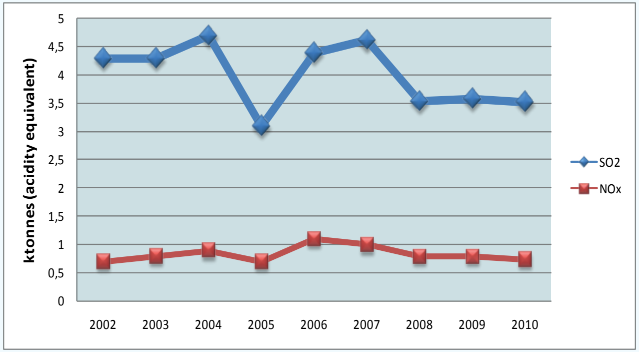


Figure 2. Total emission of SO_2 causing acidification by sector under SNAP – selective nomenclature

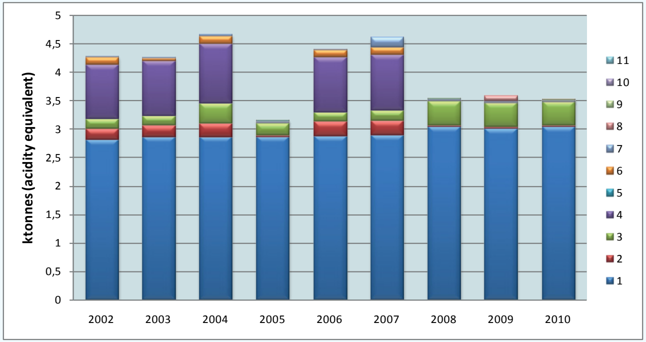
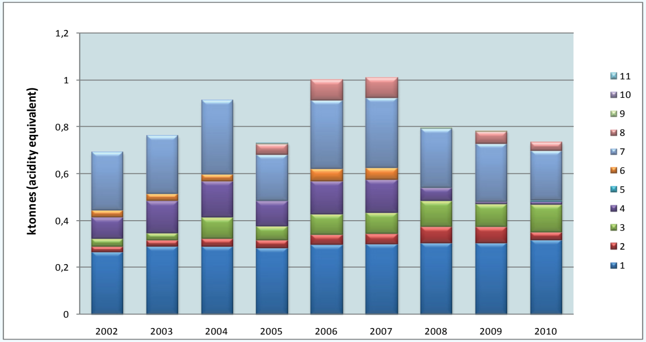


Figure 3. Total emission of NOx causing acidification by sector under SNAP – selective nomenclature



Assessment

In order to identify the amounts of air emissions of the main polluting substances, the Cadastre of Air Polluters and Pollutants in the Republic of Macedonia was developed and updated.

The Cadastre identified the polluting substances at the level of facility, however, in an observation of the requirements of the relevant international agreements, such as UNECE/CLRTAP. In order to obtain compatible and comparable data on the given polluting substances, regular inventory is carried out by application of the CORINAIR Methodology and SNAP nomenclature.

SO_2 emissions by sectors

By application of the CORINAIR methodology, inventory of SO_2 emissions was made for the period 2002 - 2010.

Variation in the trend of amounts of air pollutants in the air in this period may be attributed mainly to the decreased number and/or closed industrial processes in metallurgy, which used to be sources of pollution, given the fact that the country has been going through a period of development.

Namely, this shows that in absence of introduced specific measures and programmes for reduction of polluting substances, we cannot achieve continuous falling trend in the amounts of emission at annual level and for certain longer period.

Electricity production is the main source of this type of emissions. Namely, in 2010, around 86 % of sulphur dioxide emissions originated from electricity production and use of poor quality and low calorific value lignite.

Major proportion of these emissions is located in the southwestern part of the country, where the biggest thermal power plant for electricity production is located. The quality of both solid and liquid fuels is low (with high content of sulphur).

For the near future, activities and measures have been envisaged both on local and central levels, within the frames of the implementation of the National Plan for air quality protection

2012- 2017, and National Programme for emissions phasing-out by 2020

NOx emissions by sectors

Inventory of NOx emissions was made for the period 2002 - 2010.

This indicates that the main sources of NOx emission in the country include electricity production (41.8%), again owing to the poor quality of fuel, transport (32.6%) and other industrial production processes contributing more than 21.2% to the estimated emission.

Targets

Does any of the national documents set targets or targets set under international documents should be achieved?

National documents listed as references in the above text provide guidelines and specify actions that should be undertaken as a matter of priority. It is important to mention that the transposition of Directives 96/61/EC, 2000/81/EC, 2000/76/EC, 99/13/EC and 2001/81/EC into the national legislation, by way of development of laws and bylaws is in the final stage, while activities towards their implementation are in progress.

In accordance with the requirements of the UNECE Convention on Long-Range Transboundary Air Pollution, inventory based on the CORINAIR Programme has been introduced, setting the target of regular inventory of pollutants in tonnes per year.

Also, in accordance with Directive 2001/81/EC, as well as Gothenburg Protocol, the ceilings of the amounts of emissions have been set at the level of the Republic of Macedonia, that shall not be exceeded by 2020, while by 2020 the emissions should be reduced to 1990 level. At this moment, these have been delivered for verification to the Executive Body of the Convention on Long-Range Transboundary Air Pollution.

Inventory of pollutants by main sectors of relevance for effects caused by climate change is also performed in accordance with the United Nations Framework Convention on Climate Change (UNFCCC).

In order to achieve the targets for reduction of acidifying substances emission, causing also degradation of environment and materials, as well as negative effects on human health, it is necessary to adopt all documents planned under the National Programme for Approximation with the Acquis.

Methodology

- Methodological and data uncertainty

The methodology for this indicator calculation is based on aggregation and calculation of data on SO_2, NH_3 and NOx emissions at annual basis, on national level, as overall and distributed to sectors, i.e. activities. Calculations are in line with the Guidelines of UNECE/EMEP Convention on Long-Range Transboundary Air Pollution, and CORINAIR methodology for inventory and application of the SNAP – selective nomenclature of air pollution. With regard to this specific indicator, factors have been used in order to express the acidifying property potential. These factors are specific to each pollutant, namely NOx 0.02174, SO_2 0.03125 and NH_3 0.05882. The results are expressed in kilotonnes equivalent acidity

Uncertainty

- Methodological and data uncertainty

Use of factors of the acidifying property potential leads to some uncertainty. It has been assumed that the factors are representative for Europe as a whole; different factors may be estimated at local level. Comprehensive discussion on uncertainty of these factors can be found in de Leeuw (2002).

EEA uses data delivered officially by EU Member States and other EEA member countries that follow common guidelines for data emission calculation and reporting (EMEP/EEA 2001) concerning the following air pollutants: NOx, SO_2 and NH_3.

■ Reference of used methodology

EEA/ETC-ACC Technical Report outlining the methodologies for gap filling. EEA/ETC-ACC CLRTAP and information on GHG air emissions (CRF).

Data specification

Title of the indicator	Source	Reporting obligation
Emissions of acidifying substances	– State Statistical Office, Energy balance of the country – Report by the Government; – Cadastre of Air Polluters and Pollutants; – Data from measurements in companies – major polluters: – Database on motor vehicles of the Ministry of Interior; – Project: Introduction of CORINAIR Inventory Methodology of the Ministry of Environment and Physical Planning, – Spatial Plan of the Republic of Macedonia.	– Reporting obligations under multilateral agreements –UNECE/ CLRTAP and EEA – Annual report of processed data on air emissions

Data coverage:

Table 1: Total emission of acidifying substances

Substances (Кtonnes)	2002	2003	2004	2005	2006	2007	2008	2009	2010
SO_2	4.3	4.3	4.7	3.1	4.4	4.62	3.54	3.59	3.53
NO_x	0.7	0.8	0.9	0.7	1.1	1	0.796	0.793	0.74

Table 2: Total emission of SO2 by sectors presented relative to acidification coefficients

SNAP		2002	2003	2004	2005	2006	2007	2008	2009	2010
1	Combustion in energy and transformation industries (stationary sources)	2,8211	2,8714	2,8714	2,8707	2,8811	2,9	3,04	3,017	3,04
2	Non-industrial combustion plants (stationary sources)	0,1968	0,1968	0,232	0,0332	0,2588	0,25	0,034	0,034	0,034
3	Combustion in manu-facturing industry (stationary sources)	0,1688	0,1688	0,3656	0,2016	0,1688	0,18	0,424	0,424	0,42
4	Production processes (stationary sources)	0,9581	0,965	1,0369	0,0111	0,9581	0,98	0,007	0,0006	0,007
5	Extraction and distri-bution of fossil fuels and geothermal energy									
6	Solvent and other product use	0,1244	0,0444	0,1383		0,1244	0,132			
7	Road transport	0,0161	0,0161	0,0308	0,0242	0,0161	0,18	0,032	0,0244	0,0244
8	Other mobile sources and machinery				0,0078				0,09	0,0065
9	Waste treatment and disposal				0,0001			0,00021		0,000125
10	Agriculture									
11	Nature				0,0012					
total		4,2852	4,3429	4,675	3,1499	4,4	4,622	3,54	3,59	3,53

