PALACKÝ UNIVERSITY OLOMOUC

FACULTY OF SCIENCE

DEPARTMENT OF DEVELOPMENT & ENVIRONMENTAL STUDIES

Bc. Nela ŘÍMANOVÁ

# Particulate matter in Ostrava's air: analysis and foresight

Master Thesis

Thesis supervisor: Mgr. Martin Schlossarek

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## Abstract

Ambient air pollution is a problematic in several countries in the European Union, not excepting the Czech Republic. One of the areas with the most polluted air by particulate matter, is Ostrava district. The district combines several sources of particulate matter emissions. This paper is analysing the trend of particulate matter ambient air pollution in the area during the years 2004 – 2017. Attention is focused on the legal frame, measurement network, sources of emission and particulate matter values. The second part of the thesis is examining possible and preferred futures of the particulate matter air pollution trend and it is proposing the steps which need to be done to achieve the preferred scenario.

## Key words

Particulate matter, air pollution, emission, Ostrava, industry, local furnaces, transportation, transboundary air pollution, measurement, foresight, Delphi method, extrapolation.

## Abstrakt

Znečištění venkovního ovzduší je problémem ve většině členských zemí Evropské Unie, Českou republiku nevyjímaje. Jedna z oblastí s nejvíce znečištěným ovzduší prachovými částicemi, je okres Ostrava. V tomto okrese se nachází hned několik zdrojů emisí prachových částic. Tato práce analyzuje trend znečištění venkovního ovzduší prachovými částicemi v této oblasti během let 2004–2017. Pozornost je soustředěna na právní úpravu, síť měřících stanic, zdroje emisí a hodnoty prachových částic. Druhá část zkoumá možné a preferované vývoje trendu znečištění ovzduší prachovými částicemi a dále navrhuje opatření, která musejí být podniknuta, aby bylo dosaženo scénáře preferované budoucnosti.

## Klíčová slova

Prachové částice, znečištění ovzduší, imise, emise, Ostrava, průmysl, lokální topeniště, doprava, přeshraniční znečištění ovzduší, měření, foresight, Delfská metoda, extrapolace.

## Statutory declaration

I, the undersigned Nela Římanová, declare that the work presented in this thesis is, to the best of my knowledge and belief, original, except as acknowledged in the text, and that the material has not been submitted, either in whole or in part, for a degree at this or any other university.

Olomouc, June 6, 2019 ……..……..

## Acknowledgement

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**PALACKÝ UNIVERSITY OLOMOUC**
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# DISSERTATION ASSIGNMENT

(PROJECT, ART WORK, ART PERFORMANCE)

| | |
|---|---|
| First name and surname: | **Bc. Nela ŘÍMANOVÁ** |
| Study program: | **N1301 Geography** |
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| Assigning department: | **Department of Development and Environmental Studies** |

Rules for elaboration:

According to the Ministry of the Environment of the Czech Republic (2016), the most loaded area in Czech Republic is the agglomeration Ostrava/Karviná/Frýdek-Místek. The goal of the thesis is to analyze the particulate matter ambient air pollution in Ostrava and to forecast its further development. The thesis describes several futures of air pollution in Ostrava, special attention is put on preferable future and how to achieve it. Separate chapter will be dedicated to the measurement network in Ostrava - the devices, measuring methodology and analysis of the data.

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**1. Moussiopoulos N. (ed.) 2003. Air Quality in Cities. Berlin: Springer. 2. Ministry of the Environment of the Czech Republic 2017. Zpráva o kvalitě ovzduší 2016. 3. European Environment Agency (EEA) 2018. Air quality in Europe - 2018 report. 4. Bishop P.C., Hines A. 2012. Teaching about the Future. Hampshire: Palgrave Macmillan. 5. Salthammera, T., Schiewecka, A., Gua, J., Amerib, S., Uhdea, E. 2018. Future trends in ambient air pollution and climate in Germany - Implications for the indoor environment. Building and Environment 143 (2018), 661-670 6. WHO Regional Office for Europe, OECD 2015. Economic cost of the health impact of air pollution in Europe: Clean air, health and wealth. Copenhagen: WHO Regional Office for Europe.**

| | |
|---|---|
| Tutor for dissertation: | **Mgr. Martin Schlossarek**<br>Department of Development and Environmental Studies |
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L.S.

doc. RNDr. Martin Kubala, Ph.D.
Dean

doc. RNDr. Pavel Nováček, CSc.
Head of Department

Olomouc, dated: 4 May 2018

# Content

# Acronyms and abbreviations

| | |
|---|---|
| CENIA | Czech Environmental Information Agency |
| PM | Particulate Matter |
| $PM_{2.5}$ | Particulate Matter smaller or equal to 2.5 µm |
| $PM_{10}$ | Particulate Matter smaller or equal to 10 µm |
| NGO | Non-Governmental Organisation |
| UFP | Ultra-Fine Particles |
| $SO_2$ | Sulphur Dioxide |
| $NO_x$ | Nitrogen Oxides |
| EEA | European Environmental Agency |
| EU | European Union |
| WHO | World Health Organisation |
| SPM | Suspended Particular Matter |
| EIA | Environmental Impact Assessment |
| REZZO | Register of emissions and air pollution sources<br>*Registr emisí a zdrojů znečištění* |
| ISPOP | Integrated System for fulfilment of announcing obligations in the field of environment<br>*Integrovaný systém plnění ohlašovacích povinností z oblasti životního prostředí* |
| RPHA | Regional Public Health Authority of the Moravian Silesian region |
| IDS | Integrated transportation system<br>*Integrovaný dopravní system* |
| CNG | Compressed Natural Gas |
| LV | Limit Value |

| | |
|---|---|
| CHMI | Czech Hydrometeorological Institute |
| LAT | Lower Assessment Threshold |
| UAT | Upper Assessment Threshold |
| ISKO | Air Quality Information System<br>*Informační system kvality ovzduší* |
| PHIO | Public Health Institute Ostrava |
| AMS | Automated Monitoring Stations |
| MS | Manual Stations |
| RADIO | Radiometric method |
| TEOM | Tapered Element Oscillating Microbalance method |
| OPEL | Optical Electronic method |
| GRV | Gravimetric method |

# List of pictures, charts and tables

## Pictures



## Tables



## Charts

# 1. Introduction

The air pollution is nowadays widely discussed topic, especially when talking about the climate change, but also when considering the impacts on human health. The *"First WHO global conference on air pollution and health"*, held at the end of year 2018, is proving that negative effects of air pollution on health is globally recognized problem (WHO, 2018). The most common indicator of ambient air pollution is particulate matter, which affect health of the people the most (ŠLACHTOVÁ, et al., 2016, p. 28). In 2014, particulate matter annual limit values have been exceeded in most of the countries in European Union (EEA, 2017). There has been a lot of efforts to solve this problem at the level of European Union (especially when assessing the transboundary air pollution, which is affecting the countries without any, or with only few, sources of emissions) as well as at the national and regional level.

According to the Ministry of the Environment of the Czech Republic (2016), the agglomeration Ostrava/Karviná/Frýdek-Místek is the area with the most polluted air in the Czech Republic. This territory has been highly urbanized, industrialized and has a strongly developed road infrastructure, contributing to a worse air quality. Since particulate matter has a proven effect on the human health, there has been a lot of attention brought to the air quality issues. The amount of particulate matter emissions decreased significantly during the years 1990–1998 in the Czech Republic, due to the implementation of emission reduction measures and technological innovations. However, this fast reduction of emissions was followed by stabilisation of the trend and air pollution still remains a problem (CENIA, 2005, pp. 10-11).

This thesis can be divided into two parts. The first one is focused on the analysis of the particulate matter air pollution development in the period 2004-2017 in Ostrava district. It explores changes in legal frame, measurement techniques and instruments, effects of air pollution on health of people and sources of emissions. The second part of the thesis is researching the probable and preferred futures of the particulate matter air pollution trend.

# 2. Methodology

## 2.1 Research aims and objectives

During the process of formulation of the aim(s), the author was consulting her ideas with the members of organization Čisté nebe[1], to secure the usefulness of this research.

Aim 1: Analysis of the trends, factors and effects of the particulate matter in the ambient air in Ostrava district[2] in 2004–2017.

Objectives:

1. describe the effects of particulate matter on the human's health,
2. identify the sources of particulate matter air pollution and their contribution to the air pollution,
3. describe the evolution of legal frame concerning the particulate matter air pollution,
4. describe the measurement network in Ostrava,
5. present the evolution of particulate matter concentrations in ambient air during the chosen time period.

This time frame was selected because by the year 2004, the Czech Republic accessed the European Union, which meant it had to implement all the legal documents into its legislature. Most of the regional institutions have begun to issue their publications and overview since the year 2004.

Aim 2: Create possible futures of the particulate matter air pollution trend.

Objectives:

1. describe the "business as usual" future,
2. create scenarios of possible, the most probable and desirable future,
3. propose the ways for achieving the desirable future.

[1] Čisté nebe is a non-governmental, non-profit organization whose activities are focused on the problem of air pollution in the Moravian Silesian region. Among the activities of the organisation are watchdog activities (controlling the activities of municipal, regional and state institutions), awareness and educational activities, and activities engaging citizens of Moravian Silesian region into air pollution solving process (ČISTÉ NEBE, n.d.).

[2] By the Ostrava district, the Ostrava municipality and all cities administratively lying within district of Ostrava are considered.

## 2.2 Methods

The first part of this paper, which is dedicated to the Aim 1, is based upon an academic research of relevant literature, related to particulate matter ambient air pollution in Ostrava district. Since the chosen location is small-scaled, the main sources of the data were regional institutions, such as Czech Hydrometeorological Institute, Regional Public Health Authority of Moravian Silesian region, and national environment resort – Ministry of the Environment of the Czech Republic and CENIA.

An academic research of relevant literature is used in the second part of the thesis as well, but is complemented by the practical researches, which were the main sources of data in the second part of the paper. The extrapolation method carried out with the software Microsoft Excel is used in the chapter *"6.2 Future trends of particulate matter air pollution in Ostrava".* The selection of the measuring stations was the first step. Measuring stations, which performed the continuous measurement for at least six years from 2017 backwards, were chosen. List of the selected stations:

- Přívoz,
- Fifejdy,
- Zábřeh,
- Poruba/CHMI,
- Českobratrská hotspot,
- Mariánské Hory,
- Bartovice (later renamed to Radvanice ZÚ).

The total annual mean value of $PM_{10}$ for each year is calculated as a mean of sum of the annual mean values of $PM_{10}$ in respective year from all selected measuring stations. After a single trend of $PM_{10}$ values is created, the trend line is added and FORECAST.LINEAR function is used to calculate the future value of $PM_{10}$.

To explore possible and preferred trend of the particulate matter air pollution, the Delphi method is used. Since there is no valid measurement or index of the possible or preferred future trend of the air pollution, this method provides the ideas and opinions of various experts, and consensus of experts in stated field of research. To cover all areas connected to air pollution, representatives of the industry, non-governmental organisations, municipality

and environment resort were asked to cooperate, so the maximum variation sample is used. During the selection of respondents, snowball method was applied. From all the potential respondents approached, those who agreed with the research participation are listed in Table 1.

| Name | Institution |
|---|---|
| **BÍLEK, Jiří** | Institute of Environmental Technology |
| **BOHÁČ, Aleš** | Mayor of Radvanice ward |
| **BRUŠTÍK, Marek** | Head of the Air protection and integrated prevention department, Regional Authority |
| **CARIĆ, Nikola** | Čisté nebe (NGO) |
| **DULAVOVÁ, Pavlína** | Ecologist in ČEZ, Ltd. |
| **FELLER, Michal** | DUHA movement |
| **HELLEBRANDOVÁ, Lucie** | Public Health Institute Ostrava |
| **KRAINA, Leo** | Ministry of the Environment of the Czech Republic |
| **KREJČÍ, Blanka** | Director of Czech Hydrometeorological Institute Regional Office Ostrava |
| **LOLLEK, Vladimír** | E-Expert, LLC |
| **MOSLER, Tomáš** | Arcelor Mittal, Air protection department |
| **SEIBERT, Radim** | Czech Hydrometeorological Institute Regional Office Ostrava |
| **SEVERA, Ervín** | Head of the Local planning department, Regional Authority |

*Table 1 - List of the Delphi method participants. Created by author.*

The aims and objectives of the research were presented to all participants in initial email, as well as the anonymity principle[3], basics of used method and how the data will be processed. Each of the participants provided informed consent via email.

Three rounds of the questionnaires (see Appendix) were performed within two months in the software Survey Monkey. In view of the fact that all respondents are Czechs, all questionnaires were conducted in Czech language. The first questionnaire contained five closed questions

[3] Names of the participants are declared, but the questionnaires are completely anonymous. The software that was used for data collection provides anonymity, so no one, not even the author of the study, does not know what the responses of individual expert were.

and 13 opened questions, to obtain every idea of each respondent. According to Survey Monkey, the first questionnaire took in average 43 minutes to complete. Questions for the second questionnaire were based on the answers from the first round, all ideas were covered (even the "extreme"[4] ones). The questionnaire contained 119 closed questions only, with the possibility to add a comment, and results of the first round were presented. The purpose of this round was to find the consensus about the thoughts and ideas provided in the first round. The amount of the questions was really high, but all respondents were notified in advance, and since those questions were closed only, the average time of completion was 36 minutes. The questions with high incidence of the answer "I do not know" and those with agreement/disagreement ratio 60/40 (and closer to 50/50) were reformulated and asked again in the third round. To fill-in this questionnaire took in average 19 minutes.

From initial 14 respondents, one participated only in first round. After the third round, confirmation about completion was received from 11 respondents, but Survey Monkey indicate only nine completed questionnaires.

Some of the data collected by Delphi method are analysed quantitively (median, frequency) and the rest of them are analysed qualitatively, employing the realistic approach. Data were coded and after that, the thematic analysis and content analysis were applied. Data were analysed in the software Atlas.ti. To present the results in complex and coherent way, the scenario method is used for the interpretation.

The chapters are supplemented with maps, charts and tables, created by author, to provide comprehensible interpretation of analysed data. Maps were created with the software QGIS 2.18.26, charts and tables were created in Microsoft Excel.

[4] As an extreme opinion is considered that answer which provides any kind of drastic solution – e.g. close down every industrial company.

## 3. Particulate Matter

Particulate matter (PM) is a dusty aerosol with a size smaller or equal to 10 µm. It remains in the air for several days because of low falling speed (VYSOUDIL, 2002). The PM can be divided into two groups given by their size. Coarse particulate matter ($PM_{10}$) is smaller or equal to 10 µm and fine particulate matter ($PM_{2.5}$) is smaller or equal to 2.5 µm (MOUSSIOPOULOS, 2003, p. 95). The fine particles are important to monitor because of their greater impacts on the health (HŮNOVÁ, JANOUŠKOVÁ 2004, p. 63; CENIA 2005, p. 15), larger particles, on the other hand, have greater negative impacts on the vegetation (HŮNOVÁ, JANOUŠKOVÁ 2004, 63). The scientific focus moved from $PM_{10}$ to $PM_{2.5}$ and the attention is currently addressed to $PM_1$ – smaller or equal to 1 µm – and ultrafine particles (UFP) – smaller than 0,1 µm (VECCHI, et al., 2018, p. 679).

Fractions of $PM_{2.5}$ may contain admixture of various heavy metals – astatine, cadmium, chrome, copper, mercury, nickel, lead and zinc - those substances are toxic even in trace amount. The heavy metals are produced by fossil fuels combustion, iron production and processing, waste incinerator, cement and glass production and transportation (VYSOUDIL, 2002, p. 27). The particles may grow by coagulation of primary particles and by condensation of gases on particles. In urban areas, the fine particles are usually formed by chemical reactions ($SO_2$, NOx) or other similar slow processes in the atmosphere. The coarse particles are formed by abrasion of road material, tyres, construction works, soil dust and traffic turbulence (MOUSSIOPOULOS, 2003, p. 95). Nontoxic particulate matters in large areas initiate the weakening of natural intensity of solar radiation – this causes the changes in radiational balance of the Earth, which contributes to the climate change[5] and causes disruptions in natural ecological equilibrium (VYSOUDIL, 2002, p. 25).

According to the EEA (2018, p. 26), the PM amount in the air remains above the EU daily limit value in large parts of Europe. *"PM concentrations are rapidly increasing because of globally increasing urbanization and industrialization, thus industrialized cities - and their agglomerations - are facing serious air quality problems caused by high levels of air pollutant concentrations related to environmental hazards"* (ŠTRBOVÁ, et al., 2017, p. 1190). As the

[5] PM air pollution is cooling the climate by scattering solar radiation. Nevertheless, "*PM also affects climate indirectly by affecting cloud formation which leads to changes in cloud reflectivity, cloud distribution and precipitation patterns"* (UN Environment, 2019, p. 124).

major sources of PM pollution in European urban areas are considered traffic and wood burning (VECCHI, et al., 2018, p. 682).

## 3.1 Health Effects

*"Only a few risks have a greater impact on human health than pollution in the current global world"* (TOMÁŠKOVÁ, et al., 2016, p. 34). PM has a significant impact on human health even at relatively low concentrations. Effects of short-term exposure to $PM_{10}$ on respiratory health have been documented, but $PM_{2.5}$ is a stronger factor affecting the mortality (WHO Regional Office for Europe, 2013). Several studies presented how exposure of pregnant women to $PM_{2.5}$ air pollution affects the foetus - head circumference, low birth weight[6], preterm births[7] and stillbirth (LI, et al., 2019, p. 249). The long-term exposure to high concentration of PM is correlating with the incidence of cardiovascular and respiratory diseases (HIME et al., 2018, p. 1207), higher level of $PM_{2.5}$ is associated with cardiopulmonary deaths and lung-cancer deaths (BOLDO, et al., 2006). Premature deaths from air particulate matter pollution in the WHO European Region in 2010 (498 538 premature deaths) decreased compared to 2005 (565 271 premature deaths), the same trend was observed in the Czech Republic. Nevertheless, the number of premature deaths still abides remarkably high (WHO Regional Office for Europe & OECD, 2015, pp. 8-9). Ambient $PM_{2.5}$ air pollution was responsible for 7.6 % of global deaths and 4.2 % of global disability-adjusted life years in 2015 (HIME et al., 2018, p. 1206). Life expectancy of a 30-year-old person would increase by average between one month and more than two years, provided that the annual mean value of $PM_{2.5}$ would not exceed 15 $\mu g.m^{-3}$ (BOLDO, et al., 2006). Due to the relationship between human exposure to PM and mortality and morbidity, people from risk group (those with cardiovascular disease, the elderly, diabetics, pregnant women, those with respiratory disease) should spend only limited time outdoor during the days with higher concentrations of air pollution (AMARAL, et al., 2015, p. 1328).

PM penetrating the pulmonary alveolus and induces oxidative stress, which causes airway inflammation in asthmatics (LI, et al., 2003, p. 251), elevate the need to use asthma medication (YAMAZAKI, et al., 2013, p. 401) and causing neurological problems (AMARAL, et al., 2015, p. 1328). Higher systemic oxidative stress and inflammation may lead to impaired placentation,

[6] *„Infant weighing 2 499 g or less, regardless of gestational age"* (LI, et al., 2019, p. 249).
[7] *„Birth at 37 weeks or less of gestation"* (LI, et al., 2019, p. 249).

