COMPARATIVE SWOT ANALYSIS IN THE FRAME OF TAB PROJECT

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WP3: Transnational baseline and monitoring with stakeholder involvement

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1 INTRODUCTION

Comparative SWOT analysis define common fields of actions helping to prepare detailed plans of pilot actions, joint strategy for AAPs and to be fed into knowledge base built by CEUHEP.

The Comparative SWOT analysis is prepared on the basis of partners' SWOT analyses for The Šalek Valley (Slovenia), Sosnowiec (Poland), Várpalota (Hungary), Usti Region (Czech Republic) and Val Sangone Valley (Italy)). SWOT analysis was used within TAB project to evaluate strengths, weaknesses, opportunities and threats with the aim to analyse impact of polluted air and to select the right strategy of problem solving in further strategic development.

SWOT analysis involves specification of the objective of the project and identification of the internal and external factors that are favourable and unfavourable to achieve that objective.

Internal factors:

- Strengths: characteristics of the study area that give it an advantage over others.
- Weaknesses: characteristics of the study area that place it at a disadvantage relative to others.

External factors:

- Opportunities: external chances to improve the quality of air in the study area.
- Threats: external elements in the environment that could cause trouble for the achieving improvement of the quality of air in the study area.

Figure 1: The locations of the study areas in the frame of the project TAB. The Šalek Valley (Slovenia), Sosnowiec (Poland), Várpalota (Hungary), Usti Region (Czech Republic) and the Val Sangone Valley (Italy).

2 CHARACTERISTICS OF STUDY AREAS

2.1 VELENJE (THE ŠALEK VALLEY)

Velenje is located in the northern part of Slovenia.
Population: 44,925 (50.9% men, 49.1% women)
Area of region: 197.3 km²
Population density: 227.7 inhabitants/km^2
Municipalities: 3 (Velenje, Šoštanj, Šmartno ob Paki)

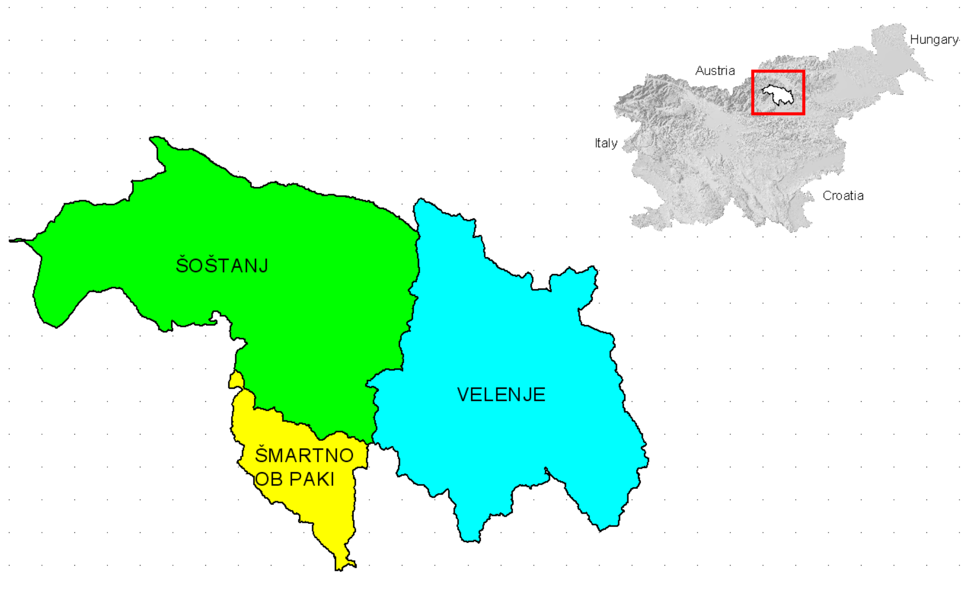


Figure 2: Map of the area of the Šalek Valley.

Most of the data (emission and emission concentration, health data) refers to the area, which besides the Municipality of Velenje includes also two other municipalities, Šoštanj and Šmartno ob Paki. This area is called the Šalek Valley, so this term will be most often used in the report.

2.1.1 Sources of air pollutants in the Šalek Valley

The most important source of air pollution in the Šalek Valley are industry and traffic, while small individual heating systems have no significant impact on air quality, since in the Šalek Valley district heating system is arranged. Among the industrial plants in the Šalek Valley, Šoštanj Thermal Power Plant is the most important plant, which contributed the largest amount of emissions in the study period. In the period from 2006 to 2010 it emitted nearly all of the SO_2

(99.9%), from 99.0% to 99.7% of NO_2 and 81.2% (2006) to 96.5% (2010) of total dust. In general, emissions of SO_2, NO_2 and total dust in the period 2006-2010 from the industry decreased (SO_2: 6196.9 t → 4041.7 t; NO_2: 9203.1 t 7→ 7854 t, total dust: 193.3 t → 154.8 t) (Fig. 3).

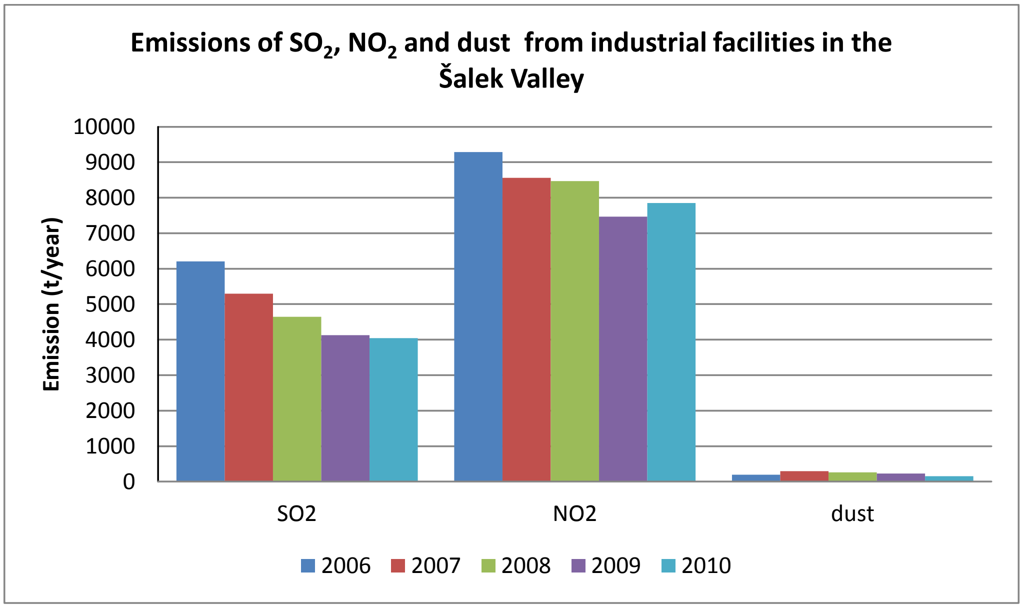


Figure 3: Emissions of SO_2, NO_2 and dust from industrial facilities in the Šalek Valley.

2.1.2 Imission concentrations of air pollutants at monitoring stations in the Šalek Valley

Average SO_2 emission concentrations in the period 2006-2010 did not exceed the limit value for the protection of ecosystems at any of the 8 locations/monitoring stations. Only in 2006, the concentration of SO_2 at the location Veliki vrh was equalized to this value. At the same time the number of exceedances of the hourly limit concentration for health protection was higher than it is permitted. Emission concentration of SO_2 after 2006 did not exceed the limit values for the protection of ecosystems and human health. The same was also true for NO_x, as in the period 2006-2010 the annual average NO_2 emission concentration did not exceed limit value for plant protection and for the protection of human health. (Fig. 4)

Average annual concentrations of PM_{10} during the study period did not exceed the threshold for human health. Number of days with exceeded maximum 24-hour concentration was smaller than it is prescribed, but the upper assessment threshold was exceeded. With the exception of the year

2008, the number of cases of exceeded threshold for 8-hour ozone concentration at the sampling points Zavodnje and Velenje was higher than it is the limit value for the protection of human health. The number of exceedances was particularly high in 2006 and 2007.

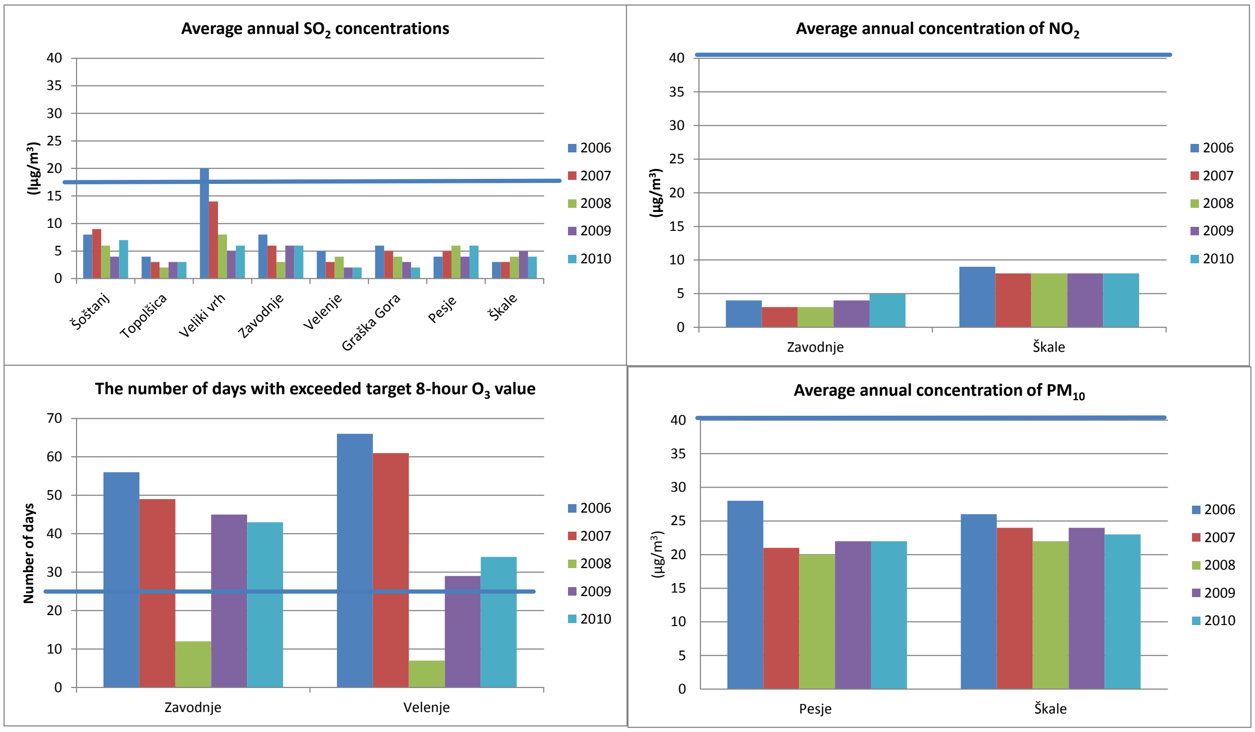


Figure 4: Average imission concentrations of different pollutants (SO_2, NO_2, O_3 and PM_{10}) in the Šalek Valley. Limit values are marked with blue lines.

2.1.3 Health data

According to the age structure of the population, the Šalek Valley ranks among the areas of the old population, since there were more than 13.3% of the population aged over 65 years (58.6% were women) in 2010. Specific mortality in a population of the Šalek Valley slightly increased in the period 2006 to 2010. The reason is probably in aging of the population, as the proportion of deaths in the age group above 85 years in 2010 was considerably higher in comparison with the year 2006.

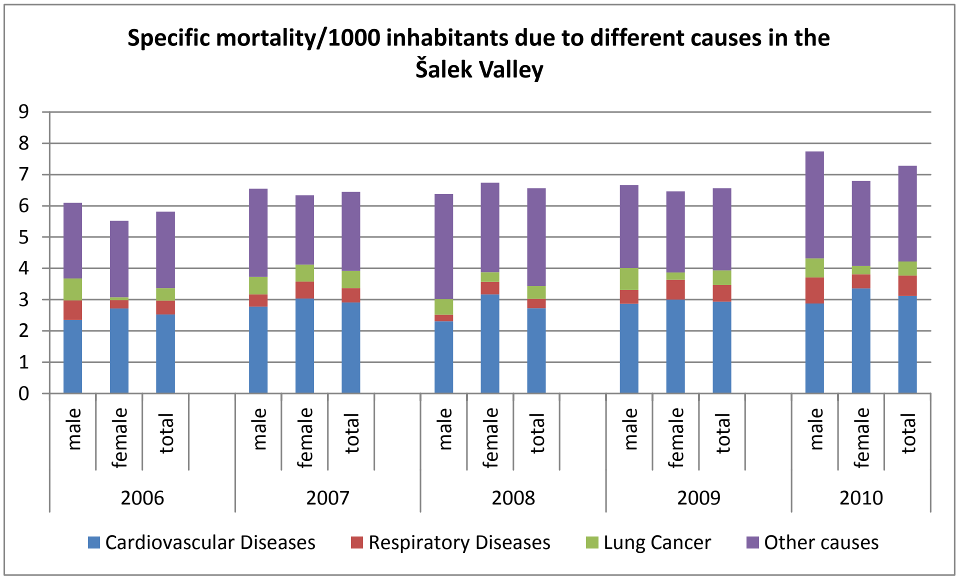


Figure 5: Specific mortality per 1000 inhabitants due to different causes in the Šalek Valley in the period 2006–2010 (Konec Juričič, 2012).

Table 1: Changes of mortality in time: standardized death rates per 100 000 inhabitants in the Šalek Valley (2006-2010).

Health outcome	ICD10	2006	2007	2008	2009	2010
All causes*	A00-R99	410.8	443.6	487.4	448.4	453.0
Cardiovascular mortality	I00-I99	143.1	181.3	200.3	219.8	208.1
Respiratory mortality	J00-J99	27.83	35.86	28.36	28.2	35.68
Lung cancer mortality	C33-34	28.92	28.98	28.3	26.65	20.51

Standard: European population, 1976

2.1.3.1 Health impact assessment of the benefit of the reduction of air pollutants

<u>Assessment of excess mortality on days when daily PM_{10} concentration exceeded the limit value (50 µg/m^3)</u>

Table 2 presents the excess total mortality in the period 2006-2010 on days when the daily PM_{10} concentration was >50 µg/m^3. The number of such days in mentioned period was between 10 and 19 days per year. Calculation shows that the short term impact of PM_{10} concentration on mortality on days with daily values exceeding the limit value is very negligible in Velenje; 2-4 cases per 1 million inhabitants could be attributed to "peak days".