Table 3: Total emission of NOx by sectors presented relative to acidification coefficients

SNAP		2002	2003	2004	2005	2006	2007	2008	2009	2010
1	Combustion in energy and transformation industries (stationary sources)	0,2667	0,2923	0,2923	0,2848	0,2967	0,3	0,304	0,304	0,317
2	Non-industrial combustion plants (stationary sources)	0,0246	0,0246	0,0333	0,0326	0,0446	0,045	0,07	0,07	0,033
3	Combustion in manu-facturing industry (stationary sources)	0,0328	0,0328	0,0885	0,0596	0,0885	0,09	0,11	0,098	0,12
4	Production processes (stationary sources)	0,0906	0,1352	0,1541	0,1072	0,1411	0,14	0,06	0,01	0,013
5	Extraction and distri-bution of fossil fuels and geothermal energy									0,0075
6	Solvent and other product use	0,0309	0,0309	0,0309		0,0512	0,05			
7	Road transport	0,2475	0,2467	0,3167	0,2	0,2914	0,3	0,25	0,25	0,211
8	Other mobile sources and machinery				0,045	0,0871	0,087		0,051	0,036
9	Waste treatment and disposal				0,0005			0,002	0,00065	
10	Agriculture									
11	Nature				0,0037					
total		0,6922	0,7619	0,9157	0,7334	1,0006	1,012	0,796	0,793	0,74

General metadata

Code	Title of the indicator	Compliance with CSI EEA or other indicators		Classification by DPSIR	Type	Linkage with area	Frequency of publication
MK NI 001	Emissions of acidifying substances	CSI 001	Emissions of acidifying substances	P	B	- acidification - air	annually

EMISSIONS OF OZONE PRECURSORS

Definition

This indicator tracks trends in emissions of ozone precursors: nitrogen oxides, carbon monoxide, methane and non-methane volatile organic compounds, caused by anthropogenic activities, and each weighted by their tropospheric ozone-forming potential.

The indicator also provides information on emissions by sectors: energy industries; road and other transport; industry (processes and energy); other (energy); fugitive emissions; waste; agriculture and other (non energy.

Units

- kt (NMVOC - equivalent)

Policy relevance of the indicator

The European Partnership Action Plan has been adopted, the National plan for approximation of the national legislation with the European regulations stating the bylaws that need to be prepared.

NEAP II has been prepared, specifying the measures that need to be taken to improve the overall status of air and in that sense to reduce emissions leading to acidification. The National Ambient Air Protection Plan 2012-2017 has been adopted, the National program for gradual reduction of emissions until 2020 in order to improve the quality of certain LSG and action plans (pilot City of Skopje), Building capacities for technical control of vehicles, during registration, annual technical control and road checks.

All 8 protocols of the Convention for Long-range Trans boundary Air Pollution – CLRTAP have been adopted. A National Action Plan for Ratification and Implementation has been adopted for the last three Protocols for heavy metals, POPs and the Gutenberg Protocol.

Regularly prepares the annual inventory of the air pollution according to the CORINAIR methodology and the reports toward the UNECE and CLRTAP Convention.

The National plan for implementing reduction of POPs emissions has been prepared.

Legal grounds

The Law on Ambient Air Quality establishes the legal grounds for adoption of a number of bylaws. Since it was adopted in 2004 it has suffered many amendments and changes. So far have been adopted: Decree on the limit values of levels of polluting substances in ambient air, Rulebook on criteria, methods and procedures for ambient air quality assessment, Rulebook on the methodology for inventory and determination of the levels of polluting substances in the atmosphere, the Rulebook for the preparation of the National Ambient Air Protection Plan, the Programme for pollution reduction and air quality improvement and the action plan for air protection, the Rulebook of the quantities and upper limits – ceilings of emissions of polluting substances, the Rulebook on limit values and permitted levels of emissions and types of polluting substances, the Rulebook on the methodology for ambient air quality monitoring, Rulebook on air quality information transfer, the Rulebook on the manner, the form and content for keeping the air cadaster, the Rulebook on the form and content of the forms for keeping the emission measurement diary, the Decree for determining the combustion capacities that need to undertake measures for ambient air pollution protection. By means of endorsement method, 72 ISO and CEN standards in the area of air emissions and quality have been adopted.

Other legislation related to the regulation of air quality and air emissions includes the Law on Road Transport Safety, Law on Standardization, Rulebook on liquid fuels quality with national standards for liquid fuels quality, etc. The Law on Ambient Air Quality establishes the legal grounds to include compulsory examination of the compliance with the legal standards for the level of emission during the technical examination in the process of registration of non-road mobile sources of pollution.

Key policy issue

What progress has been made in ozone precursors emissions reduction in Europe?

At present, activities are carried out in relation to the implementation of the system of Integrated Pollution Prevention and Control based on the Law on Environment and in accordance with Directive 96/61/EC. In this context, Decree and Rulebook for their implementation have been prepared. These acts define the business entities, i.e. production facilities obliged to acquire A and B integrated environmental permits, which specify the conditions for air pollution control and the limit values of emissions they will be allowed to release in the air. The introduction of this system will enable control of air emissions, thus providing possibility to reduce the emissions of pollutants identified as ozone precursors. 22 IPPC and 23 B integrated permits have been issued by December 2012.

Specific policy issue

Which different sectors and processes contribute to ozone precursors emissions?

Key message

In 2005, in the frames of the CORINAIR Programme, the Inventory of Air Emissions was established in the country, presenting emissions by individual sectors, i.e. activities, and assessment was made for the period 2002-2005. Application of this manner of data processing, especially due to the lack of data in real time, the trend presented cannot be determined precisely.

Sectors based on the above stated Methodology and SNAP – selective nomenclature are given in the table below:

SNAP	
1	Combustion in energy and transformation industries (stationary sources)
2	Non-industrial combustion plants (stationary sources)
3	Combustion in manufacturing industry (stationary sources)
4	Production processes (stationary sources)
5	Extraction and distribution of fossil fuels and geothermal energy
6	Solvent and other product use
7	Road transport
8	Other mobile sources and machinery
9	Waste treatment and disposal
10	Agriculture
11	Nature

In the period 2002 – 2010, a rising trend has been tracked in the emissions of ozone precursors in the Republic of Macedonia until 2006, and a slight reduction in nitrogen oxides, while in CO-carbon monoxide the reduction is more drastic. The NMVOC trend is constant in all three years with data (almost the same values of the NVOC equivalent). More significant NMVOC – equivalent expressed in kilotons has been marked in electricity production – sector 1, road traffic – sector 7, as well as sector 11 – nature, as main sources of emissions of ozone precursors.

At this moment, the only program for emission reduction is the National Program for Gradual Reduction of Emissions until 2020, where measures for gradual reduction of polluting substances in the atmosphere have been specified, at any level of the country.

The diagram below shows the annual trend in the emissions of CO (carbon monoxide) and nitrogen oxides presented as ozone precursors.

