2. Air pollution

Emissions to air

This indicator characterizes the extent of existing and expected impact of emissions of major pollutants to the environment and determines the path for achieving the target values, expressed through national emission limits.

The indicator «emissions» consists of two components: emissions from stationary sources and emissions from mobile sources.

Pollutant emissions from stationary sources

Currently in the Republic of Belarus to receive information on emissions from stationary sources the data of state statistical reports on Form 1-OS (air) is used. Form 1-OS (air) is annually provided by enterprises which emissions exceed 25 tons per year, and if the emission of hazard class substances exceeds 1 tons/year. Pollutant emissions from stationary sources are characterized as the total amount of pollutants got into the air from all organized and unorganized stationary sources.

Pollutant emissions from stationary sources in the territory of Belarus are shown in *Table 2.1.*

Sulfur dioxide emissions from stationary sources in 2006-2008 are characterized by a decline and a sharp increase in 2009, due to the increased level of its revenues from the energy sector. The significant increase in ammonia emissions, noted in 2008 and 2009 compared with previous years was the result of using new method of assessment of emissions from livestock farms.

Emissions of nitrogen oxides, particulate matter and NMVOC from stationary sources for the period remained virtually unchanged and averaged 66.6; 45.7 and 74.4 tons/year, respectively. The volume of carbon monoxide in 2005-2009 was gradually declining and in 2009 was 74.6 tons, which is 29% less than in 2005.

The main volume of pollutant emissions from stationary sources is associated with the industry (including energy) and housing and communal

Table 2.1

Emissions of air pollutants from stationary sources in 2005-2009

Pollutant	2005	2006	2007	2008	2009
Sulphur dioxide (SO_2), ths t	73.80	87.80	80.70	64.00	139.50
Nitrogen oxides are converted to nitrogen dioxide, ths t	67.38	69.94	65.30	65.00	65.38
Ammonia, ths t	7.08	7.64	8.28	16.65	19.61
Solid particles in total, ths t	43.90	45.80	45.10	47.50	46.20
Carbon monoxide (CO), ths t	103.90	107.70	94.40	88.40	74.60
Non-methane volatile organic compounds (NMVOC), ths t	75.43	72.99	74.38	77.33	71.76
Cd, t	0.030	0.030	0.035	0.013	0.002
Pb, t	4.230	3.950	4.317	3.644	3.244
Hg, t	–	–	–	0.002	0.004

services which contribution to total emissions was in average 70 and 14% respectively.

More than half of the total emission to each of the ingredients is from industries, except for hydrocarbons, the volume of which comes from the housing and communal services (50%). Also a significant contribution to hydrocarbons emissions makes transport and communications (20%). Significant sources of solid substances emissions in addition to the industry are the housing and communal services (10%) and agriculture (10%), carbon monoxide – housing and communal services (20%) and transport and communications (about 10%).

Pollutant emissions from mobile sources

Emissions from mobile sources of pollutants are calculated on the basis of fuel consumption and data on the distribution of vehicles in the country, for environmental classes in the percentage of total amount on the basis of data of the Ministry of Transport and Communication of the Republic of Belarus according to records in the field of environmental protection.

Emissions from mobile sources during the period characterized by some growth, which depending on the substance ranges from 8 to 17% *(Table 2.2)*.

The maximum amount of emissions from mobile sources is noted in Minsk and Minsk region, the minimum – in Mogilev region) *(Fig. 2.1)*.

The definitions of the indicator «Emissions of pollutants into the air» are shown in *Table 2.3*.

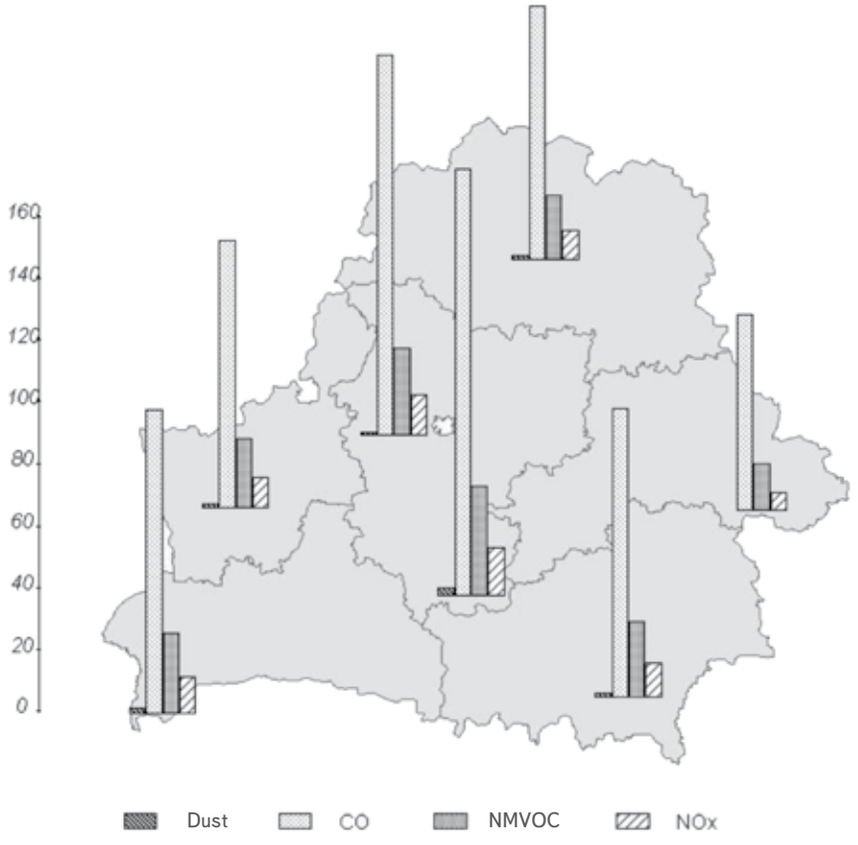

Figure 2.1 – Emissions from mobile sources in 2009, ths t

Total emissions of sulfur dioxide from 2006 until 2008 were reducing, while in 2009 there was a sharp increase in the emissions of this compound (due to emissions from stationary resources). In general, over the past 5 years SO_2 emissions increased by 1.9 times *(Fig. 2.2)*.

Inflow of suspended solids in the five-year period ranged from 73.8 to 85.7 thousand tons (see *Figure 2.2*.). Emissions of nitrogen oxides, carbon monoxide and NMVOC changed slightly – the change was within 10% *(Fig. 2.3)*. It should be noted that compared with 2005 in 2009 the emissions of these compounds increased in 1,1 times.

Inflow of cadmium and lead emissions into the atmosphere during the period decreased by 15 and 1.3 times respectively. According to table 2.3, mercury emissions in 2009 increased by 2 times compared with 2008.

Emissions of all pollutants are characterized by positive dynamics aimed on reducing.

