

CONSIDERATIONS ON THE IMPORTANCE OF PROPER FACTOR MONITORING ENVIRONMENTAL PROTECTION MEASURES TO PREVENT POLLUTION IN LARGE CITIES

Camelia Stefanescu¹

Abstract: The correct monitoring of environmental factors is very important, we could say essential in large urban centers. This importance is due to the fact that, if done properly, it can lead to the prevention of pollution. This can be done primarily by identifying the main sources that pollute the city, by assessing the impact of pollution on the environment and the health of the population. After detecting the sources of pollution and their effects, effective control measures must be implemented that will lead to the avoidance of pollution from the same causes in the future.

A correct monitoring can be done only if the basic rules imposed by the laws in force are observed. Monitoring must be carried out by competent persons in this field who understand the physical, chemical and biological phenomena in that environment. Thus, it is necessary to reach a solution to the existing problems and, if necessary, to the elaboration of laws to prevent and mitigate the negative impact

Keywords: air quality, public health, pollution levels

1. INTRODUCTION

In a large city, the number of inhabitants increases significantly, which leads to multiple effects on the level of pollution, influencing both the environment and public health.

Within a large city, industrial activities, heavy road traffic and other anthropogenic sources have a significant effect on environmental pollution. This requires continuous monitoring, which has been found to be becoming a priority necessity in this regard.

Monitoring environmental factors in general and especially in a large city, in crowded urban areas is an essential component in the permanent and sustainable management of resources and in ensuring a healthy environment for the population.

Due to the continuous increase in the number of inhabitants in a large city, pollution problems are accentuated. This requires the implementation of sustainable development policies, the promotion of environmentally friendly transport, efficient waste management and the conservation of natural resources in order to mitigate the

negative impact on the environment. The effects of the increase in the number of inhabitants in large cities are as follows:

- **Increased emissions of air pollutants:** A larger population directly leads to an increase in industrial activities, road transport and energy consumption, all of which contribute to the emission of pollutants such as nitrogen oxides (NO_x), volatile organic compounds (VOCs), fine particulate matter (PM_{2.5} and PM₁₀) and carbon dioxide (CO₂). These emissions increase concentrations of air pollutants, impacting air quality.

- **Pressure on transport infrastructure:** A larger population leads to increased road traffic congestion, which amplifies greenhouse gas and fine particulate matter emissions. In addition, the excessive use of private vehicles contributes to noise pollution and the formation of smog, affecting the respiratory and cardiovascular health of the population.

- **Impact on the aquatic environment and soil:** Population growth can lead to inadequate management of household and industrial waste, resulting in contamination of water and soil. Uncontrolled waste and leakage of toxic substances can lead to groundwater and surface water pollution.

- **Effects on biodiversity:** Urban sprawl associated with population growth can lead to the destruction of natural habitats, the fragmentation of ecosystems and the reduction of biodiversity, which has indirect effects on environmental quality and ecological balance.

- **Pressure on natural resources:** A growing population demands natural resources such as water, energy and raw materials, which can lead to resource depletion and increased intensity of industrial and agricultural activities, while contributing to pollution.

¹ Politehnica University Timișoara, Faculty of Civil Engineering, Department of Hydrotechnical Engineering, Splaiul Spiru Haret no. 1/A, 300022, Timișoara, Romania, e-mail: achim_camelia@yahoo.co.uk

2. THE IMPORTANCE OF AIR QUALITY MONITORING

The main question of this study is why is air quality monitoring important? Numerous studies conducted over time have found that there are numerous benefits of air quality monitoring. The most important benefits of air quality monitoring include the following:

- Improving air quality - air quality monitoring is very important because it helps us identify areas with poor air quality and pollutants due to which this air quality is damaged. This information can then be used to implement specific air pollution control measures, measures that are meant to improve air quality up to the limits provided by Romanian and European standards. Reducing the levels of pollutants in the air can lead to an improvement in the quality of health of the population and a better quality of life.