Figure 1. Trend of emissions of ozone precursors

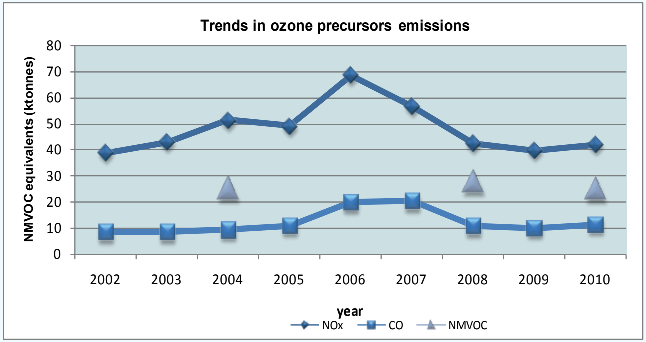


Figure 2. Total emissions of ozone precursors

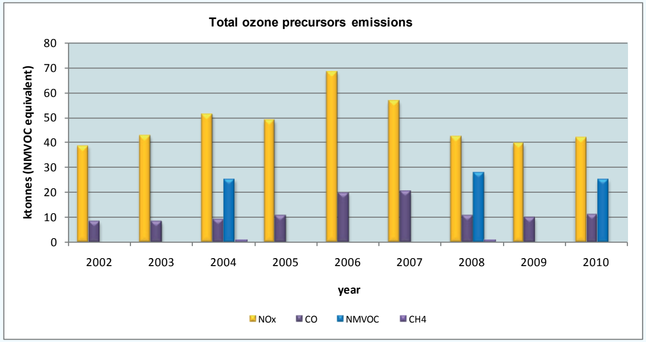


Figure 3. Total NOx emissions by sectors/year

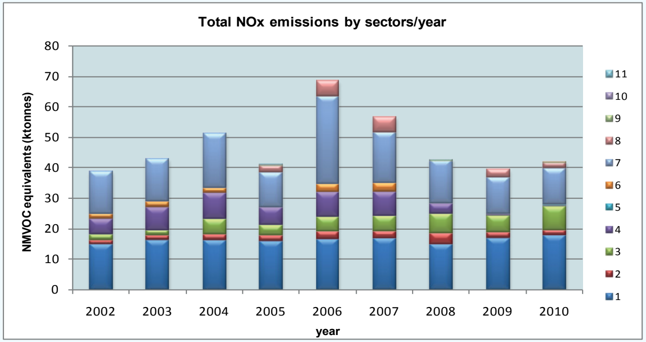


Figure 5. Total NMVC emissions by sectors/year

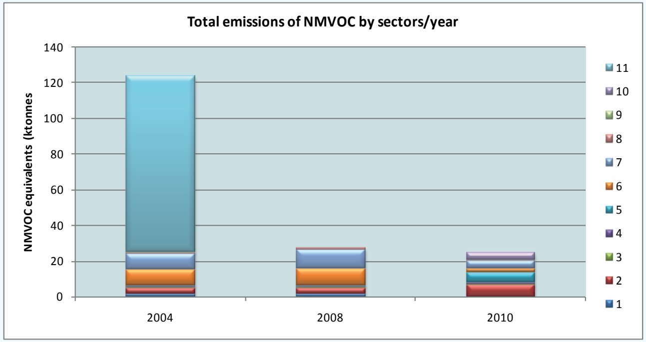


Figure 4. Total CO emissions by sectors/year

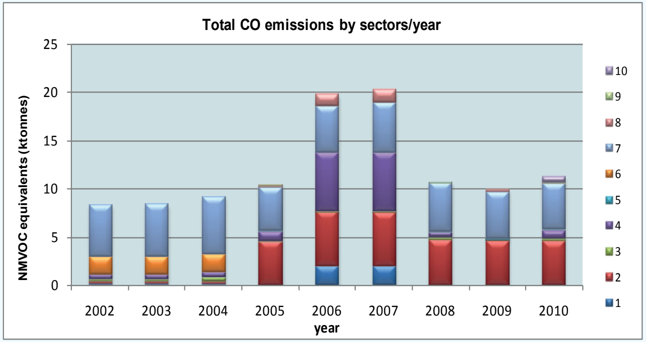
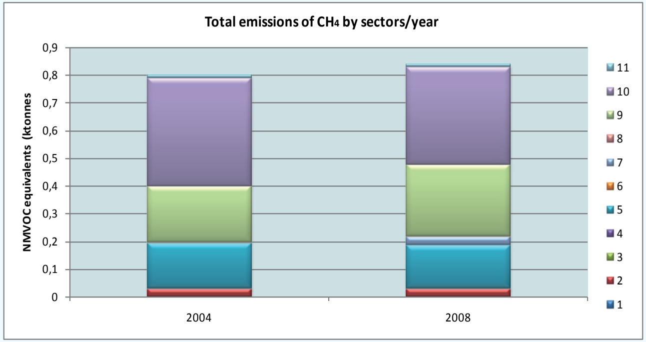


Figure 6. Total CH4 emissions by sectors/year



Assessment

For the purpose of identifying the amounts of air emissions of the main polluting substances, the Cadaster of Air Polluters and Pollutants in the Republic of Macedonia was developed in updated. The latest data update was performed in 2008-2009.

The cadaster identified the main polluting substances at the level of facilities, however in an observation of the requirements of the relevant international agreements, such as UNECE, and in order to obtain comparable and comparable data for the polluting substances, an inventory according to the CORINAIR and SNAP methodology was prepared from 2004 until 2010.

Total emission of ozone precursors

Series of emissions of ozone precursors were assessed for the period 2002 - 2010.

Extensive annual time series exist for the total emissions of ozone precursors on annual level. It can be concluded that, for the analyzed years from 2002 until 2012, NO_X and CO have rising trend until 2006 and declining from then until 2010. Quantities for NMVOC are presented for 2004, 2008 and 2010, and for CH_4 could be presented for 2004 and 2008 only. Namely, these two pollutants were covered in the inventory of the CORINAIR methodology. Most of the quantities of NMVOC and CH_4 emissions derive from the sectors: nature, road traffic and use of solvents and other product by SNAP.

Emissions of NOx as ozone precursor by sectors

Series of NOx emissions were assessed for the period 2002 - 2010.

Through application of the CORINAIR methodology in the inventory of nitrogen oxides emission, it was found out that the main sources of NOx in the country include electricity production, again due to the poor quality of fuel, transport and other industrial production processes.

Emissions of CO as ozone precursor by sectors

Series of CO emissions were assessed for the period 2002 - 2010.

Emissions of CO as ozone precursor show mild increase in the total quantity in the given years and in relation

SNAP sectors, the prevailing sectors are nonindustrial facilities and road transport

Emissions of NMVOC and CH4 as ozone precursor by sectors

Data for the emissions of NMVOC are provided for 2004, 2008 and 2010, whereas data for CH4 is provided for 2004 and 2008.

The application of the CORINAIR methodology in the inventory of NMVOC and CH4 emissions leads to the conclusion that the main sources of this emission in the country originate from the SNAP 11 sector.

Targets

Does any of the national documents set targets or targets set under international documents should be achieved?

National documents listed as references in the above text provide guidelines and specify actions that should be undertaken as a matter of priority. It is important to mention that the development of new regulations in the area of air emissions is in progress, and they will transpose the following Directives into the national legislation: 96/61/EC, 2000/81/EC, 2000/76/EC, 99/13/EC and 2001/81/EC.

In accordance with the requirements of the UNECE Convention on Long-Range Trans boundary Air Pollution, inventory based on the CORINAIR Programme has been introduced, setting the target of regular inventory of pollutants in tons per year.

Inventory of pollutants by main sectors of relevance for developments caused by climate change is also performed in accordance with the United Nations Framework Convention on Climate Change (UNFCCC).

The above documents provide basis for achievement of the targets for reduction of ozone precursors emission, causing degradation of environment and materials, as well as negative effects on human health.

Methodology

- Methodology for the indicator calculation

The methodology for this indicator calculation is based on aggregation and calculation of data on CO, NMVOC, CH_4 and NOx emissions at annual basis, on national level, as overall and distributed to sectors, i.e. activities.

Calculations are in line with the Guidelines of UNECE/EMEP Convention on Long-Range Transboundary Air Pollution, and CORINAIR methodology for inventory and application of the SNAP – selective nomenclature of air pollution.

With regard to this specific indicator, factors have been used in order to express the property of ozone precursors. These factors are specific to each pollutant, namely for NOx it is 1.22, for NMVOC it is 1, for CO it is 0.11 and for CH_4 this value is 0.014. The results are expressed in kilotons NMVOC equivalent.

- Reference of used methodology

Methodology applied in the calculation and presentation of this indicator has been taken from the Guidelines under CLRTAP and de Leeuw, F. (2002), Set of emission indicators of long-range transboundary air pollution, Environmental science and policy.