Emissions of major pollutants per unit of the country are increasing: for nitrogen

Table 2.2

Emissions of air pollutants from mobile sources in 2005-2009

Pollutant	2005	2006	2007	2008	2009
Sulphur dioxide (SO_2), ths t	1.3	1.5	1.5	1.6	1.4
Nitrogen oxides are converted to nitrogen dioxide, ths t	94.2	107.1	106.6	116.4	109.8
Solid particles in total, ths t	29.9	34.2	34.3	38.2	34.0
Carbon monoxide (CO), ths t	698.6	780.4	768.5	815.2	777.8
Non-methane volatile organic compounds (NMVOC), ths t	189.9	214.3	212.4	229.2	214.4

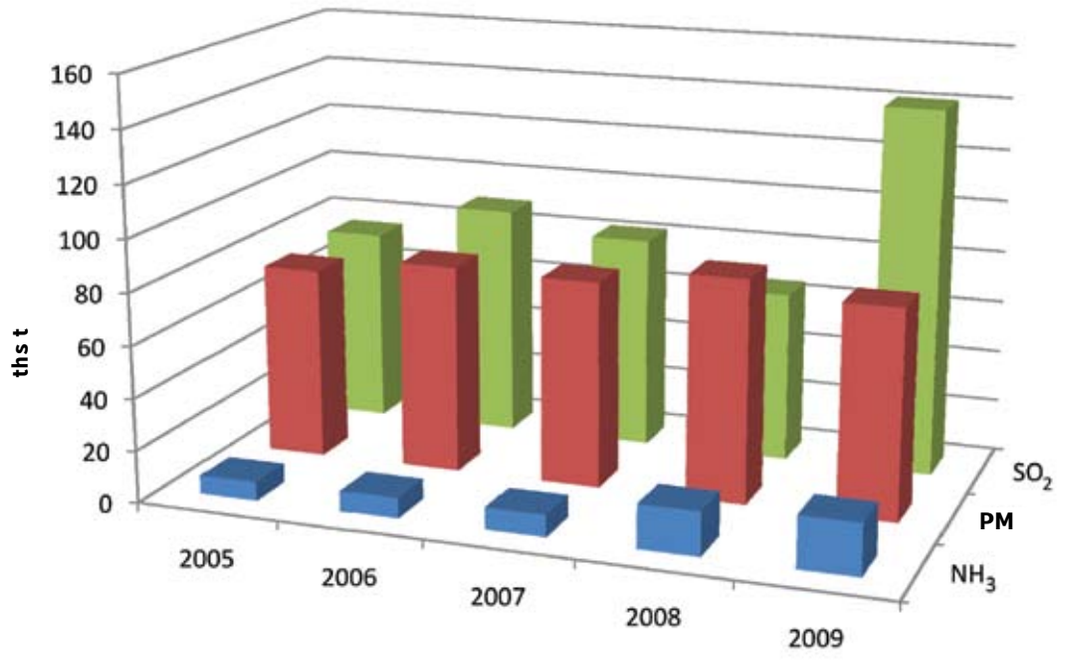

Figure 2.2 – Total emissions of sulfur dioxide, particulate matter and ammonia on the territory of Belarus in 2005-2009

Table 2.3

Dynamics of national emissions of major pollutants into the atmosphere in Belarus in 2005-2009

Pollutant	2005	2006	2007	2008	2009
Sulphur dioxide (SO_2), ths t	75.10	89.30	82.20	65.60	140.90
Nitrogen oxides are converted to nitrogen dioxide, ths t	161.580	177.040	171.900	181.403	175.180
Ammonia, ths t	7.08	7.64	8.28	16.65	19.61
Solid particles in total, ths t	73.80	80.0	79.40	85.70	80.20
Carbon monoxide (CO), ths t	802.50	888.10	862.90	903.60	852.40
Non-methane volatile organic compounds (NMVOC), ths t	265.33	287.29	286.78	306.53	286.16
Cd, t	0.030	0.032	0.035	0.013	0.002
Pb, t	4.227	3.948	4.317	3.644	3.244
Hg, t	–	–	–	0.002	0.004

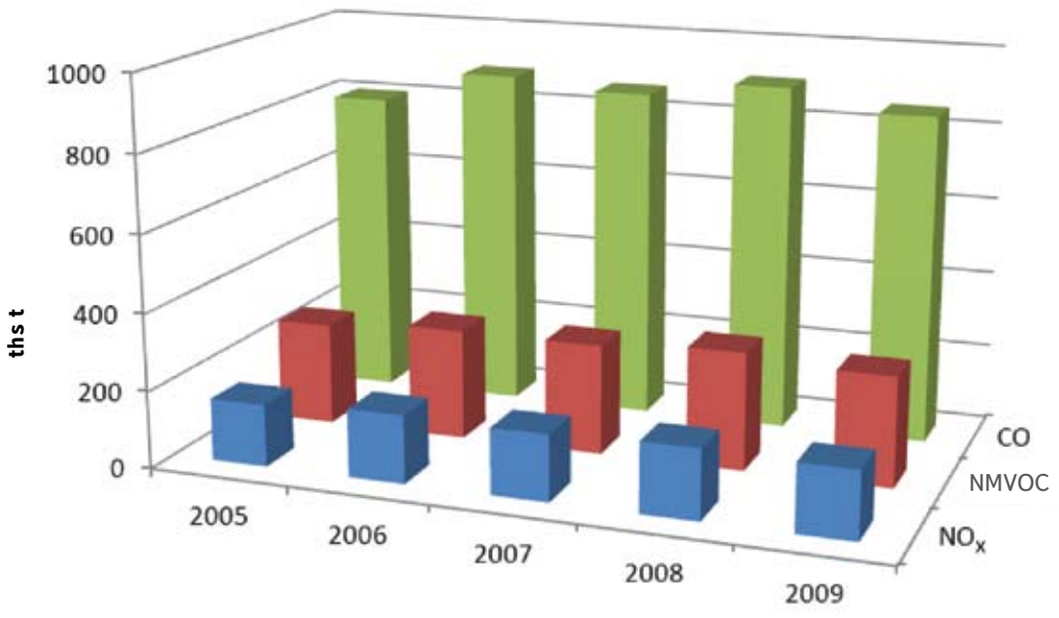

Figure 2.3 – Total emissions of nitrogen oxides, carbon monoxide and NMVOC on the territory of Belarus in 2005-2009

oxides, particulate matter and NMVOC this figure for the last 5 years has increased by 8%, for carbon monoxide – by 6% and sulfur dioxide – by 89%, for ammonia – 200% *(Table 2.4)*.

Minsk region is characterized by the maximum density of carbon dioxide emissions – about 8 t/km^2, followed by the Grodno region – 4,3 t/km^2, for other areas the density does not exceed 3 t/km^2 *(Fig. 2.4A)*. Density distribution of sulfur oxides is different from carbon monoxide. Thus, the maximum density for emissions of SO_x is observed in Vitebsk region (1,1 t/km^2), followed by

Minsk and Gomel regions (0,7-0,9 t/km^2) *(Figure 2.4B)*.

The maximum density of nitrogen oxides and particulate matter recorded in Minsk region – more than 1.1 respectively and more than 0,5 t/km^2. By the value of the density of nitrogen oxides there is Grodno region (0,8-0,9 t/km^2), for all other areas the density of pollutant emissions do not exceed 0.8 t/km^2 *(Figure 2.4C)*.

By the density of particulate emissions besides Minsk region there is Grodno and Mogilev regions – 0.45 and 0.37 t/km^2, for other areas this figure does not exceed 0,3 t/km^2 *(Figure 2.4D)*.

It is determined that emissions of major pollutants the per capita increase: for carbon monoxide this figure for the last 5 years has increased by 10%, for NMVOC – 11, for particulate matter and nitrogen oxides – 12, for sulfur dioxide – by 94, for ammonia – by 188% *(Table 2.5)*.

The highest specific emissions of carbon monoxide have Minsk and Grodno regions (more than 94 kg/person). The inflow of sulfur dioxide is maximum for Vitebsk region (over 30 kg per person.) *(Fig. 2.5)*.

By the emissions of nitrogen oxides in Vitebsk region this figure exceeds 22 kg/person, followed by Grodno (20 kg/pers.), Mogilev and Gomel regions (from 18 to 20 kg/person). For Minsk and Brest regions emissions of nitrogen oxides shall not exceed 18 kg per person.

Quite different is distribution of specific emissions of particulate matter. For Vitebsk, Grodno and Mogilev regions this option is above 10 kg/person. For the rest is less than 8 kg per person.