- monitoring in accordance with the regulations in force with the help of air quality sensors and other devices allow the monitoring of emissions from industrial sources. These sources of industrial pollution are power plants and factories that must comply with the standards set by environmental agencies. One of the main benefits of air quality monitoring is that monitoring helps us ensure that the air we breathe is safe, clean and within the limits set by European standards.

- Climate change monitoring – climate change that occurs due to pollution, such as the increase in the frequency of heat waves and wildfires, can negatively affect the levels of pollutants in the air by removing pollutants into the atmosphere, which can affect the environment and implicitly the health of the population. By monitoring all these changes, i.e. by monitoring air quality, it is possible to identify more quickly the impact of climate change on air quality and to take the correct and effective measures as soon as possible to mitigate, correct and avoid this type of pollution in the future.

- Supporting research and development – the data collected on air quality is an important source that needs to be done correctly in order for research and development of new pollution control technologies to be possible. These studies and research have the role of reducing emissions from industrial sources, sources that contribute in a large proportion to the deterioration and pollution of air quality and, therefore, to the deterioration of the health of the population.

- Protecting health – due to pollution, a number of health problems arise, including respiratory and cardiovascular diseases. Air quality monitoring can help identify areas where

air is polluted and take steps to protect public health.

The European Environment Agency's air quality reports reveal that most people living in European cities are still exposed to levels of air pollution considered harmful by the World Health Organization. According to the 2024 report, particulate matter concentrations caused 450000 premature deaths in 41 European countries in 2024 [1,2].

Poor air quality also has a considerable economic impact. Poor air quality can lead to increased medical costs for curing people, reducing the productivity of those in economic activity. Poor air quality also leads to damage to soil, crops, lakes, forests and rivers.

Even if air pollution is most often associated with peaks and episodes of pollution, long-term exposure to even small doses represents an equally serious threat to the health of humanity and implicitly of nature.

3. PURPOSE OF AIR QUALITY MONITORING

Another question that is increasingly being circulated refers to the attention to air quality. Why is it important to pay attention to air quality? The answer is easy to give, the purpose of air quality monitoring gives us clear, accurate, real-time data on air pollutant levels. This information is very important, we can even say essential for protecting public health, for guiding and supporting environmental policies and for ensuring a clean environment for large cities. Without all these monitorings, it would not be possible to know when or where and how serious the pollution is. For this, an efficient use of this data is urgently needed, which can only be done by outlining smarter policies [1]. .

When pollution is discovered by the competent bodies and it is known exactly where it comes from, specific rules can be created regarding transport, industry or the source of pollution discovered that affects the environment in that city. An eloquent example would be that of a highway. If high levels of nitrogen dioxide are constantly present on this motorway, the competent bodies must take measures to reduce pollution or improve air quality. Such an example would be adding green spaces or restricting certain vehicles in order to reduce traffic pollution.

Another very important benefit, we can even call it the key benefit of air quality monitoring is how easily we can develop these systems. They operate in cities, industrial areas or rural regions, and monitor the pollutants that affect and pollute

the most in each place. For example, they can monitor ozone along busy roads or dust near construction sites, adjusting to suit local needs.

4. AIR POLLUTION IN THE EUROPEAN UNION, ANTI-POLLUTION MEASURES AND LAWS (2)

Following studies carried out in the European Union and according to the latest data from the European Environment Agency, it was found that **97% of the urban population of the EU** was exposed in 2021-2025 to concentrations of fine particulate matter (PM_{2.5}, which is considered the most dangerous of all air pollutants) above the level recommended in the latest provisions of the World Health Organization (WHO) [1, 2].

Air pollution causes a lot of **premature deaths** every year in Europe. Exposure to particulate matter alone was responsible for 238,000 premature deaths by 2020. An eloquent example would be that this number of deaths due to pollution is more than 12 times higher than the number of people killed as a result of road accidents (18,800 in 2020).