Data specification

Title of the indicator	Source	Reporting obligation
Emissions of ozone precursors	– State Statistical Office, Energy balance of the country-Report by the Government; – Cadaster of Air polluters and Pollutants; Data from measurements in companies – major polluters: – Database on motor vehicles of the Ministry of Interior; – Project: Introduction of CORINAIR Inventory Methodology of the Ministry of Environment and Physical Planning, – Spatial Plan of the Republic of Macedonia.	– Reporting obligations under multilateral agreements – UNECE transboundary air pollution transfer, as well as to EEA – Annual report of processed data on air emissions

Data coverage:

Table 1: Total emissions of ozone precursors

	2002	2003	2004	2005	2006	2007	2008	2009	2010
NOx	38,8	42,8	51,4	49,1	68,517	56,63	42,55	39,61	42,02
CO	8,4	8,4	9,2	10,9	19,768	20,28	10,72	9,921	11,25
NMVOC			25,22				27,822		25,07
CH_4			0,8				0,839		

Table 2: Total emission of NOx by sectors

SNAP		2002	2003	2004	2005	2006	2007	2008	2009	2010
1	Combustion in energy and transformation industries (stationary sources)	14,965	16,405	16,405	15,981	16,65	16,850	14,910	17,02	17,78
2	Non-industrial combustion plants (stationary sources)	1,379	1,379	1,867	1,831	2,501	2,510	3,780	1,83	1,83
3	Combustion in manufacturing industry (stationary sources)	1,842	1,842	4,965	3,347	4,965	5,050	6,300	5,44	7,78
4	Production processes (stationary sources)	5,084	7,590	8,647	6,018	7,917	7,860	3,310	0,59	0,32
5	Extraction and distribution of fossil fuels and geothermal energy									0,422
6	Solvent and other product use	1,732	1,732	1,732		2,873	2,820			
7	Road transport	13,888	13,845	17,773	11,224	28,731	16,650	14,150	11,85	11,84
8	Other mobile sources and machinery				2,524	4,88	4,890		2,88	2,01
9	Waste treatment and disposal				0,025			0,100		0,037
10	Agriculture									
11	Nature				0,205					
Total		**38,847**	**42,756**	**51,387**	**41,158**	**68,52**	**56,630**	**42,550**	**39,61**	**42,019**

Table 3: Total annual CO emissions by sector

SNAP		2002	2003	2004	2005	2006	2007	2008	2009	2010
1	Combustion in energy and transformation industries (stationary sources)	0,181	0,181	0,181	0,042	2,037	1,99	0,045	0,05	0,051
2	Non-industrial combustion plants (stationary sources)	0,203	0,203	0,241	4,559	5,621	5,62	4,701	4,56	4,6
3	Combustion in manufacturing industry (stationary sources)	0,214	0,214	0,428	0,061	0,054	0,05	0,265	0,21	0,233
4	Production processes (stationary sources)	0,520	0,579	0,601	0,990	6,062	6,06	0,591	0,021	0,86
5	Extraction and distribution of fossil fuels and geothermal energy				0,061			0,001	0,06	0,061
6	Solvent and other product use	1,825	1,825	1,825						
7	Road transport	5,424	5,424	5,963	4,502	4,759	5,23	5,110	4,77	4,78
8	Other mobile sources and machinery				0,223	1,235	1,33		0,25	0,064
9	Waste treatment and disposal				0,001			0,006		0,001
10	Agriculture									0,6
11	Nature				0,533					
Total		**8,366**	**8,426**	**9,238**	**10,971**	**19,768**	**20,28**	**10,718**	**9,921**	**11,25**

Table 4: Total annual NMVOC and CH_4 emissions by sectors

		2004		2008		2010
SNAP		NMVOC	CH_4	NMVOC	CH_4	NMVOC
1	Combustion in energy and transformation industries (stationary sources)	1,6901	0,0007	1,762	0,00066	0,1
2	Non-industrial combustion plants (stationary sources)	3,5088	0,0306	3,506	0,0305	7,1
3	Combustion in manufacturing industry (stationary sources)	0,2105	0,002	0,27	0,00255	0,3
4	Production processes (stationary sources)	1,1078	0,0002	0,95	0,000014	1
5	Extraction and distribution of fossil fuels and geothermal energy	0,4249	0,1626	0,424	0,154	5,4
6	Solvent and other product use	8,4847		9,005		2,1
7	Road transport	8,8241	0,0026	10,828	0,031	4,6
8	Other mobile sources and machinery	0,9692	0,0002	1,077	0,00021	0,217
9	Waste treatment and disposal	0,001	0,2023		0,26	
10	Agriculture		0,3877		0,35	4,257
11	Nature		0,0119		0,0101	
total		**25,2211**	**0,8008**	**27,822**	**0,839034**	**25,074**

General meta-data

Code	Title of the indicator	Compliance with CSI EEA or other indicators		Classification by DPSIR	Type	Linkage with area	Frequency of publication
MK NI 002	Емисии на озонски прекурсори	CSI 002	Emissions of ozone precursors	P	A	- air - air quality	annually

EXCEEDANCE OF AIR QUALITY LIMIT VALUES IN URBAN AREAS

Definition

The indicator shows the portion of urban population potentially exposed at ambient air concentrations of pollutants in excess of the limit value set for human health protection.

Urban population taken into account is actually the total number of inhabitants living in cities with at least one monitoring station. These cities include the capital and other major cities of the Republic of Macedonia. The number of inhabitants is based on the last census carried out by the State Statistical Office in 2002.

Exceedance of air quality limit values occurs when the concentration of air pollutants exceeds the limit values for SO_2, PM10, NO_2 and the target values for O_3 as specified in the Decree on the limit values of levels and types of polluting substances in ambient air and on the alert thresholds, deadlines for the limit values achievement, margins of limit value tolerance, target values and long-term ozone targets (Official Gazette of the Republic of Macedonia No. 50/05, 4/2013), wherein the requirements of the Directive on Ambient Air Quality and Cleaner Air in Europe 2008/50 EC and Heavy Metals Directive 2004/107/EC have been transposed. Where there are multiple limit values (see section on Policy Targets), the indicator uses the most stringent case:

- Sulphur dioxide (SO_2): the daily limit value
- Nitrogen dioxide (NO_2): the annual limit value
- Particulate matter of a size up to 10 micrometer (PM10): the daily mean limit value
- Ozone (O_3): the short term objective

Units

The percentage of urban population potentially exposed at ambient air concentrations of sulphur dioxide (SO_2), particulate matter sized up to 10 micrometer (PM10), nitrogen dioxide (NO_2) and ozone (O_3) above limit values set for human health protection. Ambient air concentrations of sulphur dioxide (SO_2), particulate matter sized up to 10 micrometer (PM10), nitrogen dioxide (NO_2) and ozone (O_3) are expressed in microgram/m^3(µg/m^3).

Policy relevance of the indicator

List of relevant policy documents

The National Plan for Air Protection presents the state of air quality, defines the measures for ambient air quality protection and improvement in the Republic of Macedonia and all relevant institutions responsible for their implementation within 5 year period, namely from 2013 50 2018.

Legal grounds

The Law on Ambient Air Quality was adopted in August 2004 and later amended on several occasions in line with the requirements of the relevant EU legislation (Official Gazette of the Republic of Macedonia Nos. 67/2004, 92/2007, 83/2009, 35/2010, 47/2011 and 59/2012) and it is framework law in the area of air. The main goals of this Law are: avoidance, prevention and reduction of harmful effects on human health and environment as a whole, prevention and reduction of pollution resulting in climate change, as well as provision of the relevant information on the quality of ambient air. This Law establishes the legal grounds for adoption of a number of bylaws in line with the requirements of the relevant AcquisCommunitaire.So far, 12 bylaws have been adopted. Calculations ofor this indicator are based on the provisions of the Decree on the limit values of levels and types of polluting substances in ambient air and on the alert thresholds, deadlines for the limit values achievement, margins of limit value tolerance, target values and long-term ozone targets (Official Gazette of the Republic of Macedonia No. 50/05, 4/2013).*

Targets

The Decree on the limit values of levels and types of polluting substances in ambient air and on the alert thresholds, deadlines for the limit values achievement, margins of limit value tolerance, target values and long-term targets, defines the limit values for SO_2, PM10, NO_2 and target values for O_3.

Limit values for concentrations of sulphur dioxide in ambient air

In accordance with the said Decree, two limit values are specified for sulphur dioxide for the purpose of human health protection.

- Mean daily limit value of 125 µg/m^3 which shall not be exceeded by more than three times during one calendar year
- Hourly limit value of 350 µg/m^3, which shall not be exceeded by more than 24 times during one calendar year.

Limit values for concentrations of nitrogen dioxide in ambient air

In accordance with the said Decree, two limit values are specified for nitrogen dioxide for the purpose of human health protection.

- Hourly mean concentration of nitrogen dioxide shall not exceed the limit value of 200 μg/m^3 by more than 18 times during one calendar year.

- The mean annual concentration shall not exceed 40 μg/m^3.

Limit values for concentrations of suspended particulate matter of size up to 10 micrometers in the ambient air

The said Decree specifies two limit values for suspended particulate matter of size up to 10 micrometers, for the purpose of human health protection.

- 24-hourly limit value is 50 μg/m^3,and it shall not be exceeded by more than 35 times during one calendar year

- The mean annual concentration shall not exceed 40 μg/m^3 .

Target values for ozone concentrations in ambient air

The said Decree, with regard to ozone, specifies target value for the purpose of human health protection and long-term target for the purpose of human health protection.

- The target value for ozone, for the purpose of human health protection, is specified so that 8-hourly mean value is calculated from the hourly concentrations in each day. The maximum daily 8-hourly mean value of ozone shall not exceed the value of 120 μg/m^3 in more than 25 days in the course of the year (calculated as an average value for three years). This target value should be achieved by 2010.