Table 2: Deaths all non-external causes (ICD10 A00-R99). Attributable deaths on days when daily PM_{10} level was above 50 µg/m^3. Absolute number and number per 100 000 inhabitants attributable to the acute effects of PM_{10}.

Year	**Number of days per year exceeding 50 µg/m^3**	**N° of deaths**	**N° of deaths per 100 000**
2006	19	0.2	0.4
2007	10	0.1	0.2
2008	12	0.1	0.2
2009	13	0.2	0.4
2010	13	0.1	0.2

Short-term predictions to assess impacts of PM10 exceedances on the mortality of people

The daily mean PM_{10} concentration was at the measurement station Škale in the period 2006-2010 between 21.8-25.4 µg/m^3. Its reduction to 20 µg/m^3 could prevent 1-2 death cases per 100 000 residents due to non-external total mortality. The reduction by 5 µg/m^3 of all the 24-hour values of PM_{10} would prevent similar amount of death cases (2 cases per 100 000).

Table 3: Potential reduced total mortality (excluding external causes) due to reduced annual rate of PM_{10} pollution to 20 µg/m^3 or due to the reduction of 24-hour PM_{10} levels by 5 µg/m^3.

Year	Scenarios	Total annual number of deaths postponed	Annual number of deaths postponed per 100 000
2006	Decrease by 5 µg/m^3	0.8	1.7
2006	Decrease to 20 µg/m^3	0.9	1.9
2007	Decrease by 5 µg/m^3	0.9	1.9
2007	Decrease to 20 µg/m^3	0.7	1.4
2008	Decrease by 5 µg/m^3	0.9	2.0
2008	Decrease to 20 µg/m^3	0.3	0.7
2009	Decrease by 5 µg/m^3	0.9	2.0
2009	Decrease to 20 µg/m^3	0.6	1.4
2010	Decrease by 5 µg/m^3	1.0	2.2
2010	Decrease to 20 µg/m^3	0.6	1.2

Long-term predictions to assess impacts of $PM_{2.5}$ exceedances on the mortality of people

The long term reduction of $PM_{2.5}$ concentration by 5 µg/m^3 would prevent 26-31 death cases /100 000 people per year of all causes mortality, a reduction of $PM_{2.5}$ to 10 µg/m^3, would prevent similar number of cases (14-25 death cases /100 000 people per year). Similar benefits could be gained concerning cardiovascular mortality.

The benefits can also be expressed in the gains of life expectancy for a person of 30 years old due to reduced risk of death from all causes. If annual $PM_{2.5}$ levels in the town Velenje decrease by 5 µg/m^3, gain in life expectancy would be about 0.2-0.3 years, while when annual $PM_{2.5}$ levels decrease by 20 µg/m^3, gain in life expectancy would be about 1.6-2.6.

Table 4: Potential benefits of reducing annual $PM_{2.5}$ levels on total mortality and on life expectancy.

year	Scenarios	Total annual number of deaths postponed	Annual number of deaths postponed per 100 000	Gain in life expectancy (year)
2006	Decrease by 5 µg/m^3	8	26	0.2
2006	Decrease to 10 µg/m^3	7	24	2.6
2007	Decrease by 5 µg/m^3	8	29	0.3
2007	Decrease to 10 µg/m^3	4	14	1.5
2008	Decrease by 5 µg/m^3	9	29	0.3
2008	Decrease to 10 µg/m^3	4	14	1.5
2009	Decrease by 5 µg/m^3	8	29	0.3
2009	Decrease to 10 µg/m^3	6	20	2.3
2010	Decrease by 5 µg/m^3	9	31	0.3
2010	Decrease to 10 µg/m^3	5	17	1.8

2.2 SOSNOWIEC

Sosnowiec is located in the Silesian region. Silesia is the most industrialized and the most urbanized region in Poland.
Population: 209 758 (31.12.2011)
Area of region: 91.06 km^2
Population density: 2303 persons/km^2
Municipalities: 19 structural units

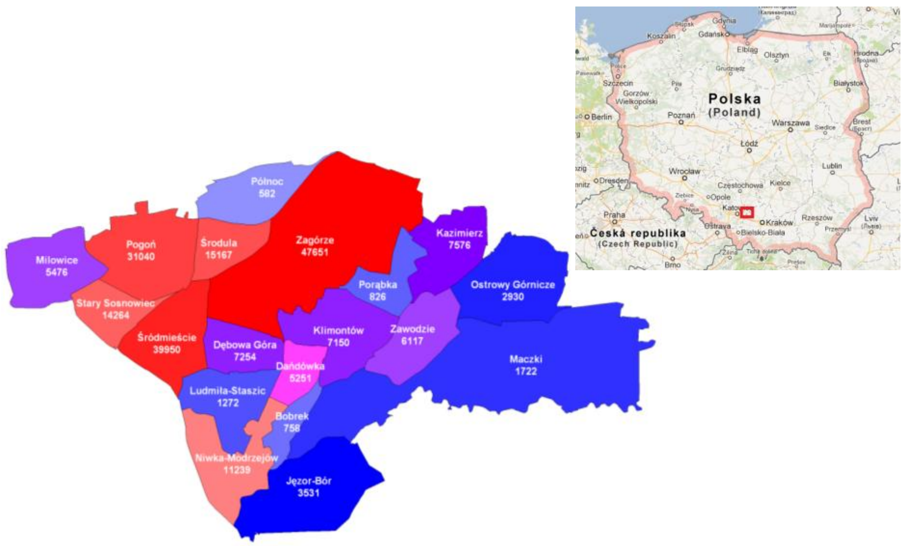


Figure 6: Map of the area of the Sosnowiec.

2.2.1 Sources of the air pollutants in Sosnowiec

The main air pollutants in Poland are gaseous precursors of particulate matter: carbon monoxide and sulphur dioxide. Increased emissions and excessive concentrations in the outdoor air take place in winter season. The highest concentrations of CO and SO_2 are triggered by coal related combustion processes. Significant source of emissions of pollutants are from traffic. The emission of gas and dust pollution has increased in last years. The highest increase was noted in the case of SO_2 and particulate matter (Table 5).

Table 5: Emission of main air pollutants from plants in Sosnowiec (expressed in tons/year)

Pollutant	2006	2007	2008	2009	2010	2011
	tons/year					
SO_2	519	452	445	509	686	1 018
NO_X	282	330	213	196	213	189
dust	116	140	173	162	217	149

Data source: www.stat.gov.pl

2.2.2 Imission concentrations of air pollutants at monitoring stations in Sosnowiec

The daily mean concentrations of SO_2, NO_2 and ozone were in period 2008-2010 under the limit values. In year 2006 and 2007 concentration of those pollutants were not measured. The daily mean concentration of PM_{10} in the period 2006-2010 each year exceeded the limit value (Fig. 7).

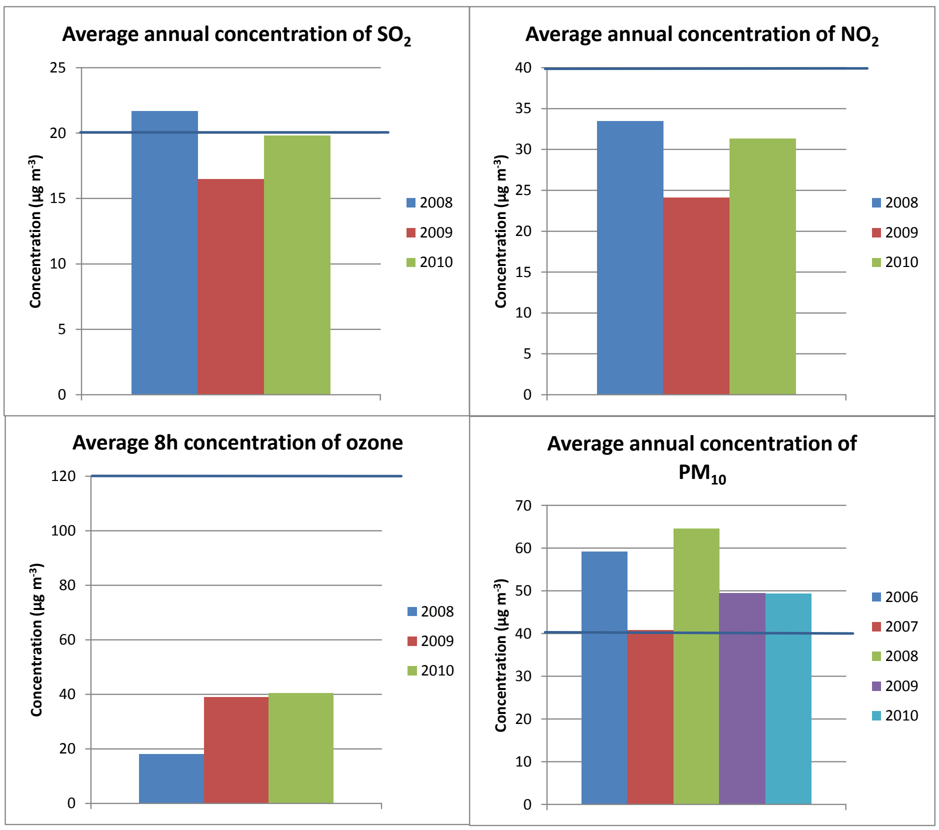


Figure 7: Average imission concentrations of different pollutants (SO_2, NO_2, O_3 and PM_{10}) in Sosnowiec. Limit values are marked with blue lines.

2.2.3 Health data

Table 6: Annual number of deaths and annual rate per 100 000 inhabitants in Sosnowiec (2008).

Health outcome	ICD10	Age	Annual mean number	Annual rate per 100 000
Non-external mortality*	A00-R99	All	2 401	1085
Cardiovascular mortality	I00-I52	All	1159	549
Respiratory mortality	J00-J99	all	142	64
Lung cancer mortality	C33-34	all	160	72

* Non-external mortality excludes violent deaths such as injuries, suicides, homicides, or accidents.

Table 7: Changes of mortality in time: standardized death rates per 100 000 inhabitants in Sosnowiec (2006-2010).

Health outcome	ICD10	2006	2007	2008	2009	2010
All causes	A00-R99	884.1	831.8	832	828.3	802.7
Cardiovascular mortality	I00-I99	414.8	390	398.4	385.6	371.2
Respiratory mortality	J00-J99	47.2	43.7	51.5	38.7	30.1
Lung cancer mortality	C33-34	61.6	54.1	53.8	57.1	52.4

Standard: European population, 1976

2.2.3.1 Health impact assessment of the benefit of the reduction of air pollutants

Assessment of excess mortality on days when daily PM_{10} concentration exceeded the limit value (50 µg/m^3)

The number of days when PM_{10} concentration was above the 50 µg/m^3 was in Sosnowiec the highest in 2006 (146) and 2009 (116). The attributable number of deaths due to all non-external causes was 441 (2006) and 386 (2009) per 100 000 inhabitants. The number of days with exceedence of the limit value was smaller in the other years (between 45 and 92 days) and the attributable number of deaths was 139 - 271 cases/100 000 inhabitants.

Table 8: Deaths all non-external causes (ICD10A00-R99). Attributable deaths on days when daily PM_{10} level was above 50 µg/m^3. Absolute number and number per 100 000 inhabitants attributable to the acute effects of PM_{10}.

Year	Number of days per year exceeding 50 µg/m^3	N° of deaths	N° of deaths per 100 000
2006	146	6.78	3.02
2007	92	6.54	2.94
2008	45	6.82	3.08
2009*	116	7.30	3.33
2010*	53	6.96	3.19

*In the years 2008 and 2009 measurements of PM_{10} were limited; they were conducted only 81 days in 2008 and 160 days in 2010.

Short-term predictions to assess impacts of PM_{10} exceedances on the mortality of people

The daily mean PM_{10} concentration was in Sosnowiec in the period 2006-2010 40-64 µg/m^3, and the reduction to 20 µg/m^3 could prevent 17-36 death cases per 100 000 due to non-external total mortality.

Table 9: Potential reduced total mortality (excluding external causes) due to reduced annual rate of PM_{10} pollution to 20 µg/m^3.

Year	Scenarios	Total annual number of deaths postponed	Annual number of deaths postponed per 100 000
2006	Decrease to 20 µg/m^3	70.1	31.3
2007	Decrease to 20 µg/m^3	38.8	17.4
2008	Decrease to 20 µg/m^3	80.2	36.2
2009	Decrease to 20 µg/m^3	53.6	24.4
2010	Decrease to 20 µg/m^3	55.2	25.4

2.3 VÁRPALOTA

Várpalota is located in western part of Hungary.
Population: 20 482 (2010)
Area of region: 77.26 km²
Population density 267.8 inhabitants/km^2
Number of municipalities: 1

Figure 8: Map of the area of the city of Várpalota.

2.3.1 Sources of air pollutants in Várpalota

Mining, energy and chemical industry have a long tradition in Várpalota and its surroundings and it has strategic economic position in the regional and national economy. Nowadays probably the most significant is the big chemical industrial company (processing nitrogen), Nitrogénművek Zrt (www.nitrogen.hu). Although it takes effort to reduce emission, it can be the biggest industrial potential polluter in the region.

2.3.2 Imission concentrations of air pollutants at monitoring stations in Várpalota

The municipal air quality according to SO_2 (highest hourly average: 29.0 µg/m^3, 24-hour average: 29.0 µg/m^3) is excellent. Air quality on concentration of NO_2 (highest hourly average: 27.7 µg/m^3, 24-hour average: 26.7 µg/m^3), NOx (highest hourly average: 45.80 µg/m^3, 24-hour average: 45.8 µg/m^3) and O_3 (highest 8-hour average: 78.3 µg/m^3) is good (Annual report on Air Quality, 2012). Occasionally threshold value of 24-hour concentrations of PM_{10} has been exceeded and the occurrence of temperature inversions and smog. It is one of the most smog-effected city in Hungary. Although the 24-hour average of PM_{10} in the years 2007-2010 did not exceeded the limit level 40 µg/m^3, there were many days per year (between 50 and 137 days (average 86.2)), when the threshold 50 µg/m^3 has been exceeded (Fig. 9).

