GLOBAL UTILITY INDEX AND AIR QUALITY RANKINGS IN ROMANIA

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ABSTRACT

Despite slow progress, according to updated data and information released by the European Environment Agency, air pollution continues to surpass the limits and values set out in the guidelines of the European Union and the World Health Organisation (EEA). There is also a threat to human health and the atmosphere from air pollution. In the environment, people breathe incessantly, and the presence of toxins is very harmful for human health. Many international organizations and governments have introduced a set of regulations to keep the level of pollutants low as a result of the frightening increase in air pollution, especially in large urban areas. According to the EEA report entitled Air Quality in Europe - Report 2018, road transport is one of the main sources of air pollution in Europe, especially harmful pollutants such as nitrogen dioxide and suspended dust. Air pollution is also aided by emissions from agriculture, electricity production, manufacturing and households. The goal of this article is to highlight the key sources of air pollution, to compare the particular indicators in Romania with those in Germany and France, and to highlight some potential solutions or mechanisms for pollution prevention and control.

KEYWORDS: *air quality, global utility index, ranking, Romania*

1. INTRODUCTION

The atmosphere is the gaseous mass surrounding our earth and is separated into layers of varying densities of gas. The troposphere is considered the layer with the smallest thickness and situated at the bottom (at ground level). This is the layer where plants and animals live and where the cycles of weather that we know happen. The height this layer reaches is approximately 7 kilometers at the poles and 17 kilometers at the equator. The troposphere, like the rest of the atmosphere, is complex. The air has a distinct density and a different chemical composition depending on the altitude. The air circulates across the globe continuously, crossing oceans and large areas of land. The wind is able to move small organisms from one place to another, including bacteria, viruses, seeds and invasive species (Bran et al., 2020).

Around 78 percent nitrogen, 21 percent oxygen and 1 percent argon are found in dry air. Water vapor in the air is also present, representing between 0.1 percent and 4 percent of the troposphere. Usually, warmer air produces more water vapor than colder air.

The air also includes very small quantities of other gases, including carbon dioxide and methane, known as waste gases. The concentrations in the atmosphere of these minor gases are normally measured in parts per million (ppm). In 2019, for instance, carbon dioxide concentrations, one of the most critical waste gases in the atmosphere, were calculated at around 391 ppm or 0.0391 percent (AEM atmospheric concentrations indicator) (Bran et al., 2019).

Air pollution is an invisible enemy and we must step up our efforts to tackle the causes. Emissions from road transport are much more dangerous in terms of air pollution than those from other sources.

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Sources, since these emissions occur at ground level and appear to occur in cities, close to people. That is why it is so important for Europe to redouble its efforts to minimize and invest in greener and more sustainable emissions from transport, energy and agriculture (Bruyninckx, 2013)

2. STAGE OF KNOWLEDGE IN THE FIELD

In the atmosphere, the composition of the air is continuously changing. In other words, certain compounds in the air have a high reactive potential and are more likely to bind with other substances in order to form new ones. When some of these substances combine with others, "secondary" contaminants that are harmful to our health and the environment may be created. Heat is typically a catalyst, like solar heat, which facilitates or induces chemical reactions (Bran et al., 2018).

Not all chemicals are known as contaminants in the air. Air pollution is commonly characterized as the presence of certain atmospheric contaminants at levels that have a negative effect on human health, the environment and our cultural heritage (buildings, monuments and materials).

Air pollution continues to harm health and the environment, despite substantial changes in recent decades (Burlacu et al., 2020). In particular, particulate matter and ozone emissions pose significant health threats to European people, impacting their quality of life and reducing their life expectancy (Burlacu et al., 2019).

The particles are the pollutant in the air that affects human health the most. Some of these particles are so tiny that they not only penetrate deep into the lungs, but also into the blood, much like oxygen (one-third to one-fifth the diameter of a human hair). Any particles are released into the atmosphere directly. Others such as sulfur dioxide, nitrogen oxides, ammonia and volatile organic compounds, are the result of chemical reactions containing precursor gases. These particles may be made up of different chemical compounds, and their composition depends on the effect they have on our health and the environment. Some heavy metals, such as arsenic, cadmium, mercury and nickel, may also be found in the particles.

Air pollution appears to affect urban dwellers to a greater degree than rural dwellers because the amount of air pollutants emitted (for example, from road transport) is higher due to population density in cities and because dispersal happens more harshly in cities than in rural areas.