Forecast of the expected development of pollutant emissions into the atmosphere is presented in *Table 2.6* and *Figure 2.6.*

According to the forecast emissions in 2020 emissions of sulfur and NMVOC will

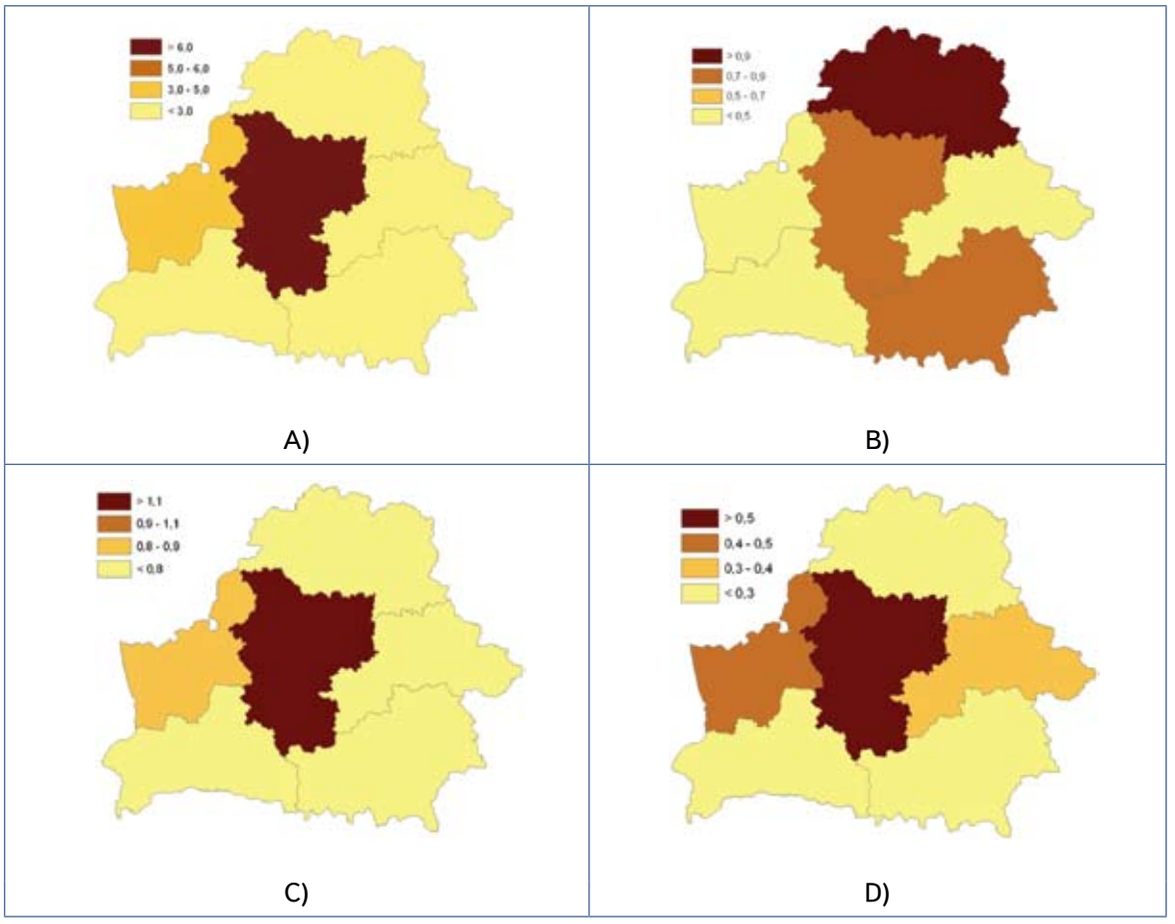

Figure 2.4 – Density of emissions of carbon monoxide (A), sulfur oxides (B), nitrogen oxides (C) and particulate matter (D) in administrative regions of Belarus in 2009, t/km^2

Table 2.4

Emissions of pollutants into the atmosphere per unit area of the country, t/km²

Pollutant	2005	2006	2007	2008	2009
Sulphur dioxide (SO_2)	0.36	0.43	0.40	0.32	0.68
Nitrogen oxides are converted to nitrogen dioxide	0.78	0.85	0.83	0.87	0.84
Ammonia	0.03	0.04	0.04	0.08	0.09
Solid particles in total	0.36	0.39	0.38	0.41	0.39
Carbon monoxide (CO)	3.87	4.28	4.16	4.35	4.11
Non-methane volatile organic compounds (NMVOC)	1.28	1.38	1.38	1.48	1.38
Cd	1.45×10^{-4}	1.54×10^{-4}	1.69×10^{-4}	6.26×10^{-5}	9.63×10^{-6}
Pb	0.02	0.02	0.02	0.02	0.02
Hg	–	–	–	9.63×10^{-6}	1.93×10^{-5}

Table 2.5

Emissions of air pollutants per capita, kg/person

Pollutant	2005	2006	2007	2008	2009
Sulphur dioxide (SO_2)	7.66	9.16	8.46	6.77	14.84
Nitrogen oxides are converted to nitrogen dioxide	16.49	18.16	17.70	18.72	18.45
Ammonia	0.72	0.78	0.85	1.72	2.07
Solid particles in total	7.53	8.20	8.17	8.84	8.45
Carbon monoxide (CO)	81.89	91.08	88.83	93.25	89.79
Non-methane volatile organic compounds (NMVOC)	27.07	29.46	29.52	31.63	30.14
Cd	3.06×10^{-6}	3.28×10^{-6}	3.60×10^{-6}	1.34×10^{-6}	2.11×10^{-7}
Pb	4.31×10^{-4}	4.05×10^{-4}	4.44×10^{-4}	3.76×10^{-4}	3.42×10^{-4}
Hg	–	–	–	2.06×10^{-7}	4.21×10^{-7}

decrease. At the same time will increase emissions of nitrogen oxides. At the same time the excess of target values in the future is not expected.

Currently, the most significant source of air pollution is transport with more than 70% of total emissions.

Particulate emissions are caused by the industrial sector at 34% and mobile sources – 43%. The main contribution to the inflow of nitrogen oxides, NMVOC oxide and carbon makes transportation – 63, 74 and 89% respectively. Industry is also the source of NO_x and NMVOC (32 and 23%). Hydrocarbons mainly got to the atmosphere from housing, transport and communications.