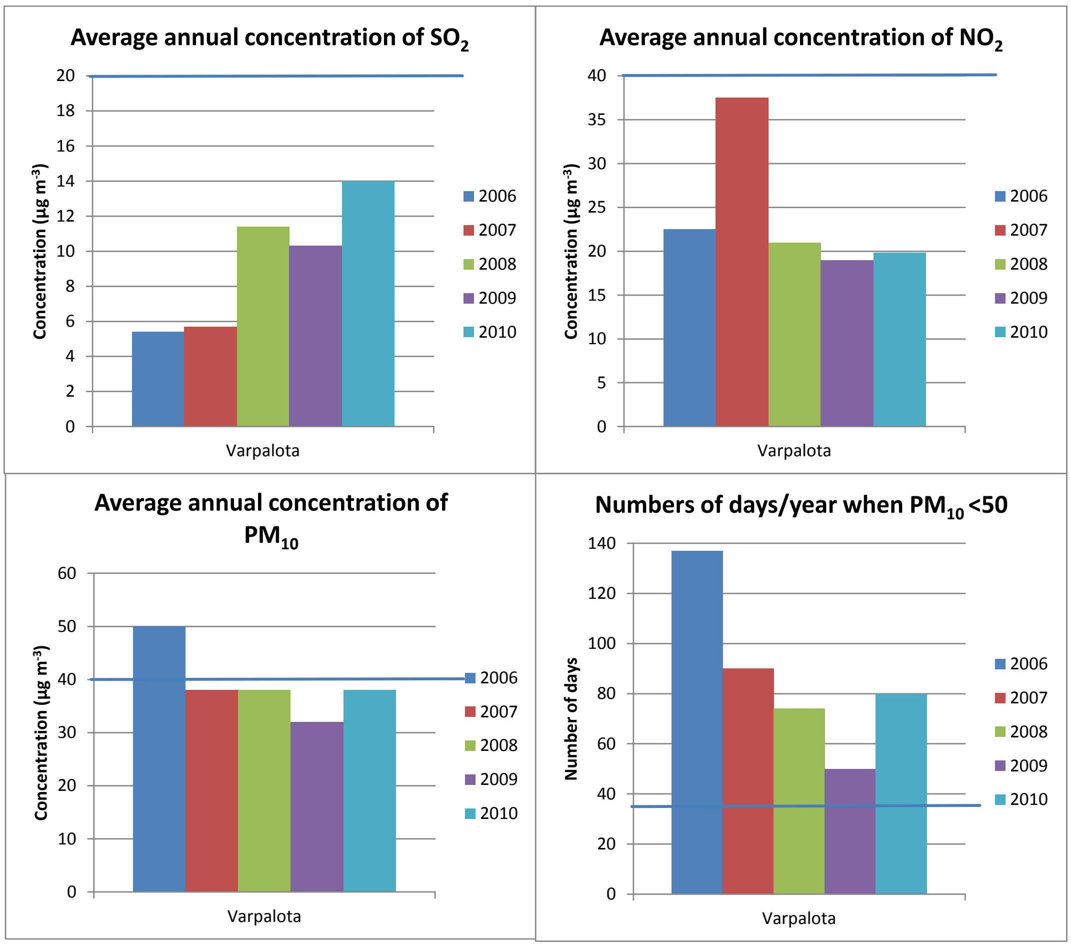


Figure 9: Average imission concentrations of different pollutants (SO_2, NO_2, and PM_{10}) in Várpalota. Limit values are marked with blue lines.

2.3.3 Health data

Table 10: Changes of mortality in time: standardized death rates per 100 000 inhabitants in Sosnowiec (2006-2010).

Health outcome	ICD10	2006	2007	2008	2009	2010
All causes	A00-R99	955.47	912.00	908.12	807.37	908.96
Cardiovascular mortality	I00-I99	448.98	485.74	435.14	392.46	435.21
Respiratory mortality	J00-J99	36.67	35.46	44.34	24.08	38.69

Standard: European population. 1976

2.3.3.1 Health impact assessment of the benefit of the reduction of air pollutants

Assessment of excess mortality on days when daily PM_{10} concentration exceeded the limit value (50 µg/m³)

The number of days when PM_{10} concentration was above the 50 µg/m³ was in Várpalota the highest in 2006. The attributable death due to all non-external causes was 8 per 100 000 inhabitants. The number of days with exceedence of the limit value was smaller in the following years (between 50-90 days) and the attributable number of deaths was 2-4 cases/100 000 inhabitants.

Table 11: Deaths all non-external causes (ICD10A00-R99).

Year	Number of days per year exceeding 50 µg/m³	N° of deaths	N° of deaths per 100 000
2006	137	1.8	8.3
2007	90	0.7	3.2
2008	74	0.8	3.7
2009	50	0.4	1.9
2010	80	0.9	4.2

Short-term predictions to assess impacts of PM_{10} exceedances on the mortality of people

The daily mean PM_{10} concentration was in Várpalota in the period 2006-2010 33-49.8 µg/m³, and the reduction to 20 µg/m³ could prevent 12-22 death cases per 100 000 due to non-external total mortality. A reduction by 5 µg/m³ of all the 24-hour values of PM_{10} would prevent 3-4 deaths cases per 100 000 inhabitants.

Table 12: Potential benefits of reducing annual PM_{10} levels on total non-external mortality.

Year	Scenarios	Total annual number of deaths postponed	Annual number of deaths postponed per 100 000
2006	Decrease by 5 $\mu g/m^3$	0.8	3.6
2006	Decrease to 20 $\mu g/m^3$	4.8	21.9
2007	Decrease by 5 $\mu g/m^3$	0.7	3.4
2007	Decrease to 20 $\mu g/m^3$	2.7	12.2
2008	Decrease by 5 $\mu g/m^3$	0.7	3.4
2008	Decrease to 20 $\mu g/m^3$	2.7	12.3
2009	Decrease by 5 $\mu g/m^3$	0.6	3.0
2009	Decrease to 20 $\mu g/m^3$	1.7	7.8
2010	Decrease by 5 $\mu g/m^3$	0.7	3.5
2010	Decrease to 20 $\mu g/m^3$	2.7	12.6

Short-term predictions to assess impacts of $PM_{2.5}$ exceedances on the mortality of people

The long term reduction of $PM_{2.5}$ concentration by 5 $\mu g/m^3$ would prevent 43-51 death cases per 100 000 inhabitants due to all-cause mortality in Várpalota, more reduction of $PM_{2.5}$ (to 10 $\mu g/m^3$) would prevent 2-4 times more (78-183) death cases (Table 13). Similar benefits could be gained concerning cardiovascular mortality. The benefits can also be expressed in the gains of life expectancy for a person of 30 years old due to reduced risk of death from all causes in Várpalota: the gain from a reduction of annual $PM_{2.5}$ levels to 10 $\mu g/m^3$ would be between 1.6-2.6 years, while a reduction by 5 ug/m^3 would result only in 0.2-0.3 years' gain.

Table 13: Potential benefits of reducing annual $PM_{2.5}$ levels on total mortality and on life expectancy.

year	Scenarios	Total annual number of deaths postponed	Annual number of deaths postponed per 100 000	Gain in life expectancy (year)
2006	Decrease by 5 $\mu g/m^3$	7	51	0.3
2006	Decrease to 10 $\mu g/m^3$	26	183	14.4
2007	Decrease by 5 $\mu g/m^3$	6	46	0.3
2007	Decrease to 10 $\mu g/m^3$	15	108	8.6
2008	Decrease by 5 $\mu g/m^3$	7	49	0.3
2008	Decrease to 10 $\mu g/m^3$	16	116	8.5
2009	Decrease by 5 $\mu g/m^3$	6	43	0.3
2009	Decrease to 10 $\mu g/m^3$	11	78	6.8
2010	Decrease by 5 $\mu g/m^3$	7	50	0.3
2010	Decrease to 10 $\mu g/m^3$	17	117	0.7

Short-term predictions to assess impacts of ozone exceedances on the mortality of people

For ozone, WHO set two guideline values for maximum 8-hours target value. The interim target value (WHO-IT1) is set at 160 μg/m^3. The purpose of the interim value is to define steps in the progressive reduction of air pollution in the most polluted areas. This was not relevant for Várpalota, while the maximum concentration of 8 hours was always below 160 μg/m^3. The second value, the air quality guideline value (WHO-AQG) is set at 100 μg/m^3.

Two scenarios were drawn:

1. scenario, where all maximum 8-hours values above 100 μg/m^3 were reduced to WHO-AQG (100 μg/m^3)
2. scenario, where all daily mean values is decreased by 5 μg/m^3.

Table 14: Potential benefits of reducing daily ozone levels on total non-external*[1] mortality.

year	Scenarios	Total annual number of deaths postponed	Annual number of deaths postponed per 100 000
2006	Decrease to 100 μg/m^3	0.1	0.6
2006	Decrease by 5 μg/m^3	0.4	1.9
2007	Decrease to 100 μg/m^3	0.1	0.5
2007	Decrease by 5 μg/m^3	0.4	1.7
2008	Decrease to 100 μg/m^3	0.1	0.5
2008	Decrease by 5 μg/m^3	0.4	1.7
2009	Decrease to 100 μg/m^3	0.0	0.0
2009	Decrease by 5 μg/m^3	0.4	1.7
2010	Decrease to 100 μg/m^3	0.0	0.2
2010	Decrease by 5 μg/m^3	0.4	1.8

*[1]Non-external mortality excludes violent deaths such as injuries, suicides, homicides or accidents.

The decrease of the maximum 8-hours values of O_3 concentration to 100 μg/m^3 in each day would produce negligible benefit: maximum 1 death per 100 000 would be avoidable. A slightly higher benefit could be achieved if the all maximum 8-hours values of O_3 concentration would be reduced by 5 μg/m^3: it could result in the avoidance of 2 death cases per 100 000.

2.4 USTI REGION

The Usti Region is located in the northwest of the Czech Republic.
Population: 827 508 (30.3.2012)
Area of region: 5 335 km² (533 500 ha)
Municipalities: 354; 7 districts

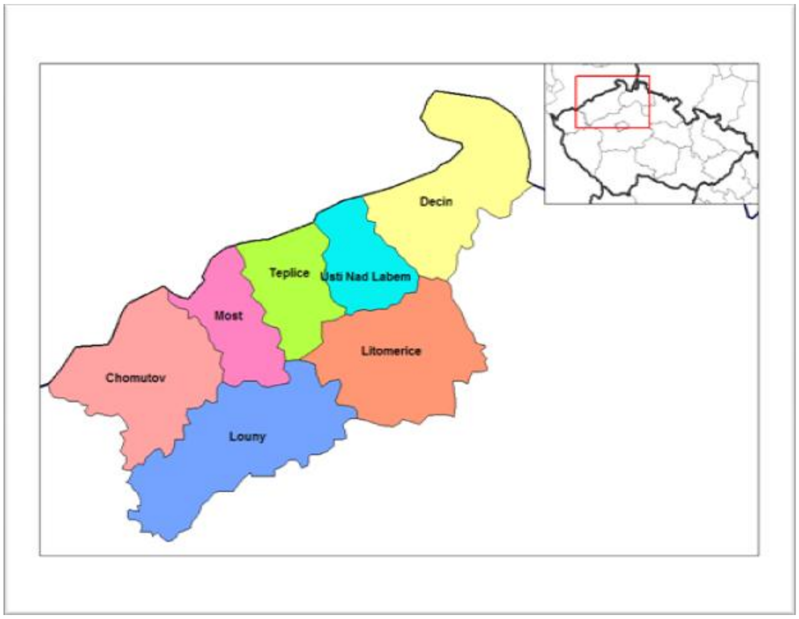


Figure 10: Map of the y area Usti Region.

There are some different areas in the region:

1. the area with highly developed industrial production concentrated particularly in the Ore mountains area (districts of Chomutov, Most, Teplice, partially Ústí nad Labem). Power engineering, coal mining, engineering, chemical and glass industries belong to important branches in this area.
2. areas of Litoměřice and Louny, which are important for their production of hop, wine, fruit and vegetable.
3. the area of Dečín concentrates mainly the light engineering and processing industries. This area, together with Šluknov foreland, is because of its natural resources used particularly for the development of tourism.

2.4.1 Sources of air pollutants in the Usti Region

Air quality in the area of Usti Region is much better than 20 years ago. Emission of the pollution substances in the Usti region significantly decreased. Since 1994 the big sources of pollution, which have 70% share in total emission of stationary source, reduced their emissions of particulate matters almost by 94% and similar reduction was achieved also from the medium and small-sized-sources of pollution.

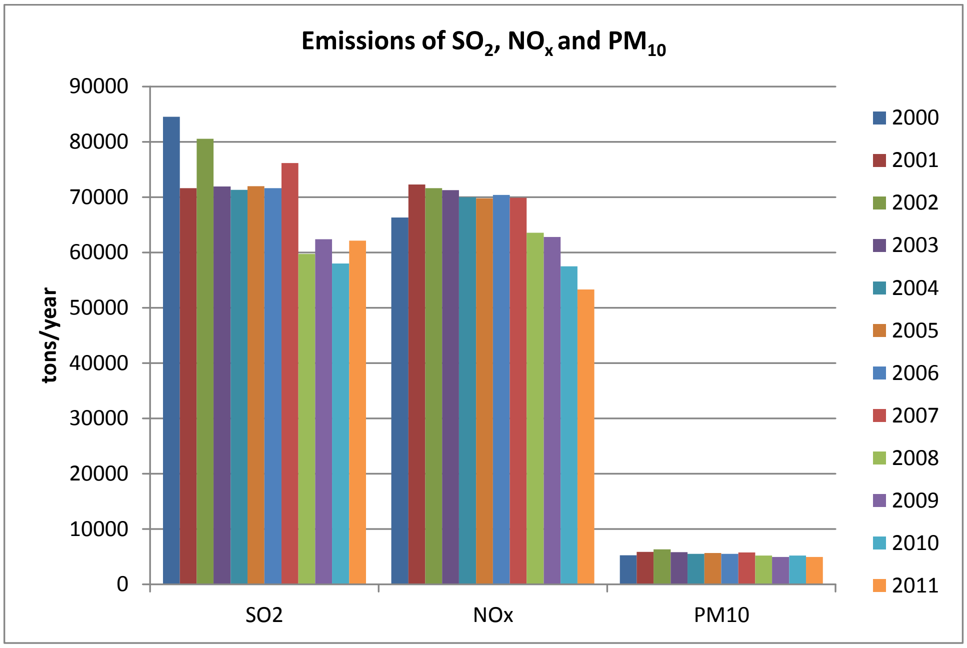


Figure 11: Emissions of SO_2, NO_2 and PM_{10} from sources of air pollution in Usti Region in the period 2000-2011.