Particulate matter (PM), nitrogen dioxide (NO2), sulfur dioxide (SO2) and ground-level ozone are the air pollutants deemed most detrimental to human health by the WHO (O3). In 2014, fine particulate matter (PM2.5) caused approximately 400,000 premature deaths among people, nitrogen dioxide (NO2), approximately 75,000, and ozone, according to EEA data (O3). Roughly 13,600. The EEA warns that air pollution affects the population every day and that long-term exposure to lower doses presents a greater danger to human health, while its most visible impact is peak pollution.

Principal air contaminants

Suspended particles (PM) include air-suspended solid and liquid particles. They contain a wide variety of chemicals, ranging from sea salt and pollen to benzo(a) pyrene and carbon black human carcinogens. Suspended particles can be categorized into PM10 (coarse particles) and PM2.5 based on their size (fine particles). Emissions of air pollutants (especially suspended particles) tend to increase in those parts of Romania where solid fuel is still used to heat homes when winters are harsher. Nitrogen dioxide (NO2) is a reddish-brown gas that is poisonous. It belongs to the Nitrogen Oxides group (NOX). A poisonous, colorless gas with a pungent odor is sulfur dioxide (SO2). It is one of the oxides of sulfur that (SOX).

Earth-level ozone (O3), also known as tropospheric ozone, is a colorless gas that is produced by the chemical reaction of some contaminants in the presence of sunlight, such as volatile organic compounds (VOCs) and nitrogen oxides (NOX), in a layer close to the ground.

A new research by the World Health Organization (WHO) indicates that fine particulate emissions (PM2.5, that is, particles with a diameter of up to 2.5 microns) may be a bigger health concern than previously thought. Long-term exposure to fine particles can cause atherosclerosis, adverse effects on pregnancy, and childhood respiratory disease, according to the WHO Review of Evidence on Health Aspects of Air Pollution. The study also indicates that brain development, cognitive function and diabetes may be related and strengthens the causal link between PM2.5 and cardiovascular and respiratory disease deaths. Heart disease and stroke are the cause of 80 percent of all premature deaths caused by air pollution, according to the WHO. These are accompanied by lung diseases and other disorders, including cancer.

The particles may also impact the global environment depending on their chemical composition, by heating or cooling the earth. For instance, carbon black, one of the common compounds in soot, results from incomplete combustion of fuels, both fossil fuels and wood, mainly in the form of fine particles (less than 2.5 microns in diameter). Carbon-black emissions in urban areas are mainly caused by road transport, especially diesel engines. In addition to the effect on health, by absorbing solar heat and warming the atmosphere, carbon black particles contribute to climate change..

Measuring the human health effects

In both developed and developing countries, air pollution affects all people alike. While everyone is affected by air pollution, it does not affect everyone equally and in the same way. Owing to greater population densities, most residents are exposed to air pollution in urban areas (Alpopi et al, 2018). Some individuals are more vulnerable, including those with cardiovascular and respiratory conditions, people with sensitive airways, elderly people and children with airway allergies (Burlacu et al., 2018).

Air pollution in Europe decreases life expectancy by around 8.6 months per person, according to the Aphekom project, co-financed by the European Commission. Some business models may be used to estimate the costs of air pollution (Bodislav et al., 2019). In general, these models include the health costs resulting from air pollution (decreased efficiency, increased medical costs, etc.), as well as the costs resulting from smaller crops and the harm to certain products (Angheluta et al., 2019). These models do not however, contain all the costs to society caused by air pollution.

There are also studies that estimate potential gains that could be made by improving air quality. The Aphekom report, for example, predicts that lowering the average annual PM2.5 levels to the World Health Organization recommendations will lead to higher life expectancy. It is anticipated that achieving this objective alone would lead to potential improvements in life expectancy, ranging from an average of 22 months per person in Bucharest and 19 months in Budapest to 2 months in Malaga and less than half a month in Dublin.

It is not just human health that is impaired by air pollution. Different air contaminants affect a broad range of habitats differently (Negescu et al., 2019). Unique risks are caused by excess nitrogen, however. Nitrogen is one of the key nutrients for survival and healthy production that plants require.