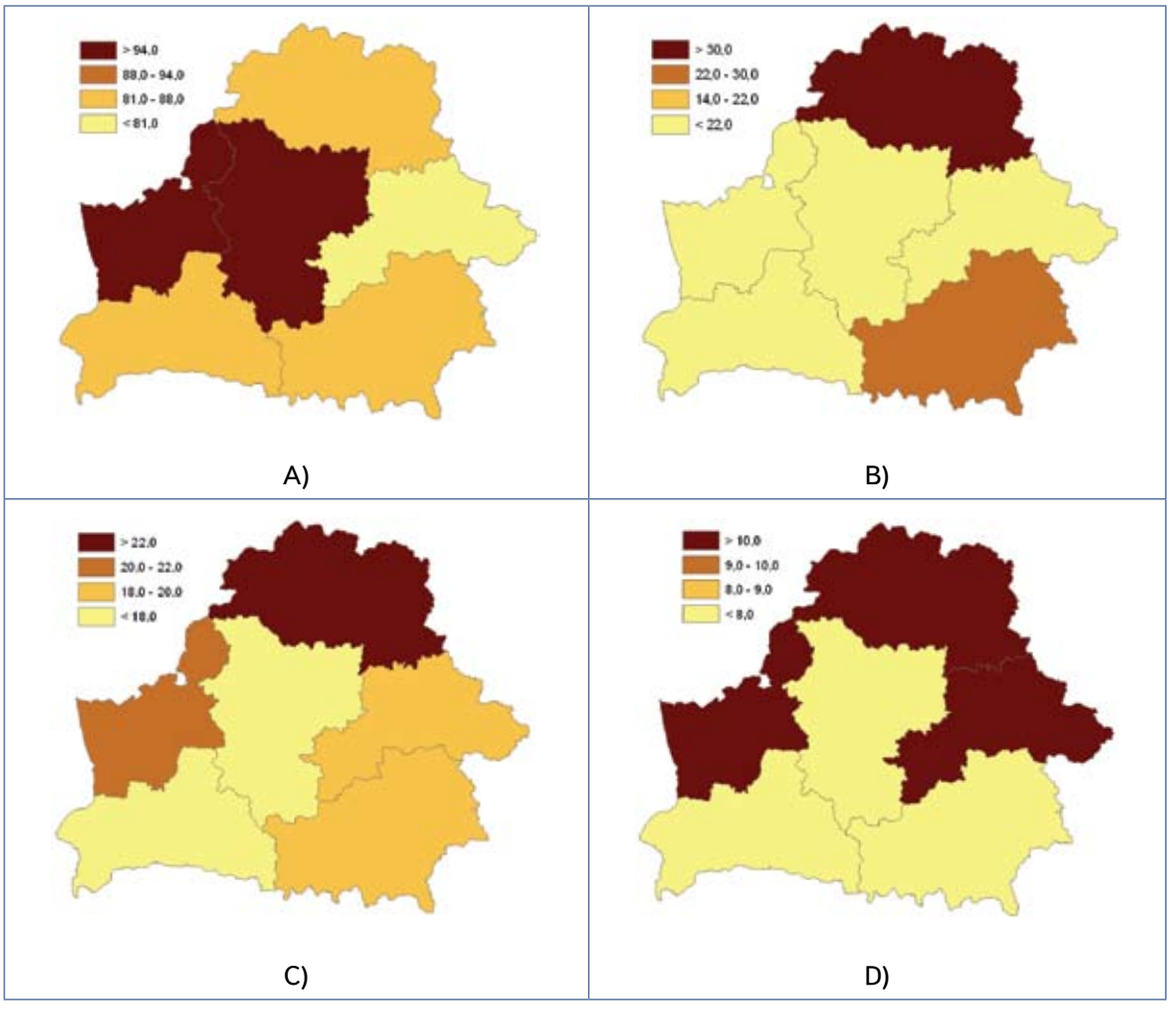

Figure 2.5 — Emissions of carbon monoxide (A), sulfur oxides (B), nitrogen oxides (C) and particulate matter (D) per capita by regions in 2009, kg/person

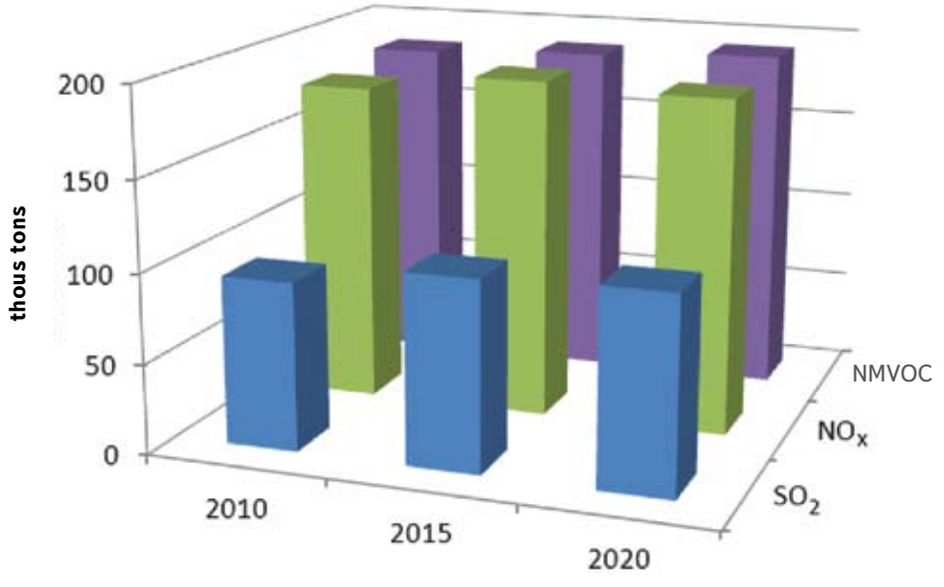

Figure 2.6 — Forecast of pollutant emissions into the atmosphere in Belarus until 2020

Table 2.6

Forecast of development of national emissions of SO_2, NO_x, NMVOC and ammonia in the atmosphere of Belarus by 2020 compared with the last actual and target values, thous tons

Pollutant	Targets	2009	2015	2020
Sulphur dioxide (SO_2)	518	140.90	105.58	108.27
Nitrogen oxides (NO_x converted to NO_2)	263	175.20	189.42	186.31
NMVOC	–	286.16	188.30	192.41

The latest industry includes the transportation of liquid and gaseous fuels through gas flow line. About 50% of ammonia emissions are due to agriculture, 20% – transport and communications, 17% of housing and communal services. The main source of sulfur dioxide and heavy metals serves the industrial sector. In the industrial sector emissions of sulfur dioxide are related to the electric power industry, lead – with the production of building materials, cadmium – from engineering and metalworking industry.

Captured and disposed of pollutants

The effectiveness of existing dust filters provides an analysis of the indicator «captured and disposed of pollutants», which consists of two components:

– the actual number of trapped and neutralized pollutants, in ths t;

– the proportion of trapped and neutralized pollutants in the total amount of walking-pollutant, expressed in % *(Table 2.7)*.

According to the state statistical reporting more than 2.5 tons of pollutants is captured every year by the systems of gas treatment station. The exception was 2009 when this figure decreased to 2.0 ths tons. Perhaps this is due to the fact that the number of enterprises which report on Form 1-OS (air) in 2009 decreased to 1.9 thousand, while in 2005 there were 3.3 thousand of such enterprises, in 2006 and 2007 - 3,0 thousand, in 2008 – 2,1 thousand.

The efficiency of existing systems of gas treatment station ranges from 82 to 88%.

Reducing emissions of pollutants into the air after the activities

The index takes into account the total actual reductions of emissions of pollutants into the air as a result of activities and evaluates the efficiency of conservation measures *(Table 2.8)*.

The maximum number of activities was held in 2006 – 304, the minimum in 2009 – 206. At the same time for one event in 2006 emissions reduction is by 9.5 tons and in 2009 – 19,7 tons. Maximum efficiency is characterized by activities in 2007 (64.6 tons emission reductions for one activity).

Air quality in urban areas

The indicator shows the state of the environment in terms of air quality and the negative impact of elevated concentrations of polluting substances on the population.

Table 2.7

The changes of the «captured and disposed of pollutants»

Indicator	2005	2006	2007	2008	2009
The actual number of trapped and neutralized pollutants, ths t	2901.98	2724.92	2595.92	2540.50	2041.45
Proportion of trapped and neutralized pollutants in the general volume of waste contaminants,%	0.88	0.87	0.87	0.87	0.82

Table 2.8

The changes of the «reduced emissions of pollutants into the air after the activities»

Indicator	2005	2006	2007	2008	2009
Completed activities	299	304	238	223	206
Reducing emissions of pollutants into the air after the activities, tons	5216.7	2880.0	15385.2	1124.5	4055.2

Inhalation of high concentrations of particulate matter during short period of time can cause symptoms of asthmatic diseases and diseases of the respiratory tracts, reducing lung capacity and increasing the risk of cardiovascular diseases. There are numerous data on negative effects on humans of carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxides (NO_x), ozone and other compounds presented in atmospheric air.

Currently, air monitoring in Belarus is carried out in 18 industrial cities, including regional centers, as well as Polotsk, Novopolotsk, Orsha, Bobruisk, Mozyr, Rechitsa, Svetlogorsk, Pinsk, Novogrudok Zhlobin, Lida and Soligorsk. Regular observations cover the territory with 81.3% of the population of large and medium-sized cities in the country. Network of air monitoring station includes 61 stations *(Fig. 2.7).* In Minsk, Vitebsk and Mogilev operate automatic stations, which make it possible to obtain information about the content in the air of priority pollutants in real time.

