Air Quality Management in Developing Economies

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ABBREVIATIONS

AQI…… Air Quality Index
CAP……. Clean Air Programme
CEE……... Central and Eastern European
CNG……. Compressed Natural Gas
GHG…..…… Green House Gasses
LEZ…..……..Low Emission Zones
LPG……. Liquid Petroleum Gas
NAQP……...National Air Quality Plan
NEVP…. National Electric Vehicles Policy
$PM_{2.5}$…Particulate Matter 2.5 µm diameter
PM_{10}…. Particulate Matter 10 µm diameter

ABSTRACT

When observing the AQI values, up to 100 is acceptable, while 151 to 200 is "unhealthy", and 201+ "very unhealthy". In the list, the cities of Krakow and Lahore can be seen among the highest on the AQI list, which are the most polluted cities in Poland and Pakistan, respectively.

INTRODUCTION

Governments from around the world will be using different methods of air quality management and at the same time, will be using similar methods, which is what will be discussed. This is done by countries to reduce its emissions and reach the target as agreed and signed on the Paris Agreement. The countries of interest will be Poland, Pakistan, and Vietnam and how effective their policies of air quality management are. Looking at the recordings, (Koschalka, 2021) the AQI on December 14, 2021, recorded Kraków with a figure of 264, ahead of Lahore (250) and New Delhi (191). Wrocław was in fourth place, with 181. For Vietnam, the situation is not as bad, however, it does still have air pollution challenges due to the main source being transportation.

POLAND

When looking at some of the developing countries, Poland always stands out as it is one of the largest growing economies in Europe. It was stated that it was one of the most promising economies of the ex-soviet countries and had shown this throughout the 2000s and 2010s.

With this rapid economic growth, an increase in industrialisation was inevitable. Which caused an increase of GHG emissions and the release of $PM_{2.5}$ and PM_{10} into the atmosphere. Much of the non-western European countries have plans for one or more specific areas within Western Europe (Euro-area 17), Poland's natural benchmark and an objective fall into Poland falls in this category due to being a central European country with areas that have higher air pollution levels than others, as can be seen in Figure 1.

There is also CAP, this is the programme put in place to counter the air the government sets plans for actions that need to be taken for air quality management on a sub-national level to decrease the concentrations of PM10, PM2.5, B(a)P

(Benzo[a]pyrene), NO2 (Nitrogen Dioxide) and O3 (Ozone) This is so levels do not exceed the ones agreed to in the NAQP and the Paris Agreement, 81%, 87% and 98% exceedances of PM10, PM2.5 and B(a)P, respectively (Koschalka, 2021). This is so there are technical requirements for smaller solid fuel boilers, for residential use and in the service sector. This is to solve the already stated heating system related air pollution issues. Where:

- Penalties are put in place when these requirements are not met by individuals and sectors.

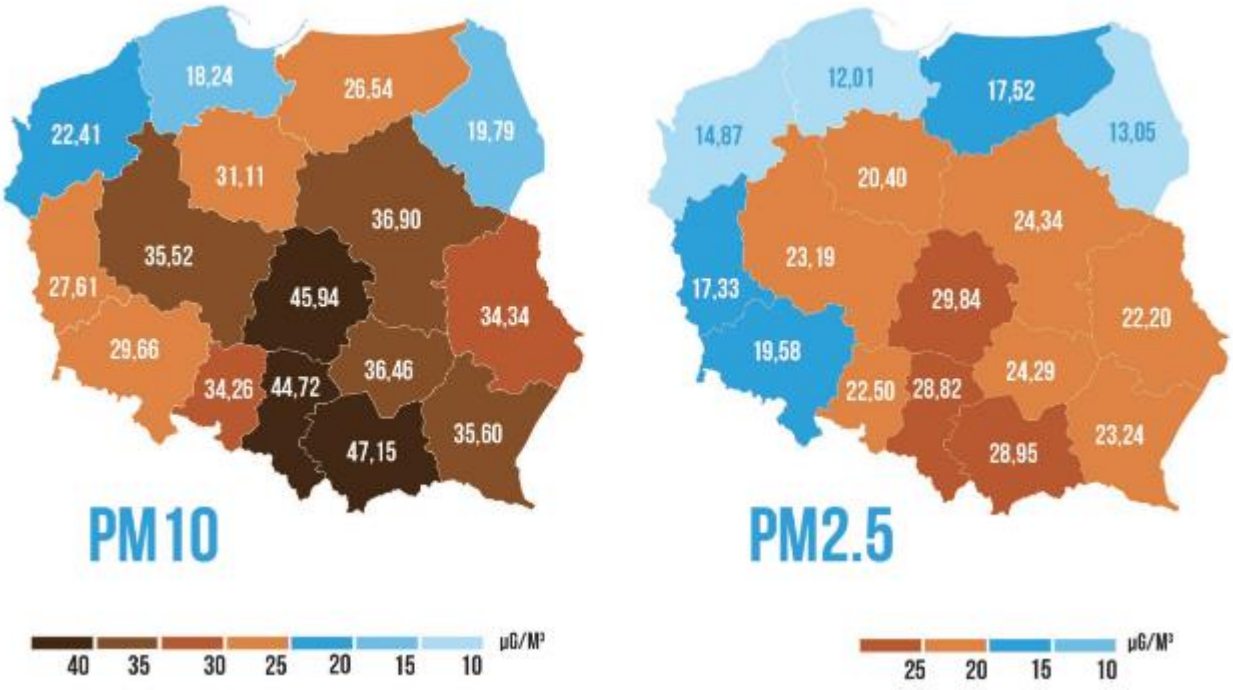

Figure 1: Average Concentration of $PM_{2.5}$ and PM_{10} in Poland (Kowalski, 2020)