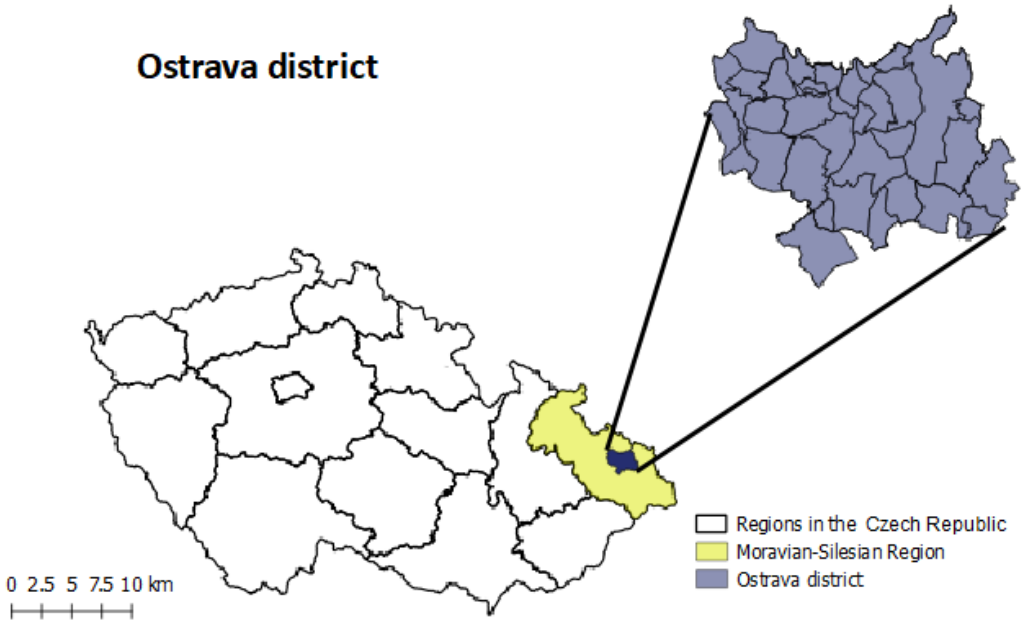
which cause endocrine disruption, and increased maternal susceptibility to infections, and therefore the risk of preterm birth is enlarged. Greater danger of stillbirth by 42 % occurs when woman is regularly exposed to a high concentrations of PM air pollution during the third trimester of pregnancy (LI, et al., 2019, p. 250). The association between chronic kidney disease and long-term exposure to$PM_{2.5}$ was discovered. Every 10 $\mu g.m^{-3}$ increase of $PM_{2.5}$ value represents a 6 % higher risk of developing chronic kidney disease (CHAN, et al., 2018, p. 4).

To evaluate the impacts of the air pollution on health, there are important these properties – state (liquid/solid), volatility, hygroscopicity, chemical composition (content of organics, metals, salts, acid), morphology and density (MOUSSIOPOULOS, 2003, p. 92). For example, the particles from traffic have high oxidative potential due to metals from engine and brakes abrasion (HIME et al., 2018, p. 1212). The air pollution, and thus impacts on human health, is deteriorating during rush hours[8] and congestions (ZHANG & BATTERMAN, 2013). Short-term exposure to PM from diesel exhaust results in allergic inflammation and asthma symptoms, long-term exposure leads to enhanced risk of lung cancer (HIME et al., 2018, p. 1217). Higher prevalence of asthma can be found in polluted urban areas (LI, et al., 2003, p. 252). The health effect from exposure to PM emitted from transportation and coal-fired power station may be greater than the health effect of other sources of PM emissions (HIME et al., 2018, p. 1221).

[8] Morning rush hour represents a greater risk due to poorer dispersion conditions (ZHANG & BATTERMAN, 2013, p. 311).

## 4. Ostrava - Geography and Climate

Ostrava is the third biggest city in the Czech Republic and it pertains to the Moravian Silesian region (see Picture 1). According to the Czech Statistical Office, the Ostrava district has 321 273 inhabitants[9] (CZSO, 2019) and it covers the area of 214 square kilometres (OstravaInfo u.d.).




*Picture 1 - Location of Ostrava district within the Czech Republic. Source: ArcČR500, map created by author*

The district is located in Ostrava basin, which is a lowland with an average height around 200 meters above sea level. Fundamental characteristics of Ostrava basin were formed by quarter accumulation. In this area we can find an extensive surface subsidence and accumulation of massive earthwork (DEMEK, 1965, p. 227). Ostrava district is part of the Upper Silesian Basin where important European coal deposits are accumulated. This area is situated near the border of Czech Republic and Poland (DOPITA & KUMPERA, 1993, p. 292). The entire region of Upper Silesian Basin is considered as the most polluted area in the Czech Republic and most likely in the whole Central Europe (JIŘÍK, et al., 2017, p. 282).

Since the region was highly industrialized and henceforth urbanized, there can be found several characteristic anthropogenic shapes – for example the slag heaps. Those formations are generating gas emissions which are increasing the number of fine particles in the ambient air. Likewise, anthropogenic depressions, produced by undermining, caused in some areas

[9] To the date of 31st December 2018.

a ground subsidence of ca. 12 meters. The other fact, that cannot be missed out, is that there is no substantial orographic border in this location (DEMEK, 1965, pp. 228-229). The local air pollution is influenced by specific emission sources. The terrain character and meteorological conditions are the crucial features for the dispersion condition - air flowing, pressure system, temperature stratification of the atmosphere (HŮNOVÁ, JANOUŠKOVÁ 2004, 38). During the winter time in the Czech Republic, an occurrence of the advection inversion[10] is characteristic. The advection inversion is declining the possibility of the pollutant dispersion which leads to the air quality deterioration (VYSOUDIL, 2002, p. 35). There are significantly increased values of PM during a days with a poor dispersion conditions (LACH, et al., 2016, p. 54). The air pollution improves once it starts raining – there are two possible ways of cleaning the air. The first one is the "rain out", when the pollutants get into the precipitation water during the genesis of the precipitation inside the clouds. The second one is the "wash out", when the pollutants get into the precipitation water during the rain (BRANIŠ, HŮNOVÁ 2009, 48).

The characteristics of the Ostrava district mentioned above are one of the reasons that affect the air quality. The district is situated in lowland with relatively low height above sea level, it is highly industrialized and urbanized and there are no orographic borders around the area that would protect it from the distant air pollution sources. During the windless days (or days with a weak wind), the low altitude and depressions cause that the air pollutants are concentrated above the district resulting in smog situations, during which the fixed regulations need to be introduced.

[10] It is caused by relatively warmer air above a colder surface (VYSOUDIL, 2002, p. 35).

# 5. Trend analysis

The evolution of environment in the Czech Republic since the Velvet Revolution is usually divided into four periods. In the years 1989–1992 we talk about the so called "*Founding Period".* At the beginning of the period, the suspended particular matter (SPM) emissions in Northern Moravia (including part of the Ostrava) were one of the highest in the world. During that time the government was preparing new environmental laws and amendments, new institutions and supportive organizations were established (e.g. Czech Ministry of the Environment, the Czech Environmental Inspectorate, State Environmental Fund of the Czech Republic, Czech Environmental Institute). The second period (from 1993 to 1998) is called the *"Implementation Period".* Within those five years the implementation of environmental laws had begun. The purification devices were installed in power plants and other facilities generating the pollution; the environmental impact assessment (EIA) was employed. In 1995 the negotiation regarding the accession to European Union (EU) have started. Since the year 1999 the Czech Republic was preparing for the accession to the EU – this period is called the *"Pre-Accession Period"* and it lasted until the end of 2003. Czech government was replacing the existing legal regulations by new ones on the basis of European regulations. The new national environmental policy compatible with the policy of the EU was updated in 2001. After the Czech Republic officially accessed the EU in 2004, the "*European Period"* have started, lasting until today (CENIA, 2005, pp. 7-8).

In view of the fact that there is lack of data for the years before 2004, the analysis will be focused on the period from 2004 to 2017.

## 5.1 Sources of Particulate Matter Air Pollution

In general, there are two types of the air pollutants - the primary and the secondary. The primary pollutants are those matters that are not exposed to any changes and they have the concrete source (dust, ash, carbon particles). The secondary pollutants do not have specific source and they underwent the transformation and chemical reactions (BRANIŠ, HŮNOVÁ 2009, 184). The entrance of a pollutant into the atmosphere is called emission. The pollutants contained in the atmosphere at the places where it interferes with the humans, nature and objects are called the air pollution (JANČÍK et al. 2013, 20).

When assessing the sources of the pollution, we can categorize them by the time frame, height of the emissions, track of the pollution etc. The most common evaluated categories are the time category and the track of the pollution. The pollution in time can be either immediate or continual. Source of the pollution might be:

- stationary (industrial sources – facilities, smokestacks),
- mobile (roads, highways), or
- areal (local furnaces, deforested areas, agricultural lands) (VYSOUDIL, 2002, p. 25).

Major source of the particles in urban air in the most European cities is the road traffic. The problem is not only the exhaust, but also the pollution from wear on the road, tires, brakes, airborne dust from road surfaces (MOUSSIOPOULOS, 2003, p. 95). During the years 1989–2004, the local furnaces together with the traffic were considered as the biggest air polluters (CENIA, 2005, p. 15). At the present time, there is no unified opinion about what the most significant source of the emissions is (further information can be found in the chapter "*6.2 Possible future trends of particulate matter air pollution in Ostrava").* JANČÍK et al. (2013, 28) claims that the industry is the biggest source of the emissions. The largest sources in Ostrava are iron and steel works, power plants and coking plant. JANČÍK et al. (2013, p. 28) stated two further sources of emissions in Ostrava - local furnaces and transportation. There exists one another source of the pollution and it is a transboundary air pollution from Poland. It occurs when the airflow direction is from Poland to the Czech Republic[11] (ČERNIKOVSKÝ, et al. 2016).

The database gathering data about the emission and air pollution sources can be found in the Czech Republic. Register of the emissions and air pollution sources[12] - REZZO - is administrated by the Czech Hydrometeorological Institute (hereinafter referred to as CHMI). The REZZO is dividing the sources into four categories – see Table 2 (VYSOUDIL, 2002, p. 45).

| | |
|---|---|
| REZZO1, REZZO2 | Large and medium sized sources registered as stationary sources. |
| REZZO3 | Small areal sources on the municipality level. |
| REZZO4 | Mobile sources at the national level. |

*Table 2 - REZZO classification. Source: (VYSOUDIL 2002, 45), table created by author.*

[11] When the airflow is in the direction from the Czech Republic to the Poland, it is negatively influencing the air quality in Poland (ČERNIKOVSKÝ, 2016, p. 48).
[12] Translated from the Czech – Registr emisí a zdrojů znečištění ovzduší.

With the novelization of the law, the new record-keeping system has been created in 2013 - ISPOP – Integrated system for fulfilment of announcing obligations in the field of environment[13]. This system divides sources of air pollution as follows:

- large sources (industrial facilities, incineration plants, coking plants etc.),
- middle-sized sources (boiler houses),
- transportation,
- small sources (local furnaces) (RPHA, 2014, p. 14).

### Industry

As an industrial sources of emission and air pollution can be considered power plants, heating plants, coking plants, boiler houses, steel works etc. Those kind of sources are bound to release only the amount of pollutants allowed by the legislation, the maximum line of the pollution is referred as the emission limit or ceiling. Sources that exceed the emission limit have to pay the fine (JANČÍK, 2013, p. 28). Discovery of coking coal can be seen as a starting point for industrial development in Ostrava, and it continued for another two centuries, transforming the city into an industrial giant (TOMÁŠKOVÁ, et al., 2016a, p. 18). The industry is still dominating sector in the city, the most common is coal mining industry, metallurgy (covers almost 100 % of the capacity of the country) and energetics industry. Ostrava is the industrial core of the Moravian Silesian region (RPHA, 2005, p. 5). The most significant stationary sources are Vysoké pece Ostrava Ltd., Třinecké železárny Ltd., Mittal Steel Ostrava Ltd., Dalkia Czech Republic Ltd., OKD OKK Ltd., Vítkovice Steel, Energetika Vítkovice Ltd., ČEZ Ltd. (CENIA, 2006, p. 5). Mittal Steel Ostrava (nowadays called Arcelor Mittal) is the largest steel works facility in the Czech Republic and it give a rise to the particulate matter values measured at a permanent measuring station in Radvanice and Bartovice ward downwind from the industrial complex (see Picture 2[14]). The measured values here are higher than at other measuring stations in Ostrava (VOSSLER, et al., 2016, p. 503). Nevertheless, the air pollution from industrial part of the city is significantly influencing the long-term air quality in suburban

[13] Translated from the Czech – Integrovaný systém plnění ohlašovacích povinností z oblasti životního prostředí.
[14] At the photograph from Open Street Map, a smoke from the Arcelor Mittal steel works facility can be seen.

city areas, even though the industry facilities are not in the prevailing wind direction (JIŘÍK, et al., 2017).

During the year 2005, the operators of the most important stationary sources of emissions were conducting general repairments and they were improving their technological facilities in conformity with trends of the European Union (EU). The modernization has had a positive effect on the air quality in the city (CENIA, 2006, p. 7), but compared to the air pollution decline in 1999 (the emissions of PM from the stationary sources were reduces by 94 %), the reduction of emissions was much smaller. Even though there was a significant decrease of emissions, the concentration of air pollution was increasing again (RPHA, 2007, p. 8).


*Picture 2 - Location of Arcelor Mittal. Source: ArcČR500, Open Street Map. Map created by author.*

For the following years, heavy industry, along with other sources, contributed to the air pollution, especially during inversion periods (RPHA, 2010, p. 15). Coking plant Šverma (part of the company OKD OKK Ltd.) has terminated its operation in December 2010 and Coking plant Svoboda has modernized its facilities (RPHA, 2011, p. 13). During this year, Třinecké železárny Ltd. implemented the dust lowering projects, which led to the decrease of the amount of PM emissions (RPHA, 2014, p. 15). Due to the implementation of several projects for lowering emissions from industrial facilities, the proportion of mobile and small sources of

air pollution has become more significant (CENIA, 2015, p. 6). Arcelor Mittal has launched the project for dedusting by fabric filters in 2015 and has continued with several other projects, Třinecké železárny has conducted the secondary dedusting and therefore lowered its emissions of PM to one tenth compared to year 2005 (RPHA, 2016, p. 11), the total decrease of PM emissions from the industry was more than 700 tun per year. Sources from the category REZZO1 are obeying the legislative duties and limits which, along with the improvement of technologies focused on lower environmental impact, resulted in lower emissions (CENIA, 2016, pp. 31,34). The lowering or stagnating trend remained until the year 2017 (CENIA, 2018, p. 32). As VOSSLER et al. (2015) suggested, industry in Ostrava is not the exclusive source of PM, there are regional and seasonal sources influencing the amount of PM in the air.

### Transportation

Since Ostrava is highly urbanized city, there is a thick road infrastructure and a great number of cars which make the transportation substantial source of the air pollution, especially in the city centre. As mentioned above, the main problem of the traffic-caused air pollution are the particles from tyres, breaks, road surface and raised dust sedimented on the roads – the term for this process is resuspension (JANČÍK, 2013, p. 34). To combat the intensive traffic, construction of highway D47 has begun in the year 2004 (CENIA, 2006, p. 20). The traffic is peaking in the morning and combined with the meteorological conditions – occurrence of fog – there is a high incidence of smog (RPHA, 2006, p. 17). The concept of measures to support public transportation, cycling and walking was elaborated in 2005, due to annual increase of PM emissions from the transportation. The outcome of the concept was to create unified integrated transportation system (IDS), that would be competitive to individual transportation in price and quality. Transportation in the city should be focused in suitable corridors, planned bypasses will eliminate the emissions (CENIA, 2006, pp. 21-22).

Intensity of the transportation was increasing during following years, even though the integrated transportation system was developed successfully and the construction of D47 was finished in 2009 (CENIA, 2010, p. 2). The resuspension of dust on the roads and their surroundings is more important source of the air pollution during the summer time (POKORNÁ, et al., 2018, p. 848). To lower the amount of dust alongside the roads, Moravian Silesian region has launched the project to lower the dustiness in surroundings of the roads in 2015. The project has included planting and regeneration of green vegetation separating

livelihood areas and frequented roads[15], and excess cleaning of the roads (decreasing of the amount of pollutants, reduction of resuspension). The region supported low-emission transportation development, at the individual level and public transportation, by establishing cooperation with ČEZ Ltd. (electromobility) and Vítkovice Ltd. (CNG) (CENIA, 2016, pp. 24,26). The transportation growth rate in agglomeration Ostrava/ Karviná/ Frýdek-Místek is one of the highest in the Czech Republic (CENIA, 2018, p. 38). The proportion of transportation on air pollution is significant during rush hours (8 a.m. and 6 p.m.) when the amount of emissions from cars peak (LEONI, et al., 2018, p. 148). Passenger cars participated on $PM_{10}$ emissions by 10.6 %, and on $PM_{2.5}$ by 10.9 % in 2016 (CHMI, 2018).

### Local Furnaces

Local furnaces are small sources of energy designated for heating of houses or flats. This source of air pollution is quite significant in the area. The chimneys are situated in the low height, so the emissions are released right in the breathing zone of the inhabitants. Additional issue is the misusing of a furnace by the owner (burning of waste, poor-quality solid fuels) and the outdated types of furnaces (JANČÍK, 2013, p. 30). The highest PM concentrations are connected to the burning of poorly processed wood (wet, not dried up enough) and brown coal (RPHA, 2016, p. 11). *"Domestic wood combustion heaters can significantly contribute to ambient PM in locations with cold or moderate winters"* (HIME et al., 2018, p. 1218). Especially during the bad dispersion conditions and inversion, the local furnaces became significant sources of air pollution. During the year 2005, the government attempted to convince people to use natural gas, but it was not successful because of rising prices. Nevertheless, the using of renewable sources of energy (solar, biomass, heat pumps) has increased (CENIA, 2006, pp. 5,8). The rise of natural gas prices has resulted in relapse to solid fuels and therefore the proportion of local furnaces at total air pollution increased (MoE, 2006, p. 9). Population density in the district is high, so the emissions from local furnaces are significantly above national average (CENIA, 2009, p. 4).

[15] Green vegetation can remove pollutants via wet and dry deposition, adsorption and absorption. On the other hand, vegetation, especially trees, in urban areas, or more precisely alongside the roads, may reduce the air flow between the street and the atmosphere and thus increase the pollutant concentrations bellow the tree crown. The benefits of vegetation on air quality in local scale are still being discussed. Aerodynamic effects are considered more important than deposition in the cases of PM air pollution (JEANJEAN et al, 2016; BUCCOLIERI et al., 2018).

In 2014, the region started with an awareness campaign. Throughout the campaign, the methods of heating and the importance of quality fuels were medialized, and furnaces replacements were funded by subsidy programmes (RPHA, 2015, p. 11). Local furnaces and transportation are a dominant contributor to the PM air pollution, but due to lack of information, it is not possible to calculate the specific contribution of those two sources (VOSSLER, et al., 2016, p. 508).

### Transboundary air pollution from Poland

In 2009, the effects of transboundary air pollution were discussed, for the first time (RPHA, 2010, p. 15). It is difficult to determine how significant is the transboundary air pollution from Poland. Proportion of measured PM with determined source as a local furnace can originate from Poland (VOSSLER, et al., 2015, p. 462). The concentrations are dependent on the airflow direction – during north-east directions the PM values are significantly higher, which is the consequence of pollution transport from Poland. When the north-east direction wind occurs, there is much higher frequency of days exceeding daily limit value of PM concentration. The quantification estimate remains tough (ČERNIKOVSKÝ, 2016). The international negotiations and several scientific projects (e.g. Air Silesia, Air Border) are under way (RPHA, 2018, p. 12).

## 5.2 Legal Frame

Air protection in the Czech Republic can be separated into two fields. The emissions, which is concerning the emissions of pollutants into the air, and the air pollution levels, which is concerning the concentration of air pollutants in the air (CENIA, 2005, p. 10). Regulation based on measured values came into effect in 1980s, in Northern Bohemia and later at Ostrava region (VYSOUDIL, 2002, p. 4). The air protection administration is entrusted to districts, regions and environmental resort (RPHA, 2005, p. 10).