The major sources of air pollution in the Usti Region are steam coal power plants (ČEZ. a.s.), located in the districts of Chomutov, Louny and Teplice. From the Fig. 11, it can be recognized that the total amount of emitted pollutants (SO_2 and NOx) in the past 10 years has a downward trend. The emissions of particulate matter (PM) remained unchanged.

Table 15: Main sources of air pollution in Usti Region, 2010 (expressed in tons/year).

Pollutant	Road	Heating	Industry	Total
SO_2	35.7	2 118.6	55 851.00	58 005.30
NO_x	6 461.9	456.9	50 561.60	57 480.40
PM_{10}	1 778.3	1 236.4	2 150.60	5 165.30

2.4.2 Imission concentrations of air pollutants at monitoring stations in the Usti Region

On the territory of the Usti Region exceedance of ambient air pollutant annual limit values for PM_{10} were defined (Fig. 12). The concentrations of other pollutants remained under the limit values.

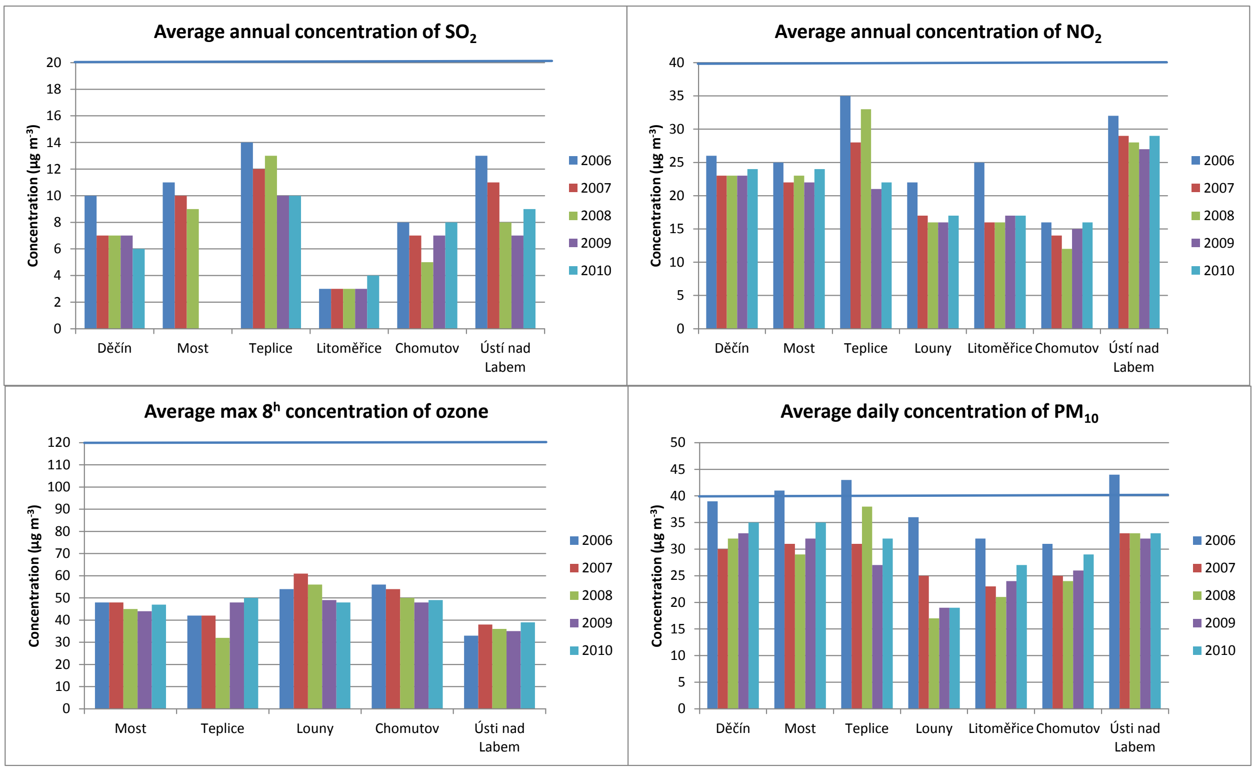


Figure 12: Average imission concentrations of different pollutants (SO_2, NO_2, O_3 and PM_{10}) in the Usti Region. Limit values are marked with blue lines.

2.4.3 Health data

Relatively young population lives in the Usti Region. The average age in the region is almost 40 years. However, the population in the Usti Region is getting older. In the next years the population will decrease in the age group of 0 -14 years (15% of population in 2008) and increase in age groups of 15 – 64 years (72% of population in 2008) and 65 years and above (13% of population in 2008).

Table 16: Annual number of deaths and annual rate per 100 000 inhabitants in Usti Region (2008).

Health outcome	ICD10	Age	Annual number of deaths (males)	Annual rate per 100 000 (males)	Annual number of deaths (females)	Annual rate per 100 000 (females)
Non-external mortality*	A00-R99	all	4 126	1 003	4 146	980
Cardiovascular mortality	I00-I99	all	1 994	484.8	2354	556.4
Respiratory mortality	J00-J99	all	231	56.2	229	54.1
Lung cancer mortality	C33-34	all	391	95.1	151	35.7

* Non-external mortality excludes violent deaths such as injuries, suicides, homicides or accidents.

Table 17: Changes of mortality in time: standardized death rates per 100 000 inhabitants in Usti Region (2006-2010).

Health outcome	ICD10	2006	2007	2008	2009	2010
All causes	A00-R99	776.4	765.6	749.6	720.3	799.4
Cardiovascular mortality	I00-I99	356.4	305.6	305.8	316.6	344.9
Respiratory mortality	J00-J99	42.30	34.2	34.2	43.1	53.1
Lung cancer mortality	C33-34	46.87	50.9	50.9	45.7	53.3

Standard: European population. 1976

2.4.3.1 Health impact assessment of the benefit of the reduction of air pollutants

Assessment of excess mortality on days when daily PM_{10} concentration exceeded the limit value (50 $\mu g/m^3$)

Table 18 present the excess mortality due to different causes on days when the daily PM_{10} concentration was >50 $\mu g/m^3$. Calculation shows that the short term impact of PM_{10} concentration on mortality on days, when daily values exceeding the limit value is in Usti Region negligible. Considering the impact on total mortality, 2 - 6 cases per 100 000 inhabitants could be attributed to “peak days” in Usti nad Labem, the highest excess mortality was calculated for towns of Most and Teplice (7-8 cases). In the case of specific mortality, the impact is even less: 1 - 3 cases due to cardiovascular diseases and 1 case due to respiratory diseases per 100 000 inhabitants.

Table 18: Excess mortality due to all non-external causes (ICD10A00-Q99) on days when the daily PM_{10} concentration was >50 µg/m^3 in Usti nad Labem.

Year	Number of days per year PM>50 µg/m^3	N° of deaths	N° of deaths per 100 000
2006	86	5.3	5.6
2007	53	1.7	1.8
2008	53	2	2.1
2009	48	1.9	2.0
2010	64	3.3	3.5

Table 19: Number of days with daily mean PM_{10} concentration >50 µg/m^3 and number of attributable death cases due to all causes in 6 town of Usti Region, 2006-2010.

	Chomutov		Litomerice		Most		Teplice		Decin		Louny	
Year	N° of days per year <50 µg/m^3	N° of excess deaths	N° of days per year <50 µg/m^3	N° of excess deaths	N° of days per year <50 µg/m^3	N° of excess deaths	N° of days per year <50 µg/m^3	N° of excess deaths	N° of days per year <50 µg/m^3	N° of excess deaths	N° of days per year <50 µg/m^3	N° of excess deaths
2006	45	2.6	37	2.2	82	6.9	82	8.4	74	5.0	69	3.3
2007	24	0.8	30	1.3	58	2.0	45	2.7	44	1.8	16	0.7
2008	16	0.5	19	1.0	38	1.3	27	-	54	2.3	6	0.1
2009	35	1.2	29	1.9	46	2.3	25	2.2	55	3.2	8	0.7
2010	48	2.1	41	2.6	61	4.0	40	5.6	73	4.2	16	0.6

Short-term predictions to assess impacts of PM_{10} exceedances on the mortality of people

The average daily PM_{10} concentration was in the town Usti nad Laben in the period 2006 – 2010 between 31.6-43.5 µg/m^3, thus the reduction to 20 µg/m^3 could prevent 8 death cases/100.000 residents, while a reduction by 5 µg/m^3 of all measured 24-hour values of PM_{10} would prevent similar number of death cases due to non-external total mortality. (Table 20)

Table 20: Potential benefits of reducing annual PM_{10} levels on total non-external* mortality in Usti nad Labem

year	Scenarios	Total annual number of deaths postponed	Annual number of deaths postponed per 100 000
2006	Decrease by 5 $\mu g/m^3$	2.7	13.1
2006	Decrease to 20 $\mu g/m^3$	2.9	13.9
2007	Decrease by 5 $\mu g/m^3$	2.8	7.0
2007	Decrease to 20 $\mu g/m^3$	2.9	7.4
2008	Decrease by 5 $\mu g/m^3$	2.8	7.4
2008	Decrease to 20 $\mu g/m^3$	2.9	7.8
2009	Decrease by 5 $\mu g/m^3$	2.7	6.4
2009	Decrease to 20 $\mu g/m^3$	2.9	6.8
2010	Decrease by 5 $\mu g/m^3$	3.1	8.0
2010	Decrease to 20 $\mu g/m^3$	3.2	8.4

* Non-external mortality excludes violent deaths such as injuries, suicides, homicides or accidents

Long-term predictions to assess impacts of $PM_{2.5}$ exceedances on the mortality of people

The long term reduction of $PM_{2.5}$ concentration by 5 $\mu g/m^3$ would prevent 15- 32 of death cases of all causes mortality, more reduction of $PM_{2.5}$ (to 10 $\mu g/m^3$), would prevent two-three times more (27-89) death cases (Table 21). Similar benefits could be gained concerning cardiovascular mortality. The benefits can also be expressed in the gains of life expectancy for a person of 30 years old due to reduced annual $PM_{2.5}$ levels. If annual $PM_{2.5}$ levels in the town Usti nad Labem decrease by 5 $\mu g/m^3$, gain in life expectancy would be about 0.3 years, while annual $PM_{2.5}$ levels decrease by 20 $\mu g/m^3$, gain in life expectancy would be about 6 year.

Table 21: Potential benefits of reducing annual $PM_{2.5}$ levels on total mortality and on life expectancy in Usti nad Labem.

year	Scenarios	Total annual number of deaths postponed	Annual number of deaths postponed per 100 000	Gain in life expectancy
2006	Decrease by 5 $\mu g/m^3$	31	52	0.3
2006	Decrease to 10 $\mu g/m^3$	89	149	10.4
2007	Decrease by 5 $\mu g/m^3$	15	54	0.3
2007	Decrease to 10 $\mu g/m^3$	27	96	6.1
2008	Decrease by 5 $\mu g/m^3$	16	50	0.3
2008	Decrease to 10 $\mu g/m^3$	30	94	6.1
2009	Decrease by 5 $\mu g/m^3$	32	53	0.3
2009	Decrease to 10 $\mu g/m^3$	53	88	5.9
2010	Decrease by 5 $\mu g/m^3$	15	53	0.3
2010	Decrease to 10 $\mu g/m^3$	28	96	6.1

2.5 THE VAL SANGONE VALLEY

Population: 30,360 inhabitants (31/12/2010)
Area of region: 167.91 km^2
Population density: 180.7 inhabitants / km^2
Municipalities: 6 (Giaveno, Coazze, Valgioie, Reano, Trana, Sangano)

Figure 13: Map of the area of the Val Sangone Valley.

2.5.1 Sources of air pollutants in the Val Sangone Valley

The main air pollutants in the Val Sangone Valley are nitrogen oxides (NO_x) and particulate matter (PM_{10}): the main source of air pollution in the district is road transport, in particular heavy trucks and commercial vehicles traffic, related especially to diesel engines and to re-suspension of particulate deposited on the road surface. Another important source of air pollution is domestic heating systems (used fuel is mostly wood) that increases emission levels in winter. Some small industrial plants (paper and glass manufactures), which are presented inside the district, are mainly responsible for emission of sulphur dioxide (SO_2) and nitrogen oxides (NO_X).

Table 22: Main sources of air pollutants in the Val Sangone Valley (emissions expressed in tons/year).

Sources/pollutant	Year	SO_2	NOx	PM_{10}
Heating	2005	15.0	78.2	32.7
	2007	11.4	72.2	32.5
	2008	6.5	54.2	102.0
Industry	2005	2.7	7.4	10.1
	2007	3.9	23.4	5.7
	2008	17.8	11.0	0.7
Road Traffic	2005	6.2	142.7	36.1
	2007	4.8	114.8	22.0
	2008	1.0	120.1	30.8
Agriculture	2005	0.0	2.7	0.0
	2007	0.0	0.7	0.3
	2008	0.0	0.3	0.3
Other Sources	2005	0.2	14.7	2.2
	2007	0.2	13.6	2.5
	2008	0.0	13.0	1.1
Total	2005	24	246	81
	2007	20	225	63
	2008	25	199	135

Data source: Piedmont Region - http://www.sistemapiemonte.it/ambiente/irea/

2.5.2 Imission concentrations of air pollutants in the Val Sangone Valley

The exposure data (related to PM_{10}, NO_2, SO_2 and O_3 concentrations) for the six cities located in the Val Sangone Valley are obtained combining two sources of information: air quality monitoring network and numerical models. There are no air quality monitoring stations in the Val Sangone Valley. To fulfil the lack of information about air quality in this region, the air quality Chemistry Transport Models (CTMs) was used. Such models can provide complex spatial information about pollutant concentrations based on the fundamental description of atmospheric physical and chemical processes involving emissions, meteorology and chemical transformations.