- The Decree also defines long-term target for the purpose of human health protection, set at 120 μg/m^3, as maximum daily 8-hourly mean value during a calendar year.

Key policy issue

What progress has been achieved in reducing the concentrations of pollutants in urban areas in order to achieve the limit values (for SO_2, PM10, NO_2) and target values (for O_3) set in the Decree?

Key message

Suspended particulate matter of size up to 10 micrometers(PM10)

In the period from 2004 to 2011, 100% of the population has been exposed at concentrations of suspended particulate matter in excess of the limit values specified in the Decree. Significantly higher concentrations are measured during winter period.

Nitrogen dioxide (NO_2)

In the period from 2004 to 2011, the portion of the population exposed at concentrations of nitrogen dioxide above the limit values set for human health protection ranged between 0 and 69%. The highest percentage of population exposure of 69% was recorded in 2011.

Ozone(O_3)

In the period from 2004 to 2011, the portion of the population exposed at concentrations of ozone higher than the target value set for human health protection ranged from 12 to 43%. The highest percentage of population exposure of 43% was recorded in 2007, followed by falling trend and the percentage of exposure was 12% in 2011.

Sulphur dioxide(SO_2)

No excess of mean daily concentrations of sulphur dioxide was recorded in the period from 2004 to 2011, i.e. the population was not exposed at sulphur dioxide concentrations above limit value, except in 2006 when out of the allowed 3 days, exceedance of the limit value was recorded in the course of 8 days in Skopje, which was not seen as significant problem.

Diagram 1: Percentage of urban population exposed at air pollution in areas where concentrations of pollutants are in excess of limit/target values

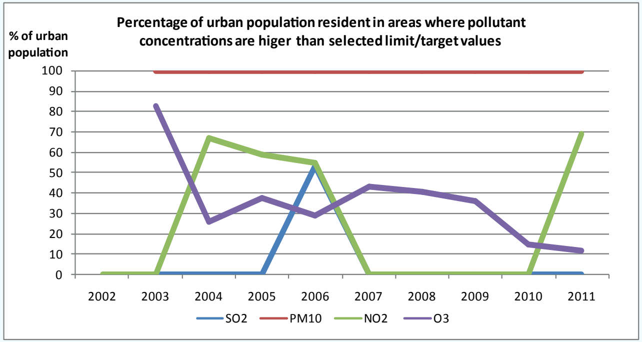


Diagram 2: Percentage of urban population exposed at concentrations of PM10above the daily mean limit value, expressed as number of days in the course of a calendar year

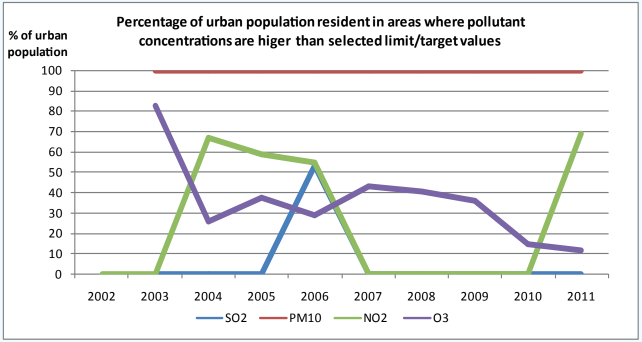


Diagram 4: Percentage of population exposed at NO_2 annual concentrations in urban areas

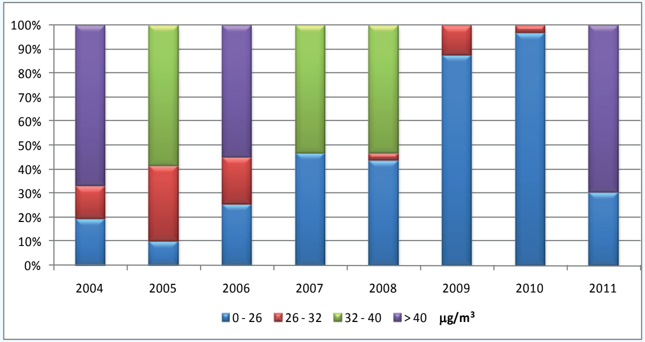


Diagram 3: 36th highest mean daily concentration of PM10

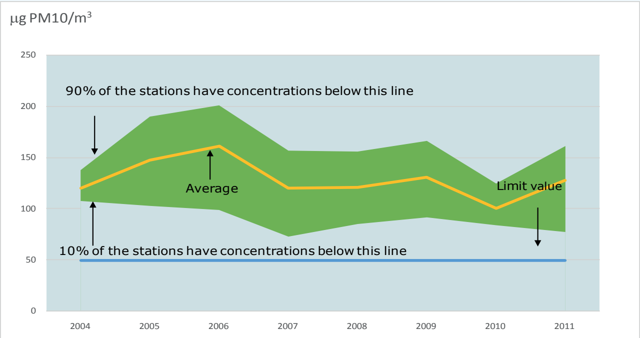


Diagram 5: Average annual concentration of NO_2

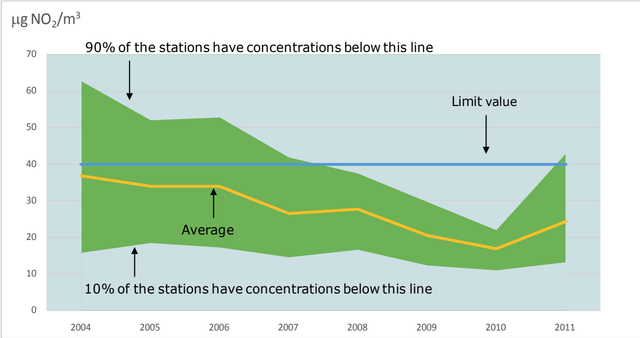


Diagram 6: Percentage of urban population exposed at concentrations of O_3 above the long-term target value for human health protection, expressed as number of days in the course of a calendar year

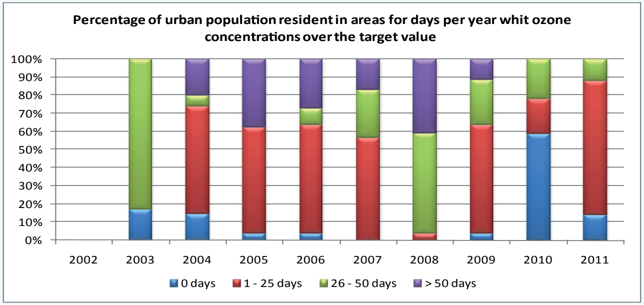


Diagram 7: 26th highest maximum 8-hourly mean concentration of O_3

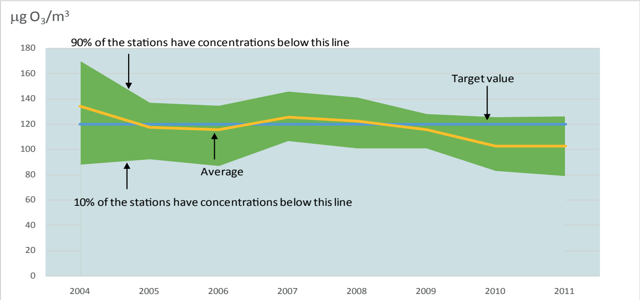


Diagram 8: Percentage of urban population exposed at concentrations of SO_2 above the daily mean limit value expressed as number of days in the course of a calendar year

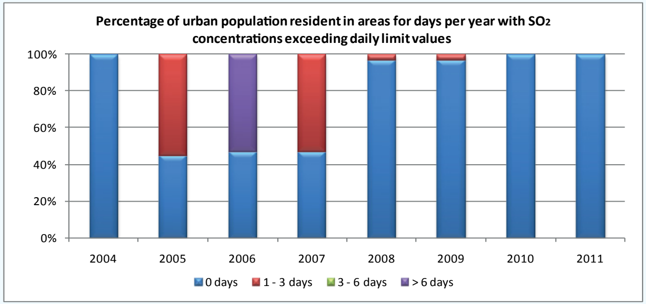
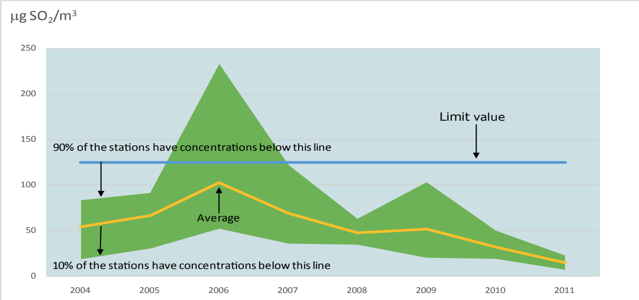


Diagram 9: 4th highest average mean daily concentration of SO_2



Assessment

Suspended particulate matters (PM10)

Suspended particulate matters of size up to 10 micrometers are particles able to pass through an opening conducting selection by size, with 50% loss in efficiency at aerodynamic diameter of size less than ten micrometers (10 µm). These particles of size not exceeding 10 micrometers are the so called fine particles or aerosols. Their retention time in the air is long and they originate from natural and anthropogenic sources. Among natural sources, the more prominent include yellow rains, present also with us, forest fires and chemical reactions going on in nature. Combustion of coal, wood and oil, industrial processes, transport and waste burning are the most significant anthropogenic sources.