The fundamental law regarding the air quality was the Act No. 76/2002 Coll. on integrated prevention[16] and the Act No. 86/2002 Coll. on air protection. By this Act, the Government Decree no. 350/2002 Coll. was issued, setting down an annual limit value (LV) for $PM_{10}$ to 40 $\mu g.m^{-3}$, daily limit value was set down to 50 $\mu g.m^{-3}$. The daily LV has an exceeding tolerance

[16] The amended Act established the Directive 2010/75/EU of the European Parliament and of the Council of 24 November on industrial emissions (integrated pollution prevention and control) as a referential document about the best techniques available (BAT) (PARLIAMENT OF THE CZECH REPUBLIC, 2002, §2, j).

for 35 days per calendar year (CHMI, 2005). The limits of $PM_{10}$ air pollution concentrations were declared, but there were no limits ordering the authorities to inform citizens or to regulate the sources of emissions and therefore the negotiations of involved parties in Moravian Silesian region has begun in 2005. The Regional Public Health Authority of the Moravian Silesian region (RPHA) was responsible for the suggestion of daily limit value whose exceeding would give the authorities a duty to inform citizens. RPHA suggested a $PM_{10}$ concentration of 100 $\mu g.m^{-3}$ for at least two following days, which was calculated by assessment of health risks (RPHA, 2006, p. 19). The Regional Regulation No. 1/2005 was issued, listing the regulatory conditions and creating the system of providing the information about an aggravated air pollution situation to citizens (CENIA, 2006, p. 7). The information support has been assured by CHMI Ostrava and the regulations has been issued by Regional Authority based on meteorological forecasts and dispersion conditions (RPHA, 2007, p. 9). Responsibility for air quality at regional level is secured by the "Air Quality Plans", which are published for each region (MoE, 2017, p. 19).

The Government Decree No. 597/2006 Coll., on monitoring and evaluating air quality, came into effect by the end of 2006, cancelling the Government Decree No. 350/2002 Coll. (CENIA, 2007, p. 5). This Decree, besides other things, set down the upper assessment threshold (UAT) and lower assessment threshold (LAT) of $PM_{10}$ concentrations – see Table 3.

| | 24-hour average | Annual average |
|---|---|---|
| **LAT (in $\mu g.m^{-3}$)** | 20 | 10 |
| **Allowed number of exceeded days per year** | 7 | - |
| **UAT (in $\mu g.m^{-3}$)** | 30 | 14 |
| **Allowed number of exceeded days per year** | 7 | - |
| **LV (in $\mu g.m^{-3}$)** | 50 | 40 |
| **Allowed number of exceeded days per year** | 35 | - |

*Table 3 - $PM_{10}$ concentration limits. Created by author with data from Government Decree No. 597/2006 Coll.*

A work group, composed of representants of the main emissions producers in the region, national authorities and other important institutions, was created in 2007. This group was working on The National Emission Reduction Program of the Czech Republic, which was published by Government Decision No. 630 of 11 June 2007 (RPHA, 2008, p. 10).

After a recognition of serious health effect of $PM_{2.5}$, Directive 2008/50/ES of the European Parliament and of the Council of May 2008, on ambient air quality and cleaner air for Europe, besides the other things, laid down the limits of $PM_{2.5}$ concentrations in ambient air – see Table 4 (CHMI, 2008).

| | First stage annual average | Second stage annual average |
|---|---|---|
| LAT (in µg.m$^{-3}$) | 12 | 12 |
| UAT (in µg.m$^{-3}$) | 17 | 17 |
| LV (in µg.m$^{-3}$) | 25 | 20 |
| Date by which limit value is to be met | 1.1.2015 | 1.1.2020 |

*Table 4 - $PM_{2.5}$ limit concentrations. Created by author based on data from Directive 2008/50/ES.*

Following the "Air Quality Plans", other strategic document was issued – "Lowering Emissions in Moravian Silesian Region Program". So called "Smog regulation" was created, extending the existing regulations during days with exceeded limit values of particulate matter (RPHA, 2010, p. 15).

The Act No. 86/2002 Coll. on air protection was replaced by the Act No. 483/2008 Coll., which came into effect in February 2009. This Act was replaced in 2012 by the Act No. 201/2012 Coll. on air protection, which also created the possibility to declare low emission zones[17] and set down a new regulation limit value of $PM_{10}$ concentrations. The regulation limit value was decided on 150 µg.m$^{-3}$ for three following days in at least half of the measuring stations. The Act set down a new limit values of $PM_{10}$ concentrations – see Table 5.

| | 24-hour average | Annual average |
|---|---|---|
| LAT (in µg.m$^{-3}$) | 25 | 20 |
| Allowed number of exceeded days per year | 35 | - |
| UAT (in µg.m$^{-3}$) | 35 | 28 |
| Allowed number of exceeded days per year | 35 | - |
| LV (in µg.m$^{-3}$) | 50 | 40 |
| Allowed number of exceeded days per year | 35 | - |

*Table 5 - $PM_{10}$ limit concentrations. Created by author based on data from the Act No. 201/2012 Coll.*

[17] Low emission zones should contribute to lowering air pollution caused by traffic (MoE, 2017, p. 20).

"Air Quality Improvement Programs" are currently the main instruments of air quality management (CENIA, 2016, p. 12). In 2016, project "Sustainable Moravian Silesian Region" was launched, whose aims are to create a medium-term Action plan for low emission transport development in Moravian Silesian region in years 2017 – 2021, awareness campaign to support alternative drives etc (CENIA, 2017, p. 44). The No. Act 201/2012 Coll. was amended by Act No. 369/2016 Coll. which implements the new Directives of European Union (CHMI, 2017).

## 5.3 Measurement

The most important and commonly used PM measurements are particle concentration and particle size. Devices, which are measuring the size distribution, use the properties of particles, such as diffusion, aerodynamics, optical and electrical mobility (AMARAL, et al., 2015, p. 1329). Based on the process dynamic, the long-time trends, seasonal changes (annual trends) and daily trends are being measured and evaluated. The measuring devices are distributed according to the representativeness of location characteristics – see Table 6 (BRANIŠ & HŮNOVÁ, 2009, p. 185). Calculation techniques are used for the areas without a measuring device, specially $PM_{2.5}$ can be modelled very successfully. Concentrations of an air pollutant in suburban parts of cities are usually defined by dispersion models. Therefore, these areas are less monitored than city centres. It is difficult to decide the optimal number of monitoring stations and to choose their location to provide a representative outcomes of the measurement (JIŘÍK, et al., 2017, pp. 381-382).

| Locality type | Zone type | Zone characteristics |
|---|---|---|
| Traffic | Urban | Residential |
| Industrial | Suburban | Commercial |
| Background | Rural | Industrial |
| | | Agricultural |
| | | Natural |
| | | Residential/Commercial |
| | | Commercial/Industrial |
| | | Industrial/Residential |

| | | |
|---|---|---|
| | | Residential/Commercial/Industrial |
| | | Agricultural/Natural |

*Table 6 - Division of measurement stations. Created by author based on data from CHMI (2005).*

Since the 1967, the Hydrometeorological Institute (present day Czech Hydrometeorological Institute) has been responsible for the air pollution measurement network. A systematic measuring at Ostrava region has begun in 1969. Later on, eight regions which was most affected by the air pollution were established by a government decision, Ostrava region being one of them, considered as a medium-level polluted area. The then Czechoslovak Socialist Republic was among the first European countries that measured background concentrations of an air pollution. From that time on, the measurement network has been developing and broadening. All measured data have to be stated and all monitoring stations need to be registered in information database – ISKO (Air Quality Information System)[18] which has been operated by CHMI (HŮNOVÁ & JANOUŠKOVÁ, 2004, pp. 84-87). The information about an air quality are published online at CHMI website regularly at 3 a.m. and 1 p.m. CHMI and Public Health Institute Ostrava (hereinafter referred to as PHIO)[19] are the main providers of air quality monitoring services in Ostrava district (RPHA, 2005, p. 11). The CHMI is also responsible for processing data from other resorts which perform monitoring and it is creating overviews and publications afterwards (RPHA, 2006, p. 16).

There are two most common measurement techniques. The first one is based on collection of particles on a filter, the collected sample is later examined in laboratory which take a longer time. The second one is a real-time measurement, which is able to provide results within seconds (KULKARNI, et al., 2011, p. 10). In Ostrava, $PM_{10}$ and $PM_{2.5}$ has been measured by automated monitoring stations (AMS) and manual stations (MS). The automated monitoring stations use radiometric[20] method (RADIO), tapered element oscillating microbalance[21]

[18] Translated from the Czech – informační systém kvality ovzduší.

[19] The Public Health Institute Ostrava is monitoring air quality as a part of the „Monitoring of population health condition related to the environment" (RPHA, 2005, p. 11).

[20] *„It stands on beta-ray absorption in a sample captured on filtering material. The difference between the beta-ray absorption of the exposed and non-exposed filtering material, which is proportional to the mass of the captured suspended particulate matter, gives the information on its concentration"* (CHMI, 2018a).

[21] *„The collection substrate, either a filter or an implication surface, is placed at the end of a tapered vibrating tube. The amount of mass collected on the substrate is related to the decrease in the resonant vibrational frequency of the tube. This approach appears to have a fewer artefacts, though variations in temperature, humidity, and pressure, and external vibrations can sometimes affect the accuracy of the measurement"* (KULKARNI, et al., 2011, p. 58).

method (TEOM) and since 2007 also optical electronic method (OPEL) – nephelometry[22] to be more specific. The manual stations use gravimetric[23] method (GRV) (CHMI, 2005; CHMI, 2008). This method does not enable to identify the fast processes, nevertheless the collected material can be analysed chemically (AMARAL, et al., 2015, p. 1330).

According to the CHMI (2005), there were eight stations registered in ISKO which were measuring particulate matter in Ostrava district in 2004 (for locations and their minimal and maximal representativeness see Picture 3):

**Poruba/CHMI (TOPO).** This station, run by CHMI, monitors an air quality in background suburban locality in residential zone. It is located in the area with family houses and its representativeness is from 0.5 kilometres to 4 kilometres. TOPO station uses a gravimetric method and provides concentrations of $PM_{10}$ and $PM_{2.5}$ daily.

**Fifejdy (TOFF).** TOFF station, run by CHMI, monitors an air quality in background urban locality in residential zone. It is located in the area with multi-storied buildings and its representativeness is from 0.5 kilometres to 4 kilometres. This station uses a radiometric method and provides concentrations of $PM_{10}$ every hour.

**Poruba/district V. (TOPB).** The second station in Poruba, run by CHMI, was monitoring an air quality in urban traffic locality in residential zone. It was located in the area with administrative, commercial and residential buildings and its representativeness was from 100 metres to 500 metres. TOPB station used a radiometric method and provided concentrations of $PM_{10}$ in thirty minutes intervals. The station was cancelled in December 31, 2004.

**Zábřeh (TOZR).** This station, run by CHMI, monitors an air quality in background urban locality in residential zone. TOZR is located in the area with multi-storied buildings and its representativeness is from 0.5 kilometres to 4 kilometres. It uses a radiometric method and provides concentrations of $PM_{10}$ and $PM_{2.5}$ every hour.

[22] *„This method is dedicated for air aerosol particle number concentration measurement; it could be also used for quantification of aerosol mass concentration in air. Principle of this method is proportionality of scattered light to ae. particle cross-section. Particle number concentration and particle size corresponds to measured counts and intensity of light pulses; these data could be recalculated and expressed as an aerosol particle mass concentration in air."* It is used to measure $PM_x$ at hotspot stations (CHMI, 2018a).

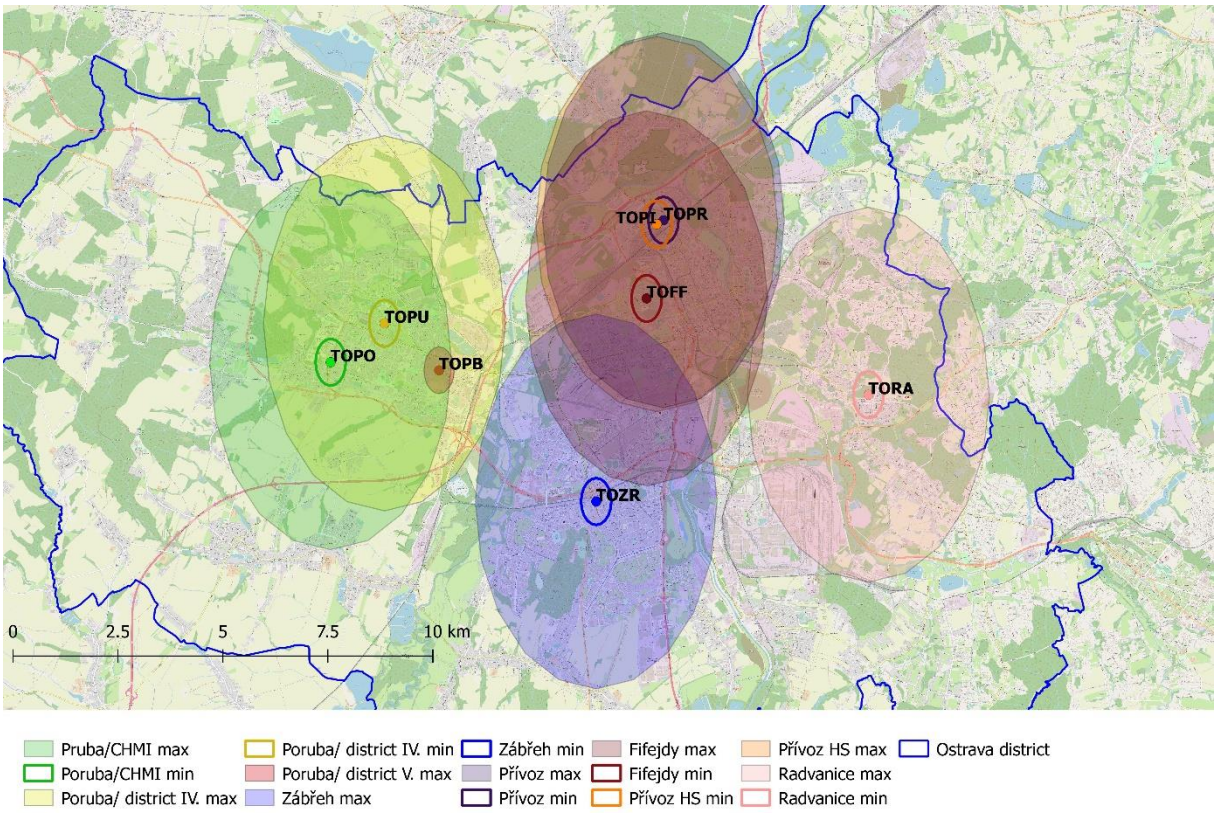
[23] *„The sample is taken through continuous filtration of ambient air on selected filtering material (membrane filters made of cellulose derivates or teflon with appropriate pore size or of glass fibre; capturing efficiency > 99.5 %). The difference between the weight of the filter prior to and after the exposure is determined gravimetrically"* (CHMI, 2018a).

**Přívoz (TOPR).** Station in city ward Přívoz, run by CHMI, monitors an air quality in industrial urban locality in industrial/residential zone. TOPR is located in the area with mostly industrial buildings and its representativeness is from 0.5 kilometres to 4 kilometres. This station uses a radiometric method and is providing concentrations of $PM_{10}$ and $PM_{2.5}$ every hour.

**Radvanice (TORA).** The station, run by CHMI, was monitoring an air quality in background suburban locality in residential zone. TORA was located in the area with family houses and its representativeness was from 0.5 kilometres to 4 kilometres. This station used a radiometric method and provided concentrations of $PM_{10}$ in thirty minutes intervals. Radvanice station was cancelled in April 8, 2005.

**Poruba/district IV. (TOPU).** Third station in Poruba ward is run by PHIO and it monitors an air quality in background urban locality in residential zone. TOPU is located in the area with administrative, commercial and residential buildings and its representativeness is from 0.5 kilometres to 4 kilometres. This station uses a gravimetric method and provides concentrations of $PM_{10}$ in three days interval.

**Přívoz HS (TOPI).** The second station in Přívoz ward run by PHIO monitors an air quality in industrial urban locality in industrial/residential zone. TOPI is located in the area with mostly industrial buildings and its representativeness is from 0.5 kilometres to 4 kilometres. Přívoz HS station uses a radiometric method and provides concentrations of $PM_{10}$ in thirty minutes interval. The station was renamed to **Přívoz ZÚ** in 2005 (code remained the same).




*Picture 3 - PM measurement stations in Ostrava district and their representativeness in 2004. Data source: Open Street Map, ArcČR500, CHMI. Map created by author.*

In 2005, the new measuring station was created. **Českobratrská, hotspot (TOCB),** run by CHMI, monitors an air quality in traffic urban locality in commercial/residential zone. The station is located in the area with administrative, commercial and residential buildings and its representativeness is from 100 metres to 500 metres. TOCB uses a gravimetric method and provides concentrations of $PM_{10}$ every day (CHMI, 2006). The station was put out of operation during the period of June 2017 – January 2018, due to the technical reasons (CHMI, 2018a).

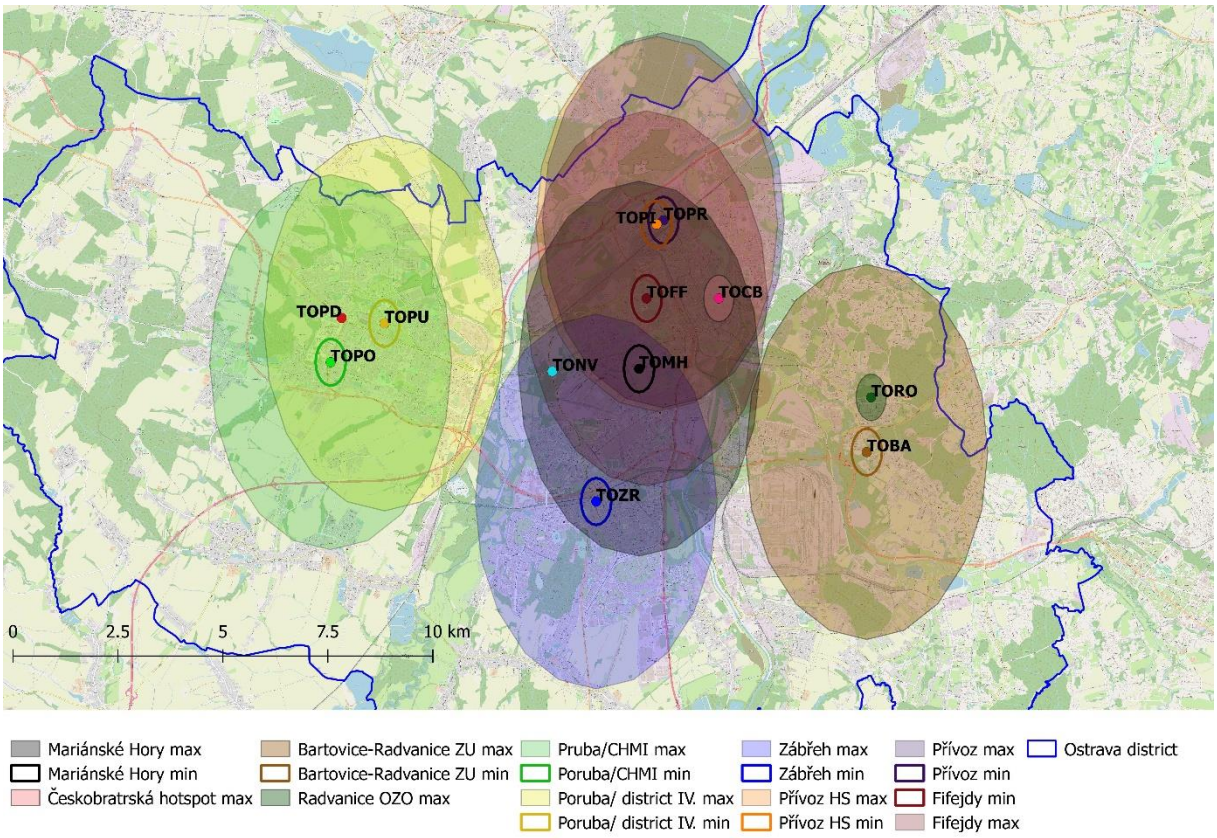
The elemental national network of air pollution monitoring in the Czech Republic was put into operation in 2006 (MoE, 2015, p. 3). Following the improvements in the air pollution monitoring, two new measuring stations were registered to ISKO in Ostrava. **Mariánské Hory (TOMH)** monitors an air quality in industrial urban locality in industrial/residential zone. This station is located in the area with administrative, commercial and residential buildings and its representativeness is from 0.5 kilometres to 4 kilometres. TOMH, run by PHIO, uses radiometric method and provides concentrations of $PM_{10}$ in thirty minutes intervals. **Bartovice (TOBA)** is also run by PHIO and it monitors an air quality in industrial suburban locality in industrial/residential zone. The station is located in the area with family houses and its

representativeness is from 0.5 kilometres to 4 kilometres. TOBA uses radiometric method and provides concentrations of $PM_{10}$ in thirty minutes interval (CHMI, 2007). In 2008, TOBA station has begun using an optical electronic method – nephelometry (CHMI, 2009) and in 2009, the station launched the hourly measurement of $PM_{2.5}$ using nephelometry method (CHMI, 2010). Bartovice station was renamed to Radvanice ZÚ in 2010 (code remained the same) (CHMI, 2011).