- There are types of boilers, however that are exempt from these regulations, such as: (i) boilers generating heat exclusively for providing hot drinking or sanitary water; (ii) boilers for heating and distributing gaseous heat transfer media such as water vapor or air.

P A K I S T A N

Today, Pakistan is the world's fourth most polluted country, which can be due to the sheer size of its population, its growing economy, and its rapid increase in vehicles with low quality fuel, much like Vietnam but more polluted, which shall be discussed further on.

objection Such a system is beneficial if the designer aims to design the junction signal free a free and it lessens the travel time overall.

This also leads to a lower travel time, which means there will be less PM and GHG emissions and contributes effectively to the air quality management. The layout of the protected U-turns is shown in Figure 2 below.

To meet its carbon dioxide (CO2) emissions reduction target, Pakistan signed the Paris Agreement, much like Poland and Vietnam, as today, 194 Parties (193 States plus the European Union) have joined the Paris Agreement. (Nations, 2015).

More importantly, the government has applied tighter rules to ensure compliance with the National Environmental Quality Standards for motor vehicle exhaust and noise ambient air quality.

Even with the use of coal as fuel, Pakistan has adopted new methods for countering emissions from the power plants, it has adopted Multistage enthalpy extraction technology (MEET) systems, which use (Malik, Naveed and Nawaz, 2007) hot gas clean-up including low temperature removal of SO_2.

Another one of these improvements is the introduction of protected U-turns at junctions. With the implementation of this technique, moving traffic is given priority as they traverse without any obstruction. (Tanveer et al., 2018b)

The government also gets rid of what they deem 'excess' and 'unnecessary' from the roads as they think that 'display of religiosity at busy crossings hinders vision of drivers and creates bottlenecks' (Ahmad, 2008). Within the powerplants, it is observed that that the particulates from the coal syngas, is collected by systems in the plants. These systems are called Flue Gas Desulphurisation, Electrostatic precipitators and Selective catalytic reduction and reduce the emissions facilities, and vehicle operations, proper enforcement.

Much like Pakistan, Transportation is the primary source of these emissions, followed. shortly by its growing industry, as Vietnam is one of the developimg economies of South-East Asia. However, unlike Pakistan, instead of busses and public transport, Motorcycles are the primary form of transport in Vietnam, meaning the trip lengths can be longer, releasing more GHG and PM. Unlike Poland and Pakistan, Vietnam shows no incentives for the use of electric cars.

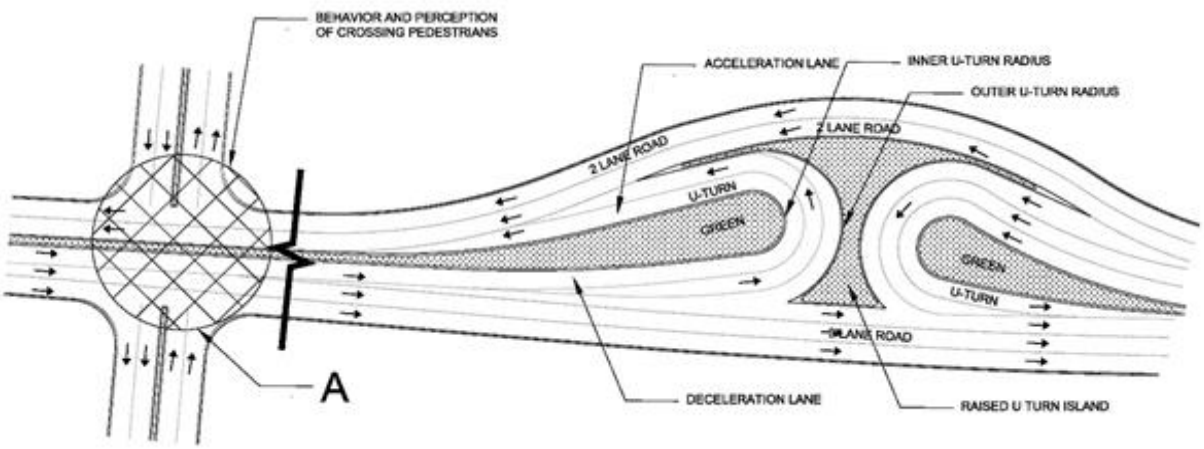

Figure 2: Layout of protected U-turns used in Lahore, Pakistan (Tanveer et al., 2018)

VIETNAM

Vietnam is the least polluted country of the 3 discussed, however, there are still detrimental effects of the various emissions, especially the PM levels. With an AQI that reaches a threshold of over 150 indicating that air quality is harmful to health (Truong, Nguyen and Truong, 2021).