Increased concentrations of suspended particulate matters can be recorded in urban areas, especially in autumn-winter seasons, which is most probably due to increased frequency in traffic, fossil fuels combustion and meteorological conditions.

The processed data for the period 2004 to 2011 show that during the entire period, 100% of the urban population was exposed at concentrations of suspended particulate matters are in excess of the limit value (mean daily limit value of 50 µg/m^3that shall not be exceeded in more than 35 days in the course of a calendar year). 100% of the urban population was exposed at concentrations above the limit value in more than 35 days in a calendar year.

Nitrogen dioxide(NO_2)

Investigations have testified the presence of several nitrogen oxides in the air, but the most significant among them are nitrogen dioxide and nitrogen monoxide. These pollutants most often originate from natural sources. However, in urban environments, the main source is the traffic, and industry is minor source. The most toxic of all nitrogen oxides is the nitrogen dioxide, the concentrations of which are dependent on season and meteorological conditions. Namely, concentration of NO is higher in morning hours when the traffic is more frequent, while the intensification of solar radiation during the day leads to transformation of NO into NO_2 resulting in increased concentration of NO_2. Nitrogen oxides influence the content of ozone and other photochemical oxidants in the air. During the spring-summer period, the concentration of NO_2 is higher, while in autumn-winter period, the concentration of NO is higher. The quantity of NOx increases in winter period due to the higher frequency of traffic.

In the period 2004 to 2011, the portion of population exposed at nitrogen dioxide concentrations above the limit value for human health protection (40 µg/m^3 mean annual limit value) ranged from 0 to 69%. The highest percentage of 69% population exposure was recorded in 2011.

In 2004, 2006 and 2011, significant portion of the population (55-67%) of the population was exposed at concentrations above 40 µg/m^3.

Ozone (O_3)

Ozone layer is positioned at height of 10 km to 15 km from Earth and it plays the role of a filter for UV radiation and climate stabilizer.

Automatic monitoring stations measure the ground-level ozone formed as a result of photochemical reactions involving nitrogen oxides, volatile organic compounds (most frequently hydrocarbons), etc. However, its content is also dependent on solar radiation and annual seasons. Thus, higher ozone concentrations are observed in warmer days, especially during summer.

In In the period 2004 to 2011, the portion of population exposed at ozone concentrations above the target value for human health protection ranged from 12 to 43%. The highest percentage of 43% population exposure was recorded in 2007, followed by falling trend to reach 12% in 2011.

In the period 2004 to 2009, population was exposed at concentrations above the target value of 120 µg/m^3 in more than 25 to 50 days in a calendar year during the entire reporting period, except in 2005.

Sulphur dioxide (SO_2)

Sulphur dioxide in the air most frequently originates from major thermal power plants, as well as from small and medium size boilers for coal combustion in urban environments. The main anthropogenic sources include coal and oil combustion. This pollutant is also released in the air from industrial processes (production of cellulose and paper, sulphuric acid, lead and zinc ores smelting).

In the period 2004 to 2011, there have been no concentrations above the daily mean limit value for sulphur dioxide, i.e. population was not exposed at sulphur dioxide concentrations above the limit value, except in 2006 when out of the allowed 3 days, exceedance of the limit value was recorded in the course of 8 days in Skopje, which was not seen as significant problem.

In 2006, 53% of the population was exposed at sulphur dioxide concentration above125 µg/m³ for more than 6 days in the course of the year. In 2005 and 2007, there was higher percentage (around 50%) of the population exposed at sulphur dioxide concentration above 125 µg/m³ for 1 to 3 days in the course of the year, while in 2008 and 2009, this percentage of population exposure was very low (3%).

Methodology

- Methodology for the indicator calculation

Sulphur dioxide - SO_2

For each measuring station located in urban environment, the number of days with mean daily concentration higher than the limit value (daily mean value of 125 µg/m³) is calculated from the available hourly data. Selected urban stations include stations of the following types: stations measuring traffic pollution, stations measuring industrial pollution and so called urban background stations. The number of days with excess in a city is obtained by averaging the results of all stations located in that city.

Suspended particulate matter up to 10 micrometers – PM10

For each urban measuring station, the number of days with daily mean concentration above the limit value (daily mean limit value is 50 µg/m³) is calculated from the available hourly data. Selected urban stations include stations of the following types: stations measuring traffic pollution, stations measuring industrial pollution and so called urban background stations. The number of days with exceedancein a city is obtained by averaging the mean values of the results from all stations located in that city.

Nitrogen dioxide - NO_2

The mean annual concentration in a city is calculatedas an average of the mean annual value measured in all monitoring stations located in urban areas. Selected urban stations include stations of the following types: stations measuring traffic pollution, stations measuring industrial pollution and so called urban background stations.

Ozone – O_3

For each measuring station located in urban environment, the number of days in which the maximum daily 8-hourly mean concentration of ozone is in excess of ozone target value for human health protection - 120 μg/m^3 is calculated. Selected urban stations include stations of the following types: stations measuring traffic pollution, stations measuring industrial pollution and so called urban background stations. The number of days with excess in a city is obtained by averaging the results of all stations located in that city.

Uncertainty

- Methodological uncertainty and data uncertainty

In general, data is not representative for all urban environments in the Republic of Macedonia. Compared to the methodology of the European Environmental Agency, where the calculation of the indicator is based only on data produced by the so called urban background stations, in our calculations we used data from all measuring stations located in urban environments. Also, due to the minimum number of monitoring stations, the calculation of the indicator also took into account the stations where data coverage is below 75% per calendar year. We can also point out as uncertainty in the indicator calculation the fact that the number of inhabitants in cities is based on the census of the population conducted by the State Statistical Office in 2002, instead of estimated number of population for each year.

Data specification

Title of the indicator	Source	Reporting obligation
Exceedance of air quality limit values in urban areas	MEPP	European Environmental Agency – Exchange of data on air quality, based on the Council Decision on the establishment of reciprocal exchange of information and data among all networks and individual ambient air quality measuring stations (97/101/EC). – Exceedance in ozone concentrations during April, May, June, July, August and September, under the requirements of Ozone Directive 2002/3/EC. – Exceedance in ozone concentrations during summer period, under Ozone Directive 2002/3/EC.

Data coverage: :

Table 1: Percentage of urban population exposed at air pollution in areas where concentrations of pollutants are in excess of limit/target values

	2004	2005	2006	2007	2008	2009	2010	2011
SO_2	0	0	53	0	0	0	0	0
PM10	100	100	100	100	100	100	100	100
NO_2	67	59	55	0	0	0	0	78
O_3	26	37	29	43	41	36	15	12

Table 2: Percentage of urban population exposed at concentrations of PM10above the daily mean limit value, expressed as number of days in the course of a calendar year

	2004	2005	2006	2007	2008	2009	2010	2011
0 days	0	0	0	0	0	0	0	0
0 - 7 days	0	0	0	0	0	0	0	0
7 - 35 days	0	0	0	0	0	0	0	0
> 35 days	100	100	100	100	100	100	100	100

Table 3: 36th highest mean daily concentration of PM10

City	Monitoring station	Unit	2004	2005	2006	2007	2008	2009	2010	2011
Skopje	Lisiche	μg/m³				117	156	215	134	326
	Karposh	μg/m³	114	139	199	123	125			
	Centar	μg/m³		190		66	65			
	Gazi Baba	μg/m³						117	84	
	Rektorat	μg/m³		190	227	176	147	160	87	87
Veles	Veles 1	μg/m³	106	83	93	71		91	85	78
	Veles 2	μg/m³	112	138	154	117	106	115	97	115
Tetovo	Tetovo	μg/m³		224	201	150	170	167	104	
Kumanovo	Kumanovo	μg/m³	148	144	166	117	109	144	104	88
Kochani	Kochani	μg/m³		130	99	81	84	99	86	130
Kichevo	Kichevo	μg/m³		185	181	152	137	138	125	73