**Radvanice OZO (TORO)** was registered to ISKO in 2013. The station, run by PHIO at the beginning and by Statutory city of Ostrava later, monitors an air quality in background suburban locality in residential zone. TORO is located in the area with family houses and its representativeness is from 100 metres to 500 metres. This station uses a radiometric method and provides concentrations of $PM_{10}$ and $PM_{2.5}$ every hour (CHMI, 2014).

Ostrava district has the highest number of measurement stations in the Czech Republic and the attention is focused on a long-time monitoring of air pollution, specially measurement of PAH and particulate matter (RPHA, 2016, p. 10). The national network of air pollution monitoring was completely renewed in 2015 – the instruments for air pollution monitoring were replaced for more advanced in the whole Czech Republic (MoE, 2016, p. 3). With this renovations, the new measurement station in Ostrava was registered to ISKO. **Poruba DD (TOPD),** run by PHIO, monitors an air quality in traffic urban locality in residential zone. The station is located in garden of retirement home at the city periphery and its representativeness is from few metres to 100 metres. TOPD uses a TEOM method and provides concentrations of $PM_{10}$ every hour (CHMI, 2016).

Since 2016, TOCB station has been using a nephelometry method (CHMI, 2017). A new measurement station in Ostrava was registered to ISKO in 2017 – **Nová Ves – Ovak areal (TONV).** This station was monitoring an air quality in traffic urban locality in industrial/agricultural/natural zone. It was located in the city periphery in partly built-up area and its representativeness was from few metres to 100 metres. TONV used a radiometric method and provided hourly concentrations of $PM_{10}$. It operated for one year (since January 2017 to January 2018) (CHMI, 2018a). Evaluation of air quality can be done only with data from those measurement stations, which fulfil the requirement for minimum data capturing amounting to 90 % (CHMI, 2016). For locations and representativeness of measurement stations in the year 2017, see Picture 4.




*Picture 4 - PM measurement stations in Ostrava district and their representativeness in 2017. Data source: CHMI, Open Street Map, ArcČRC500. Map created by author.*

## 5.4 Concentrations of Particulate Matter

The analysed trends of $PM_{10}$ and $PM_{2.5}$ can be seen in Chart 1 and Chart 2, respectively. Only stations measuring continuously for six and more years were covered. Monthly average temperature in analysed period are shown in Chart 3 and monthly average of wind speed can be found in Chart 4.

After the trend of PM air pollution was sharply decreasing during 1990s (due to heavy industry decline and investments to technologies), the declining slowed down and increasing tendency occurred because of repeated increase of industry and legislation changes in monitoring and evaluation of particulate matter. Annual limit value was exceeded in almost all measuring stations in 2004 and measuring station in Bartovice had exceeded the 24-hour limit value for 157 days (RPHA, 2005, pp. 10-11). During following years, the exceeding of $PM_{10}$ limit value remained problematic. In 2005, the worst air quality was measured at the Přívoz station (CENIA, 2006, p. 6). As soon as the new measurement station in Bartovice (TOBA, later

renamed to Radvanice ZÚ) have started, it became the area with the worst air quality, nonetheless all the stations exceeded the annual limit value (CENIA, 2007, p. 5).

The air quality in Ostrava district is significantly influenced by climatic and meteorological conditions, with lower temperatures and inversion situations in winters, the PM concentrations are rising up, exceeding the 24-hour and annual limit values (as can be seen in the Chart 1 regarding $PM_{10}$, and in the Chart 2 for $PM_{2.5}$). In Bartovice, predominant directions of wind are either from Arcelor Mittal or from Rychvald and Petřvald[24]. The average measured values were higher (53 $\mu g.m^{-3}$) when the wind direction was from the cities than the average values measured in days with wind direction from Arcelor Mittal (45.9 $\mu g.m^{-3}$). The average annual concentration of $PM_{10}$ from direction of Arcelor Mittal has decreased, whereas the concentrations from direction of surrounding cities and Šenov-Bartovice road have increased during the years 2004-2008 (RPHA, 2009, pp. 11, 16-17).

Due to the economic crisis in 2008, which affected the industry, the emissions of PM decreased, specially from air pollution sources from REZZO1 category. On the other hand, the emissions from local sources has become more important (CENIA, 2009, p. 2). The poor dispersion conditions during winter time causes smog situations, during which PM values exceed the limits multiple times (RPHA, 2014, p. 14). Transformations and innovations made in the region take a long time to positively affect the air quality, so in following years the PM concentrations did not evidence any significant changes, despite the efforts (RPHA, 2015, p. 10). The major positive change can be observed since 2015 (RPHA, 2016, p. 11).

Exposure to $PM_{10}$ air pollution is significantly associated with respiratory morbidity in Ostrava, hospitalization due to respiratory difficulties increase by 1.52 %[25] with the concentrations of PM <150 $\mu g.m^{-3}$ (TOMÁŠKOVÁ, et al., 2016). Incidence of allergic diseases and infection of the upper respiratory tract (with more severe course) within the Ostrava district is higher in Radvanice ward. The occurrence of unspecified respiratory symptoms (cough, stridor, irritated mucous membrane) in the region is higher than in the rest of the Czech Republic (RPHA, 2009, p. 17).

[24] Nearby cities with population up to 8 000, note of the author.
[25] Data were observed during the years 2010-2012.

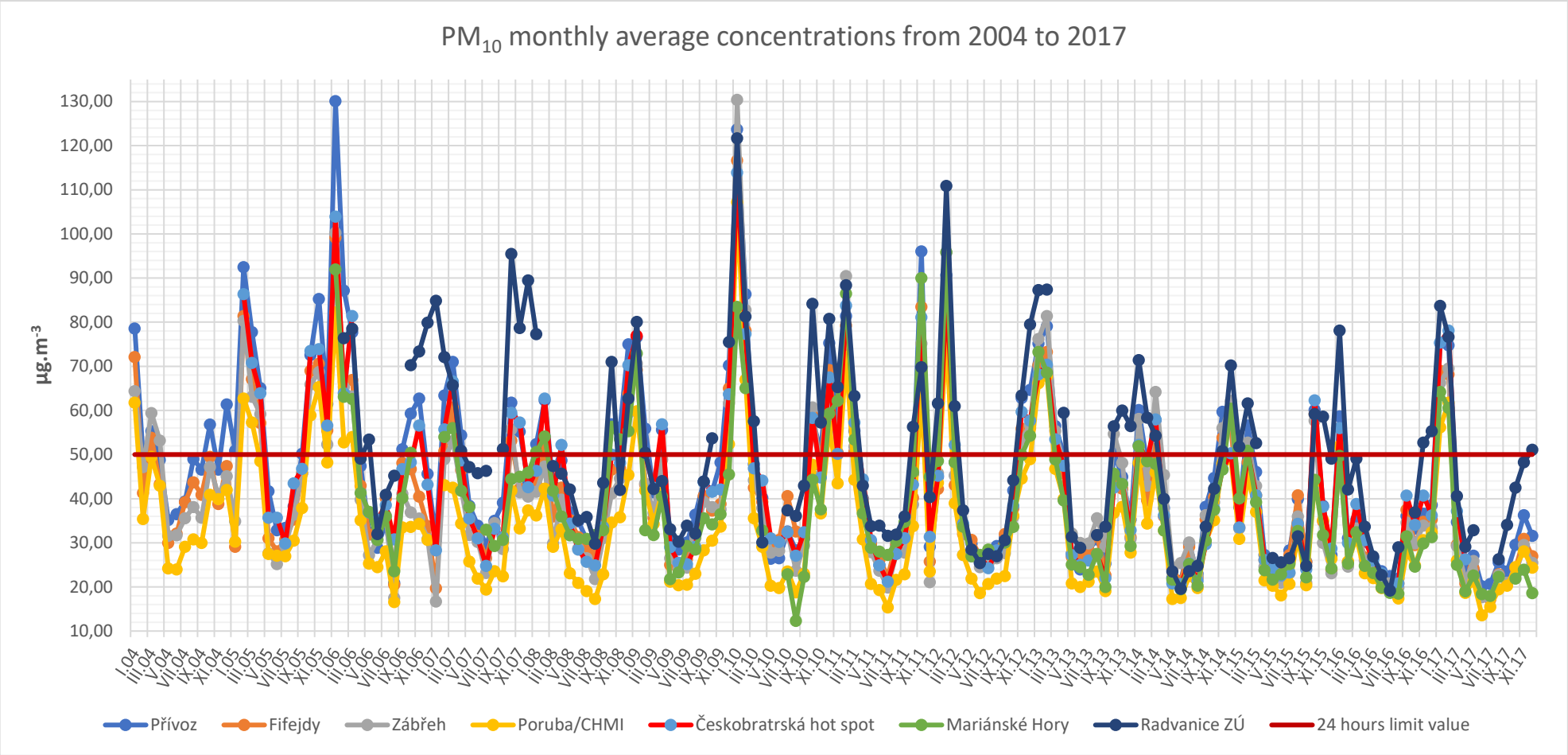



*Chart 1- Monthly average concentrations of $PM_{10}$ in years 2004-2017. Created by author based on data from CHMI.*

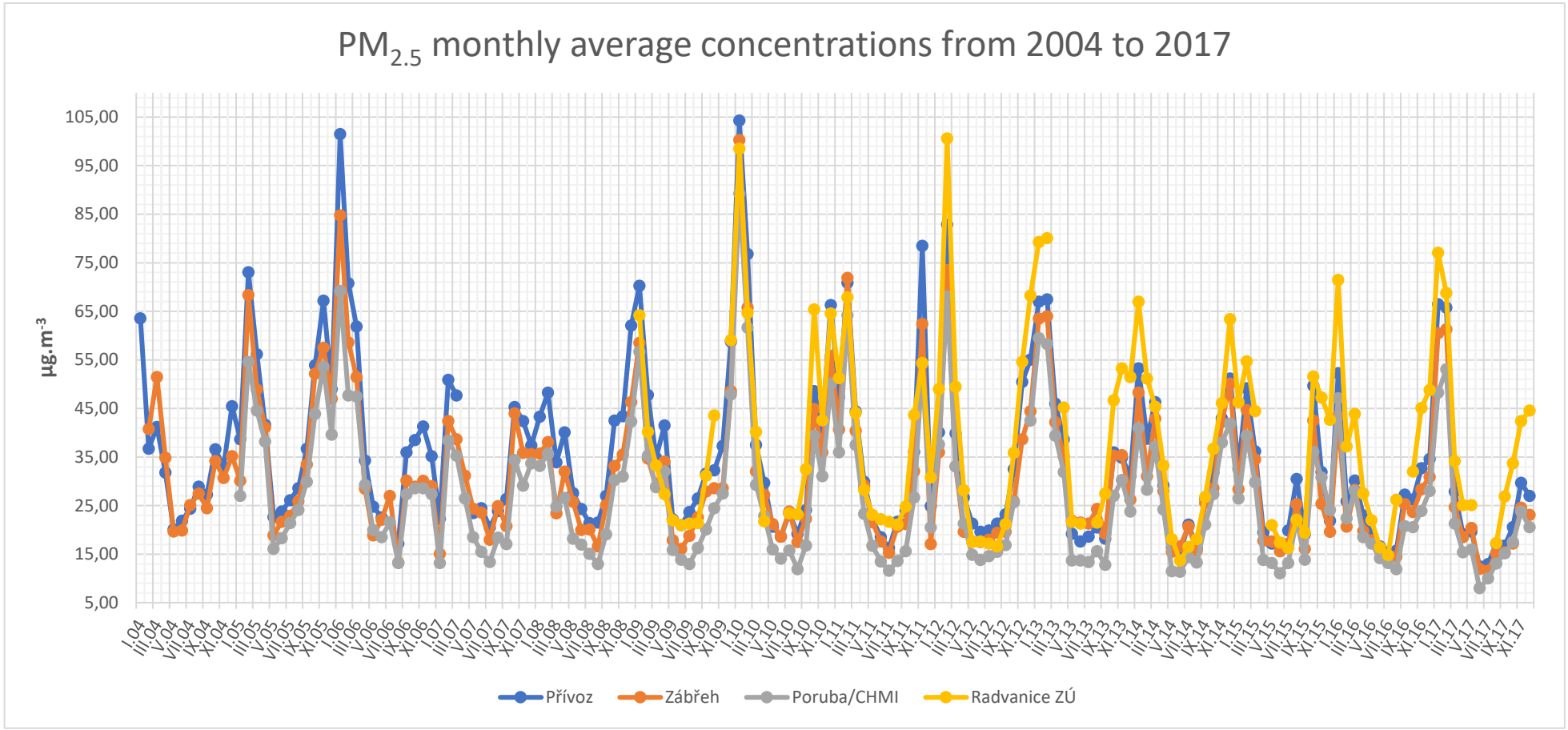



*Chart 2 - Monthly average concentrations of $PM_{2.5}$ in years 2004-2017. Created by author based on data from CHMI.*

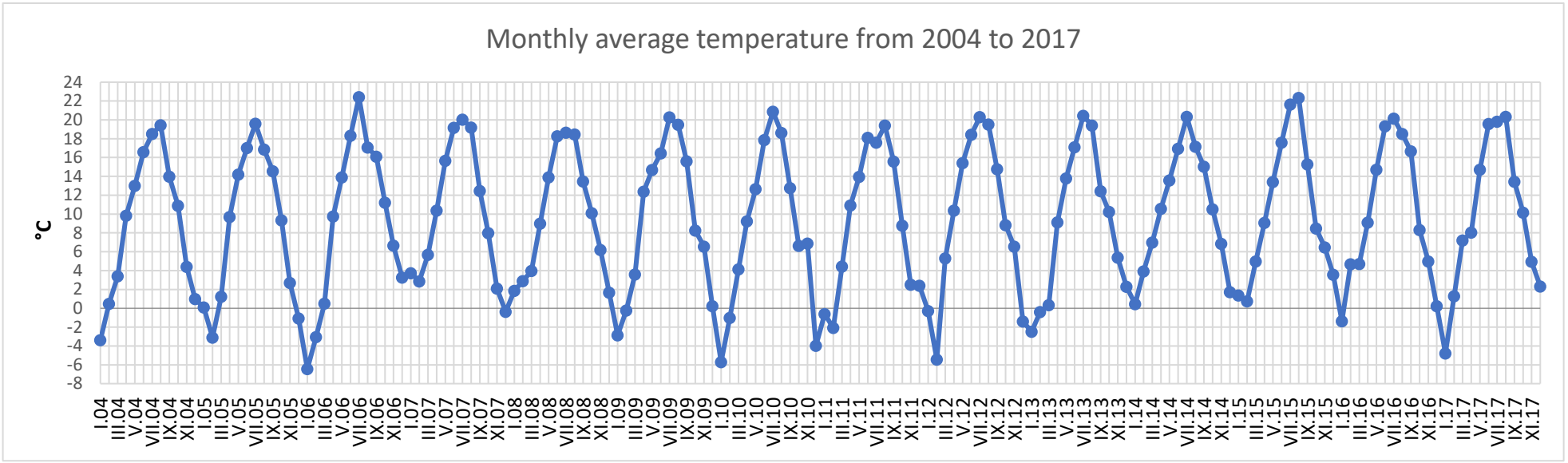



*Chart 3 - Monthly average temperature in years 2004-2017. Created by author based on data from CHMI.*

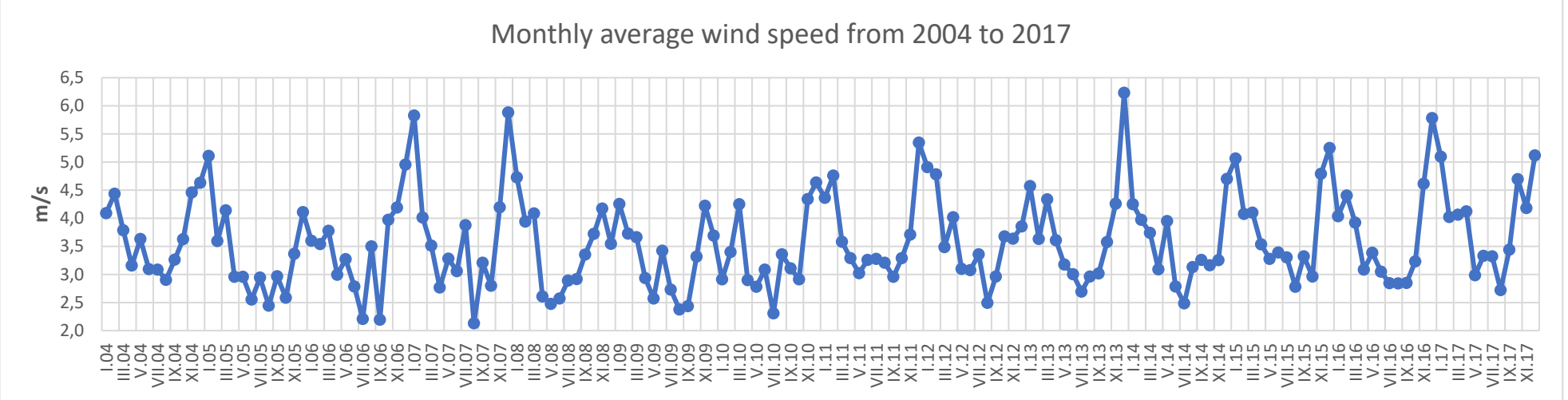



*Chart 4 - Monthly average of wind speed in years 2004-2017. Created by author based on data from CHMI.*

From the Chart 1 and Chart 2 it is evident that $PM_{10}$ and $PM_{2.5}$ concentrations correlate with the temperature and wind speed. The concentrations of air pollution are peaking during the winter time. With a tougher winter is increasing the need for heating and thus the emissions from local furnaces is increasing. The Chart 3 shows that the most freezing winters were those in the years 2006, 2010, 2012 and 2017. The Chart 1 and Chart 2 portray that the highest $PM_{10}$ and $PM_{2.5}$ values were in the years 2006, 2010 and 2012. Year 2017 showed repeated increase of PM values. As mentioned above, since the 2005 the prices of natural gas have been higher causing that people started to use solid fuels again. Winters in 2006 and 2010 were accompanied with slow wind speed (3.6 m/s and 2.9 m/s, respectively).

Measuring station Poruba/CHMI has a good air quality in the long term (the situation is worsened during the winter, but not as extensively as at the other stations). Measuring station Radvanice ZÚ indicate significantly higher concentrations of $PM_{10}$ and $PM_{2.5}$ than the other measuring stations, especially during winter times. This differences during the winters might point out to the influence of the local furnaces on the air pollution in the area in view of the fact that the station is placed in the locality with family houses using their own furnaces, and the industry is performing the same throughout the whole year.