In all the cities in the air the concentration of major pollutants are determined: total particulate matter, sulfur dioxide, carbon monoxide, nitrogen dioxide. The concentration of specific priority pollutants is measured: formaldehyde, ammonia, phenol, hydrogen sulfide, carbon disulfide. In all controlled cities the content in the air of lead and cadmium is defined, in 16 cities – benzo (a) pyrene, in

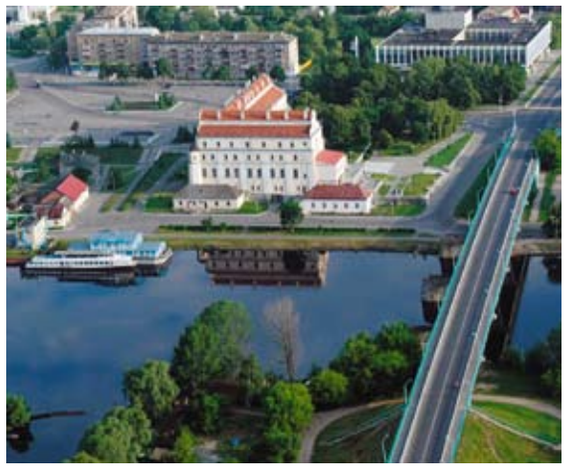

Figure 2.7 – Network monitoring stations of air quality in Belarus

9 cities – volatile organic compounds (VOCs). In accordance with the recommendations of the World Health Organization regular monitoring of concentrations is held with diameter of 10 microns or less (PM-10) in Minsk, Mogilev, Vitebsk, Gomel and Zhlobin.

In assessing the air quality daily average and maximum permissible concentration (MPC) of pollutants is considered. Average annual concentrations of particulate matter fraction PM-10 and pollutants measured on the automatic stations with continuous operation are compared with the average annual MPC. For stations with a discrete sampling of the average annual values it is compared with the MPC mid-day, while the maximum – with a maximum single *(Table 2.9)*.

In addition, to assess the state of air the following indicators are used: such as number of days during which there was the excess of daily maximum concentration limit, and repeatability (share) of samples with concentrations above the maximum single MPC. Data on the number of days with daily average concentration PM-10 above the MPC derived from continuous measurements is compared with the targets adopted in the European Union.

Analysis of data on ambient air monitoring networks in 2009 showed that the average annual concentrations of major and specific pollutants are controlled by the overwhelming majority of cities in Belarus, as in previous years, were below quality standards. In some cities recorded exceedances of daily maximum concentration limit of the total particulate matter, carbon monoxide and nitrogen dioxide. The level of pollution of the air with sulfur dioxide remains stable low: both the average and maximum single concentrations are much lower than the quality standards.

During 2009 there were not fixed any concentrations of any pollutants more than 10 MPC. The excess of maximum single MPC is noted only in 0,25% of the total analyzed samples. The vast majority of exceedances were in amounts from 1 to 2 MPC *(Table 2.10)*.

In some years the period 2006-2009 the percentage of air samples with concentrations of contaminants sculpt substances above the maximum one-time MPC ranged from 0,25 to 0,50%. In this case from 80 to 90% of the exceedances were in the range of 1-2 MPC. Pollutant concentrations above 5 MPC

Table 2.9

Maximum allowable concentrations of priority pollutants in air

Pollutant	Value MPC, mkg/m³		
	Maximum single	Average daily	Average annual
The main pollutants			
Particulates in total	300	150	100
Particulate 10 microns in diameter or less (PM-10)	150	50	40
Dioxidesulfur	500	200	50
Carbon monoxide	5000	3000	500
Nitrogen dioxide	250	100	40
Specific pollutants			
Hydrogen sulfide	8	–	–
Carbon disulfide	30	15	5
Ammonia	200	–	–
Formaldehyde	30	12	3
Phenol	10	7	3
Lead	1,0	0,3	0,1
Cadmium	3,0	1,0	0,3
Benzo(a)pyrene	–	5 ng/m³	1 ng/m³

Table 2.10

Distribution of cases (the number of samples) with high levels of air pollution in cities of Belarus on the extent of exceeding the maximum single MPC in 2006-2009.,%

Concentration	2006	2007	2008	2009
1 MPC < q_{max}* ≤ 2 MPC	89.7	81.3	88.0	89.8
2 MPC < q_{max} ≤ 3 MPC	7.5	12.5	8.7	7.6
3 MPC < q_{max} ≤ 4 MPC	1.7	4.2	2.7	1.9
4 MPC < q_{max} ≤ 5 MPC	0.9	1.2	0.6	0.6
q_{max} > 5 MPC	0.2	0.8	0.0	0.1

* q_{max} – maximum of one-off concentrations.

recorded less than 1% of the excess (see *Table 2.10.*).

State of air in Bobruisk, Grodno, Novogrudok, Svetlogorsk, Lida, Soligorsk and in the majority-controlled districts of Brest, Vitebsk, Minsk, Gomel, Mozyr, Pinsk, and in 2009 was assessed as consistently good. Compared with 2007 the number of «problem» areas in the industrial centers of Belarus decreased by 22% *(Fig. 2.8)*.

However, in some areas of Mogilev, Polotsk and Novopolotsk there is a problem of air pollution with nitrogen dioxide; in Brest, Vitebsk, Orsha, Pinsk – with formaldehyde.

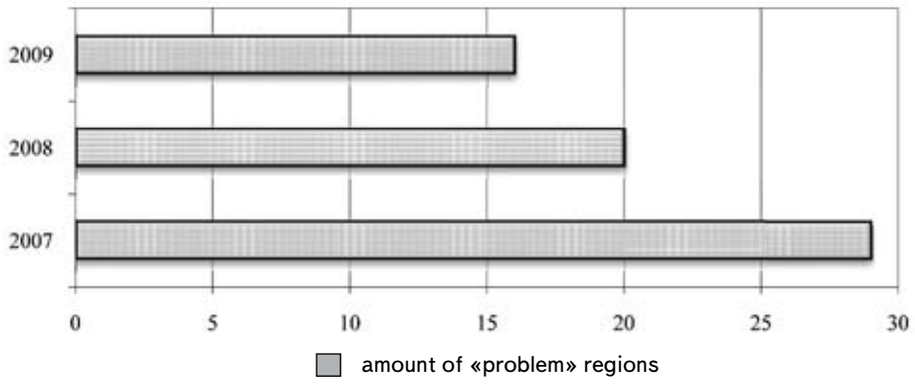

Figure 2.8 – The number of «problem» areas for air pollution in the industrial centers of Belarus in 2007-2009

In cities located in southern Belarus where the large-scale reclamative activities were held (Gomel, Zhlobin, Mozyr, Rechitsa) there is a problem of air pollution with particulate matter *(Table 2.11).* During periods of no precipitation maximum concentrations of total solids in these cities come by 2.6 MPC. In two industrial regions of Minsk elevated levels of contamination of air PM-10 are noted.