3. METHODOLOGY

The approach is used in cases where the decision criteria have different coefficients of value. The operation of choice is at the center of the decision-making process. The global utility method addresses the issue of typological diversity of characteristics by converting all of them into a single unit of measurement. The calculation algorithm consists of three steps:

Stage 1. Establishing metrics and grouping them into four domains/dimensions:

The economic dimension

- *C1. GDP per capita (euro)*
- *C2. Population (million inhabitants)*
- *C3. Unemployment rate (%)*

The social dimension

- *C4. Average lifespan (years)*
- *C5. Population density (place / km2)*
- *C6. Infant mortality rate (deaths per 1000 known children)*
- *C7. Area (km2)*

The size of the environment

- *C8. Waste (kg / capita)*
- *C9. CO2 emissions*

The size corresponding to natural resources

- *C10. Distributed drinking water (billion m3)*
- *C11. Ranking of green countries (place occupied)*

Stage 2. Completion of the table with data from the previous stage

Table 1 – The values of the criteria for each country

Country	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
Romania	12.3	19.41	3.90%	75.31	84.4	5.2	238397	527	90.425	0.97	44
France	34.5	66.99	10.60%	82.52	40	3.2	643801	468	373.693	7.46	8
Germany	37.6	83.02	5%	80.9	225.1	3.6	357386	534	450.135	6.51	7

Source: Eurostat (2020)

The method used is the global utility method. This characterizes air quality according to 11 indicators, divided into 4 dimensions, and we rate regions using the global indicator:
$U_{ij} = (C_{ij} – C_j^0) / (C_j^1 – C_{j0})$, where:
U_{ij} – represents the utility of variant i according to criterion j
C_{ij} – represents the consequence of the variant according to the criterion
Cj1 - most favorable = highest value (MAX) *
Cj0 - most unfavorable = lowest value (min) *

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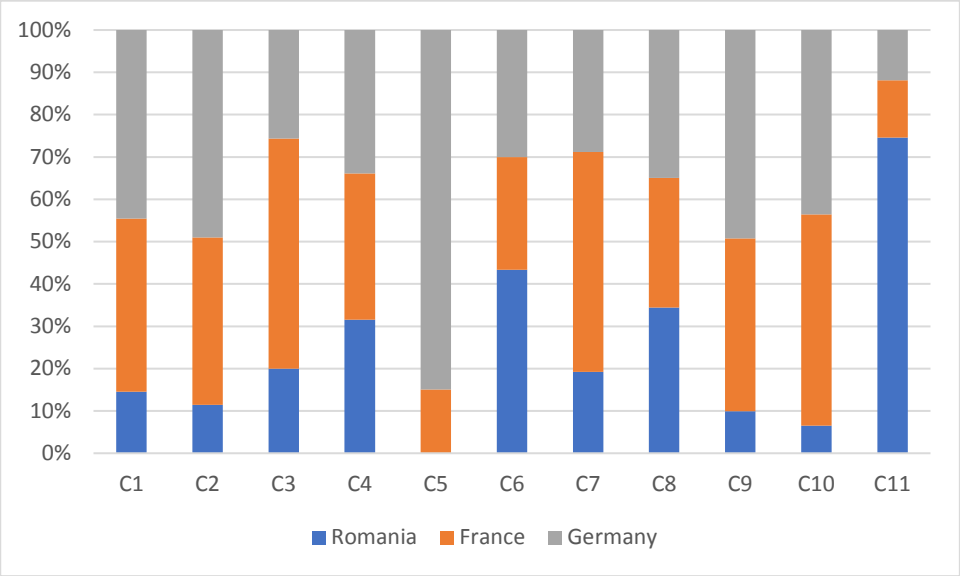

Figure 1. Sustainability Ranking (Global Index)

Source: own computation

4. FINDINGS

4.1 Measurement of air quality in Romania

A synthetic air quality index is used in Romania. The specific air quality index, in the short term 'specific index,' is a framework for the coding of concentrations reported for the following nationally monitored pollutants: SO2 (sulfur dioxide), NO2 (nitrogen dioxide), O3 (ozone), CO (carbon monoxide), PM10 (suspension powders). For each monitoring station, the general index shall be defined as the highest of the particular indices corresponding to the pollutants monitored.

4.2 Measurement of air quality in France

The air quality situation in France represents the general trend in the developed countries: air quality improvements over the last two decades are steadily eroding due to the rise in emissions in the transport sector. In France, substantial progress has been made towards meeting the air quality goals to reduce the levels of all major air contaminants (to the lowest in the OECD) in all sectors except transport. This represents the continued central importance of the transport sector to the French economy. There has been a dramatic rise in the movement of goods and people in France since 1970: freight transport has increased by 70% and private vehicle traffic has doubled from 1970 to 1994.

In addition, road freight transport grew at a rate of 5% per year between 1985 and 1995.

This increased mobility was followed by a similar rise in ownership of motor vehicles from around 25 private cars per capita to around 43 from 1970 to 1994.