In Vietnam, the situation with pollution has started to become dangerous for the residents as the capital, Ho Chi Minh city is vulnerable to high levels of pollution where, NO2, PM10, SO2 and O3 had inconsistent effects on cardiorespiratory hospitalizations (Phung et al., 2016).

The capacity of the city's institutions to develop a comprehensive urban transport policy that provides priority to public transport. One of which was the development of the bus system in urban areas as well as a railway system (Nguyen and Coowanitwong, 2010).

SIMILARITIES

Although all these countries are far from each other and have distinct cultures and social climates, they seem to have similar methods to address the problems.

In both Pakistan and Poland, the governments are directing the populus to use more electric vehicles. With this, they also have aims to have a proportion of the country using only electric vehicles. For instance, Pakistan approved an ambitious National Electric Vehicles Policy (NEVP) in 2019, which aims to achieve an electric vehicles (EV) share of 30% of all passenger vehicles and heavy-duty truck sales by 2030, and 90% by 2040. (Sadiqa et al., 2021)

The way that Pakistan views alternative energy is to change of technology including fuel substitution & conversion to less polluted fuels (e.g. low Sulphur / Lead fuels, CNG). Hydro-Carbon Development Institute of Pakistan has

been main driving force in promoting CNG as alternate fuel for transport sector (only for Gasoline driven vehicles for the time being) due to financial restraints (Noman and Qadir, 2008). Similarly, Vietnam is having investment in CNG and LPG distribution and refuelling stations and buying dedicated buses powered by CNG and having facilities for taxi engine conversion (Nguyen and Coowanitwong, 2010). Conventional fuel vehicles that are powered by diesel and gasoline are causing for harmful GHGs to be released into the atmosphere, and the fact that almost all encourage private investment in charging infrastructure (Sadiqa et al., 2021).

Renewable sources (RES) in final energy consumption in Poland in 2018 was 11.6% (Zyśk et al., 2020). Where Poland tries to push for more decarbonisation policies. Vietnam also has presented policies of decarbonisation usage for domestic coal only and setting a low carbon tax. These actions would decrease carbon dioxide emissions respectively by 120 Mt, 160 Mt and 94 Mt yearly in 2030 (Talvela, 2022). It is stated that with this programme, Vietnam could achieve its CO_2 emission targets as set in policies. Vietnam also has presented policies of decarbonisation, where it was estimated that based on the results, the most efficient policies to reduce carbon dioxide emissions seem to be halting new coal capacity additions, capping coal usage for domestic coal only, and setting a low carbon tax. These actions would decrease carbon dioxide emissions respectively by 120 Mt, 160 Mt and 94 Mt yearly in 2030 (Talvela, 2022). It is stated that with this programme, Vietnam could achieve its CO2 emission targets as set in the Paris Agreement. Similarly, Poland also incentivises the use of electric cars with a plan that aims to implement the National Electromobility Development Plan, launched in March of 2017. The Plan envisages 1 million electric cars in Poland by 2025 and provides for a system of incentives including excise exemptions to promote electric cars (Polish Ministry of Energy, 2018) and exemption of electric cars and plug-in hybrids from parking fees and permitting them to drive on bus lanes, until 1st January 2026.

There are also low emission incentives put in place and (Campisi et al., 2021) the programme is divided into two independent components: one aiming at the development and production of electric buses and one that focuses on the design and production of a Polish electric car. Therefore incentives for moving towards electric vehicles are in place in Poland and Pakistan.

KEY POINTS

- Flue Gas Sulphurisation eliminates sulphur, Electrostatic precipitators eliminate $PM_{2.5}$ and PM_{10}, Selective Catalytic reduction removes Nitrogen Oxides.
- Investment in public transport is the main approach to lower emissions
- Low emission incentives directs populations to use electric vehicles.

CONCLUSION

In this article, the air quality management of the counties of Poland, Pakistan and Vietnam was analysed. From the evaluation of the various techniques used to counter the air pollution issues in these countries, Vietnam is the most successful candidate. Having a higher population than Poland and being much lower down on the AQI chart. This could be due to a more effective oversight of equipment suppliers for the motorcycles and a strict enforcement of its rules to minimise congestion. All of these combined lead Vietnam as the more successful candidate for air quality management out of the 3 assessed. Poland would then have to be next due to having more laws and air quality requirements due to policies adapted from the EU. As well as this, the GDP is higher in Poland than in both the other countries, so the government has more money to invest in such policies. However, Poland has many more cities with higher AQI values than that of many of the Vietnamese cities which could be due to not being able to enforce these rules effectively as it has already been stated that Eastern Europe has only recetly started adopting exemptions for electric cars and the implementations of these laws may have years to go to be fully in effect. Pakistan would have to be the worst at the air quality managemnt, however, this could be down to the fact that the country simply does not see air quality management as an imperative issue and invests the money in growing its industry and other investments.

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