Total solids

Analysis of data on the content of total particulate matter in the air during the period 2005-2009 showed that their average concentrations in almost all cities of Belarus are below quality standards *(Table 2.11).* The exception was Rechitsa where in 2007 the annual average content of total particulate matter exceeded the MPC in 1,2 times, and in 2008 – was at the MPC level *(Figure 2.9).*

However, the maximum single concentration of total particulates in the air of most cities in the country during the period were higher than the MPC. The largest pre-elevated quality standards were characteristic for Gomel, Zhlobin, Mozyr and Rechitsa where exceeding the maximum single MPC ranged from 1.5 to 6.0 times *(Fig. 2.10).*

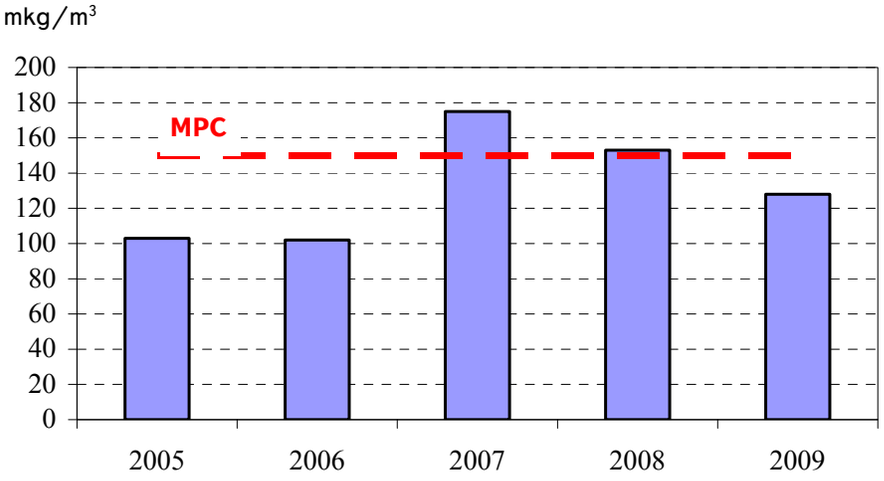

Figure 2.9 - Average annual concentration of total particulate in the air in Rechitsa in 2005-2009

Table 2.11

Average annual concentrations of total particulate in the air of cities of Belarus in 2005-2009, mkg/m³

City	2005	2006	2007	2008	2009
Bobruisk	34	32	21	14	<15
Brest	26	28	23	28	28
Vitebsk	84	110	97	109	117
Gomel	45	29	61	51	63
Grodno	40	33	53	57	51
Zhlobin	–*	–	82	98	97
Lida	–	–	–	53	<15
Minsk	11	–	–	–	15
Mogilev	42	55	43	46	42
Mozyr	39	64	72	59	67
Novogrudok	90	37	40	40	59
Novopolotsk	30	22	21	17	<15
Orsha	7	–	–	24	15
Pinsk	82	76	59	67	57
Polotsk	54	39	31	26	25
Rechitsa	103	102	175	153	128
Svetlogorsk	31	29	36	43	30
Soligorsk	39	55	25	24	<15
MPC	150				

* The substance was not determined.

In addition, for these cities is characteristic the excess of daily MPC of total solids. So, in Gomel during 2009 there were marked 18 days in excess of the average MPC, in Zhlobin – 43 days, in Mozyr – 5 days *(Table 2.12)*. The above data is characteristic for the city as a whole, but for some monitoring stations, they can be much higher than the value.

At other times, the number of days with daily average concentration of total particulate matter higher than MPC was negligible *(Fig. 2.11)*.

During the five-year period (2005-2009) average annual total solid content of particles in the air in Bobruisk, Novogrudok, Novopolotsk, Pinsk, Polotsk and Salihorsk decreased in 1,4-2,6 times; in Vitebsk, Gomel, Grodno, Mozyr, Orsha and Rechitsa – increased in 1,2-2,1 times. The level of air pollution of particulate matter in Brest, Mogilev and Svetlogorsk did not change significantly.

Particulate matter 10 microns in diameter or less (PM-10)

Annual average concentrations of PM-10 in Gomel, Vitebsk, Mogilev, Zhlobin and residential district of Minsk in 2007-2009 were in the range 0,4-0,6 MPCs. In 2009, number of days with daily average concentration above the MPC in Mogilev and Vitebsk did not exceed 3%, in the residential district of Minsk, Gomel and Zhlobin – 8%. At the same time for two

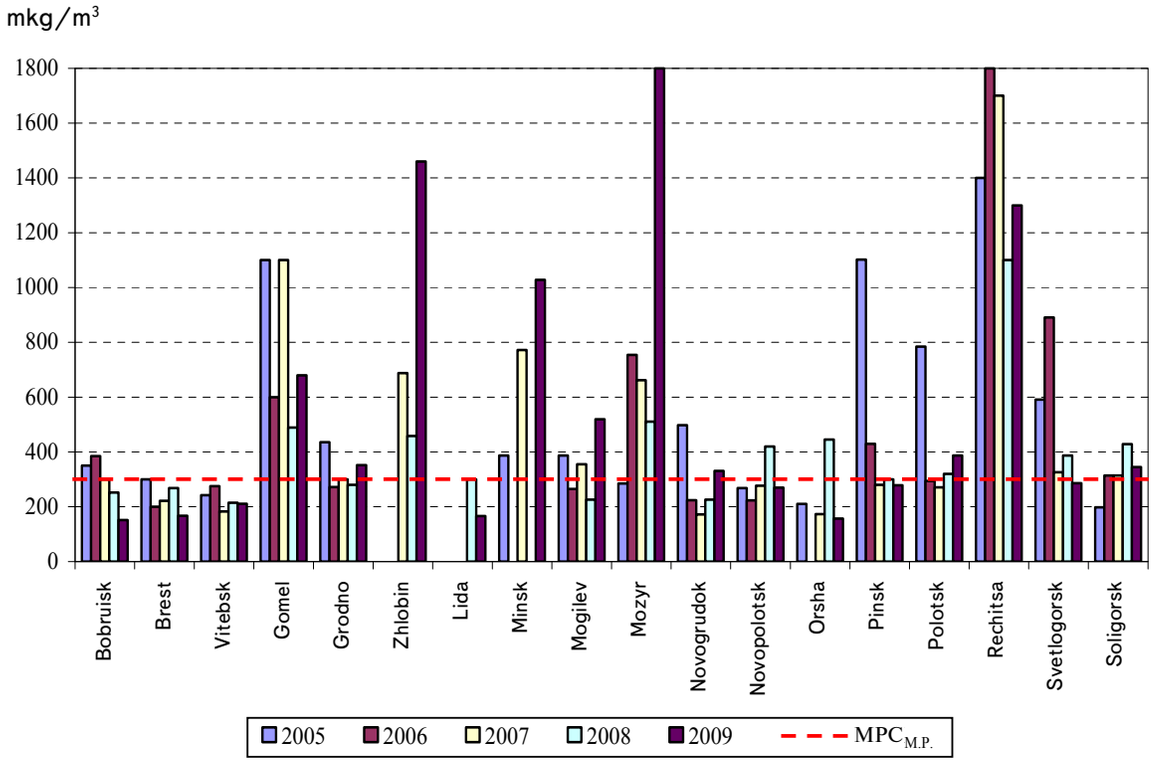

Figure 2.10 - The maximum single concentration of total particulate in urban air in Belarus in 2005-2009

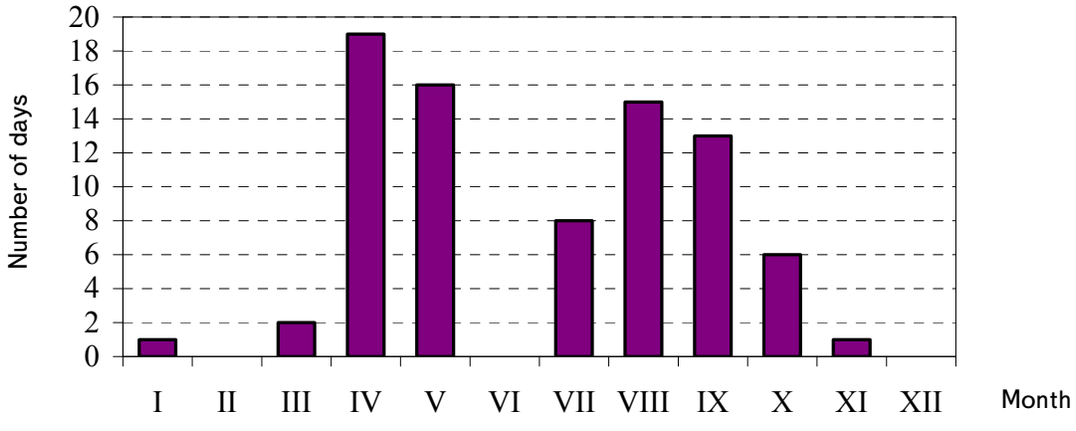

Figure 2.11 – Number of days exceeding the daily average maximum permissible concentration of total particulate in the air in Rechitsa in 2009