In addition, the size of transport infrastructure has also increased significantly, so that France now has the third motorway system in the world.

Following these trends, most of the emissions of air pollutants that continue to be problematic in France come from the transport sector, despite significant efforts to control these emissions.

According to a European Commission report, more than 50% of emissions of pollutants such as nitrogen oxides (NOx) or carbon monoxide come from road transport vehicles. In Paris, approximately 3 million cars enter the Capital every day, and the smoke mist engulfs the city and causes health problems such as asthma and chronic cough, filling the emergency rooms with people suffering from bronchial diseases ice. The French tourism industry is concerned that tourists to Paris will leave behind with memories of clogged highways, open skies and smoke-filled images of the Eiffel Tower. France is also Europe's main emitter of dioxins. In order to regulate the issue of air

pollution, the French Department for the Environment and Energy Control (ADEME) is trying to equip the country with a monitoring system that meets the criteria of the National Air Pollution Act.

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4.3 Measurement of German Air Quality

Air pollution in Germany has decreased dramatically over the last decade. Air pollution occurs when toxic chemicals are emitted to the Earth's atmosphere. These contaminants are released by human activity and natural resources. Germany has expressed its interest in reducing greenhouse gas (GHG) emissions by transitioning to renewable energy sources. Renewable energy consumption rose from 6.3 per cent in 2000 to 34% in 2016. By turning to renewable energy sources, some people claim that Germany has become a pioneer in climate change policy and a leader in renewable energy in the European Union (EU). And in the world with aggressive climate change policies, while CO2 emissions per capita in Germany are currently among the highest in Europe, nearly twice that in France. The current objective of the German Government was adopted on 14 November 2016 in the German Climate Action Plan 2050, which includes steps to allow Germany to achieve its greenhouse gas emissions by 2050. By 2050, Germany wants to reduce GHGs by 80 to 95 per cent and by 2030 wants to reduce GHGs by 55 per cent compared to the EU target of 40 per cent.

5. CONCLUSIONS

According to the World Health Organisation:

- Air pollution is a significant health danger to the world. By reducing air pollution, countries will reduce the burden of stroke, heart disease, lung cancer and both chronic and acute respiratory diseases, including asthma.
- The lower the level of air pollution, the better the cardiovascular and respiratory health of the population, both long-term and short-term.
- In 2019, 89% of the world's population lived in areas where the WHO recommendations on air quality were not complied with.

In order to enhance air quality in these three nations, the following steps should be placed in place:

- Addressing steps to mitigate pollution
- The creation of metropolitan belts
- Renewal of the fleet of cars
- Thermal isolation of households and organizations
- Stimulating the residents to stay in the centralized district heating system;

In order to enhance air quality in these three cities, the following steps should be ordered:

- rehabilitation and quality assurance of housing by providing a focal point for communities with open spaces and public amenities for all ages and socio-professional categories;
- improving the need for green space in relation to the number of inhabitants;
- recovery and arrangement of residual areas in public land as recreation and recreation areas for the community; preventing the over-denial of residential neighborhoods;
- improving environmental and environmental factors, reducing CO2 emissions, improving urban appearance in suffocated communities in particular parked cars and garages;
- improving ties between the inhabitants and the landscape.

The densification of the neighborhoods, the extreme rise in traffic and the shortage in parking spaces in recent years have led to an increasing reluctance of the community to invest in any sort, other than widening the streets and complementing parking spaces. Achieving a green recreation area that meets high expectations of picture and efficiency is crucial to correct the community's view of priorities in suburban communities.

Air is the environmental component that offers the fastest assistance to the transport of pollutants in the environment. Air pollution has several and significant adverse effects on human health and can cause harm to flora and fauna in general.

For these purposes, special attention is given to the control, preservation and enhancement of air quality.

Air quality is determined by air pollution from stationary and mobile sources (road traffic), primarily in large cities, as well as long-distance transport of air pollutants. The air quality data obtained from the monitoring network indicate a marginal improvement in air quality due to a decrease in economic activities and refurbishment and modernization programs carried out at the level of some industrial units, but also to a rise in the number of inspections of economic agents.

Car traffic, especially along major roads, including heavy traffic, is one of the main sources of pollutants. Each of us will help to clean" the dirty air as little as possible. By giving up the practices that make our lives pleasant, such as throwing waste into nature, overuse of personal vehicles, to the detriment of public transport and much more, we will achieve a healthier world, and if the earth and the air we breathe are safe and healthy, it can only enable us to be well.

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