City	Monitoring station	Unit	2004	2005	2006	2007	2008	2009	2010	2011
Bitola	Bitola 1	µg/m^3		101	100	110	101	79	79	143
	Bitola 2	µg/m^3		130	165	126	97	110	97	102
Kavadarci	Kavadarci	µg/m^3		121	189	158	155	134	122	133
LV			**50**	50	50	50	50	50	50	50
Mean value			**120**	148	161	120	121	131	100	128
10 ‰			**108**	103	99	73	85	92	84	78
90 ‰			**138**	190	201	157	156	166	125	161

Table 4: Percentage of population exposed at NO2annual concentrations in urban areas

	2004	2005	2006	2007	2008	2009	2010	2011
0 - 26 µg/m^3	20	10	26	47	44	88	97	31
26 - 32 µg/m^3	14	31	20	0	3	12	3	0
32 - 40 µg/m^3	0	59	0	53	53	0	0	0
> 40 µg/m^3	67	0	55	0	0	0	0	69

Table 5: Average annual concentration of NO_2

City	Monitoring station	Unit	2004	2005	2006	2007	2008	2009	2010	2011
Skopje	Lisiche	µg/m³	62.82	52.05	46.51	39.83	37.69	12.04	4	42
	Karposh	µg/m³	57.68	50.78	46.2	36.31	34.15			
	Centar	µg/m³	61.6	52.11	52.76	50.3	56.74			
	Gazi Baba	µg/m³	37.73		52.82	23.42	27.44	15.05	22	
	Rektorat	µg/m³			55.04	42.76	36.67	32.02	11	
Veles	Veles1	µg/m³	14.28	13.87	8.98	14.35		15.81	12	12
	Veles 2	µg/m³	25.82	28.83	25.55	19.65	16.59	18.52	22	21
Tetovo	Tetovo	µg/m³	28.04	27.71	29.42	24.67	21.03	26.53	21	17
Kumanovo	Kumanovo	µg/m³	74.48	28.93	23.01	25.5	22.42	17.95	13	
Kochani	Kochani	µg/m³	27.98	18.46	15.8	15.07	12.91	11.66	13	
kichevo	Kichevo	µg/m³	17.71	45.37		12.21	27.57	30.01	29	44
Bitola	Bitola 1	µg/m³	15.59	22.88	25.44	18.71	16.76	20.36	18	14
	Bitola 2	µg/m³	19.34	34.25	36.79	22.55	29.87	27.13	20	20
Kavadarci	Kavadarci	µg/m³			24.56	25.87	20.43	19.46		
LV			40	40	40	40	40	40	40	40
Mean value			37	34	34	27	28	21	17	24
10 ‰			16	18	17	15	17	12	11	13
90 ‰			63	52	53	42	37	30	22	43

Table 6: Percentage of urban population exposed at concentrations of O_3 above the long-term target value for human health protection, expressed as number of days in the course of a calendar year

	2004	2005	2006	2007	2008	2009	2010	2011
0 days	15	4	4	0	0	4	59	14
0 - 25 days	59	59	60	57	4	60	19	74
26 - 50 days	6	0	9	26	55	25	22	12
> 50 days	20	37	27	17	41	11	0	0

Table 7: 26th highest maximum 8-hourly mean concentration of O_3

City	Monitoring station	Unit	2004	2005	2006	2007	2008	2009	2010	2011
Skopje	Lisiche	$\mu g/m^3$	103	105	86	120	113	105	49	117
	Karposh	$\mu g/m^3$	162	109	108	106	63			
	Centar	$\mu g/m^3$								
	Gazi Baba	$\mu g/m^3$								
	Rektorat	$\mu g/m^3$		77	67	115	118	101	87	54
Veles	Veles 1	$\mu g/m^3$	163	126	129	132		123	118	121
	Veles 2	$\mu g/m^3$	139	137	130	147	136	121	99	102
Tetovo	Tetovo	$\mu g/m^3$	169	134	127	131	139	125	119	98
Kumanovo	Kumanovo	$\mu g/m^3$	81	136	143	155	149	142	125	126
Kochani	Kochani	$\mu g/m^3$	97	91	97	106	101	94	90	94
Kichevo	Kichevo	$\mu g/m^3$	89	109	114	127	130	119		

City	Monitoring station	Unit	2004	2005	2006	2007	2008	2009	2010	2011
Bitola	Bitola 1	µg/m³	175	135	130	134	132	112	120	108
	Bitola 2	µg/m³	163	137	135	114	141	128	130	127
Kavadarci	Kavadarci	µg/m³		115	120	123	122	106	94	82
LV			120	120	120	120	120	120	120	120
Mean value			134	118	116	126	122	116	103	103
10 ‰			88	92	87	107	101	101	83	79
90 ‰			170	137	135	146	141	128	126	126

Table 8: Percentage of urban population exposed at concentrations of SO_2 above the daily mean limit value expressed as number of days in the course of a calendar year

	2004	2005	2006	2007	2008	2009	2010	2011
0 days	100	45	47	47	97	97	100	100
1 - 3 days	0	55	0	53	3	3	0	0
3 - 6 days	0	0	0	0	0	0	0	0
> 6 days	0	0	53	0	0	0	0	0

Table 9: 4th highest average mean daily concentration of SO_2

City	Monitoring station	Unit	2004	2005	2006	2007	2008	2009	2010	2011
Skopje	Lisiche	μg/m³	53	64	130	91	34	32	29	15
	Karposh	μg/m³	95	92	233	123	66			
	Centar	μg/m³	66	118	234	133	44			
	Gazi Baba	μg/m³	17			52	47	103	19	7
	Rektorat	μg/m³								
Veles	Veles 1	μg/m³	63	84	72	34		54		
	Veles 2	μg/m³	85	68	71	46	41	39	65	16
Tetovo	Tetovo	μg/m³	49	56	92	60	38	37	26	14
Kumanovo	Kumanovo	μg/m³	49	70		54	60	61		
Kochani	Kochani	μg/m³	32	28	52	73	54	39	40	20
Kichevo	Kichevo	μg/m³	64	49	57	42	63	122	20	
Bitola	Bitola 1	μg/m³	64	68	61	42	55	41	46	28
	Bitola 2	μg/m³	14	23	30	30	21	20	23	6
Kavadarci	Kavadarci	μg/m³		79	97	118	42	14	18	9
LV			125	125	125	125	125	125	125	125
Mean value			54	67	103	69	47	51	32	14
10 ‰			19	30	52	36	34	20	19	7
90 ‰			83	91	233	122	63	103	50	22

General metadata

Code	Title of the indicator	Compliance with CSI EEA or other indicators		Classification by DPSIR	Type	Linkage with area	Frequency of publication
MKNI 004	Exceedance of air quality limit values in urban areas	CSI 004	Exceedance of air quality limit values in urban areas	S	A	– air – Air quality	annual

CONSUMPTION OF OZONE DEPELTING SUBSTANCES

Definition

Substances that deplete the ozone layer (ODSs) are the compounds which cause depletion of the ozone layer. This group includes CFCs, HCFCs, HBFCs CCl_4, halons, methyl chloroform, methyl bromide. In general, these compounds are very stable in troposphere and they decompose only under the influence of ultra-violet radiation emitted by the Sun. While decomposing, they release chlorine or bromine atoms which destroy the molecules of stratospheric ozone.

This indicator quantifies the consumption of ozone-depleting substances (ODSs) in the Republic of Macedonia.

Units

- ODSs consumption is expressed in ODP tons which means quantity of each substance in metric tonnes (MT) multiplied by its Ozone Depletion Potential (ODP).

Policy relevance of the indicator

Upon the ratification of the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer, series of policy measures aimed at steady reduction and elimination of ODSs consumption were undertaken in the Republic of Macedonia in the period between 1997 and 2011.

List of relevant policy documents

National Environmental Action Plan (NEAP II, 2006)

Country Programme for Phasing-out Substances that Deplete the Ozone Layer (1996) – strategic document establishing the main directions in the domain of management and elimination of ODSs in the Republic of Macedonia. It was adopted in 1996. Based on the recommendations of the Country Programme, ODSs elimination has been completed in industry (production of refrigerators, flexible and rigid foams), agriculture, private sector. By 2011, more than 99% of ODSs consumption defined in the National Programme was eliminated. Projects have been implemented by means of the financial support provided by the Multilateral Fund of the Montreal Protocol through the Ministry of Environment and Physical Planning/ Ozone Unit.

Legal grounds

- Law on the Ratification of the Vienna Convention for the

Protection of the Ozone Layer was adopted by the Republic of Macedonia by means of succession in 1994.

- Law on the Ratification of the Montreal Protocol on Substances that Deplete the Ozone Layer was adopted by the Republic of Macedonia by means of succession in 1994.

- Law on the Ratification of London Amendment to the Montreal Protocol.