## 5.5 Summary of the situation in Ostrava

Due to the location of Ostrava district, several sources of air pollution can be found here. It is a greatly urbanized area, significantly connected to industry, with a highly frequented traffic. There is a substantial amount of family houses with furnaces and the geographical proximity to the Poland and its sources of air pollution cannot be neglected. Emissions from transportation and local furnaces are considered to be more dangerous because of their incidence in the breathing zone of people. Local furnaces used during winter are increasing the concentrations of $PM_{10}$ and $PM_{2.5}$ and in the days with a bad dispersion conditions they contribute to the smog situations.

In Ostrava district were eight measuring stations in 2004 and by the year 2017, there was twelve measuring station. It is obvious that there is effort to secure as precise information about air quality as possible. As can be seen in the Picture 3 and Picture 4, the main focus is on the city centre. To determine the sources of air pollution, it might be useful to place more

measuring stations around industrial complexes and areas with high proportion of local furnaces.

The concentrations of particulate matter are influenced by the climate and meteorological conditions, e.g. temperature, wind speed and wind direction. During the winter, the particulate matter values are significantly higher, peaking with the low wind speed. The overall trend of particulate matter air pollution is declining as a result of a long-term investments, legal changes and measures. There is an apparent increase in the year 2017, but this might be caused by a colder winter after a few years of relatively warm winters.

# 6. Future trends

This chapter is depicting the foresight, its process and foresight methods, applied in the research. Based on the research, probable future trend is described here, and desirable future scenario is created.

## 6.1 Foresight process and selected methods

At the beginning of this part of the paper, it is important to define the foresight and outline the process of foresight. Foresight is *"a systematic way to examine alternative ´futures´"* (UNDG, 2016, p. 3). It covers "*the capacity to think systematically about the future to inform decision making today. It is a cognitive capacity that we need to develop as individuals, as organisations and as a society. In individuals, it is usually an unconscious capacity and needs to be surfaced to be used in any meaningful way to inform decision-making"* (CONWAY, 2015, p. 2). Research, done for the foresight, may have two approaches. The first one is explorative (sometimes called descriptive) approach, which is analysing trends and options of development that might probably occur. This approach answers the question "what will happen if" and results in description of possible futures. The second approach is called normative and it anticipates and formulates preferable outcomes of the future. It also describes the ways to achieve those outcomes – this approach answers the question "what should be done for something to happen" (NOVÁČEK, 2011, p. 197). It is crucial, that the impact have to be the core of any foresight process (UNDG, 2016, p. 16).

CONWAY (2015, pp. 4-5) presented six basic principles of the foresight.

1. *"The future does not yet exist"* – during the foresight process, our imagination about the possible futures and events is as important as data we have today.
2. *"The future is not predetermined, inevitable or fixed"* – there is a range of alternative futures available.
3. *"The future is uncertain and not predictable"* – no one can predict the future (singular) and our choices are changing possible futures.
4. *"There is always more than one future"* – it is not good to focus only on desirable future, during the foresight, all possibilities should be considered.
5. *"Future outcomes can be influenced by our action or inaction today"* – people should take action to head to their preferred future and to mitigate an undesirable future.

6. *"We are all responsible for future generations"* – everything we do today will have consequences on them in the future. Foresight is used to create a strategy for today and to secure no harm to future generations.

Process of the foresight can be divided into six activities, according to BISHOP & HINES (2012, pp. 56-57). The very first activity that needs to be done, is framing which scopes the project and results in project plan. Successive activity is scanning. This activity ensures the collection of information and results in trends, drivers etc. The third step during the foresight process, is forecasting, which describes baseline and alternative futures by using forecasting methods, such as Delphi method or scenario technique (those methods will be describe later). When the forecast is done, and the pictures of alternative futures are created, following activity is visioning. The preferred future (vision, goals) is chosen during this activity. The next activity is planning, resulting in strategic plan (strategies). To create the strategic plan, the resources have to be organized, to determine the options for carrying out the vision. The last step of the foresight process is acting, when the plan is implemented.

There are three elementary types of forecast, based on the time frame. When the time frame is up to one year, the forecast is short-termed. Time frame of five to ten years is usual for the medium-term forecast. The long-term forecast has a time frame from 25 to 50 years. Forecasts for longer time frame than 50 years are rare (NOVÁČEK, 2011, p. 197) Forecasted futures might be possible (incorporates alternative paths, usually generated by intuitive and personal processes), probable (examining the possible paths, estimation of the probabilities) and preferable (finding desired outcomes, most effectively found with participative methods) (AMARA, 1991, p. 647).

### Delphi method

The method emerged in the 1960s in the United States and its aim was to obtain consensus of experts (NOVÁČEK, 2011, p. 199). At the beginning, it was used by the American Armed Forces and the method was classified as reserved for military use only[26]. After a declassification the use of this method spread rapidly, both geographically and thematically. Delphi method is most commonly used when forecasting and evaluating the complex social problems (LANDETA, 2006, p. 468), since it is useful in topics where a high degree of credibility

[26] The initial purpose of Delphi method was to predict cold war enemy attack probabilities (DIAMOND, et al., 2014, p. 401).

is needed and where uncertainty is involved (CONWAY, 2015, p. 17). The method is weakened when experts do not have an emotional or professional commitment to the one who runs the study (LANDETA, 2006, p. 479).

The whole process of Delphi needs to have three basic characteristics – anonymity, controlled feedback (*"conducting the exercise in a sequence of rounds between which summary of the results of the previous round are communicated to the participants"*) and statistical group response (*"use of statistical definition of the group response is a way of reducing group pressure for conformity; at the end of the exercise there may still be a significant spread in individual opinions"*) (DALKEY, 1969, p. 16). The group consensus does not have a unanimous definition, each study using Delphi method worked with its own definition (DIAMOND, et al., 2014, p. 404). This study talks about the consensus when more than 60 % of participants answered as "strongly agree" and "agree" or "strongly disagree" and "disagree". The aim of the first questionnaire, where the open questions were used, was not to establish a consensus of the group.

### Scenario method

*"In foresight, scenarios represent narratives of alternative futures – the emerging environments in which today´s decision play out – both with intended and unintended consequences"* (UNDP, 2018, p. 31). To be of a high quality, scenario needs to be credible, internally consistent, interesting and inspiring so it would influence decision-making. Procedure of scenario drafting contains three stages. During the first stage, preparation, objects of study are characterised in depth. Second stage is the creation of scenarios, which is broken down into several steps. In this stage, driving forces are identified, events that shape form of a scenario are identified, then the driving forces are projected, and narrations are prepared. The third stage means the use of scenarios via documentation and formulation of the consequences of alternative scenarios (NOVÁČEK, 2011, p. 201).

## 6.2 Future trends of particulate matter air pollution in Ostrava

### Future values of particulate matter

The group of experts was not able to agree on a several things. The first one is to determine which source bears the greatest proportion of PM air pollution. The highest percentage of respondents agreed that the main contributors to the PM air pollution are transportation and transboundary air pollution from Poland. However, only 54 % of respondents agreed and 38.3 % disagreed (23.8 % of all respondents answered "strongly disagree"). According to the comments of participants, the principal reasons of disagreement were two. First one says it depends on the location in Ostrava. In areas which are in immediate proximity to industrial complexes, the major source of PM air pollution would be the industry, on the other hand in the areas with high density of family houses with their own source of heating, the local furnaces would be the major source of PM air pollution. The second reason of disagreement is fact, that local furnaces are the major sources of PM air pollution in Poland which makes it only seasonal source of the pollutant.

Nevertheless, a higher percentage of participants agreed that transportation and transboundary air pollution from Poland will be responsible for the greatest proportion of PM in the ambient air in 2030. 61.4 % of the respondents agreed on those two sources, so it could be called a consensus in this study because of fulfilment of the agreement higher than 60 % criteria. The respondents unequivocally agreed that the 2030 $PM_{10}$ annual value will be 20 %[27] lower than is current value. This would mean $PM_{10}$ annual value in 2030 would be 26.14 $\mu g.m^{-3}$. To examine a possible future annual value of $PM_{10}$ in ambient air in Ostrava district, the another one of the used method is extrapolation. Annual values of $PM_{10}$ were extrapolated – see Chart 5. The extrapolation does not reflect a recent changes in the trend (increase in 2017) and it forecasts the $PM_{10}$ total annual value to be 21.06 $\mu g.m^{-3}$ in Ostrava district, 5.08 $\mu g.m^{-3}$ lower than value anticipated by the group of experts. The group of experts agreed on the desirable $PM_{10}$ annual value in the year 2030, it should be 40 % lower than it is nowadays, meaning it would be 19.6 $\mu g.m^{-3}$. Nonetheless, only 61.5 % of the participants share the opinion of desirable value.

[27] The questions about the future values of particulate matter in the air in the first round were designed as a scale line with values from -100 % to +100 %. During the analysis of the first round, the median values were selected and presented in the second round to the experts to approve or disapprove.

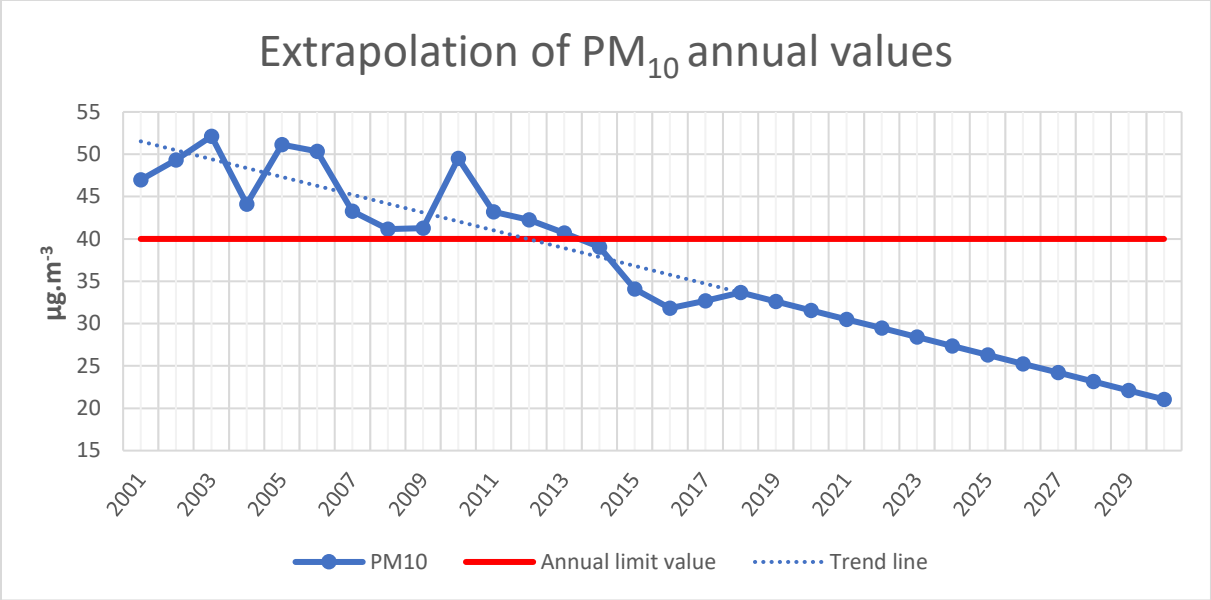



*Chart 5 - Extrapolation of $PM_{10}$ annual values. Created by author based on data from CHMI.*

The trend of PM ambient air pollution in Ostrava district is declining and it will likely continue until the year 2030. According to the results of the Delphi method, the most probable is 20 % decline of the $PM_{10}$ value and desirable is 40 % decline of the value. The extrapolation method shows that the trend will rise during the year 2018 and it begin to decrease up to 35.5 % lower value than in 2017. This scenario might likely happen.

## Opinions on current measures and policies

The next part of the questionnaires was focused on the current measures and policies concerning the air quality. The mechanisms of control of emission sources were found insufficient by 61.5 % of the participants. Comments stated that controlling mechanisms of the other emission sources, so called unenumerated sources[28], have to be introduced. Ten respondents out of thirteen agreed that the lacking in regulations and controls of local furnaces and transportation is a big problem (three of them answered *"strongly agree"*). The overall popularization of clean air and healthy living should help to solve the air pollution problem. As a useful contribution to the problem solving might be a higher interconnection with the local planning (agreed by 69.2 % of the respondents). One of the biggest contributors to the air pollution problem is the carelessness of the politicians who are afraid to make unpopular steps and only minor measures are being implemented. Eight respondents out of

[28] Unenumerated sources are those which are not specified in the legislature, note of the author.

thirteen agreed that the legislature needs to be more interconnected and it should be enforced more consistently. Four participants did not agree with that, claiming that current legislature is interconnected enough, and the Czech Environment Inspectorate is punishing the violations sufficiently.

### Probable future measures and policy

Following section of the questionnaires was devoted to the probable future of the measures and policy. All thirteen participants reached an agreement on emission limit values – the values will be probably stricter than nowadays. One participant added that this will have a negative impact on the agglomeration. Twelve respondents agreed that the stricter legislature will be a consequence of the technological innovations. Eleven experts think that the government of the Czech Republic will be probably intensifying the attempt of the interconnection of its policy with the policy of Poland.

### Probable development of the industry in Ostrava district

Next part of the research was dedicated to the probable future development of the industry in Ostrava. All participants are convinced that the emissions caused by the industry will probably decrease, but the decline will not be significant. Two respondents stated that only small decrease is possible, because most of the industrial companies are using modern technologies and in the view of the following ten years it is unlikely to innovate them significantly. 61.5 % of the respondents claimed that the industry will probably restructure, and 76.9 % are convinced that the "historical" industry (such as metallurgy and mining) will be probably stagnating and mostly automotive industry will be developing. The high-emission industry will probably not develop anymore, since it will not be economically beneficiary (agreed by 69.2 % of the participants). Very tight were answers about the probable expansion of the industry – 53.8 % of the participants think that the industry is probably going to expand, and 44.6 % say that the expansion of the industry is unlikely to occur.

### Probable development of the transportation in Ostrava district

In the next section, a probable development of the transportation in Ostrava was discussed. All respondents are convinced that in a probable future, there will be no essential changes in transportation. One respondent stated that it will be caused by the lack of funding and that the time horizon is too short, other respondent claimed that if there will be any changes, it

will be driven by technological rather than political changes. According to the 76.9 % of the participants, the public transportation will be probably subsidized and broadened, and the park and ride parking lots will be built. Ten out of thirteen respondents think, that the cycling will probably gain more support and twelve of them claims that low-emission vehicles will gain more support as well. 84.6 % of the experts agreed that it is likely that zero-emission vehicles will be used more often. The question about the expansion of tram and trolleybus transportation remained unresolved. 38.4 % of the respondents marked that the expansion is likely to happen, and the same percentage marked that it is unlikely to happen (23 % answered *"I do not know"*). On the other hand, a strong consensus can be found regarding the "smart transportation". Eleven participants out of thirteen said that the occurrence of the "smart transportation" is probable, and no participant did say it is not probable. 61.5 % of the participants believe, that low-emission zones are likely to be introduced, 38.4 % think they will probably not be introduced. The same percentage of experts assumes that it is probable that cars will be banned from some parts of the Ostrava, but only at a negligible extend, and that lorries entrance into the city will be restricted. One respondent stated that since the Ostrava is an industrial area, there would have to be so many exceptions, making this restriction inefficient. 88.9 % stated that during the smog situations, cars movement will be restricted.

### Probable development of local furnaces issue in Ostrava district

Following questions were aimed at the local furnaces issue in Ostrava district and how it will probably develop. According to the 66.7 % of the respondents, there probably will be another wave of furnaces replacement and it will likely be subsided by the state, 61.5 % think that only heating without the emissions will be supported. 61.5 % of the respondents assume, that after the subsidiaries will end, the ecological way of heating will be probably inaccessible and expensive for many people. 77.8 % responded that emissions from the local furnaces will decrease, because of higher awareness about the issue and more people will be concerned about the air quality. A strong consensus can be found on the issue of solid fuels combustion – 84.5 % of the respondents believe its restriction is probable. No consensus was made on the usage of natural gas. Eight out of thirteen respondents do not assume that the air pollution from local furnaces will get worse, but the same number of respondents believe, that the local furnaces will probably not be replaced for the ecological ones and the emissions will probably not decrease. One respondent added that the time frame is too short for this kind of change.

### Probable development of the transboundary air pollution from Poland

This section provided the ideas about the probable development of transboundary air pollution from Poland. According to the 61.5 % of the respondents, it is probable that the Czech Republic will have only marginal power to influence this issue development. Nevertheless, 76.9 % of the participants think that most of the Poland local furnaces (major source of the air pollution in Poland) will be replaced for the ecological ones and the air pollution in Poland (and therefore the transboundary air pollution) will probably decline. All respondents agreed, that the legislature in Poland will probably get stricter which results in decrease of emissions and air pollution. The group of experts did not provide the insight about the proportion of transboundary air pollution from Poland on the air pollution in Ostrava district (66.7 % of them answered *"I do not know"*).

### Desirable development of the measures and policy in Ostrava district

The second half of the questionnaires was dedicated to the desirable future. The ways of how to achieve the desirable annual value of PM air pollution were discussed in this part. 84.6 % of the participants agreed that there needs to be some kind of awareness campaign (38.5 % of the participants answered *"strongly agree"*), one added that a small-scale campaign would not be enough and that it should be a mainstream campaign. According to the 69.2 % of the participants, there should also be an information campaign about the overall costs of the emission production, included health costs. 88.9 % of the respondents agreed that the air pollution problem and its prevention should be implemented into the schooling, one added that the implementation should also cover other branches of the environment and sustainable lifestyle. The need of tax concession on natural gas was agreed by 77.8 % of the respondents, one added that the incentives should be vast enough, so the price of natural gas would be the same as the price of the cheapest fuel.

### Desirable development of the industry in Ostrava district

This section was devoted to the desirable development of the industry. 69.2 % of the respondents think that "polluters" should be more transparent. The group of experts was inconsistent in the issue of industrial emission sources controls. Five out of thirteen experts believe that new controlling mechanisms are needed, and six experts think that current controlling mechanisms are sufficient enough. Nonetheless, they were very unified about the issue of technological innovations, modernization and investments. Twelve respondents out

of thirteen agree, that it is something that is needed (five of them answered *"strongly agree"*). Eleven respondents think that the region has to support low-emission technologies, one respondent disagreed, claiming that position of the region in the global economics is just proclamatory. As a follow up to the technological innovations, 88.9 % of the group experts believe that the region needs to be more focused on the innovations in different branches. One respondent disagreed with a comment that the technological innovations are competencies of the companies and suggested an idea that some system of incentives for those industrial companies which use more technologically advanced facilities, should be introduced. One respondent stated, that it should be applied at a national level, in the form of tax concession, with another respondent stating that it should be covered by the European Commission.

In the first round, one respondent proposed, that the whole industrial sector in Ostrava district should be closed down. Eleven respondents out of thirteen disagreed with the idea (seven of them answered *"strongly disagree"*), two respondents answered *"I do not know"*). Not even one respondent agreed that industry has to be shut down in order to achieve the desirable future. One respondent agrees with the idea of closing down the enterprise Arcelor Mittal, but other 11 respondents do not agree (one responded answered "*I do not know"*). One respondent added a comment, that it might help with the local air pollution, but it would bear great risks of the restructure of the Region. According to this respondent, closure of the Arcelor Mittal would be possible only if there is a long-term social program for newly unemployed people, and a sufficient support of alternative activities. Slightly different are the answers in the case of coke plant Svoboda in Přívoz. Three participants think this enterprise should be closed down, and eight participants do not agree with the closure (two participants answered *"I do not know"*). The reason might be a higher incidence of accidents in the case of the coke plant Svoboda.