Air quality assessment showed that the annual average of 24 hour concentrations of PM_{10} is widely under the limit value for each year and for each city located in the Val Sangone Valley. In the Sangano, Trana, Reano cities, probably due to their proximity to the Torino urban area, the 24-hour limit value was exceeded more than 35 times in each year, while in Coazze and Giaveno this exceedences happened only in the year 2007 and 2008. However there is a clear decreasing trend in the PM_{10} concentrations over the study area.

The annual average of hourly concentrations of NO_2 was always below the upper assessment threshold established by Directive 2008/50/EC. In the Coazze, Giaveno and Valgioie cities the annual average was also under the lower assessment threshold. No hourly limit value exceedences were observed.

The average ozone eight-hour concentrations in the whole study area are over the threshold established by Directive 2008/50/EC. The maximum value of daily eight-hour mean distribution is 25% - 60% higher than target value (120 μg/m^3) and the number of exceedences of long-term objective is always greater than 25 days established by European law.

Yearly, daily and also hourly concentrations of SO_2 in the whole study area are low, always widely below the assessment threshold established by Directive 2008/50/EC.

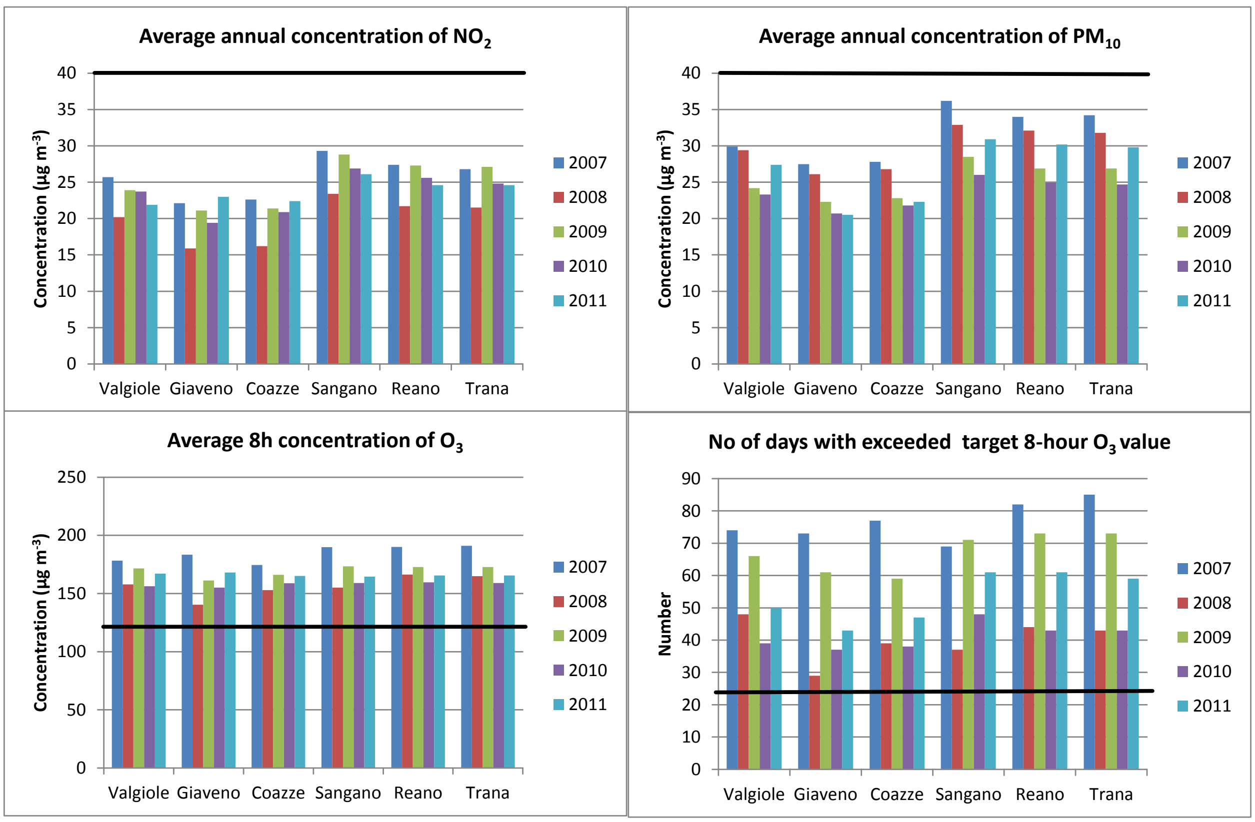


Figure 14: Average imission concentrations of different pollutants (SO_2, NO_2, O_3 and PM_{10}) in the Val Sangone Valley (Based on the air quality Chemistry Transport Models (CTMs)). Limit values are marked with bolded lines.

2.5.3 Health data

Table 23: Mortality due to all natural causes (ICDX: A00-R99) in the period 2006-2009. (Natural mortality excludes violent deaths such as injuries, suicides, homicides or accidents).

MALES			
Municipality	Observed annual mean deaths 2006-2009	Annual mean population	Annual Crude Rate per 100.000
Coazze	17	1,660	1,024.02
Giaveno	76	7,744	981.47
Orbassano	86	10,731	796.75
Reano	7	798	877.33
Sangano	16	1,821	892.24
Torino	4338	432,095	1,003.95
Trana	13	1,840	720.11
Valgioie	3	476	525.62
Total area	4556	457,165	996.47
Piedmont Region	22145	2,131,267	1,039.03

FEMALES			
Municipality	Observed annual mean deaths 2006-2009	Annual mean Population	Annual Crude Rate per 100.000
Coazze	16	1,563	1,007.68
Giaveno	115	8,315	1,386.07
Orbassano	79	11,286	702.19
Reano	8	809	927.07
Sangano	21	1,941	1,056.09
Torino	4694	473,587	991.16
Trana	12	1,877	652.81
Valgioie	4	428	993.57
Total area	4949	499,806	990.13
Piedmont Region	24379	2,263,895	1,076.85

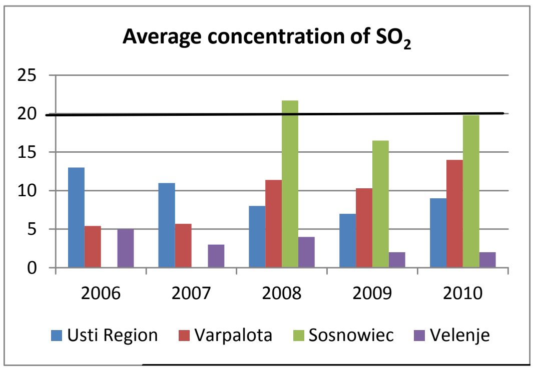
2.5.3.1 Health impact assessment of the benefit of the reduction of air pollutants

Health impact assessment was not calculated, due to lack of regullary monitoring of air in the region.

3 COMPARISON AMONG STUDY REGIONS REGARDING AIR POLLUTANTS AND HEALTH DATA

3.1 THE QUALITY OF THE AIR

The daily concentration of NO_x and SO_2 occasionally exceeded limit values in Sosnowiec, Várpalota and Usti region, but average annual values were in general under the limit values.



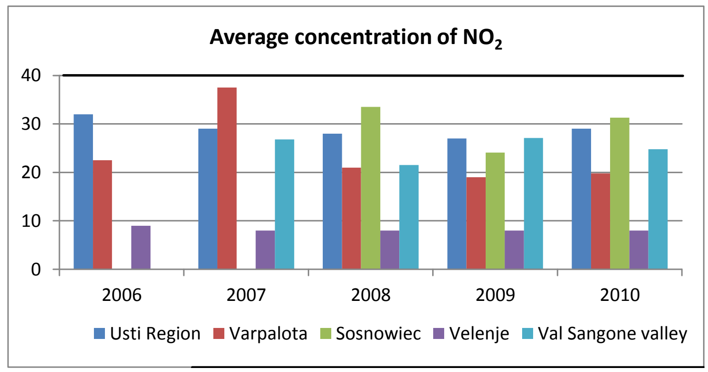


Figure 15: Average yearly SO_2 and NO_2 concentrations in studied areas in the period 2006-2010.

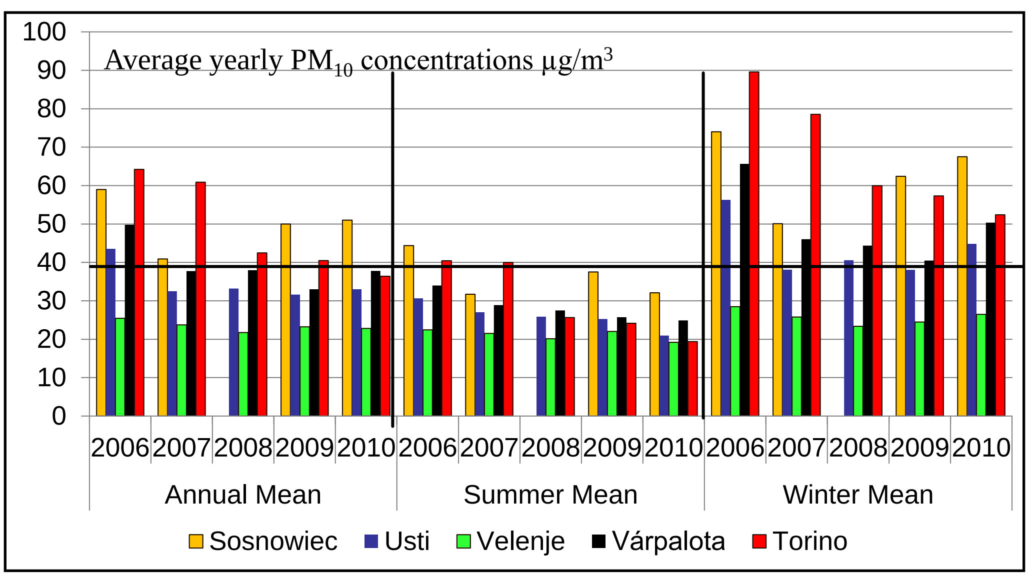


Figure 16: Average yearly PM_{10} concentrations in studied areas in the period 2006-2010. The data for Sosnowiec is missing for the year 2008, when measurement of PM_{10} was taken only 81 days. (Source: Páldy et al., 2013).

Average yearly 24-hour PM_{10} concentrations exceeded limit value 40 µg/m^3 at some study areas in the period 2006-2010 but trend was in general decreasing.

While in 2006 at all regions (except Velenje) limit value for PM_{10} was exceeded, in 2010 the exceedance was measured only in Sosnowiec. However the winter concentrations caused much more concern – limit value was exceeded at all regions, except in Velenje and in the years 2007 and 2009 in Usti region during the whole studied period. For the Val Sangone Valley the data for city Torino (lies outside the district) was used, because within Val Sangone Valley there was not regularly monitoring of air. The limit value was the most exceeded in Torino and Sosnowiec. Beside the information of average yearly 24-hour PM_{10} concentrations, it is very important information about the number of days, when daily value 50 µg/m^3 was exceeded (EU legislation: 35 days with daily conc>50 µg/m^3 are allowed in a year).

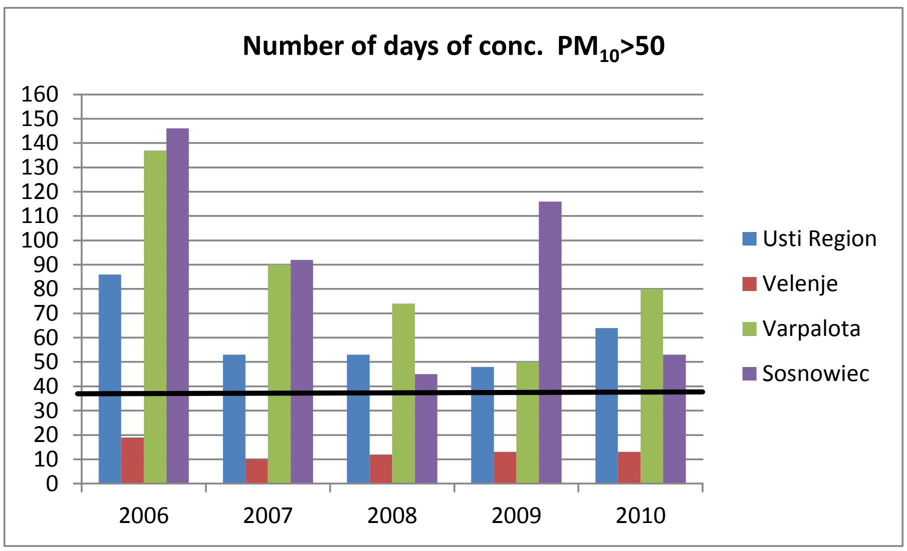


Figure 17: Number of days, when daily value 50 µg/m^3 was exceeded (EU legislation: 35 days with daily conc>50 µg/m^3 are allowed in a year). In Sosnowiec measurements of PM_{10} were limited in the years 2008 and 2009; they were conducted only 81 days in 2008 and 160 days in 2010.

From the Fig. 17 it can be seen that exceeded allowed number of 35 days of 24-hour concentration 50 µg/m^3 occurred at all regions, except in Velenje. In Sosnowiec, measurements of PM_{10} were limited in the years 2008 and 2009; they were conducted only 81 days in 2008 and 160 days in 2010.

For ozone the data was not comparable, because for some regions there are data about average 8 hours concentrations, while for other region data about the number of days, when 8 hour concentration exceeded target value. However, the highest average ozone eight-hour concentrations were in the Val Sangone Valley; the maximum value of daily eight-hour mean distribution is 25% - 60% higher than target value (120 $\mu g/m^3$) and the number of exceedences of long-term objective is always much greater than 25 days established by European law.