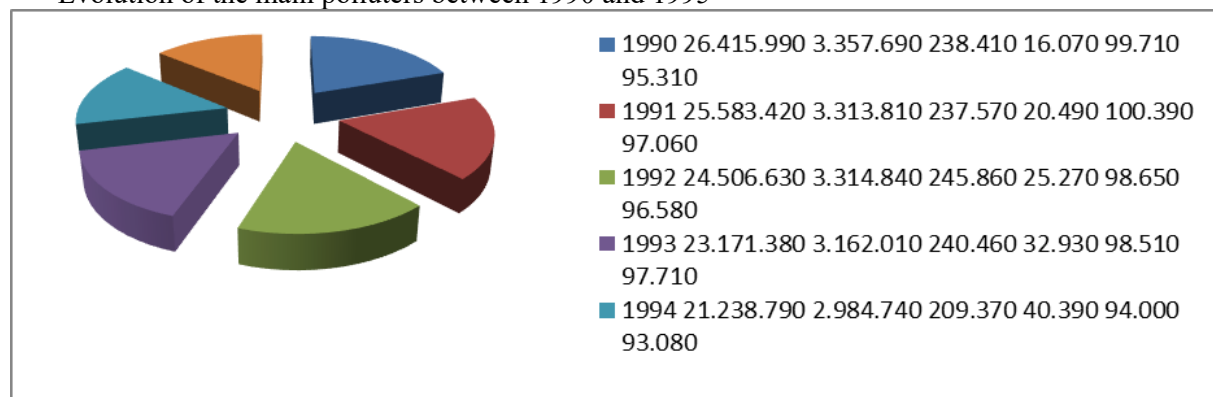
Even though there has been a downward trend in the European Union in recent years, the levels of these emissions are **well above the**

recommended standards. Therefore, reducing air pollution is paramount and also indispensable for protecting human health and the planet. Environmental institutions set **air quality standards** as well as **emission reduction targets** for the main air pollutants. In addition, many other legal acts also contribute to improving air quality in the EU.

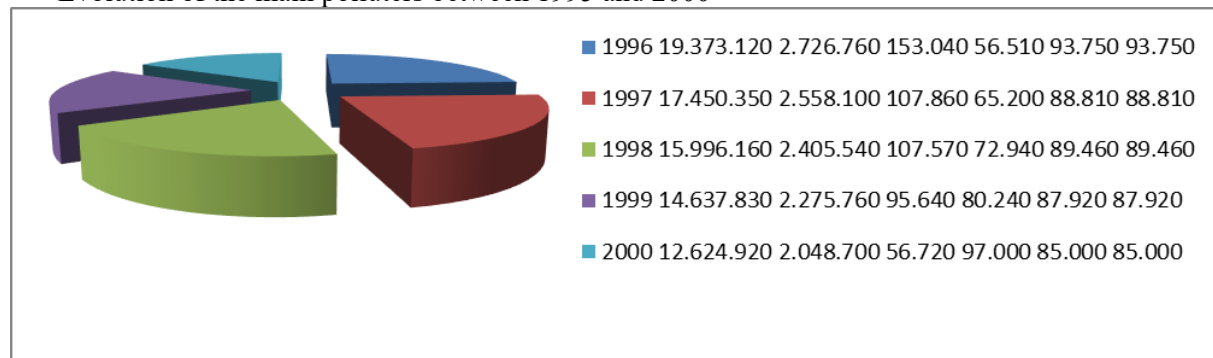
As a result of air quality measures, such as legal acts and rules for all economic sectors on greenhouse gas emissions, Euro 7 standards and industrial emission rules. Emissions of air pollutants have fallen since 1990.

In the following figures, an evolution of the quality of the environment will be highlighted from a qualitative point of view. Increases or decreases in the main substances that affect air quality will be presented. The substances included in the study are: **carbon monoxide, nitrogen oxides, sulphur oxides, ammonia, particulates < 2.5µm, non-methane volatile organic compounds, particulates < 10µm**. The contribution of road traffic to air pollution was analyzed in this paper, the data being taken from the Source sectors for emissions of air pollutants (Nomenclature for reporting, CLRTAP).