Seven participants believe that there is a need for observance of the protective zones around the industrial complexes. One participant noted that this would mean that 90 % of Ostrava would be composed of the protected zones. Eleven respondents suppose, that the industry has to develop in conformity with sustainable development principles. According to the 76.8 % of the respondents, only low-emission industry with a high added value should be allowed in Ostrava district.

## Desirable development of the transportation in Ostrava district

This subsection of the research was focused on what changes in transportation need to be done in order to achieve the desirable value of PM air pollution. 77.8 % of the respondents agreed that a low-emission zone should be introduced in Ostrava and cars would be marked during the roadworthiness test. One respondent commented that the low-emission zones should be introduced in every statutory city in the Czech Republic. Eleven respondents out of thirteen believe that the public transportation should be subsidiarized, no respondent disagreed (two of them answered *"I do not know"*). 69.2 % of the respondents assume that the tram trail will have to be reconstructed and sound-proofed. One respondent commented that this option is very expensive. 92.3 % of the experts agreed that the public transportation needs to be more interconnected and new terminals at the interchange stations need to be built (46.2 % answered *"strongly agree"*). 84.6 % of the respondents believe that shared transportation should be supported (bike sharing, car sharing). Twelve respondents suppose that the economic incentives for the low-emission transportation or zero-emission transportation should be applied. Eleven respondents believe that the company cars of the authorities should be electric.

The strongest consensus was observed in the question about the train transportation. All respondents agreed that the train transportation has to be more effective, and there have to be more opportunities for a cargo transportation via trains. One respondent commented that the flexibility of the road transportation has to be compensated. Eleven respondents agreed that the infrastructure has to be finished and investments for traffic capacity will have to be made. Two respondents disagreed; one of them noted that this would lower the resuspension, but a higher level of comfort would mean more people using individual transportation and therefore higher emissions. The whole group agreed that lorries have to be banned and only vehicles with the highest emission standards should be allowed. Some of the comments said that this process will have to be sequential and that exceptions for supplying need to be granted. The highest consensus was reached regarding the emission controls of lorries. All respondents believe that thorough lorry emission controls should be introduced. One respondent commented that they should be applied to the individual cars as well. 76.9 % of the experts think that high charges for lorries just passing through the Czech Republic should be implemented.

### Desirable development of the local furnaces issue in Ostrava district

This subcategory deals with the necessary steps to achieve the desirable value of particulate matter. 62.3 % of the respondents agreed that central heating needs to be supported and the current facilities providing the central heating have to be replaced for ecological ones. A high consensus was achieved regarding the financial motivation of people using local furnaces. All participants believe that usage of ecological and renewable sources of heating should be supported financially. Twelve participants assume that heat pumps and cogeneration units should be used (six of them answered *"strongly agree"*). Every expert from the researched group believes that finding the solution for a low-income group is important for the decline of emissions from local furnaces. According to the 88.9 % of the respondents, the tax on fuel coal should increase in case emissions from local furnaces will not decrease.

Nine out of thirteen participants agreed that local furnaces should be controlled by officers and the whole state should have a unified legislation regarding the controls and sanctions. One respondent stated that measurement of emissions should be part of the controls. When, in the following round, the group was asked whether controlling officers should measure the emissions of furnaces, 66.7 % of the participants answered that they agree with this idea. The matter of fireplaces was irresolute. Eight respondents believe that fireplaces should be regulated as well (two of them answered *"strongly agree"*), but five respondents do not support this idea.

### Desirable development of the transboundary air pollution from Poland

All experts from the group agreed that raising public awareness about the air pollution issue is needed in Poland (53.9 % of them answered *"strongly agree"*). Besides the awareness campaign, furnaces will have to be replaced by modern facilities of the fifth emission category, as was agreed by 84.6 % of the participants.

69.2 % of the respondents think that unified terms should be applied in every member country in the European Union (46.2 % answered *"strongly agree"*). Twelve out of thirteen respondents believe that the Czech government and authorities should push harder on Poland to improve air quality. They also believe that a common monitoring system and a high-quality information exchange between the Czech Republic and Poland should be in place.

## 6.3 Summary

Table 7 bellow provides a brief summary of the expert group opinions about the probable future trends.

| Issue | Strong consensus[29] | Consensus[30] | Not agreed |
|---|---|---|---|
| **Currently the most significant source of emissions** | | | × |
| **Probable future the most significant source of emissions** | | × | |
| **Probable future value of $PM_{10}$** | × | | |
| **Probable future development of policy** | | | |
| **Stricter emission limit values** | × | | |
| **Higher level of interconnection between Czech and Polish policies** | × | | |
| **Legislature will be firmer due to the technological innovations** | × | | |
| **Probable future development of industry in Ostrava district** | | | |
| **Emissions from the industry will be declining insignificantly** | × | | |
| **Industry will expand and restructure** | | × | |
| **High-emission industry will not expand** | | × | |
| **Industry will be focused on automotive production** | | | × |
| **Probable development of transportation in Ostrava district** | | | |
| **Public transportation will be subsidised** | | × | |
| **Park and ride parking lots will be built** | | × | |
| **Low-emission cars will be supported** | × | | |
| **No-emission transportation will be used more often** | × | | |
| **Tram network will be broadened** | | | × |
| **Low-emission zones will be introduced** | | × | |
| **Car movement restriction during smog situation will be implemented** | × | | |
| **Probable development of local furnaces issue in Ostrava district** | | | |
| **There will be another wave of furnaces replacements** | | × | |
| **Ecological way of heating would be too expansive without subsidiaries** | | × | |

[29] A strong consensus is reached when 80 % or more of the participants answered *"agree"* and *"strongly agree"* or *"disagree"* and *"strongly disagree"*.

[30] A consensus is reached when 61 % to 79 % of the participants answered *"agree"* and *"strongly agree"* or *"disagree"* and *"strongly disagree"*.

| | | | |
|---|---|---|---|
| **A higher awareness of citizens about the air pollution issue will lead to decline of emissions** | | × | |
| **More people will use a natural gas for heating** | | | × |
| **Probable future of transboundary air pollution from Poland** | | | |
| **Czech Republic will not be able to influence the transboundary air pollution** | | × | |
| **Local furnaces in Poland will be replaced leading to the decline of emissions** | | × | |
| **Legislature in Poland will be firmer which will cause decrease of the emissions** | × | | |
| **Proportion of transboundary air pollution from Poland to air pollution in Ostrava will be higher** | | | × |

*Table 7 - Probable future trends according to the experts. Created by author.*

The most consistent answers among the experts were in the policy category, there was the highest incidence of a strong consensus. The lowest incidence of a strong consensus can be found in the category of local furnaces issue.

# 7. Scenarios

## 7.1 Background

The main drivers used for scenario formation were the sources of particulate matter air pollution in Ostrava district (industry, transportation, local furnaces and transboundary air pollution from Poland) and policy (decision-making, legal frame). Frame for all scenarios in this chapter is based in the main drivers of the trend. Scenarios follow this sequence – policy, industry, transportation, local furnaces, transboundary pollution from Poland and are created in accordance with the trend analysis and results of the research by Delphi method. Probable future scenario and desirable future scenario are based on the consensus of the group of experts (as described above). The possible future scenario represents a broader scale of events that might possibly happen, but not very likely. This scenario covers those events obtained during the research, which were not agreed by the experts as probable to occur.

### SWOT Analysis

SWOT analysis for this paper is conducted with the information from the analysis of the trend of PM ambient air pollution in Ostrava district above and with the findings from the research.

**Strengths**

One of the strengths of the PM air pollution trend is monitoring network, which is quite thorough, and the range of measured pollutants is extended. Another big strength, that cannot be missed out, is the technical innovations applied at the industry. Most of the industrial companies went through a modernisation which led to the considerable decrease of emissions. This leads us to the next strength, which is modernised public transportation. The Integrated Transportation System (IDS) has been introduced in the Moravian Silesian region, making the public transportation more effective and comfortable. The possibility of paying for the ticket by a credit card is a big advantage as well.

**Weaknesses**

Weakness of the trend is the location of Ostrava district. It is located in basin, so with a poor dispersion conditions the probability of smog situation is increased. The district is nearby state border with Poland, which is a country with a high concentrations of air pollution. With the wind direction from the Poland, the concentrations of air pollution increase in Ostrava.

Another weakness is a high urbanisation of Ostrava. This causes two problems – a great number of cars polluting the air and a big amount of family houses which use the furnaces. With a wrong type (or poorly-serviced) of furnace or a wrong way of heating, local furnaces cause a significant volume of emissions.

**Opportunities**

As a big opportunity can be seen a rising public interest in the topic of air quality. Citizens want to participate at the public decisions regarding the lowering air pollution. This is a great starting point to launch an awareness campaign about the air pollution, pollutants and the prevention. Modernised public transportation can be seen as an opportunity as well as a strength. To decrease the volume of emissions from the cars, public transportation network should be more thick and separate lines should be more connected. The other opportunity is a support of the Moravian Silesian region for technological innovations.

**Threats**

The transboundary air pollution from Poland can be perceived as a threat. Even if the Ostrava district will make a meaningful changes towards a better air quality, in the case that the concentrations of particulate matter in Poland will increase substantially, it will have a significant impact on the air quality in Ostrava. As another threat a possible increased unemployment can be listed. Unemployed people will be trying to save money, so the will be buying the cheapest fuels, causing more air pollution.

## 7.2 Possible future scenario

People living in the Ostrava district are more alert about the air quality problems and they demand solution. Because of that, politicians feel the need to address this topic and they are becoming more courageous when talking about it. They no longer target mainly the industry, they are more confident to talk about the complexity of this problem. Since public is opened to the discussion, politicians also speak more about the individual sources of the air pollution and how to prevent it. Different branches concerning the field of air quality are cooperating, for example the Department of environment at Regional Authority is working more closely with the Department of local planning at Regional Authority. “Air Quality Improvement Program” has been found as a very useful tool, but it was not sufficient enough. Based on that, Action plans to the “Air Quality Improvement Program” have been created. Each individual

district of the agglomeration Ostrava/Frýdek-Místek/Karviná has a responsibility to create and implement its own Action plan. Those plans are not obligatory, it depends on the will of the citizens of the specific district.

Emissions caused by industry have decreased significantly due to the new technological innovations. Nonetheless, since the industry does not bear the major proportion of the total emissions, the air pollution concentrations have not decreased as it was expected. The industry in Ostrava is focused mostly on the car manufacturing. The main work force is concentrating in different areas than the industry, which caused that some of the industrial establishments had to be closed due to the lack of the employees.

Most of the attention is focused on the industry and the transportation practices have not change too much. There will be massive campaign and support for the cycling, but it will be rather political move. The newly build cycleway are not used so much because of the relief in Ostrava, which is indented. There has been an attempt to extend tram and trolleybus transportation. This idea was welcomed at first, but later the NIMBY (not in my back yard) phenomena occurred. Since then, there has been an unresolved debate about the tram and trolleybus line. One big change has been introduced – the lorries were restricted from the entering Ostrava, with some justifiable exceptions. These exceptions are so extensive, it has no actual impact. The suburbanisation is broadening and number of people commuting to the Ostrava by car has increased. This issue remains unresolved, causing a great contribution to the air pollution.

After 1 September 2022, all people have to have a furnace of fourth and higher emission category. Those who did not use the subsidiaries which were offered before that deadline, had to pay for the ecological furnaces by themselves. The control officers were appointed, who are carrying out a regular controls and violations of the regulation is sanctioned. The ecological heating has become expensive for lot of people and this problem has spread. The government reacted with a new wave of subsidiaries to support ecological ways of heating. Local furnaces exchange will cause a decline in amount of emissions. The exchange is not complete, so the decline will not be significant but neither it will be inconsiderable. After 2025 prices of solid fuels are increase by taxes.

Meanwhile, Czech Republic will pressure Poland to deal with the air pollution problem. Business and scientific agreements and cooperation will be established, allowing Czech Republic to influence opinions of decision-makers in Poland. Country will firm its legislature, but the enforcement of a new regulations will remain problematic. Poland has restricted the usage of poor-quality solid fuels, which are also widely used in Czech Republic because people are travelling to Poland to buy it there, since it is the cheapest solution. Due to the restriction, the amount of poor-quality in Czech Republic has decreased. This way Poland has improved its problem with local furnaces, and therefore the proportion of transboundary air pollution on PM air pollution in Ostrava district has decreased significantly. On the grounds of this change and of the consequences of the suburbanisation, transportation will be at the forefront as a main source of pollution. This will heat the discussion about the transformation of public transportation.

## 7.3 Probable future scenario

The legislature about the limit values of pollutants in the air was altered. The new limit values are more stringent, but all those limits correlate with a current technological innovations. The Moravian Silesian region has focused its investment into the technologic innovations, so the region would keep up with the rest of the European Union and remain its competitiveness. Cooperation between the Czech Republic and Poland has tightened up during those years, the two countries have a very good relationship.

Thinking of the people living in the district has transformed and they are demanding the solution of the air pollution problem and better air quality. These changes are reflected by the politicians who are acting accordingly and put the air pollution to their main agenda. “Air Quality Improvement Program” has been updated regularly and people have the right to make an objection about the draft of the Program.

Emissions from industry have decreased, but not significantly. Industry underwent the restructuring, it has been even more modernised and there has been a big investments into the technological innovations. The historical industry has been stagnating recently and high-emission industry was no longer economically efficient, so it did not expand, it decreased it volume. Ecological regulations towards the industry have become stricter. All these changes

have a negative impact on agglomeration due to the initial purpose of the area and number of people working in the industry.

There have been no significant changes in transportation due to the lack of financial resources. The changes that occurred were more connected to the technological innovations rather than to political will and changes. The public transportation has been subsidiarised and broaden, which was an acceptable modification for the politicians and the public. Several Park and Ride (P+R) parking lots were built, but they did not cover the total need, so it did not have any significant consequences. On the other hand, the support of cycling has been rising. There were several events to embrace people to cycle and some new cycleways have been built. The main attention is paid to the support of low-emission cars, which is in accordance with strategies of European Union. In the recent years, using of non-emission transportation has become more frequent and “Smart transportation” has been developed, covering mostly electro buses, but overall electromobility as well. Low-emission zone has been declared in Ostrava. There has been a complete ban of cars in certain locations during smog situations, but only in a small and not significant scale. Also, during the smog situation, the restriction of car movement in the city has been introduced. The entrance of the lorries to the city has been restricted.

In 1 September 2022, all local furnaces of the third emission category and lower has been banned, and violation of this regulation is penalized. After the restriction came into effect, another wave of furnaces replacements has been taking place, it was subsidiarised by the state or European Union, but only devices without emissions have been supported. This modernisation and ecological replacement led to the decrease of the emissions from local furnaces. The combustion of the solid fuels has been eliminated. More people are using a natural gas, but not as much as it would be needed. Natural gas still remains the more expensive commodity, but its price has not risen significantly.

Czech Republic has only little power to influence the transboundary air pollution coming from the Poland. Local furnaces in Poland have been replaced, and the legislature the has been stern, which led to the decline of the emissions. Due to that, the proportion of transboundary air pollution from Poland at the air pollution in Ostrava, has decreased.

## 7.3 Desirable future scenario

The legislature is more interconnected and unified in all aspects of the environment. The legal regulations are strictly enforced. To raise awareness about the air pollution, its causes, effects and prevention, huge campaign was launched, similar to those against traffic accidents and smoking. The awareness campaign covered information about all the costs of emission production, including medical costs and costs of the diseases related to the air pollution. Followed on from that campaign, the air pollution topic and its prevention have been implemented into the schools and kindergartens, as well as other environmental topics and sustainability.

"Polluters" have been even more transparent and communicate with the public. Technologic innovations, modernisation and investments in the region have been widely supported, which contributed to higher competitiveness, sustainability and decreased emissions. Region has been supporting low-emission technologies and enhances innovations in various branches. There have been two types of financial incentives for those enterprises, which use technologically modernised operations. The first one comes from a state in a form of the tax concession, and the second one comes from the European Union in a form of the subsidiaries. The region performs a continual monitoring of an industrial sources of pollution, and the cases of the excessive burden on the environment are being evaluated and punished. The overall industry is developing, with the principles of sustainable development. Only those starting industrial companies are allowed in the district, which produces a low amount of emissions and have a high added value.

Low-emission zone has been declared in Ostrava, nowadays cars get marked during the roadworthiness test to make the process as simple and smooth as possible. The subsidiarisation of public transportation has been implemented, with a special focus on long-term rover ticket. The lorries have become low-emission and therefore they are allowed to enter the city, whereas classic lorries are banned from the city. Main bypass has been constructed, leading the lorries and other trespassing car around the city. Only vehicles with the highest emission standards can enter the city, which helped to ease the air pollution caused by traffic. With this bypass, the transportation capacity has been enhanced, which led to lower resuspension. Since the public transportation has been developed, the enhanced transportation capacity did not lead to the higher incidence of cars in the city. The

interconnection of public transportation was improved, especially between the long-distance transportation and the urban public transport. Terminals at the interchange stations were built, making long-distance public transportation more comfortable. Carsharing and bike sharing were supported by a promotion campaign. “Clean” transportation has been made economically favourable by introducing the tax concession and subsidiaries. Tram tracks have been reconstructed and soundproofed and transportation by train has been effective and it is able to compete with the individual transportation. Cars of the employees of the Regional Authority, Municipality of Ostrava, Ministry of the Environment of the Czech Republic, etc. have been electrified to set a good practice example. People were delighted by this decision, they have a chance to see, how it is working, and ultimately, they want to follow. Lorries are regularly controlled for the emissions, long-distance cargo transport has been restricted in the city, drivers are using the bypass. The transporters, who are just passing by the Czech Republic, have to pay a fee. To ensure a functional transportation of cargo, the train transportation has been boosted.

In the areas, where it was possible, the central heating for the houses was installed, and where it was not possible, the old sources of the heat were replaced by the ecological ones. The state and European Union has been supporting and financially motivating people to use ecological and sustainable sources (subsidiaries and concessionary loans). All local furnaces are being regularly controlled by officers with a policeman. Unified legal frame within the Czech Republic has been introduced, and this legal frame also contains the penalty tools for the violation of the legislation. During controls, officers are measuring emissions from the local furnaces as well. The regulations also cover fireplaces. There is a high incidence of using a heat pump and cogeneration units. Since the emissions from a local sources were not decreasing during the first years, tax on fuel coal was increased.

Czech Republic had the know-how about the awareness campaign, that was launched here, it provided it to the Poland and tightening the relation. Poland has begun with a huge campaign during which almost all of the old furnaces were replaced for the ecological ones. No country in the European Union has an exception from the air pollution limits, not even Poland. Czech Republic is pushing Poland to the ecological solutions, more awareness campaigns etc. A great exchange of information and overall cooperation is set in the region, resulting in the collective monitoring network of Czech Republic and Poland.

# 8. Recommendations

Based on the research conducted in this study, several recommendations for decision-makers can be proposed. Very often comment in Delphi study was addressing a need for new emission controlling mechanisms, especially for the unenumerated sources. Current controlling mechanisms are focused mostly on the industry, and small and mobile sources of air pollution are underrated. Lifestyle of people can be influenced by economic incentives or disincentives created by government. As an example of such incentives or disincentives, UN Environment (2019, p. 309) recommends subsidies, tax credits, loans, price guarantees, fees or taxes[31]. To reduce emissions from local furnaces, application of the tax concessions or other financial incentives on natural gas heating might be a good policy. To secure efficiency of the incentives, they should get natural gas price to the same level as is the price of the cheapest fuel in the location.

Negative aspects of the suburbanisation should be addressed. Hence development of the public transportation should be a priority. Integrated policies on urban planning and transportation can lead to changes in individual behaviour by increased commuting by public transport (WHO Regional Office for Europe & OECD, 2015, p. 11).