Table 2.12

Number of days per year exceeding the daily average maximum permissible concentration of total particulates in the air in Gomel, Mozyr and Zhlobin in 2007-2009

Year	Gomel	Zhlobin	Mozyr
2007	7	32	10
2008	6	46	24
2009	18	43	5

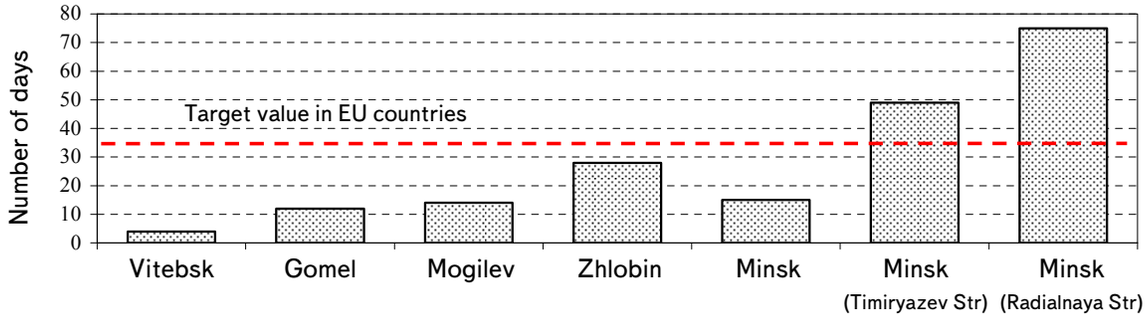

Figure 2.12 – Number of days with daily average concentration of total particulate of PM-10 above the MPC in 2009

industrial districts of Minsk elevated levels of air pollution PM-10 is characterized – the average concentration in 2009 was respectively 0.8 and 1.1 MPC.

According to the Directive of the European Council it is not allowed to exceed the level of 50 mg/m^3 more 35 days (9.6%) during the calendar year. In 2009 the number of days from mid-day concentrations of PM-10 above the MPC in Minsk in the areas of streets Timiryazev and Radialnaya the indicator exceeded in 1,4-2,1 times, Gomel, Vitebsk, Mogilev, Zhlobin and residential district of Minsk – was lower than it *(Fig. 2.12)*.

Nitrogen dioxide

The annual average content of nitrogen dioxide in the atmosphere of controlled cities of Belarus in the period 2005-2009 was substantially below the maximum allowable concentration *(Table 2.13)* In this case, the maximum single concentration of nitrogen dioxide in Minsk, Mogilev and Polotsk during all five years exceeded the MPC from 1,2 to 3,4 times *(Fig. 2.13)*.

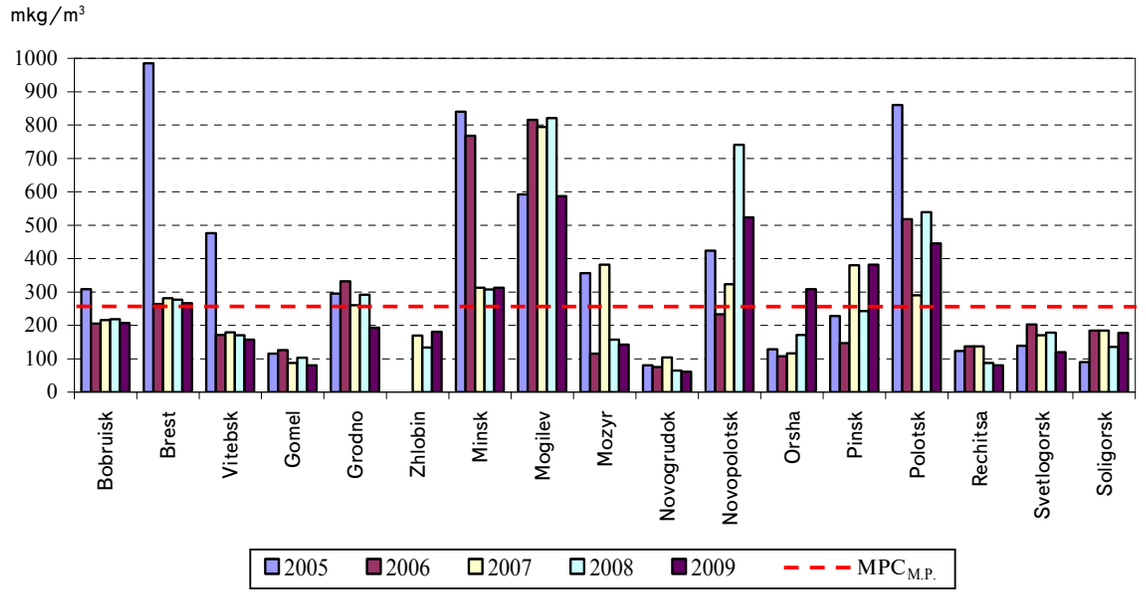

Figure 2.13 – Maximum single concentrations of nitrogen dioxide in the air in Belarus in 2005-2009

Table 2.13

Average annual concentrations of nitrogen dioxide in the air of cities of Belarus in 2005-2009, mkg/m³

City	2005	2006	2007	2008	2009
Bobruisk	26	26	27	44	36
Brest	27	31	29	26	23
Vitebsk	39	40	40	45	41
Gomel	21	23	20	19	21
Grodno	35	33	33	31	24
Zhlobin	–*	–	10	9	11
Minsk	40	39	33	31	34
Mogilev	49	50	57	57	53
Mozyr	18	18	18	24	21
Novogrudok	31	35	41	34	31
Novopolotsk	38	34	37	37	45
Orsha	17	22	20	24	22
Pinsk	19	22	18	27	33
Polotsk	41	42	43	38	52
Rechitsa	24	29	33	27	24
Svetlogorsk	23	45	46	60	46
Soligorsk	49	46	49	43	18
MPC	100				

* The substance was not determined.

In Mogilev, Polotsk and Novopolotsk during the period of 2006-2007 there were fixed from 1 to 12 days per year exceeding the daily average maximum permissible concentration of nitrogen dioxide *(Table 2.14)*. The most urgent situation is typical for Mogilev, where in Ostrovski Str within the specified period there were noted from 43 to 107 days with exceedances of the daily average maximum permissible concentration of nitrogen dioxide.

Interesting situation regarding air pollution with nitrogen dioxide is characteristic for Svetlogorsk. Despite the fact that average and maximum single concentration of the pollutant are below the limit values, during some years there is a record of a few days per year exceeding the daily average maximum permissible concentration of nitrogen dioxide. Moreover, for individual monitoring stations, this number ranges from 1 to 30 days.

During the five-year period (2005-2009) average content of nitrogen dioxide in the air in Brest, Grodno and Minsk reduced in 1,2-1,5 times, in Soligorsk – in 2,7 times. In Bobruisk, Mozyr, Novopolotsk, Orsha, Pinsk, Polotsk and Svetlogorsk it increased by 1,2-2,0 times, in Vitebsk, Gomel, Mogilev, Novogrudok and Rechitsa it did not change significantly.