Evolution of the main polluters between 1990 and 1995

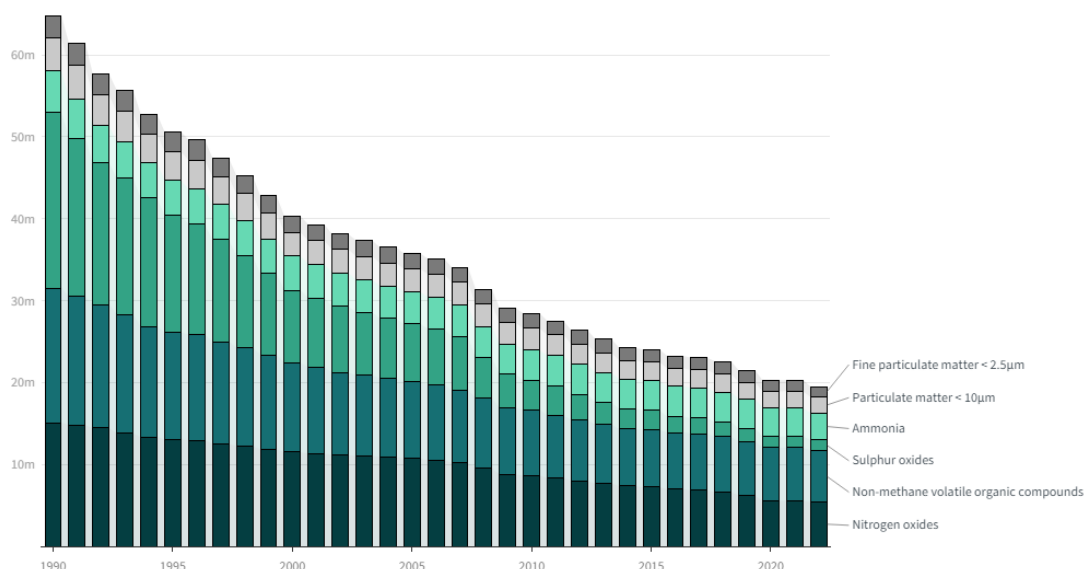


Evolution of the main polluters between 1995 and 2000



5. EVOLUTION OF THE MAIN POLLUTERS BETWEEN 1990-2022

The column chart in the following figure shows the evolution of 6 main air pollutants between 1990 and 2021: PM10, PM2.5, ammonia, sulfur oxides, non-methane volatile organic compounds, and nitrogen oxides.