Propose of an awareness campaign was very common during the study. Providing the public with a better information can lead to change in lifestyle resulting in reduction of emissions. Part of the awareness should be the information about the environmental impacts of a product. A higher access to information promotes innovation. *"Increasing awareness of the sources and impacts of pollution may increase public demand for cleaner air, lower emitting products and services, and more stringent policies"* (UN Environment, 2019, p. 311). Even though the institutions in the region are open to public, more transparent behaviour is needed. Institutions should post a more regular updates and participate in open discussion with citizens. To avoid misinterpretations and manipulations concerning the air pollution issue, a better interconnectedness of the documents about the air pollution is required. Scientific studies should be popularised, and their conclusions should be presented to the citizens (e.g. during regular discussions with citizens). Air Quality Improvement Program

[31] *"Markets are affected by many factors which are beyond government control. Therefore, market interventions must be adjusted periodically to reflect changing conditions"* (UN Environment, 2019, p. 309).

should continue to be updated regularly during a participative process with main actors in the field of the air quality (politicians, scientists, “polluters” etc.).

# 9. Discussion

This paper presents the analysis of particulate matter air pollution trend in Ostrava district and proposes its plausible development. To examine future possibilities, the Delphi method was used. This approach has some limitations. First of all, a personal opinions and ideas are collected via this method, not a proven data. A fact that some of the experts might not understand every aspect of the researched topic and therefore their answers might not be reliable, can be seen as a weakness. Since the researched area is relatively small, there is only few technical papers about the air pollution trend in Ostrava district, so this thesis relies mostly on the studies conducted or published by a regional institutions. Because of narrowness of the topic, a small-scale group of experts was created.

A possibility to bring together experts from various fields can be perceived as the biggest strength of Delphi method. Due to the online version of the questionnaires, experts were able to answer the questions at the time that was most suitable for them. Some of the respondents expressed interest in the results of the study. Each expert provided a different scale of comments and opinions, but overall can be said that most of the comments (and longest comments as well) were made when assessing what should be done in order to achieve a desirable future. Delphi method might be useful during discussions about an environmental (or any other) policy. For example, ongoing discussion about the new "Air Quality Improvement Program" could use the Delphi method.

Results of this study might be used for further research. Following focus group with the participants (confrontation between the representants of industry, environmentalists and politicians) might bring interesting findings. The proposed measures which should be done in order to achieve a desirable future could be used for further Cost-Benefit Analysis and Cost-Effectiveness Analysis.

Author of the study suggest one recommendation for possible similar research. The extrapolation should be done in advance, results presented to the group of experts and they should elaborate on them.

# 10. Conclusion

Aim of this thesis is to analyse trend of particulate matter ambient air pollution in Ostrava district and to examine possible, probable and desirable future trends. Four research methods were used to accomplish the aim – academic research of relevant literature, extrapolation, Delphi method and scenario method.

Particulate matter has a proven negative impact on human's health. The fine particles (smaller or equal to 2.5 μm) have a greater impact than coarse particles. Fractions of particulate matter contain admixture of various heavy metals which are toxic. PM affects both morbidity and mortality. The long-term exposure to high concentration of PM correlates with a higher incidence of cardiovascular and respiratory diseases, cardiopulmonary deaths and lung-cancer deaths. Maternal exposure to the PM air pollution is contributing to the risk of preterm birth, stillbirth and low birth weight. High concentrations of PM increase a risk of developing chronic kidney disease.

There are four main sources of particulate matter air pollution in Ostrava district – industry, transportation, local furnaces and transboundary air pollution from Poland. As a starting point of industrial development of Ostrava is considered discovery of coking coal and until today, Ostrava has become an industrial core of the Moravian Silesian region. The largest industrial steel works facility Arcelor Mittal is based in Ostrava. Since 2005, operators of the most important industry facilities have been modernising their technology in conformity with trends of the European Union which has had a positive effect in the air quality in the district. Ostrava is a highly urbanised city which means that there is a great number of cars and the intensity has been increasing. Emissions from the transportation peak during the rush hours. Moravian Silesian region is supporting the development of low-emission transportation in order to reduce the air pollution. Another source of the PM air pollution are local furnaces. The main problem of this source is its height – chimneys are situated in the breathing zone of the population. Additional problem are improper ways of heating – combustion of an inappropriate fuel and/or outdated types of furnaces. However, the usage of a renewable sources of energy is on the rise. The last main source of PM air pollution is transboundary air pollution from Poland. Calculation of its proportion to the air pollution in Ostrava district is problematic because the main source of air pollution in Poland are local furnaces. When

analysing the samples of air pollution, it might be concluded that the source is local furnace, but it is hard to determine whether it is from Poland or the Czech Republic.

Even though the emissions from the industrial sources have declined significantly, the concentrations of air pollution declined only slightly or not at all. Therefore, it can be stated that industry is not the exclusive source of air pollution in Ostrava. Calculation of the proportional contribution of the specific source remains problematic (the most important contributor will differ according to the location within Ostrava).

Since the admission of the Czech Republic into the European Union, legislature is aiming to follow the European guidelines. So called "Smog Regulation" was created – it describes the procedure during the days with exceeded limit values of PM. In the year 2012, new Act on air protection has come into effect which created the possibility to declare low-emission zones and set down a new regulation limit value of $PM_{10}$ concentrations (150 $\mu g.m^{-3}$ for three following days in at least half of the measuring stations). The main instrument of air quality management in the region is currently "Air Quality Improvement Program".

PM air pollution has been measured by automated monitoring stations, using radiometric method, tapered element oscillating microbalance method, nephelometry method, and manual stations which use gravimetric method. The monitoring station network has been widening – from eight monitoring stations in 2004 to twelve monitoring stations in 2017. In order to improve the measurement of air pollution in Ostrava and to define sources of the pollution, there need to be more stations in the areas with a high incidence of the sources.

Concentrations of PM are significantly influenced by climatic and meteorological conditions. Emissions of PM decreased in the year 2008 due to the economic crisis which affected an industry. During this time, the emissions from the local furnaces has become more important. Poor dispersion conditions, which occur mostly in winter, causes the smog situations during which the PM values exceed limits multiple times. During the winters with lower average temperature and slower average wind speed in 2006 and 2010, the values of $PM_{10}$ and $PM_{2.5}$ peaked. The decrease of the PM concentrations was slow because executed measures take time to cause a decline of air pollution. A major positive change came in 2015.

"Business as usual" scenario is created by extrapolation method. Extrapolated current trend forecasts that in 2030 the $PM_{10}$ annual value will be 21.06 $\mu g.m^{-3}$. According to the consensus

of the group of experts, the probable value of annual $PM_{10}$ will be 26.14 $\mu g.m^{-3}$ and desirable annual value of $PM_{10}$ will be 19.6 $\mu g.m^{-3}$. In 2030, it is probable that emission limit values will be firmer due to the technological innovations. Czech and Polish policies will be probably more interconnected, but the Czech Republic will not be able to influence the transboundary air pollution from Poland. Emissions from the industrial sources will probably decline, however it will be insignificant. The industry will expand, but with the exception of the high-emission industry. Public transportation will be subsidised, and park and ride parking lots will be built. Low-emission zones will be probably introduced, and low-emission cars will be supported. During the smog situations, car movement among the district will be restricted. During the following years, replacement of furnaces will probably continue with a financial help from the state or from the European Union. Awareness of the citizens about the air pollution and its prevention will be probably higher which will lead to the decline of emissions from local furnaces. Local furnaces in Poland will be probably replaced as well, decreasing the transboundary air pollution in Ostrava.

In 2030, there will be preferably more interconnected and unified legislature in all aspects of the environment. A huge mainstream awareness campaign will be launched, providing the information about the air pollution, its causes, effects and prevention to the citizens. “Polluters” will be even more transparent, and they will enhance their facilities. Those innovations and investments will be preferably supported by Moravian Silesian region. A major bypass will be built around the city and Ostrava will ban the entrance of lorries, preferably only low-emission lorries will be allowed. The public transportation will be developed, broadened and more comfortable, so more people will prefer to travel by public transport. The tax concession and subsidiaries on “clean” transportation will be introduced, making it economically favourable. To set a good example, cars of the employees of public institutions in the district will be electrified. The state and the European Union will try to motivate people to use ecological and sustainable sources of energy by subsidiaries and concessionary loans, and by raisin tax on fuel coal. Officers will be regularly controlling all local furnaces and fireplaces in region and those who will not obey the regulations will be penalised. No county in the European Union will have an exception from the air pollution limits. Czech Republic will cooperate with Poland very closely, resulting in collective monitoring network, awareness campaigns etc.

To achieve a desirable future as described by the experts, several measures have to be implemented. New controlling mechanism of all sources of air pollution (including local furnaces and transportation) has to be created. Subsidies, tax credits, price guarantees and/or loans would help to change a lifestyle of the people who are contributing to the air pollution. Development of the public transportation should be a priority in order to mitigate a negative aspects of suburbanisation. Awareness campaign against the air pollution of the same extend as it was e.g. in case of anti-smoking campaigns, needs to be launched. Connected to that, the authorities and scientists should have an opened dialogue with citizens to secure the full and correct transfer of information.

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# Appendix

## First round questionnaire

* 1. Jak se změní míra znečištění ovzduší prachovými částicemi v Ostravě v roce 2030 oproti roku 2018?

- 100 % 0 % + 100 %

* 2. Jaký je podle Vás žádoucí vývoj znečištění v Ostravě od roku 2018 do roku 2030?

- 100 % 0 % + 100 %

* 3. Jaká je podle Vás pravděpodobnost dosažení požadované úrovně znečištění v Ostravě v roce 2030?

0 % 50 % 100 %

* 4. Co má podle Vašeho názoru největší podíl na znečištění ovzduší prachovými částicemi v Ostravě?

- Průmysl
- Doprava
- Lokální topeniště
- Přeshraniční přenos z Polska
- Jiné (prosím uveďte)

* 5. Co podle Vašeho názoru bude mít největší podíl na znečištění ovzduší prachovými částicemi v Ostravě v roce 2030?

- Průmysl
- Doprava
- Lokální topeniště
- Přeshraniční přenos z Polska
- Jiné (prosím uveďte)

* 6. Které nástroje pro zlepšení kvality ovzduší existují (politické, technologické, ekonomické atd.)? Uveďte prosím, proč a v čem je podle Vás nástroj (ne)užitečný.

* 7. Jsou dosavadní regulační nástroje dostatečné? Svou odpověď prosím rozveďte.

* 8. Které nástroje (politické, ekonomické, technologické atd.) pro zlepšení kvality ovzduší by se podle Vás měly do roku 2030 zavést či zdokonalit a jak by pomohly ke zlepšení?

* 9. Jak se bude pravděpodobně vyvíjet česká politika týkající se kvality ovzduší?

* 10. Bude se podle Vás v oblasti Ostravy rozšiřovat průmysl nebo naopak omezovat a proč?

* 11. Jak by se měl dále vyvíjet průmysl, aby se docílilo žádoucího vývoje kvality ovzduší (dle otázky 2)?

* 12. Budou v Ostravě v roce 2030 platit nějaké druhy omezení/změn dopravy (nízkoemisní zóny, zákaz vjezdu automobilů do určitých oblastí, sdílené elektromobily, rozšíření MHD, bezplatné MHD apod.)? Pokud ano, uveďte prosím jaké.

* 13. Jaké změny týkající se dopravy by se podle Vás měly zavést, aby se docílilo žádoucího vývoje kvality ovzduší (dle otázky 2)? Zahrňte i městskou hromadnou dopravu.

* 14. Jak se do roku 2030 bude vyvíjet situace ohledně lokálních topenišť?

* 15. Jaká opatření či nástroje týkající se lokálních topenišť by měly být do roku 2030 implementovány, aby se docílilo žádoucího vývoje kvality ovzduší (dle otázky 2)?

* 16. Jak se do roku 2030 bude vyvíjet situace ohledně přeshraničního přenosu znečištění ovzduší z Polska?

* 17. Jaké kroky na české straně a jaká opatření na polské straně by měly být do roku 2030 provedeny ve vztahu k vlivu polských zdrojů na kvalitu ovzduší v Ostravě, aby se docílilo žádoucího vývoje kvality ovzduší (dle otázky 2)?

* 18. Pokud byste rád/a uvedl/a nějaké další nápady, postřehy či myšlenky týkající se vývoje kvality ovzduší v Ostravě do roku 2030, prosím uveďte je zde:

## Second round questionnaire

**Je uvedena vždy nejčastější odpověď z prvního kola. Odpovězte prosím, zdali s uvedeným souhlasíte nebo ne. Budete-li chtít odpověď komentovat, využijte prosím prostor pro poznámky.**

* 1. Nyní má nejvyšší podíl na znečištění ovzduší doprava a přeshraniční přenos z Polska.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 2. V roce 2030 bude mít nejvyšší podíl na znečištění ovzduší doprava a přeshraniční přenos z Polska.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 3. K roku 2030 se pravděpodobně úroveň znečištění sníží o 20 %. *(Extrémní odpovědi - úroveň znečištění se sníží o 50 %; úroveň znečištění se zvýší o 51 %.)*

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 4. Je žádoucí, aby se úroveň znečištění snížila o 40 %, pravděpodobnost dosažení žádoucí úrovně je 50 %. *(Extrémní odpovědi - snížení úrovně znečištění o 65 %; žádná změna v úrovni znečištění.)*

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

## Existující nástroje

**Existující nástroje, uvedené v odpovědích z prvního kola, včetně jejich negativ či pozitiv. Uveďte prosím, zdali s daným výrokem souhlasíte. Budete-li chtít odpověď komentovat, využijte prosím prostor pro poznámky.**

* 5. BREF, BAT - je potřeba je více prosazovat, prakticky je nelze kontrolovat.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

* 6. Dotace - jsou užitečné, ale vedou k populistickým rozhodnutím.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

* 7. Mechanismy kontroly zdrojů znečišťování jsou nedostatečné, je potřeba je více propracovat.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

* 8. Chybí provázanost legislativy, procesy jsou zdlouhavé a porušování nevymahatelné.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

* 9. Problémem jsou nedostatečná řešení znečištění z dopravy a lokálních topenišť - chybí regulace a kontroly.

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Váš komentář

* 10. Při řešení problému znečištění ovzduší chybí spolupráce s územním plánováním.

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Váš komentář

* 11. Integrovaná povolení - nejsou dostatečná a nezahrnují všechny zdroje fugitivních emisí.

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Váš komentář

* 12. Politici mají strach z nepopulárních kroků, špatně interpretují příčiny stavu, přijímají se jen "kosmetická" opatření.

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Váš komentář

* 13. Existující opatření a nástroje týkající se kvality ovzduší jsou dostatečná.

## Potřebná opatření a nástroje

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Váš komentář

**Potřebná opatření a nástroje, uvedená v odpovědích z prvního kola. Uveďte prosím, zdali souhlasíte s tím, že je potřeba uvedený nástroj či opatření zavést. Budete-li chtít odpověď komentovat, využijte prosím prostor pro poznámky.**

* 14. Je potřeba zavést jednotnou celoevropskou legislativu ve všech oblastech životního prostředí.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím
- ◯ Váš komentář

* 15. Je potřeba aktualizovat Plán zlepšování kvality ovzduší.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

* 16. Je potřeba vytvořit Akční plán k Plánu zlepšování kvality ovzduší.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

* 17. Musí se snížit limity emisí.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

* 18. Musí se začít s průběžnými osvětovými kampaněmi, podobně jako tomu je proti kouření a dopravním nehodám.

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Váš komentář

* 19. Školní osnovy (občanská výchova a přírodopis) se musejí změnit, je potřeba kvalifikovaných vyučujících.

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Váš komentář

* 20. Ceny zemního plynu se musí snížit.

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Váš komentář

* 21. Podniky pro výrobu pelet (např. z dřeva lesů ČR) by měl vlastnit stát, pro lepší regulaci ceny na trhu.

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Váš komentář

22. Měla by se vytvořit informační kampaň o nákladech spojených s produkcí emisí - objektivní zahrnutí všech nákladů, včetně lékařských výloh na nemoci spojené se znečištěním ovzduší.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 23. Je potřeba zavést progresivní daň ze zastavitelných ploch.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 24. Je potřeba větší provázanosti existujících dokumentů o znečištění ovzduší (včetně odborných textů).

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 25. Je potřeba důslednější ochrany zemědělského půdního fondu.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

## Pravděpodobný vývoj české politiky

**Pravděpodobný vývoj české politiky, uvedený v odpovědích v prvním kole. Uveďte prosím, jaká je podle Vás pravděpodobnost uvedené situace. Budete-li chtít odpověď komentovat, využijte prosím prostor pro poznámky.**

* 26. Emisní limity se budou zpřísňovat.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi nepravděpodobné

Váš komentář

* 27. Bude se zintenzivňovat snaha o propojení s politikou Polska.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi nepravděpodobné

Váš komentář

* 28. Bude snaha co nejdéle udržet současný stav.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravdepodobné
- ◯ Velmi nepravděpodobné

Váš komentář

* 29. Bude se měnit myšlení obyvatel - budou požadovat řešení situace a další zlepšení kvality - politici budou podle toho reagovat.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi pravděpodobné

Váš komentář

30. Díky technologickým inovacím bude docházet ke zpřísňování legislativy.

- ○ Velmi pravděpodobné
- ○ Pravděpodobné
- ○ Nevím
- ○ Nepravděpodobné
- ○ Velmi nepravděpodobné

Váš komentář

## Pravděpodobný vývoj průmyslu

**Pravděpodobný vývoj průmyslu, uvedený v prvním kole. Uveďte prosím, jaká je podle Vás pravděpodobnost dané situace. Budete-li chtít odpověď komentovat, využijte prosím prostor pro poznámky.**

* 31. Dojde k výraznému poklesu emisí z průmyslových zdrojů.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi nepravděpodobné

Váš komentář

* 32. Emise z průmyslu se již nebudou výrazně snižovat - nejsou již dominantním zdrojem znečišťování, jejich snižování by nepřineslo kýžený efekt na imise.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi nepravděpodobné

Váš komentář

* 33. Průmysl se bude rozšiřovat a restrukturalizovat.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi nepravděpodobné

Váš komentář

* 34. Průmysl se bude soustředit na výrobu automobilů.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi nepravděpodobné

Váš komentář

35. "Historický" průmysl (hutnictví, hornictví) bude stagnovat. Rozvoj bude pokračovat v automobilovém průmyslu a souvisejících výrobách.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi nepravděpodobné

Váš komentář

* 36. Dojde k omezení průmyslu z důvodu nepříznivého demografického vývoje, některé provozovny postupně zaniknou.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi nepravděpodobné

Váš komentář

* 37. Vysokoemisní průmysl se nebude dále rozšiřovat, protože to již nebude ekonomicky výhodné.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi nepravděpodobné

Váš komentář

* 38. Průmysl se bude utlumovat a ten, který zůstane, bude dodržovat přísná ekologická pravidla.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi nepravděpodobné

Váš komentář

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Váš komentář

* 39. Průmyslové podniky se již nebudou rozšiřovat, bude docházet ke zdokonalování technologií.
* 40. Dojde k razantnímu útlumu výroby, což povede ke ztrátě smyslu velké části sídelní struktury Ostravsko-Katowické aglomerace. To bude mít za následek odliv obyvatel a hledání nového smyslu stávajících sídel.

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Váš komentář

## Pravděpodobný vývoj dopravy

**Pravděpodobný vývoj dopravy, uvedený v prvním kole. Uveďte prosím, jaká je podle Vás pravděpodobnost dané situace. Budete-li chtít odpověď komentovat, využijte prosím prostor pro poznámky.**

* 41. Nenastanou žádné změny - chybí politická vůle.

- ○ Velmi pravděpodobné
- ○ Pravděpodobné
- ○ Nevím
- ○ Nepravděpodobné
- ○ Velmi nepravděpodobné

Váš komentář

* 42. Bude fungovat dotovaná a rozšířená MHD.