3.2 HEALTH DATA

Calculation of standardized death rates per 100 000 inhabitants in the period 2006-2010 (taking into consideration Standard: European population, 1976) showed that the death rates was the smallest in Velenje and the highest in Várpalota (the data for Val Sangone Valley is missing).

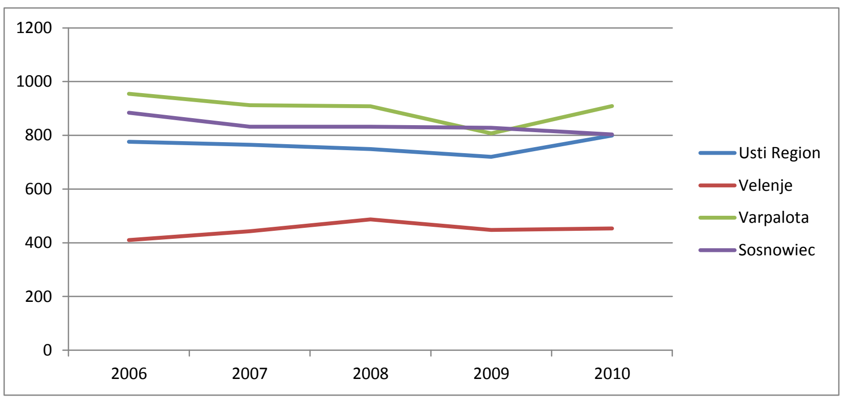


Figure 18: Standardized death rates per 100 000 inhabitants 2006-2010. (Standard: European population, 1976).

3.2.1 Excess mortality (per 100 000) due to short term effect of PM_{10} pollution >50 ug/m^3 in the studied regions in the period 2006-2010

The comparison among study areas showed that the highest excess mortality (per 100 000) due to short term effect of PM_{10} pollution >50 $\mu g/m^3$ was in Torino, which is not part of the Val Sangone Valley, but lies nearby and influence on the quality of air in Val Sangone Valley. Much smaller but however high was calculation of excess mortality (per 100 000) in Sosnowiec (Poland), while in other studied areas/cities the short term impact of PM_{10} concentration on mortality on days with daily values exceeding the limit value is quite negligible.

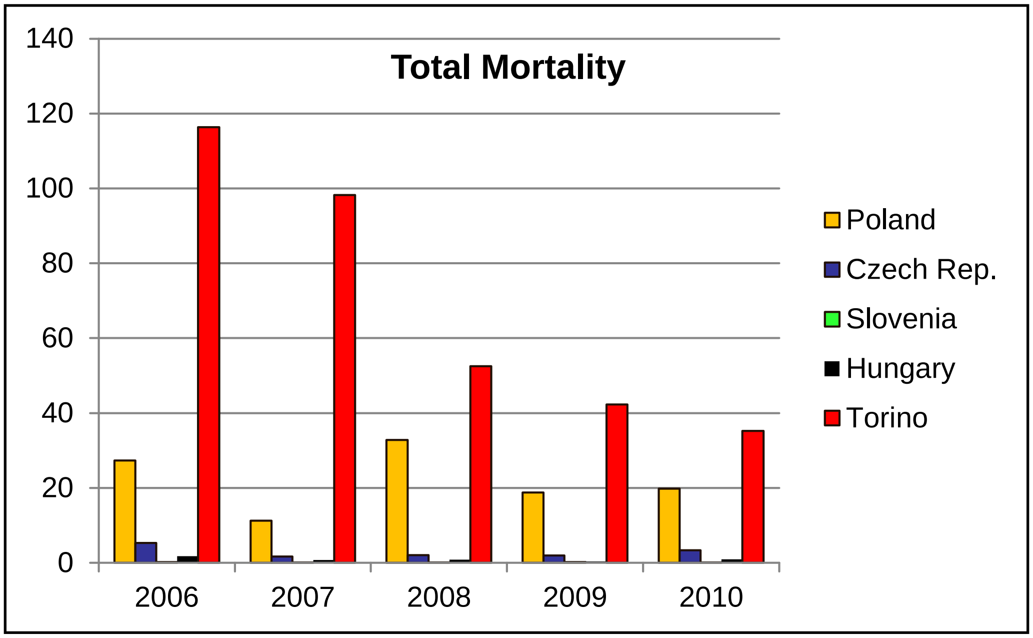


Figure 19: Excess total mortality (per 100 000) due to short term effect of PM_{10} pollution >50 μg/m^3 in the study regions, 2006-2010. Legend: Poland - Sosnowiec, Czech Rep. - Usti Regia, Slovenia – Velenje, Hungary – Várpalota. (Source: Páldy et al., 2013).

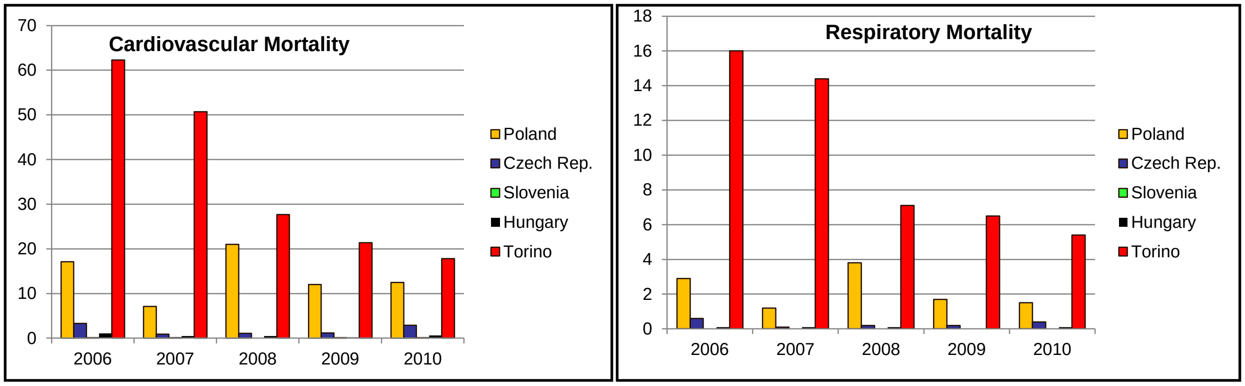


Figure 20: Excess mortality due to cardiovascular and respiratory diseases (per 100 000) due to short term effect of PM_{10} pollution >50 ug/m^3 in the studied regions, 2006-2010. Legend: Poland-Sosnowiec, Czech Rep. - Usti Regia, Slovenia – Velenje, Hungary – Várpalota. (source: Páldy et al., 2013).

3.2.2 Short term gain (life/100 000) of the reduction of PM_{10} concentration (ug/m^3) by different scenarios

The daily mean winter PM_{10} concentrations exceeded limit value in the period 2006-2010 at all regions, except in Velenje, while summer values were in general under the limit value at all regions/cities. While the number of days, when daily value 50 μg/m^3 was exceeded varied among years within the same region/city, there were differences in the number of death cases among years. However, the reduction of daily mean PM_{10} concentrations to 20 μg/m^3 could prevent the highest number of death cases per 100 000 residents due to non-external total mortality in Torino (8-22), Várpalota (12-22) and Sosnowiec (17-36), while the number was smaller in Usti region (8) and Velenje (1-2). It is interesting that the reduction by 5 μg/m^3 of all the 24-hour values of PM_{10} would prevent the highest number of death cases per 100 000 in Usti Region (8), while the number was smaller for other region/cities (Torino (4), Várpalota (3-4), Sosnowiec (4) and Velenje (2)).

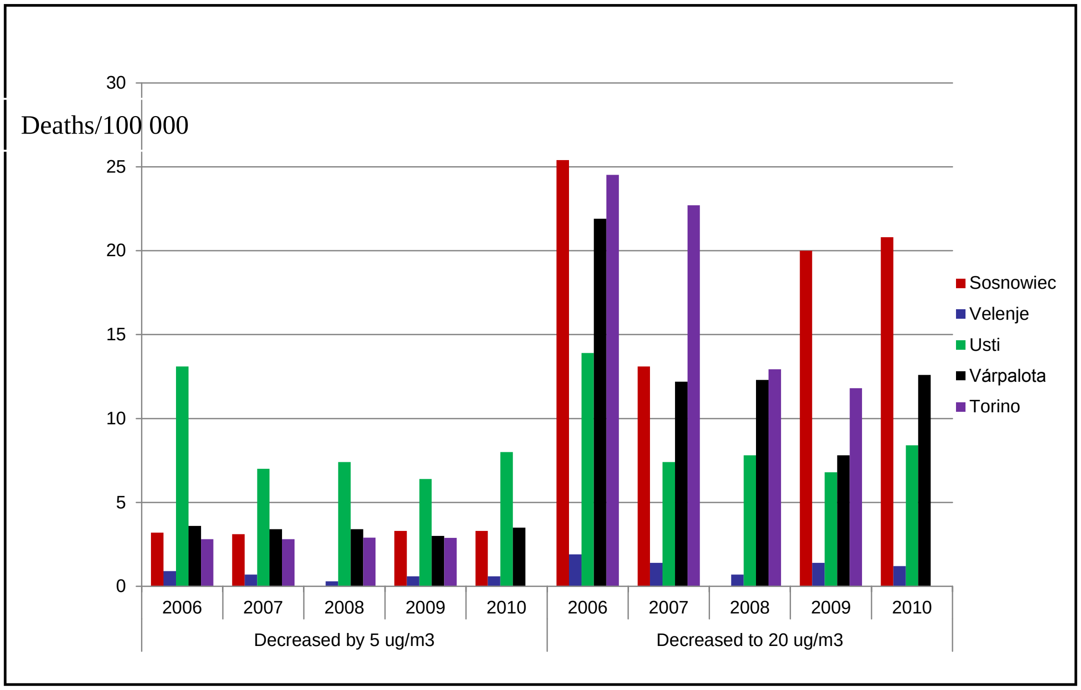


Figure 21: Environmental Health Impact Assessment (EHIA): short term gain (life/100 000) of the reduction of PM_{10} concentration (μg/m^3) by different scenarios in Sosnowiec, Usti Regia, Velenje, Várpalota, Torino (source: Páldy et al., 2013).

4 COMMON CHARACTERISTICS OR EXCEPTIONS OF STUDY AREAS

4.1 STRENGTHS AND WEAKNESSES

The most important characteristics of the study areas that give them an advantage or disadvantage over others are represent in the Table 24.

4.1.1 Geographical features

Only for Velenje (The Šalek Valley) and the Val Sangone Valley geographical features are favourable to prevent retention of pollutants in the regions. The Val Sangone Valley is not directly facing the centre of Turin, as the river stream curves towards North West during its course. The main winds that hit the industrial region of Turin tend to orientate along the Susa Valley and still rarely go back to the Val Sangone Valley. However the particular morphology of the Piedmont plain, in which the greater part of the population lives, surrounded by mountains to the north, west and south, facilitates the accumulation of pollutants coming from the east at the openings created by the routes of the river Po and its two main tributaries Ticino and Tanaro, on the border with Lombardy and Emilia-Romagna. In Velenje and Várpalota the occurrence of temperature inversions and smog occurred occasionally (in winter). Várpalota situated near the Bakony mountains in a closed basin. The climate is dry and the number of windy days is below the average. Wind often brings rain and although wind blows the pollutants out of the basin, rain washes those down causing secondary pollutions (e.g. soil contamination).

4.1.2 Monitoring system

Regularly monitoring of air quality with early warning system (when alert threshold is exceeded) is well organized at all regions, except in the Val Sangone Valley, where monitoring has not occurred. In the Val Sangone Valley the presence of air pollutants is estimated by using an information support system based on integrated models. In the analysed period of 2006-2010, in Sosnowiec there are incomplete measurement data concerning air pollution from the National Environmental Monitoring. In Sosnowiec and Várpalota the lack of suitable number of monitoring sites has also been observed. For ozone and $PM_{2.5}$ harmful effect on the human health have been recognized thus the measurement of this parameter would be obligatory for assessment of quality of air. The measurement of ozone and $PM_{2.5}$ is missing in the Val Sangone Valley and Sosnowiec, while in Velenje and Várpalota ony the measurement of $PM_{2.5}$ has not been performed.

Table 24: Strengths and weaknesses of different areas/cities.

	Characteristics	Velenje	Sosnowiec	Várpalota	Usti region	Sangone Valley
Strategic documents and access to information	An environmental data base and permanent access of citizens to information	+	+	+	+	+
	Completed studies regarding the problematic of air pollution in the study area	+	+	+	+	+
	Sufficient human resources – sufficiency of "local" experts in the "air protection" field	+			+	-
	Strategic documents	+	+	+	+	-
Geographical features	Favourable geographical and geomorphologic structure	+	-	-	-	+
	The proportion of green areas in the study area is high	+	-	-	-	+
	There is occasionally, the occurrence of temperature inversions and smog	+	+	+	-	-
Monitoring system	Regularly monitoring of air quality	+	+	+	+	**
	Alarm system	+	+	+	+	-
	Suitable number of monitoring sites/complete monitoring	+	+	-	+	-
	Measurement of $PM_{2.5}$	-	-***	-	+	-
Monitoring results	Emissions of SO_2, NO_2 and dust decrease	+	-	+	+	+
	The concentrations of SO_2 and NO_2 exceeded limit values	-	+	+	+	**
	Occasionally limit value of 24-hour concentrations of PM_{10} has been exceeded	+	+	+	+	**
Industry	Large industrial facilities are present in the study area	+	+	+	+	-
	Best available technologies are used in industry	+	+	+	+	*
Heating	The use of proper fuels/lack for residential heating	+	-	+	-	-
	Using of natural gas for heating	+	-	-	+	-
	Environmental kindly residential heating methods with low environmental impacts (district heating system)	+	-	-	-	-
Traffic	There is heavy traffic in the settlements	+	+	+	+	+
	Decrease of traffic	-	-	-	+	-
	The use of vehicles is according to emissions regulated	+	+	-	-	-
	The emissions from traffic have been regularly measured	-	-	-	+	-
	Public transport is quite efficient	+	+	-	+	+
	High proportion of low emission vehicles within the public transport system	+	-	+	-	-
	Sufficient use of all type of public transport	-	-	-	-	-
	Existence of railway transport (sufficient)	+	-	+	-	-
	Bike lanes already exist	+	-	+	-	-
	Possibilities to use electrical vehicles	+	-	-	-	-
Others	Use of alternative/renewable energy increase	+	+	-	-	-
	The health care system is well organized	+	+	+	+	+
	The population is getting older	+	+	-	+	-

Red – Weaknesses, green – Strengths; + Yes, - No
* - no industrial plants
** - no regular monitoring of air (only modelled data are available)
*** ozone was also not measured
No data

4.1.3 Monitoring results

Emissions of SO_2, NO_2 and dust decreased in all involved regions in the last decade, only in Sosnowiec the emission of gas and dust pollution has increased in last years. The highest increase was noted in the case of SO_2 and particulate matter. In spite of decrease trend of emissions of some air pollutants, the daily imission concentrations of SO_2 and NO_2 exceeded limit values in Sosnowiec, Várpalota and Usti region. At all regions (data for Val Sangone Valley, where monitoring has not occurred, is on a modeling basis) limit value of 24-hour concentrations of PM_{10} (40 $\mu g/m^3$) has been occasionally exceeded in the period 2006-2010, while allowed number of 35 days of exceedance of 24-hour concentration 50 $\mu g/m^3$, occurred at all regions, except in the Šalek Valley. The highest average ozone eight-hour concentrations were calculated for the Val Sangone Valley; the maximum value of daily eight-hour mean distribution is 25% - 60% higher than target value (120 µg/m3) and the number of exceedences of long-term objective is always much greater than 25 days established by European law.