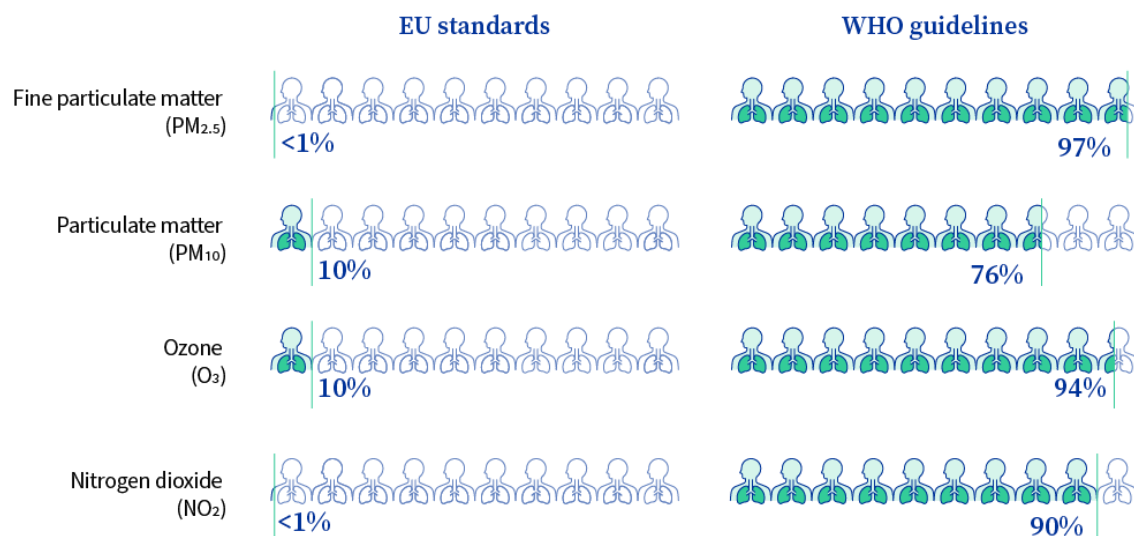


compounds and nitrogen oxides. For all these pollutants, emissions have decreased significantly, from a total of almost 65 million tons in 1990 to about 20 million tons in 2021. Emissions of sulfur oxides decreased the most, by more than 93%. Ammonia emissions fell the least, with only 32%.

In 2021, as a result of the need to take safety measures to protect the environment, the European Commission announced an ambitious zero pollution reduction target for the EU, namely to reduce air, water and soil pollution by 2050. The aim is to reduce pollution to levels that are not harmful to people and the environment. This objective is part of the European Green Deal initiative. Based on this objective, and following the publication in 2021 of the latest World Health Organisation guidelines on air quality, the

Commission in charge of climate change protection and observation has proposed to review and improve the current EU air quality rules.

EU standards need to be closer to the WHO guidelines, which is highlighted in the following graph. This graph shows that, according to current EU standards, less than 1% of the EU's urban population is exposed to harmful levels of PM2.5. However, if the latest WHO guidelines are taken into account, this percentage rises to 97% [2,3].



6. SCENARIOS USED TO CORRECT ENVIRONMENTAL QUALITY

The scenarios used in monitoring and trying to make as precise an analysis as possible of the quality of environmental factors are plausible and simplified descriptions of the environmental factors of the future, based on certain coherent and correct assumptions that refer to the factors that generate change and the relationships between the important components of the environment. These scenarios that highlight the evolution of environmental factors must integrate social, economic, political and environmental information, in order to delineate the trajectories and trends of the state of the environment, even the existing/potential threats and their projection. They are very useful to those who decide the ways of monitoring, control and quality of the environment, of decision-makers, who have to make more and more decisions with an uncertain projection in the future, a projection that is intended to be as precise as possible. The scenarios for the evolution of air quality can be carried out at global, national, regional or local level. They must take into account in particular the future functioning of administrative decision-makers, administrative instruments and the evolution of the factors that drive the development and resolution of environmental problems [5].

In the case of a scenario for maintaining air quality in a crowded locality, a reference year for which there is a sufficient and optimal number of records that are valid for all environmental pollutant indicators shall be taken into account. Local conditions that may influence air quality (e.g. geographical characteristics, sources of emissions) and must be presented in order to provide an overview of pollutants.

The following is the description of the baseline scenario, which aims to maintain and improve the current situation of pollutant emissions and identify pollutant trends, without exceeding the hourly/daily/annual limit values and target values. These target values are provided for in Law No. 104/2011 which refers to ambient air quality by applying measures to reduce the quantities of emissions from linear sources and surface sources. The amounts of emissions reported in the Emissions Inventory of the respective locality for the reference year are in the future the basis for the elaboration of the Baseline Scenario. It directly targets the evolution of the quantities of emissions from surface sources, respectively from residential sources. It also indirectly concerns the evolution of the total quantities of emissions resulting annually from all types of pollutant emission sources. The scenario

may also take into account the reduction of emissions from road traffic when estimating emissions for the respective projection year. These measures taken into account by the respective scenario are taken as a result of the implementation of the measures that are identified in the air quality maintenance plan for the respective urban area.

After the polluting factors have been analyzed and the plan to reduce them has been applied, some conclusions must be drawn on the proposed scenario and the results obtained by implementing the measures within the Air Quality Maintenance Plan proposed in the respective scenario must be analyzed.

Following the analyses of the proposed scenario, certain conclusions are drawn regarding the measures to maintain air quality in that area [6].