- Law on the Ratification of Copenhagen Amendment to the Montreal Protocol.

- Law on the Ratification of Montreal Amendment to the Montreal Protocol.

- Law on the Ratification of Beijing Amendment to the Montreal Protocol.

- As of 1 March 1997, the import of ozone depleting substances is allowed only upon permit issued by the Ministry of Environment and Physical Planning.

- As of 12 June 1998, equipment containing ozone depleting substances (used refrigerators, freezers, cooling devices, heat pumps, etc.) may be imported only upon permit issued by the Ministry of Environment and Physical Planning.

- Law on Environment.

- Order banning the import of air-conditioning devices that contain HCFCs.

- Order restricting the import of ozone depleting substances.

- Order banning production of and trade in ozone depleting substances, as well as production of and trade in products containing ozone depleting substances.

- Order banning import and export of HCFC containing products.

Targets

By the act of ratification of the Montreal Protocol, the Republic of Macedonia has undertaken all obligations deriving from this document. According to the obligations specified in the Protocol, the schedule for the ODSs elimination is as follows:

Montreal Protocol		Controlled substances applied in the Republic of Macedonia	Obligations of the Republic of Macedonia (as Article 5 country under the Montreal Protocol)
Annex	**Group**		
A	I	CFC-11 CFC-12 CFC-115	Base level: Mean of the consumption in 1995-1997 Freeze : 1 July 1999 50% reduction : 1 January 2005 85% reduction : 1 January 2007 100% reduction : 1 January 2010
	II	Halon-1211 Halon-1301 Halon-2402	Base level: Mean of the consumption in 1995-1997 Freeze : 1 January 2002 50% reduction : 1 January 2005
C	I	HCFC-22 HCFC-141b	Base level: Consumption in 2009-2010 Freeze : 1 January 2013 10% reduction : 1 January 2015 35% reduction : 1 January 2020 67,5% reduction : 1 January 2025 97,5% reduction : 1 January 2030 100% reduction : 1 January 2040
E	I	Methyl bromide	Base level: Mean of the consumption in 1995-1998 Freeze : 1 January 2005 100% reduction : 1 January 2015

Key policy question

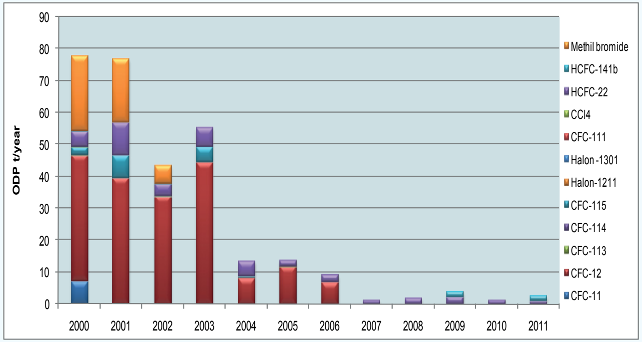
Does Macedonia fulfil the targets specified under the Montreal Protocol concerning ODSs reduction and elimination?

Key message

Considering the extent of ODSs elimination in the Republic of Macedonia, it may be concluded that the percentage of more than 99% of ODSs phased-out reflects the fact that our country has not only fulfilled its obligations under the Montreal Protocol, but reached beyond the requirements specified in the Protocol.

The act of ratification of the Montreal Protocol (1994) and the establishment of the Ozone Unit under the Ministry of Environment and Physical Planning (1997) was immediately followed by national action to protect the ozone layer, through ODSs reduction and elimination. The main task of MEPP/Ozone Unit is to coordinate the activities related to ODSs phasing-out at national level. Thus, in the period between 1997 and 2011, under the coordination of this Unit, the implemented projects for ODSs phasing-out achieved removal of more than 99% of the total consumption of ODSs in the country. Apart from this, the MEPP/Ozone Unit conducts permanent monitoring of the import, export and consumption of the ODSs in the Republic of Macedonia, monitoring of collected and recycled amounts of ODSs [through the projects "Plan for Management and handling of Cooling Substances and Devices" (2000-2005) and "Final CFCs elimination" (2006-2010), the services for cooling devices were supplied with equipment for collection, treatment and recycling of ODSs and three ODSs recycling centres were established in the country], works on the awareness of directly affected stakeholders, as well as of the public in general. The ongoing activities concern implementation of the Plan for HCFC elimination in the Republic of Macedonia.

Figure 1: Consumption of Ozone Depleting Substances (ODP t/year)



Note: Given the fact that the Republic of Macedonia has never produced any ODS, the diagram includes data only on ODSs consumption in the period 2000-2011.

Assessment

With the establishment of the Ozone Unit under the Ministry of Environment and Physical Planning in 1997, the country has joined actively the global action for ODSs reduction and phasing-out. During the last fifteen years (1997-2011), under the coordination of the Ozone Unit, application of ODSs has been phased-out in all industrial installations where such application has been identified in the Republic of Macedonia. All activities involving substitution of ODSs in industry, as well as in other economic sectors (agriculture, private sector) where ODSs found their application, have been implemented by means of financial support provided by the Multilateral Fund of the Montreal Protocol, amounting to US$ 5.894.000 US$.

According to data contained in the Country Programme for Phasing-out Substances that Deplete the Ozone Layer (1996), the average consumption of ODSs in the period 1995 - 1997 amounted 527 tons. According to the provisions of the Montreal Protocol, the said average has been taken as a base level in determining the extent of reduction to be achieved within the restrictions provided for by the Protocol. Table 1 shows the trend of decline in ODSs consumption, especially in the period of the last eleven years (2000 – 2011). Apart from ODSs elimination in industry (production of refrigerators and production of rigid and flexible foams), where technologies using ozone depleting substances before 1997 were replaced by non-ODSs solutions, interventions were also made in agriculture through substitution of methyl bromide with alternative solutions that did not involve application of ODSs, in cooling devices servicing and maintenance through establishment of the system for ODS collection and recycling. In the context of the latter, equipment for collection and recycling of cooling devices have been delivered to services and service technicians were trained in good cooling devices servicing practice. For the same purpose, training was organized for custom officers to control import-export of ozone depleting substances at border-crossings of the Republic of Macedonia.

The national action for ozone layer protection has resulted in elimination of more than 99% of the total consumption of ODSs in the Republic of Macedonia.

Methodology

- Methodology for the indicator calculation

The Indicator shows the quantity of consumed ODSs. The value presented has been obtained by multiplying the value of the consumed quantity expressed in metric tons by the Ozone Depletion Potential (ODP). The Table below presents the values of ODP for substances identified to be applied in the Republic of Macedonia and the consumption of which is subject of reduction or control. The Ministry of Environment and Physical Planning/Ozone Unit has data on ODSs consumption in both metric and ODP tons.

ODSs	CFC-11	CFC-12	CFC-113	CFC-114	CFC-115	CFC-111	CCl4	Halon 1211	Halon 1301	HCFC-22	HCFC-141b	Methyl bromide
Value of ODP	1	1	0,8	1	0,6	1	1,1	3	10	0,055	0,11	0,7

Data specification

Title of indicator	Source	Reporting obligation
Consumption of ODSs	- MEPP/Ozone Unit	– UNIDO – UNEP- Secretariat for Ozone Layer Protection – Multilateral Fund of the Montreal Protocol

Data coverage:

Table 1: Consumption of ODSs

Substances	ODP t*/year											
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CFC-11	7,12											
CFC-12	39,6	39,58	34,07	44,53	8,27	11,83	6,99					
CFC-113	0,02											
CFC-114												
CFC-115	2,72	7,1	0,04	4,8	0,5							
Halon-1211												
Halon -1301												
CFC-111												
CCl4	0,04		0,1			0,012						
HCFC-22	4,93	10,36	3,81	5,96	4,76	1,86	2,36	1,25	2,03	2,29	1,32	0,9
HCFC-141b	0,05		0,11							1,73		1,61
Methyl bromide	23,37	19,92	5,32									
Total	**77,85**	**76,96**	**43,36**	**55,29**	**13,53**	**13,702**	**9,35**	**1,25**	**2,03**	**4,02**	**1,32**	**2,51**

* ODP (Ozone Depletion Potential): integrated change in the total amount of ozone per unit mass emission of specific compound relative to integrated change in the total amount of ozone per unit mass emission of CFC-11, Source: Environmental Assessment Report No. 2, EEA, 1999.

ODP tons: consumption in metric tons multiplied by the value of Ozone Depletion Potential

General metadata

Code	Title of the indicator	Compliance with CSI EEA or other indicators		Classification by DPSIR	Type	Linkage with area	Frequency of publication
MK NI 006	Consumption of ozone depleting substances	CSI 006	Consumption of ozone depleting substances	P	B	- Climate change	annually