- ○ Velmi pravděpodobné
- ○ Pravděpodobné
- ○ Nevím
- ○ Nepravděpodobné
- ○ Velmi nepravděpodobné

Váš komentář

* 43. Postaví se odstavná/záchytná/P+R parkoviště.

- ○ Velmi pravděpodobné
- ○ Pravděpodobné
- ○ Nevím
- ○ Nepravděpodobné
- ○ Velmi nepravděpodobné

Váš komentář

* 44. Bude se zvyšovat podpora cyklistické dopravy.

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Váš komentář

* 45. Budou se podporovat nízkoemisní pohony aut.

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Váš komentář

* 46. Stále častěji se budou využívat bezemisní zdroje dopravy.

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Váš komentář

* 47. Dojde k rozvoji tramvajové sítě v nejintenzivněji osídlených místech.

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Váš komentář

* 48. Bude fungovat "chytrá doprava" - elektrobusy, elektromobilita.

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Váš komentář

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Váš komentář

* 49. Budou zavedeny nízkoemisní zóny.

50. Bude platit zákaz vjezdu automobilů do určitých oblastí, avšak pouze v nevýznamné míře.

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Váš komentář

* 51. V době smogových situací bude v Ostravě platit omezení vjezdu automobilů.

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Váš komentář

* 52. Bude platit omezení vjezdu nákladních automobilů do města.

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Váš komentář

## Pravděpodobný vývoj situace kolem lokálních topenišť

**Pravděpodobný vývoj situace kolem lokálních topenišť, uvedený v prvním kole. Uveďte prosím, jaká je podle Vás pravděpodobnost dané situace. Budete-li chtít odpověď komentovat, využijte prosím prostor pro poznámky.**

* 53. Budou zakázány kotle 3. a nižší emisní třídy, porušení budou pokutována.

- ○ Velmi pravděpodobné
- ○ Pravděpodobné
- ○ Nevím
- ○ Nepravděpodobné
- ○ Velmi nepravděpodobné

Váš komentář

* 54. Bude probíhat další vlna výměny starých kotlů, tentokrát bez příspěvku státu.

- ○ Velmi pravděpodobné
- ○ Pravděpodobné
- ○ Nevím
- ○ Nepravděpodobné
- ○ Velmi nepravděpodobné

Váš komentář

* 55. Po skončení dotací bude ekologický způsob vytápění pro mnohé nedostupný a drahý.

- ○ Velmi pravděpodobné
- ○ Pravděpodobné
- ○ Nevím
- ○ Nepravděpodobné
- ○ Velmi nepravděpodobné

Váš komentář

* 56. Bude pokračovat finanční podpora výměny topidel, ale podporována budou pouze bezemisní zařízení, u biomasy pouze plně automatická zařízení.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi nepravděpodobné

Váš komentář

57. Znečištění, pocházející z lokálních topenišť, se sníží, protože bude vyšší zodpovědnost obyvatel.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi nepravděpodobné

Váš komentář

* 58. Omezí se spalování tuhých paliv, vyjma pelet na bázi dřeva.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi nepravděpodobné

Váš komentář

* 59. Dojde k rozšíření plynofikace.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi nepravděpodobné

Váš komentář

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi nepravděpodobné

Váš komentář

* 60. Situace se zhorší. Kvůli vysokým cenám zemního plynu, elektřiny a pelet se budou dovážet méně ekologická tuhá paliva z Polska.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi nepravděpodobné

Váš komentář

* 61. Dojde ke kompletnímu nahrazení starých kotlů a vliv lokálních topenišť na znečištění ovzduší poklesne.

## Pravděpodobný vývoj přeshraničního znečištění z Polska

**Pravděpodobný vývoj přeshraničního znečištění z Polska, uvedený v prvním kole. Uveďte prosím, jaká je podle Vás pravděpodobnost dané situace. Budete-li chtít odpověď komentovat, využijte prosím prostor pro poznámky.**

* 62. ČR bude mít minimální vliv na vývoj přeshraničního znečištění z Polska.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi nepravděpodobné

Váš komentář

* 63. V Polsku dojde k výměně lokálních topenišť za ekologické a dojde tedy ke zlepšení situace.

- ◯ Velmi pravděpodobné
- ◯ Pravděpodobné
- ◯ Nevím
- ◯ Nepravděpodobné
- ◯ Velmi nepravděpodobné

Váš komentář

* 64. Situace se nebude zlepšovat.

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Váš komentář

* 65. Budou se zpřísňovat limity a kontroly lokálních topenišť - emise v Polsku budou klesat a vliv na znečištění v ČR bude marginální.

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [x] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Váš komentář

66. Podíl na celkovém znečištění ovzduší v ČR poroste (především v zimních měsících).

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [x] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Váš komentář

## Vývoj průmyslu pro dosažení žádoucí úrovně znečištění

**Jak by se měla situace kolem průmyslu vyvíjet, aby se dosáhlo žádoucí úrovně znečištění, podle odpovědí uvedených v prvním kole. Uveďte prosím, zdali souhlasíte s nutností uvedené změny. Budete-li chtít odpověď komentovat, využijte prosím prostor pro poznámky.**

* 67. Je potřeba větší transparentnosti znečišťovatelů.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

* 68. Musí se zavést nové mechanismy kontrol všech zdrojů emisí.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

* 69. Musí docházet k technologickým inovacím, modernizaci a investicím.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

* 70. Kraj musí podporovat nízkoemisní technologie.

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Váš komentář

71. MSK musí změnit své zaměření z průmyslového kraje na technologický.

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [x] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Váš komentář

* 72. Musí se vypracovat rozvojová strategie s cílem nahradit zbývající těžký průmysl moderním průmyslem s nízkými emisemi.

- [x] Rozhodně souhlasím
- [x] Souhlasím
- [x] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Váš komentář

* 73. Bude potřeba donutit průmyslové giganty, aby přestaly odvádět milionové zisky z technologicky zastaralých provozů.

- [x] Rozhodně souhlasím
- [x] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Váš komentář

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [x] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Váš komentář

* 74. Průmysl se musí zavřít.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

* 75. Musí se zavřít Arcelor Mittal.

* 76. Musí se zavřít koksovna Svoboda v Přívoze.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 77. Musí se brzdit suburbanizace.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 78. Je potřeba zavést ochranná pásma kolem výrobních podniků.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 79. Musí se monitorovat provoz průmyslových znečišťovatelů, vyhodnocovat situace, které nadměrně zatěžují ŽP a přinutit podnik k nápravě.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 80. Průmysl se musí nadále rozvíjet, samozřejmě v souladu s principy udržitelného rozvoje.

81. Musí se zvýšit podíl středních podniků na průmyslové výrobě.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 82. Zaměstnanci, kteří jsou na stejných pozicích 30 let, musejí být obměněni - hájí zájmy majitele na úkor obyvatel.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 83. Musí se povolovat pouze průmysl s nízkými emisemi a vysokou přidanou hodnotou.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 84. Je potřeba zavést uhlíkovou daň - vytvoří to predikovatelnější prostředí než systém emisních povolenek.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

## Vývoj dopravy pro dosažení žádoucí úrovně znečištění

**Jak by se měla situace kolem dopravy vyvíjet, aby se dosáhlo žádoucí úrovně znečištění, podle odpovědí uvedených v prvním kole. Uveďte prosím, zdali souhlasíte s nutností uvedené změny. Budete-li chtít odpověď komentovat, využijte prosím prostor pro poznámky.**

* 85. Je potřeba vytvořit nízkoemisní zóny - jednotně v 50 největších městech ČR.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně souhlasím

Váš komentář

* 86. Využívání MHD se musí zvýhodnit (především dlouhodobé jízdné).

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně souhlasím

Váš komentář

* 87. Musí se zavést nízkoemisní vozový park, včetně nákladních automobilů.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně souhlasím

Váš komentář

* 88. Těžká automobilová doprava musí být zcela vymístěna z města - obchvaty, ve městě jen vozidla s nejvyššími emisními standardy.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně souhlasím

Váš komentář

89. Tramvajová trať musí být zrekonstruována a odhlučněna.

- ( ) Rozhodně souhlasím
- ( ) Souhlasím
- ( ) Nevím
- ( ) Nesouhlasím
- ( ) Rozhodně souhlasím

Váš komentář

* 90. Infrastruktura musí být dobudována, je potřeba investic pro podporu průjezdnosti (a snižování tak resuspenze).

- ( ) Rozhodně souhlasím
- ( ) Souhlasím
- ( ) Nevím
- ( ) Nesouhlasím
- ( ) Rozhodně souhlasím

Váš komentář

* 91. Doprava musí lépe navazovat, různé typy veřejné dopravy musí být lépe provázány a postaveny přestupní terminály.

- ( ) Rozhodně souhlasím
- ( ) Souhlasím
- ( ) Nevím
- ( ) Nesouhlasím
- ( ) Rozhodně souhlasím

Váš komentář

*

92. Podpořit rozvoj sdílené dopravy (carsharing, bikesharing).

- Rozhodně souhlasím
- Souhlasím
- Nevím
- Nesouhlasím
- Rozhodně souhlasím

Váš komentář

* 93. Ekonomické zvýhodnění čisté dopravy.

- Rozhodně souhlasím
- Souhlasím
- Nevím
- Nesouhlasím
- Rozhodně souhlasím

Váš komentář

* 94. Legislativní opatření pro rozvoj komfortu MHD.

- Rozhodně souhlasím
- Souhlasím
- Nevím
- Nesouhlasím
- Rozhodně souhlasím

Váš komentář

- Rozhodně souhlasím
- Souhlasím
- Nevím
- Nesouhlasím
- Rozhodně souhlasím

Váš komentář

*

* 95. Při technické kontrole povinně označovat auta plaketou pro nízkoemisní zóny.
96. Efektivnější vlaková doprava, posílit možnosti železniční přepravy nákladů.

- Rozhodně souhlasím
- Souhlasím
- Nevím
- Nesouhlasím
- Rozhodně souhlasím

Váš komentář

* 97. Zpoplatnění parkování (mimo rezidentů).

- Rozhodně souhlasím
- Souhlasím
- Nevím
- Nesouhlasím
- Rozhodně souhlasím

Váš komentář

* 98. Elektrifikace vozového parku úřadu - služební vozidla.

- Rozhodně souhlasím
- Souhlasím
- Nevím
- Nesouhlasím
- Rozhodně souhlasím

Váš komentář

*

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně souhlasím

Váš komentář

* 99. Důsledná a trvalá kontrola emisí nákladních automobilů.
100. Výrazné omezení přepravy nákladů kamiony na velké vzdálenosti, vysoké poplatky pro zahraniční kamionové přepravce, kteří jen projíždí ČR.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně souhlasím

Váš komentář

*

Vývoj situace kolem lokálních topenišť pro dosažení žádoucí úrovně znečištění

**Jak by se měla situace kolem lokálních topenišť vyvíjet, aby se dosáhlo žádoucí úrovně znečištění, podle odpovědí uvedených v prvním kole. Uveďte prosím, zdali souhlasíte s nutností uvedené změny. Budete-li chtít odpověď komentovat, využijte prosím prostor pro poznámky.** * 101. Podpora centrálního zdroje tepla, zavedení i pro rodinné domy, ekologizace stávajících.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

* 102. Podpořit a finančně motivovat lidi k používání ekologických a obnovitelných zdrojů (dotace, zvýhodněné úvěry).

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

* 103. Kontrola lokálních topenišť ve všech nemovitostech - kontroly prováděné úředníky z ministerstva, pro jednotný výklad na celém území ČR. Vytvoření sankčních nástrojů.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

* 104. Využívání tepelných čerpadel a kogeneračních jednotek.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

*

* 105. Nepodporovat fosilní paliva (pouze zemní plyn).

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 106. Najít řešení pro nízkopříjmové skupiny.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 107. Zvýšit ceny palivového uhlí.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 108. Zavést omezení platná také pro krby a krbové vložky.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 109. Pravidelně měřit emise u všech typů kotlů.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 110. Snížení daně u zemního plynu používaného k vytápění domácností.

*

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

*

## Vývoj přeshraničního znečištění z Polska pro dosažení žádoucí míry znečištění

**Jak by se měla situace kolem přeshraničního znečištění z Polska vyvíjet, aby se dosáhlo žádoucí úrovně znečištění, podle odpovědí uvedených v prvním kole. Uveďte prosím, zdali souhlasíte s nutností uvedené změny. Budete-li chtít odpověď komentovat, využijte prosím prostor pro poznámky.**

* 111. V Polsku je potřeba osvěta ohledně znečištění ovzduší.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

* 112. Kotle se musí nahradit moderními topidly 5. emisní třídy.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

* 113. Je potřeba zavést stejné podmínky pro všechny země EU, včetně jednotného data plnění.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

* 114. Z české strany musí být vyvíjen větší tlak.

- ◯ Rozhodně souhlasím
- ◯ Souhlasím
- ◯ Nevím
- ◯ Nesouhlasím
- ◯ Rozhodně nesouhlasím

Váš komentář

* 115. Musí fungovat kvalitní výměna informací v rámci regionu.

*

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 116. V Polsku se musí zavést zákaz pálení černého a hnědého uhlí v lokálních topeništích a průmyslu.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 117. Společné monitorovací systémy ČR a Polska.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

* 118. Uvést v platnost závěry BAT v Polsku, nepovolovat žádné výjimky u průmyslových zdrojů.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Váš komentář

*

* 119. Bude potřeba vést politickou diskuzi na půdě EU, případně podat žalobu na Polsko k Evropskému soudu.

## Third round questionnaire

* 1. Je podle Vás potřeba rozšířit/změnit Integrovanou prevenci a omezování znečištění? Pokud ano, uveďte prosím jak.

- [ ] Ne
- [ ] Ano (uveďte prosím jak)

* 2. Měla by ČR zavést přísnější emisní limity, než jaké ukládají normy EU?

- [ ] Ano
- [ ] Ne

Prostor pro Váš komentář

* 3. Politici se do roku 2030 budou snažit potlačit jakékoliv změny v oblasti ochrany ovzduší.

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Prostor pro Váš komentář

* 4. Emise z průmyslu se budou do roku 2030 snižovat, ale ne výrazně.

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Prostor pro Váš komentář

* 5. Do roku 2030 se budou ekologická pravidla pro průmysl zpřísňovat (v souladu s vývojem technologií), dojde k dalšímu snížení průmyslové výroby.

*

- ○ Velmi pravděpodobné
- ○ Pravděpodobné
- ○ Nevím
- ○ Nepravděpodobné
- ○ Velmi nepravděpodobné

Prostor pro Váš komentář

6. Do roku 2030 se bude postupně snižovat množství průmyslových provozoven, jedním z důvodů bude také nedostatek pracovní síly.

- ○ Velmi pravděpodobné
- ○ Pravděpodobné
- ○ Nevím
- ○ Nepravděpodobné
- ○ Velmi nepravděpodobné

Prostor pro Váš komentář

* 7. V oblasti dopravy dojde do roku 2030 k zásadním změnám, především díky angažovanosti politiků.

- ○ Velmi pravděpodobné
- ○ Pravděpodobné
- ○ Nevím
- ○ Nepravděpodobné
- ○ Velmi nepravděpodobné

Prostor pro Váš komentář

* 8. V nejintenzivněji obydlených oblastech dojde do roku 2030 k rozšíření tramvajové a trolejbusové dopravy.

- ○ Velmi pravděpodobné
- ○ Pravděpodobné
- ○ Nevím
- ○ Nepravděpodobné
- ○ Velmi nepravděpodobné

Prostor pro Váš komentář

* 9. Do roku 2030 bude při smogových situacích platit omezený pohyb automobilů po Ostravě.

- ○ Ne
- ○ Ano

*

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Prostor pro Váš komentář

* 10. Bude do roku 2030 probíhat další vlna výměny starých kotlů? Pokud ano, bude finančně podpořena státem?

11. Do roku 2030 bude stále více lidí využívat zemní plyn pro vytápění.

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Prostor pro Váš komentář

* 12. Do roku 2030 se začne více lidí zajímat o problematiku znečištění ovzduší a ekologičtější možnosti vytápění, což povede ke snížení emisí z lokálních zdrojů.

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Prostor pro Váš komentář

* 13. Do roku 2030 dojde v Polsku ke zpřísnění legislativy a emise z lokálních topenišť se sníží.

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Prostor pro Váš komentář

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Prostor pro Váš komentář; Pokud souhlasíte, uveďte prosím, komu by měla tato povinnost náležet.

*

* 14. Do roku 2030 podíl přeshraničního přenosu znečištění z Polska na znečištění ovzduší v Ostravě poroste.

- [ ] Velmi pravděpodobné
- [ ] Pravděpodobné
- [ ] Nevím
- [ ] Nepravděpodobné
- [ ] Velmi nepravděpodobné

Prostor pro Váš komentář

* 15. Pro dosažení žádoucí kvality ovzduší do roku 2030, bude potřeba zavést nové mechanismy kontrol emisí také pro jiné zdroje, než průmyslové.

16. Pro dosažení žádoucí kvality ovzduší do roku 2030 by měl být zaveden systém zvýhodnění pro průmyslové společnosti, které využívají technologicky moderní provozy.

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Prostor pro Váš komentář; Pokud souhlasíte, uveďte prosím, kdo by měl tento systém zavádět.

* 17. Pro dosažení žádoucí kvality ovzduší do roku 2030, měla by být v Ostravě zavedena nízkoemisní zóna. Auta by byla označována plaketou pro nízkoemisní zóny při technické kontrole.

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně souhlasím

Prostor pro Váš komentář

* 18. Pro dosažení žádoucí kvality ovzduší do roku 2030 by se měl vytvořit systém pracovníků, kteří by měli na starosti pravidelnou kontrolu emisí u všech typů kotlů.

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Prostor pro Váš komentář; uveďte prosím, pod kterou instituci by pracovníci spadali.

*

* 19. Pro dosažení žádoucí kvality ovzduší do roku 2030 by měla ČR apelovat na Polsko, aby zavedlo zákaz pálení černého a hnědého uhlí v lokálních topeništích a průmyslu.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Prostor pro Váš komentář

20. Bude potřeba implementovat problematiku znečištění ovzduší a její prevenci do školní výuky.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Prostor pro Váš komentář

* 21. Pro dosažení žádoucí kvality ovzduší do roku 2030 bude potřeba, aby bylo zavedeno určité daňové či jiné finanční zvýhodnění na vytápění plynem.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Prostor pro Váš komentář

* 22. Pro dosažení žádoucí kvality ovzduší do roku 2030 se MSK musí více zaměřit na technologické inovace v různých odvětvích.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Prostor pro Váš komentář

* 23. Je potřeba vypracovat strategii udržitelného rozvoje průmyslu.

- ○ Rozhodně souhlasím
- ○ Souhlasím
- ○ Nevím
- ○ Nesouhlasím
- ○ Rozhodně nesouhlasím

Prostor pro Váš komentář; uveďte prosím, čí zodpovědnost by to měla být.

*

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím
- [ ] Prostor pro Váš komentář; uveďte prosím, kdo by měl tuto strategii vypracovat

* 24. Pro dosažení žádoucí kvality ovzduší do roku 2030 je potřeba zapracovat na negativních dopadech suburbanizace (rozvoj MHD apod.).

25. Systém emisních povolenek vytváří špatně predikovatelné prostředí, měl by být zaveden spíše nějaký typ ekologické daně.

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Prostor pro Váš komentář

* 26. Aby se plně rozvíjel komfort a efektivnost MHD, měla by se zavést legislativní opatření.

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Prostor pro Váš komentář

* 27. Pokud v průběhu let do roku 2030 nebudou klesat emise z lokálních zdrojů znečištění, měla by se zvýšit daň za palivové uhlí.

- [ ] Rozhodně souhlasím
- [ ] Souhlasím
- [ ] Nevím
- [ ] Nesouhlasím
- [ ] Rozhodně nesouhlasím

Prostor pro Váš komentář