Among the measures to maintain air quality in that area, we mention:

- Envelope and thermal rehabilitation of as many blocks as possible in order to use as efficiently as possible and save the amount of gas consumed

- Realization of the regional arrangement of bicycle lanes in the entire studied area, which leads to

reducing local traffic and congestion, reducing fuel consumption and, implicitly, reducing the release of pollutants into the atmosphere

- Improvement of the sanitation program at the level of the locality that can be achieved as much as possible

efficient by maintaining the cleanliness of streets and sidewalks, by mechanically sweeping streets and washing-spraying the road.

- Creating green spaces (trees) along the high-traffic arteries in the locality, even

the creation of the so-called Green Belt of the respective locality with a role in reducing pollution.

- Promoting educational ecological actions in all educational institutions but also among citizens on raising awareness and responsibility for protecting the environment and the need and importance of protecting it.

- Creating green parking lots instead of paved ones to help increase the degree of water infiltration during the period of torrential rains.

- If we refer to the air pollution generated by the power plants, the reduction of pollutant emissions from SC Colterm can be done by refurbishment and modernization of the boilers of the power plants, increasing the efficiency of the

electrofilters, identifying and implementing efficient systems to reduce SO₂ and NO_x emissions, identifying and implementing measures to reduce the emissions of pollutants that are generated by the combustion of fuel oil (replacing this fuel with gases natural gas purification systems), the purchase of mobile and modern equipment for dust retention and suction, the replacement of old power plants that have a high degree of pollution with new ones, which remove concentrations of substances into the atmosphere within the limits allowed by law, eliminating as much as possible the environmental pollution due to this. It is also necessary to consider the implementation of the provisions of the ISO 14000 standards on environmental management, rehabilitation and technological modernization of all equipment and installations in the polluting sector at all polluting units.

If we refer to gas stations, which can be a potentially polluting source, we must consider reducing VOC emissions for loading facilities - unloading gasoline into containers at terminals, reducing VOC emissions for loading and storage at gasoline distribution stations.

It is also very important to collaborate with the local public authorities in order to develop plans and programs for permanent and compliant management of air quality in the locality under study.

Within the evaluation and management of air quality as a specific objective, it is very important to consider the evaluation of the ambient air quality, with the aim of maintaining and improving the quality of the ambient air in the urban agglomeration under study. Thus, the most important indicators evaluated are the concentration of NO_x, SO₂, CO, PM₁₀, PM 2.5 pollutants, etc. For this, the sources responsible for air pollution must be identified. As a result, it is important to work with local public authorities to develop air quality management plans and programmes [7].

Monitoring air quality and informing the public is essential for the smooth running of the air quality restoration activity in the area

In order to remedy the problems, it is necessary to establish a plan to maintain air quality by taking certain measures such as reducing dependence on fossil fuels, reducing emissions from solid or liquid fuel-based energy production facilities, carrying out projects to promote/realize/use renewable energy resources, reduce the number of households with their own solid-fuel-based energy production system or liquids. modernization and construction of new installations for the production of electricity and

heat by capitalizing on renewable energy resources: wind, hydropower, solar, biomass, geothermal, agricultural products, etc.

7. MEASURES NEEDED TO REDUCE POLLUTION FROM ROAD TRANSPORT

Due to the fact that road transport is one of the most important sources of pollution in large urban centers, in conclusion, measures to be taken to reduce pollution due to fuel emissions into the atmosphere are presented. Among the measures designed to be taken into force are the following:

- Construction of overpasses where their construction is required. These passages will have the following effects: continuous traffic fluidization, significant reduction of vehicle waiting times, constant improvement of air quality, significant reduction of fuel and energy consumption.
- Creating pedestrian crossings, overpasses or underpasses, instead of pedestrian crossings located on streets that have heavy traffic. And also encouraging electric mobility, including in public transport. All these can be achieved by developing the network of electric charging stations, creating facilities for those who own electric vehicles (free parking in public parking lots of general utility on the respective territory), creating free parking spaces intended exclusively for use by owners of electric and hybrid vehicles, publicizing the Rabla Plus program; tax exemptions for countries that pollute little (examples of European countries that have such exemptions: Belgium, France); the introduction of toll-free numbers for electric vehicles, which will make it easier to provide facilities. It would also be necessary to subsidize the costs of charging electric cars for the citizens of that city who own an electric vehicle. It is also necessary to equip the Prirnaria with electric/hybrid vehicles, as the vehicles in the municipalities are renewed.