4.1.4 Industry

Large industrial facilities are present in all studied areas (except in the Val Sangone Valley), which used the best available technologies with the aim to maintain the acceptable level of emission and to reduce the emission and the impact on the environment. Only small enterprises are operated in Val Sangone Valley; large industrial centre is located nearby, in Turin.

4.1.5 Heating

At some regions (Sosnowiec, Usti region, the Val Sangone Valley) there are lack of use of proper fuels for residential heating. Burning municipal waste in individual heating systems is a big problem for the city of Sosnowiec. To stop that in Sosnowiec, financial support for the modernization of heating system in residential buildings is available and an implementation of the program of the development of heating network and the replacement of heating systems (TAURON). In Usti Region there is low use of existing natural gas distribution network for heating by households, where improper fuels are burned in obsolete improper maintained heating systems. 69% of the population in mountainous areas of the Val Sangone Valley uses wood as the main source for heating and the age of heat generators is high (14% of them are over 20 years old). Not only that the majority of the heating systems are obsolescent but in many cases also the poor quality of the wood raises the emission level. In the Šalek Valley there is a constructed system of remote heating supply (from burning coal in Šoštanj Thermal Power plant), which provides hot water and heating to residential buildings as well as to the business, administrative and industrial buildings. 90% of the population of the Šalek Valley is connected to this system. Additionally, some households and other buildings are heated with natural gas. In Várpalota distant heating system is available in certain districts but needs some improvements.

4.1.6 Usage of alternative/renewable energy

Substituting conventional energy sources with renewable energy sources: solar and air collectors, wind power plants, bio gas plants - are still not sufficiently popularized in study areas due to various factors, e.g. insufficient financial mechanisms addressed directly to renewable energy producers. Further, the costs of energy production being lower or similar to the costs or prices of conventional energy carriers (Usti Region, Sosnowiec and Várpalota). The usage of alternative energy increases in the Šalek Valley, but in insufficient level. In the Val Sangone Valley, due to its rural location and high prices of fossil fuels (wood is abundant in the valley), wood heating in the house is quite common, but the age of heat generators is high. The increased use of solar energy systems have not yet been in common usage in this area, in spite of public aids granted for the installation.

4.1.7 Traffic

Roads with heavy traffic are in the settlements of all study areas. The increase trend of traffic is recognized in all regions, except in Usti Region. The use of vehicles is according to emissions regulated in the Šalek Valley and Sosnowiec. In Slovenia, vehicles shall not be included in traffic, unless they comply with the rules laid down in Rules on roadworthiness tests for motor vehicles and trailers (Official Gazette of RS. no. 88/2005). The emissions from traffic have been regularly measured only in Várpalota, but it is not representative enough, because only one measurement unit operates there. It situates near busy main road but in a less populated residential area. Inside other areas (The Šalek Valley, Sosnowiec, Usti Region, the Val Sangone Valley) the emissions from traffic have not been regularly measured. In the Val Sangone Valley only measured data from temporary campaign, the one occurred in November-December 2012, was available, but no fixed measurement stations are placed inside the area.

Despite of the well-organized public transport, it is not used sufficiently in all studied regions. In Várpalota, regional community transport uses elder buses with high-emissions. Várpalota directly links to the national railway network; it has a railways station. In the Val Sangone Valley, the organization of public transport is quite efficient in terms of connections and frequency (bus, train) but ecological buses and electric vehicles are not used for public transport and the whole fleet should be renovated. Bus service is quite efficient, at least to and from Turin, at the main peak hours; a connection with train is possible in Avigliana. Connections to other important localities, however, are not so easy by public transport. In particular connections with Rivoli, one of the most important towns of the surroundings with an important hospital and schools is quite deficient. In Sosnowiec free transport to large supermarkets is organized. The Municipality of Sosnowiec, together with the municipalities of Będzin and Dąbrowa Górnicza, entered the Project "Modernization of public bus transportation infrastructure in the municipalities of Będzin, Dąbrowa Górnicza and Sosnowiec". Within the framework of the project, 62 buses were withdrawn from circulation and they were replaced by 72 buses, equipped with ecological power units that fulfil the requirements in the scope of pollution emission on the level of Euro 3 standard. In Usti Region there are available all kinds of public transport (bus, regional bus, railways) with coordination lines, interchanges, continuity connections of different types of public transport. There is also financial support for ecological traffic - environmental friendly modernization of public transport vehicles – e.g. building of new trolleybus lines. In Velenje there is free of charge local public transport since September 2008.

Bike lanes already exist only in Velenje and Várpalota. In Velenje bicycle rental is free of charge. In Várpalota bike lanes run all over the city connecting the centre and the outer block districts. In the Val Sangone Valley, the morphology of the area (mainly hilly and mountainous) and the remarkable distances are not favourable conditions to the extensive bike use as a means of transport. Inside the area there are only two short bike lanes in Giaveno district and a longer one in Sangano connected to the urban and periurban network of the Turin city.

A possibility to use electrical vehicles is only in Velenje and Sosnowiec. In Velenje two pillars for charging electric vehicles have been available since November 2010. However, their usage is currently quite low. There are 12 charging stations for electric vehicles in the Silesian Voivodeship. Unfortunately, these are mostly private points; there are not enough commercial stations. There is one 230 volt (1 phase) charging point in Sosnowiec.

4.1.8 The health care system

The health care system is well organized at all study areas. Three hospitals are in the vicinity of Velenje. Most of the population has basic health assurance (for employees it was paid by companies, for the unemployed and pensioners it was paid by the state), what allows access to the health services most of the population. Inhabitants have also access to information about the health condition of the population in different regions in Slovenia via different websites. In

Várpalota pulmono-respiratory diseases are monitored regularly. Rehabilitation is also well organised. The Rehabilitation Institute for Pulmonary Diseases in Várpalota records the patients and diseases and reports ones to the Municipal Assembly every year. In Usti Region existing public health system is in operation. In Sosnowiec there are 4 hospitals. Citizens have equal access to health care services, financed from public funds, irrespective of their material situation. In Giaveno District, there is a public hospital in the Val Sangone Valley and a specific Health district is seated in this municipality; close to the area are located some other hospitals (Rivoli and Avigliana hospitals. Cancer research centre in Candiolo, several hospitals in Turin, Azienda ospedaliera San Luigi in Orbassano) and highly specialised centres (Cancer research centre in Candiolo). Some other private structures are also present around Giaveno District (Villa Augusta in Bruino, Villa Serena a Piossasco). Basic data about health condition are available at the site of ISTAT – National Institute of Statistics (http://www.istat.it).

4.1.9 Access to environmental information

Inhabitants of the Šalek Valley have via the website of Environmental Agency of RS http://www.arso.gov.si/ access to all annual reports on quality of air in Slovenia. At the same website there are forecasts for increased concentration of ozone. On the website of Šoštanj Thermal Power plant http://www.te-sostanj.si/si/ hourly and daily values on some air pollutants are available (continuous monitoring). Data is renewed every hour. On this website also the forecast for every day for the pollution of area with different pollutants (SO_2, NO_2, and PM_{10}) is available. On the website of Municipality of Velenje http://www.velenje.si/ there are also available hourly and daily concentrations of SO_2, NO_2, O_3 and PM_{10} for all measuring station (the same stations than on the website of ŠTPP). Local comparable data of air quality in Várpalota is accessed via internet: http://oki.wesper.hu/levego/2013-02-21/25. Information about the quality of air in Sosnowiec is systematically published on the website of the Silesian air monitoring. The website is connected with the system of air quality forecast, where forecasts worked out by the Institute of Meteorology and Water Management based on current results from automatic stations, are available. The website of the Regional Inspectorate of Environmental Protection in Katowice publishes information and reports on the state of environment for the city of Sosnowiec and other cities of the Silesian Voivodeship. Citizens of the Piemonte Region can get much information about the environment parameters through the website of Environmental Agency of Regione Piemonte (http://www.arpa.piemonte.it). Every year a report on the Environment conditions in Piedmont is also published by Arpa and uploaded on the website. The public may also find the annual report on the State of the environment for Piemonte region. On www.sistemapiemonte.it you can find data on PM_{10}, ozone, NO_2 and others parameters. For Usti Regia, all data are freely available on the website CHMI www.portal.chmi.cz, Usti Region www.kr-ustecky.cz and The Institute of Public Health in Usti nad Labem www.zuusti.cz.

4.1.10 Strategic documents

Velenje

- Local Agenda 21
- Municipal Environmental Protection Programme

Usti Region

- The Act on Air Protection (Among others include IPPC, Strategic documents of the Environmental Education in the Czech Republic, the concept of sustainable development, Local Agenda 21, EIA / SEA, etc.).
- The Region strategic materials, the issues of energy and climate protection (Integrated regional Plan to improve air quality in the Usti Region and its Programme Complement), which are regularly updated.

Várpalota

- Integrated Urban Development Strategy (2011)
- Local Environment Protection Programme (2009)
- Programme for Restructuring Micro-regional Economic Structure (2011)
- Micro-regional Spatial Development Concept
- Economy Development Strategy for Várpalota (2004)
- Municipal Order on the Protection of Clearness of Air
- Municipal Order on Smog Alarm Plan for Várpalota
- Municipal Order on Support of Energy Saving Renovation of Block of Flats Made of Industrial Technology
- Municipal Order on Environment Protection Fund
- Municipal Order on Environment Protection Programme of City of Várpalota
- Integrated Urban Spatial Plan supports environment protection oriented urban spatial development appointing special industrial development zones and environmental criteria.
- Urban Environment Protection Programme for Várpalota (2008)

Sosnowiec

- The Low Emission Reduction Program (LERP) for the city of Sosnowiec aims at the reduction of dust and gas pollution emission into the atmosphere from individual heat sources.

The Val Sangone Valley

The lack of territorial integrated plans is also due to a series of administrative changes suffered by the Val Sangone Valley in the last years. The original Mountain Community with 6 municipalities of the valley was merged in a larger Community with adjacent Susa Valley; then at the beginning of 2013 this administrative entity was cancelled for coming back to a simple Union of the valley municipalities. Despite of these changes, the Mountain Communities were active in developing projects, services and activities in the renewable energy field.
Some studies and plans partially or totally developed in the last years are:

- Health plan for the Val Sangone Valley
- Energy plan of the former the Val Sangone Valley Mountain Community (only draft).

4.1.11 Completed studies regarding the problematic of air pollution in the study areas

Velenje

- Biomonitoring of the forest ecosystem in the area of influence of the ŠTPP (1991-2008)
- The impact of tropospheric ozone in urban and rural areas of the Šalek Valley (2000 - 2008)
- Human exposure to air pollutants in the Šalek Valley (2008-2011)
- Biomonitoring of air quality in the vicinity of roads and possible measures to reduce its negative impact on human health (2011)

Sosnowiec

Researches on the issue of air pollution and its influence on the health of the citizens are conducted for the area of the city of Sosnowiec. The works are conducted by the Chair of Climatology of the Silesian University and the Institute of Occupational Medicine and Environmental Health (IOMEH).

4.2. OPPORTUNITIES AND THREATS

External chances, which can contribute to improve the quality of air and some important constrains, which could slow down countries' efforts to improve the air quality in all study areas are presented in Table 25.

Table 25: Table of opportunities and threats of study areas.

Characteristics	Šalek Valley	Sosnowiec	Várpalota	Usti region	Sangone Valley
The national legislation in the field of air quality is regulated and entirely implements EU legislation	+	+	+	+	+
The trend in the State is limiting the use of fossil fuels - replacement with wood biomass.	+	-	+	-	+
Opportunity for financial support from the state and EU for using of renewable energy sources and saving energy	+	+	+	+	+
Operational programs and action plans at the state level for reduction of emissions	+	+	+	+	+
Plans for redirect of transport from the city's centres	+	-	+	+	-
Construction of urban bike lanes and completion of regional bike lanes network	*	-		+	+
Negative trends in the development of the economy	+	+	+	+	+
High risk of emission from neighbouring towns	-	+	-	+	+
Increase of energy resources prices.	+	+	+	+	+
Global increasing of the density of the traffic	+	+	+	+	+
Long distance transfer of the air pollution	+	+	+	+	+

Legend: Red – Threats; green – Opportunities; + Yes, - No; ☐ No data; * - bike lanes has already existed

4.2.1 Legislation

The legislation of all states involved in the project TAB has been adopted all of the European Community legislation in the field of air, which relates to various pollutants and setting limits or concentration levels above which measures are required to reduce concentrations.