Table 2.14

Number of days per year exceeding the daily average maximum permissible concentration of nitrogen dioxide in the air in Mogilev, Polotsk, Novopolotsk and Svetlogorsk in 2006-2009

Year	Mogilev	Polotsk	Novopolotsk	Svetlogorsk
2006	8	2	–	0
2007	5	2	1	15
2008	2	1	1	20
2009	12	11	4	1

Sulfur dioxide

The content of sulfur dioxide in the atmosphere of cities of Belarus is low during many years. It should be noted that the «key» is the use of natural gas as a fuel. With the end of heating season the content of sulfur dioxide in the air in most cities is below the limit of the concentration determination. Maximum of one-off concentrations in Novopolotsk and Mogilev in 2009 were at the level 0,3-0,4 MPC, in other cities – is significantly lower.

Formaldehyde

Annual average concentrations of formaldehyde in the air of most of the cities of Belarus in 2005-2009 were below the standard of quality. The only exception was Brest, Vitebsk, Orsha and Pinsk, where the average content of this pollutant over the entire period was higher than the MPC or near to it *(Table 2.15)*.

Regarding maximum single concentration of formaldehyde during the period 2005-2009 it exceeded the maximum permissible concentration in air almost in all the cities in the country from 1,4 to 10,2 times *(Fig. 2.14)*.

Minimum level of pollution is typical for Novogrudok and Zhlobin. Average annual concentrations of formaldehyde in the air in Polotsk, Mozyr, Brest, Pinsk and Vitebsk were carried out within 0,7-0,9 MPCs in other cities – 0,4-0,6 MPCs.

It should be noted that in 2009 the absolute values of maximum concentration of formaldehyde were significantly lower than in previous years. The average annual frequency of samples with concentrations of formaldehyde above the maximum single MPC in Brest was 3,1%, in Mogilev – 1,8%, in other cities – below 1%.

During five-year period the level of air pollution by formaldehyde in Bobruisk, Vitebsk, Gomel, Grodno, Rechitsa and Salihorsk decreased in 1,3-1,6 times, in Svetlogorsk – in 2,3 times. In Minsk, Orsha, Pinsk concentration of formaldehyde increased by 1,1-1,8 times, in Novogrudok – in 2,3 times. In Brest, Mozyr and Polotsk the

Table 2.15

Average annual concentrations of formaldehyde in the air of cities of Belarus in 2005-2009, mkg/m³

City	2005	2006	2007	2008	2009
Bobruisk	9.9	8.7	8.5	7.0	6.2
Brest	9.5	10.7	12.4	11.2	9.9
Vitebsk	14.7	13.4	13.5	11.0	10.9
Gomel	11.8	14.8	11.1	7.1	7.6
Grodno	7.8	4.5	5.7	5.2	5.5
Zhlobin	–*	–	4.8	1.9	2.9
Minsk	4.3	9.9	7.8	7.1	5.9
Mogilev	3.5	4.4	7.6	5.6	6.4
Mozyr	8.5	8.0	9.2	7.6	8.7
Novogrudok	0.7	1.6	2.5	2.5	1.6
Novopolotsk	7.7	8.5	5.5	5.8	7.4
Orsha	11.6	11.3	12.7	14.3	12.4
Pinsk	9.4	12.7	11.7	11.1	10.9
Polotsk	8.1	8.5	6.6	6.2	7.9
Rechitsa	9.6	8.5	8.5	8.6	6.8
Svetlogorsk	11.7	13.4	6.7	5.6	5.1
Soligorsk	7.0	8.9	11.1	9.4	5.0
MPC	12.0				

* The substance was not determined.

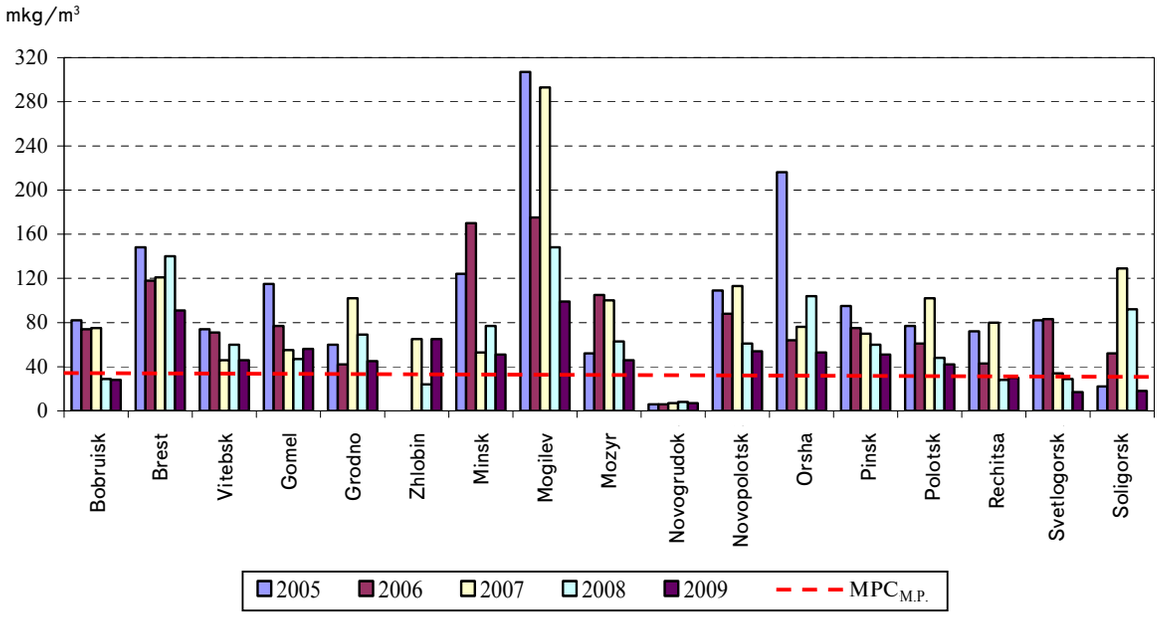

Figure 2.14 – Maximum single concentrations of formaldehyde in urban air in Belarus in 2005-2009

level of pollution by formaldehyde did not change.

The results of stationary observations on ambient air monitoring networks in 2005-2009 show that the state of atmospheric air in the cities of Belarus is good enough:

Annual concentrations of priority pollutants in most cities during the period remained below the quality standards;

Daily average concentration of total particulate matter and nitrogen dioxide exceeded the MPC only in selected cities;

Number of days with daily average concentration of particulate matter fraction PM-10 above the MPC were below the target adopted in the European Union in the Gomel, Vitebsk, Mogilev, Zhlobin and residential district of Minsk;

The maximum single MPC exceeded only in 0,25-0,50% of total number of analyzed samples. From 80 to 90% of the exceedances were in the range of 1-2 MPC, the concentration of pollutants more than 5 MPC were recorded less than 1% of the exceedances;

In 2009 compared with 2007 the number of «problem» areas with air pollution in the industrial centers of the country decreased by 22%.

However, in Orsha, some districts of Brest, Vitebsk and Pinsk for five years the level of air pollution by formaldehyde increased, in Mogilev, Polotsk, Novopolotsk and Svetlogorsk – by nitrogen dioxide. In

cities located in the southern region (Gomel, Zhlobin, Mozyr, Rechitsa) there is a problem of particulate air pollution. In two industrial regions of Minsk exceeds the target for particulate matter fraction PM-10.

According to the stationary observations over a five year period (2005-2009) in the majority controlled cities of the country there is a steady tendency to reduce air pollution by formaldehyde: annual concentrations decreased in average by 1.2 times, the maximum single – by 2,3 times. The content of sulfur dioxide in the atmosphere remains stable low. However, the content of nitrogen dioxide in the air in Bobruisk, Mozyr, Novopolotsk, Orsha, Pinsk, Polotsk and Svetlogorsk increased by 1,2-2,0 times. In the cities of Gomel region (Gomel, Mozyr, Rechitsa), Vitebsk and Grodno there is an increase in concentrations of particulate matter in 1,2-2,1 times.