One of the basic components, we can say essential, that determine the health of the population of the whole world, as well as the proper quality and well-being of the environment is the quality of the air we breathe. Thus, especially in urban areas, especially in congested urban areas, where industrial activities, vehicle emissions and other environmental factors lead to high levels of pollution.

Due to the continuous development of cities, they continue to grow and develop, thus the increasingly urgent and increasingly rapid need for effective monitoring and management of air quality appears. The pollution of large urban agglomerations leads to dangerous and alarming

effects on air pollution, which determines the creation of premises for increasing the attention paid to its monitoring and management as efficiently as possible [4].

If we say quality and we refer to air quality control, we refer to the processes and regulations that lead and aim to maintain or even improve air quality in a crowded environment, such as that of large urban agglomerations. To improve the quality of the air breathed by the population of a large city, the reduction of air pollutants such as particulate matter (PM), volatile organic compounds (VOCs), sulphur dioxide (SO₂), nitrogen oxides (NO_x), ozone (O₃) and carbon monoxide (CO) must be considered. All these substances generally exceed the permitted limits and can affect the health of the respective population and the environment. Therefore, effective air quality control is very important, we can even say crucial to mitigate the negative impact on the environment, to stop climate change and the damage to ecosystems brought by pollution.

Thus, in order to control the health of the population and the balance of the ecosystem in which it lives, it is necessary to take measures for a permanent, careful and correct monitoring of environmental factors and, through this, a monitoring of chemicals that disrupt air quality and produce imbalances in the ecosystem. Exposure to an environment that has poor air quality can contribute to respiratory problems in the population, cardiovascular diseases and various other health problems, which makes this aspect need to be seriously considered and emphasize once again the importance of accurate monitoring of air quality in the environment. As a result, in order to be able to monitor as accurately as possible the quality of environmental factors and mainly the air quality in large urban agglomerations, advanced technologies have emerged that offer an opportunity in monitoring air quality as accurately as possible [7].

8. CONCLUSIONS

For a more useful, productive and efficient monitoring and resolution of environmental problems arising in urban agglomerations, environmental promises that are numerous and require the involvement of many competent bodies and implicitly of the population of the respective cities, measures must be taken before pollution and accidents occur that affect the environment and negatively influence the health of the population. This rigorously requires and must be considered the Integrated Pollution Prevention and Control (IPPC) according to Directive 96/61/EC.

This directive has the very clear objective of achieving an integrated system for the prevention and integrated control of pollution by implementing measures to prevent or reduce emissions into the atmosphere. To do this, it is necessary to achieve actions aimed at helping to comply with the rules in force. These actions refer to the realization/updating of the inventories of installations/activities at the local level of that city, the centralization and realization of the annual reports of pollutants emitted in the respective area, the realization, permanent updating of the database evidence at local level, ensuring at all times the transparent access of the public to environmental information and environmental decision-making at local level, provision of laboratory services at local level for emission control.

If all these directives are complied with, it is much easier to stop accidental pollution than to remedy the disastrous effects of accidental pollution.

REFERENCES

- [1] https://doc.pmb.ro/monitorul_oficial/2022/01/CLS_4/HCLS_4_6.pdf.
- [2] <https://www.consilium.europa.eu/ro/policies/air-quality/#EU>
- [3] https://ec.europa.eu/eurostat/databrowser/view/env_air_emis_custom_18217272/default/table
- [4] Gresha Bhatia, Predictive Urban Air Quality Monitoring for Healthier CitiesSEEJPHVolume XXV H1,2024
- [5] Environmental Protection Agency Timiș <http://apmtm.anpm.ro/>
- [6] DIRECTIVE 2004/107/EC on arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air
- [7] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe
- [8] Council Directive 96/62/EC on the assessment and management of ambient air quality