4.2.2 Trends regarding limiting the use of fossil fuels

The trend in Slovenia is limiting the use of fossil fuels - replacement with wood biomass. In the Operational programme for protection of ambient air from pollution by PM_{10} for urban areas are reported the most appropriate measures to reduce PM_{10} emissions from combustion and industrial installations. The trend of limiting the use of fossil fuels is also in Hungary and Italy. Energy Policy of Poland until 2030 worked out by the Ministry of Economy, assumes the use of carbon as the main fuel for heavy current engineering in order to guarantee a suitable level of the country's energy safety.

4.2.3 High risk of emission from neighbouring towns

High risk of emission from neighbouring towns exists in Sosnowiec, Usti region and the Val Sangone Valley. The area of the city of Sosnowiec is exposed to the affluence of polluted air masses from neighbouring cities, i.e. Dąbrowa Górnicza, Jaworzno and Będzin. These cities are highly industrialized centres emitting significant amounts of pollution. The particular morphology of the Piedmont plain, in which the greater part of the population lives, surrounded by mountains to the north, west and south, facilitates the accumulation of pollutants coming from the east at the openings created by the routes of the river Po and its two main tributaries Ticino and Tanaro, on the border with Lombardy and Emilia-Romagna. The protection of the Alpine barrier from the northwest prevents the Atlantic air flows to generate constant winds that may mitigate or reverse the flow of air from east and the rest of the Po Valley.

4.2.4 Opportunity for financial support from the state and EU for using of renewable energy sources

There is opportunity for all involved states to use European funds in the new programming period 2014-20. The new EU perspective assumes the implementation of programs which will subsidize, among others, projects in the scope of environmental protection - energy efficiency in buildings, renewable energy sources, supporting the transition to low-emission energy in all sectors; promotion of energy efficiency and the use of renewable energy in small and medium enterprises, supporting energy efficiency and the use of renewable energy in public infrastructure, supporting actions for the quality of urban environment, including regeneration of post-industrial areas, and the reduction of air pollution.

ECO Fund Slovenian Environmental Public Fund is the largest financial institution intended to encourage environmental investments in the Republic of Slovenia. The Fund encourages the development of environmental protection by providing credit or guarantees for environmental investments and other forms of assistance. The Fund encourages investments that are consistent with the National Environmental Action Plan and the environmental policy of the EU.

In 2011, the City Council in Sosnowiec passed a resolution on the principles and the procedure of granting and accounting for designated subsidy from the funds of the budget of the city of

Sosnowiec for, among others, the modernization of heating system in residential buildings or separate residential buildings. The subsidy is granted in the case of connecting to the heating network and in the case of the purchasing of biomass, gas or oil oven. The citizens may also apply for a reimbursement of the incurred costs of the purchase of solid fuel-fired retort ovens.
In Usti Region they have opportunity to use national financial resources for the program “Green Light to Energy Savings”. The "Green Light to Energy Savings" is grant program, which is financed from national financial resources devoted to the promotion of energy saving. Applicants for a grant may be private sector, state administration and self-government.

Recently Piedmont region provided funds for initiating environmental investments such as: low-energy buildings, increase use of renewable energy in the private sector, improving energy efficiency of the public buildings and valorisation of thermic energy from biomass energy plants. At the national level, many years has been active an incineration program, which provides funds for improving the energy efficiency of single flats or buildings (replacement of obsolete boilers. better insulation. etc.). The program gives the opportunity of reimbursement up to the 55% of the total cost through tax deduction.

<u>4.2.5 Operational programs and action plans at the state level for reduction of emissions</u>

Slovenia

- Operational program for reduction emissions into the air from large combustion plants
- Operational programme for protection of ambient air from pollution by PM_{10}

Czech Republic

- National strategic plans aimed at emission reduction from industries, transport and other air pollution sources (new National Emission Reduction Plan of the Czech Republic)
- New regional air quality improvement plan

Poland

- Energy Policy of Poland until 2030
- Air protection program for the zones of the Silesian Voivodeship, where supra-normal levels of substances in the air were found

Italy

- “Regional plan for the rehabilitation and protection of air quality” is an operational program for protection of ambient air from pollution including guidelines for the preparation, adoption and implementation of programs of measures to improve air quality in the different polluted zones and agglomerations.

- "TAPE, Turin Action Plan for Energy" is developed in the framework of the Convenant of Major. This action plans aiming at improving air quality and spreading modern heating systems based on co-generation.

4.2.6 Plans for redirect of transport from the city's centres

The town Velenje is about 15 km away from highway. Construction of highway will connect the Šalek Valley with other developed regions in Slovenia and thus enable higher economic development of the region and also contribute to lower number of vehicles driving daily through the valley. In Usti Region completion of the D8 motorway leading from the capital Prague to Dresden (Germany) will significantly alleviate the impact of transport on Usti Region, which today are going through a major transport corridors especially with heavy truck traffic.

4.2.7 Negative trends in the economy and limiting financial sources at EU and state level

Fewer resources from the state budget and continuation of economic crisis could lead to the loss of free of charge urban transport, to poorer health care, less investment in education and awareness of the population and into environmental projects. All of this could lead to poorer quality of life and therefore greater vulnerability of populations on polluted air. Currently, the economic crisis is a factor that inhibits the process of the improvement of natural environment. Due to the lack of economic stability, entrepreneurs reluctantly invest in undertakings connected with environmental protection. The budgets for national and EU repair programs and for research and development projects are also being decreased.

4.2.8 Increase of energy resources prices

Increase of energy resources prices could lead to usage of improper fuels. The long-term prognosis regarding fuel prices for Poland assumes that prices of hard coal will remain on constant level, contrary to the prices of natural gas, which will systematically rise until 2030. Such prognoses may negatively influence the condition of air in the analyzed area, since hard coal will remain the least expensive, and at the same time, the most often used fuel.

5 CONCLUSIONS

On the basis of review of SWOT analysis and comparison amongst five study areas (The Šalek Valley, the Val Sangone Valley, Várpalota, Sosnowiec and Usti Region) the following conclusion can be made:

1. The legislation of all states involved in the project TAB has been adopted all of the European Community legislation in the field of air, which relates to various pollutants and setting limits or concentration levels above which measures are required to reduce concentrations.

2. Monitoring of air quality, environmental data bases and permanent access of inhabitants to the information are established at the majority of the study areas (cities/regions within TAB project).

3. The daily concentration of NOx and SO_2 occasionally exceeded limit values in Sosnowiec, Várpalota and Usti region, but average annual values were in general under the limit values. The concentrations of dust particles (PM_{10}) are increased occasionally at all study areas. **Exceeded allowed number of 35 days of 24-hour concentration 50 µg/m^3, occurred in the period 2006-2010 at all regions, except in Velenje.** The important factor for retention of pollutants within the studied areas is unfavourable geographical and geomorphological structure.

4. The main sources of air pollutants are industry, traffic and residential heating. Industrial devices are (in general) not problematic, since the large industrial facilities present in studied areas use the best available technologies. But the high number of large industrial devices with high emissions of pollutants at relatively small area could be problematic. **The traffic and residential heating remains the main problem at the majority of studied areas and contribute significantly to emissions of NOx, which are precursors for ozone and PM_{10} in the air.**

5. At some regions (Sosnowiec, Usti region, the Val Sangone Valley), there are lack of use of proper fuels (municipal waste as well) for residential heating. **Satisfied constructed system of remote heating supply, which provides hot water and heating to residential buildings as well as to the business, administrative and industrial buildings is available only in the Šalek Valley.** In Várpalota distant heating system is also available in certain districts but needs some improvements.

6. **Roads with heavy traffic are in the settlements of all studied regions. The increase trend of traffic is recognized in all regions, except in Usti Region.** Public transport is quite efficient in the Šalek Valley, Sosnowiec, Usti region and the Val Sangone Valley but needs some improvements. Bike lanes already exist only in the Šalek Valley and Várpalota. A possibility to use electrical vehicles exists only in Velenje and Sosnowiec – but usage of pillars for charging electric vehicles has not been on satisfactory level.

7. The health care system is well organized at all studied regions, **but populations are getting older and vulnerability of population is increasing.**

8. **Reducing the emissions from traffic and residential heating system will be the most important issues within actions plans as well**. However, every city/region has his own specific modification of these problems; consequently, the partner's actions plans for reducing the negative impact of air pollution (mostly dust particles) increase will be specific and unique.

9. The following external chances, which can contribute to improve the quality of air in all studied areas are: the trend in the studied states to limit the use of fossil fuels, opportunity for financial support from the states and EU for using of renewable energy sources and saving energy and operational programs and action plans at the state's level for reduction of emissions.

10. There are some important constrains, which could slow down countries' efforts to improve the air quality: negative trends in the development of the economy, high risk of emission from neighbouring towns and long distance transfer of the air pollution, increase of energy resources prices and global increasing of the density of the traffic.

6 SUMMARY

The Comparative SWOT analysis, which is prepared on the basis of partners' SWOT analyses for the Šalek Valley (Slovenia), Sosnowiec (Poland), Várpalota (Hungary), Usti Region (Czech Republic) and the Val Sangone Valley (Italy)) define common fields of actions helping to prepare detailed plans of pilot actions, joint strategy for AAPs and to be fed into knowledge base built by CEUHEP. The Comparative SWOT analysis in its first part presents sources of air pollutants, imission concentrations of air pollutants and health data for study areas in the period 2006-2010. In the second part strengths, weaknesses, opportunities and threats for each study area were presented and comparison amongst areas was made. The studied areas differed in their surfaces from 77.26 km^2 (Várpalota) to 5,335 km^2 (Usti Region). Therefore the level of emission cannot be comparable. The imission daily concentration of NO_x and SO_2 occasionally exceeded limit values in Sosnowiec, Várpalota and Usti region, but average annual values were in general under the limit values. Average yearly 24-hour PM_{10} concentrations exceeded limit value 40 ug/m^3 at some study areas but trend was in general decreasing. However, allowed number of 35 days of 24-hour concentration 50 $\mu g/m^3$ occurred at all regions, except in Velenje. The important factor for retention of pollutants within the studied areas is unfavourable geographical and geomorphological structure.

The most important findings within comparative SWOT analysis are: **(a)** The legislation of all states involved in the project TAB has been adopted all of the European Community legislation in the field of air, which relates to various pollutants and setting limits or concentration levels above which measures are required to reduce concentrations. Monitoring of air quality, environmental data bases and permanent access of inhabitants to the information are established at the majority of the study areas (cities/regions within TAB project). (**b)** The main sources of air pollutants are industry, traffic and residential heating. Industrial devices are (in general) not problematic, since the large industrial facilities present in studied areas use the best available technologies. But the high number of large industrial devices with high emissions of pollutants at relatively small area could be problematic. The traffic and residential heating remains the main problem at the majority of studied areas and contribute significantly to emissions of NOx, which are precursors for ozone and PM_{10} in the air. **(c)** At some regions (Sosnowiec, Usti region, the Val Sangone Valley), there are lack of use of proper fuels (municipal waste as well) for residential heating. Satisfied constructed system of remote heating supply, which provides hot water and heating to residential buildings as well as to the business, administrative and industrial buildings is available in the Šalek Valley. In Várpalota distant heating system is available in certain districts. **(d)** Roads with heavy traffic are in the settlements of all studied regions. The increase trend of traffic is recognized in all regions, except in Usti

Region. Public transport is quite efficient in the Šalek Valley, Sosnowiec, Usti region and the Val Sangone Valley but needs some improvements. Bike lanes already exist only in Velenje and Várpalota. A possibility to use electrical vehicles exists only in Velenje and Sosnowiec – but usage of pillars for charging electric vehicles has not been on satisfactory level. **(e)** The health care system is well organized at all studied regions, but populations are getting older and vulnerability of population is increasing. **(f)** External chances to improve the quality of air in the all studied areas presented: the trend in the studied states to limit the use of fossil fuels, opportunity for financial support from the states and EU for using of renewable energy sources and saving energy and operational programs and action plans at the state’s level for reduction of emissions. **(g)** There are some important constrains, which could slow down countries' efforts to improve the air quality: negative trends in the development of the economy, high risk of emission from neighbouring towns and long distance transfer of the air pollution, increase of energy resources prices and global increasing of the density of the traffic.

On the basis of comparative SWOT analysis it is evident that reducing of the emissions from traffic and residential heating system will be the most important issues within actions plans as well. However, every city/region has his own specific modification of these problems; consequently, the partner’s actions plans for reducing the negative impact of air pollution (mostly dust particles) increase will be specific and unique.

7 REFERENCES

Al Sayegh Petkovšek S., Mazej Grudnik Z., Orešnik K., Jelenko I., Iršič A. 2012. Vulnerability assessment of the Šalek Valley.

Al Sayegh Petkovšek S., Mazej Grudnik Z., Orešnik K., 2013. SWOT analysis for the Šalek Valley in the frame of TAB project

Balińska I., Rejman Burzyńska A., Kowalska G., Jędrysik E., Krzemień J. 2013. SWOT analysis for the city of Sosnowiec within the framework of the TAB project.

Giannetti F., Tagliaferro F., 2012. Vulnerability assessment of the city Giaveno District.

Ferencsik I., Páldy A., Pándics T. 2012. City of Várpalota. Vulnerability Assessment “Take a Breath!”

Kotzó S., Ferencsik I. 2013. City of Várpalota SWOT analysis “Take a Breath!”- 3CE356P3.

Lehká A., Michálková E., Peřina T., Rychlíková E. 2012. Impacts of air pollution on human health: vulnerability – adaptability Usti Region, Czech Republic.

Lehká A., Peřina Tomáš and stakeholders 2013. SWOT analysis for the Usti region in the frame of TAB project.

Páldy A., Pándics T., Bobvos J., Szalkai M., Fazekas B., Rudnai P. 2013. Transnational baseline and monitoring with stakeholder involvement (WP3): Comparative vulnerability assessment. Meeting of the project group. National Institute of Environmental Health, Budapest, 20-21 March, Usti nad Labem.

Giannetti F., Petrella F., Tagliaferro F. 2013. SWOT analysis for the Val Sangone Valley in the frame of TAB project.