Policy Brief

Strategy for Air Pollution Control

English Version

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Vital Strategies

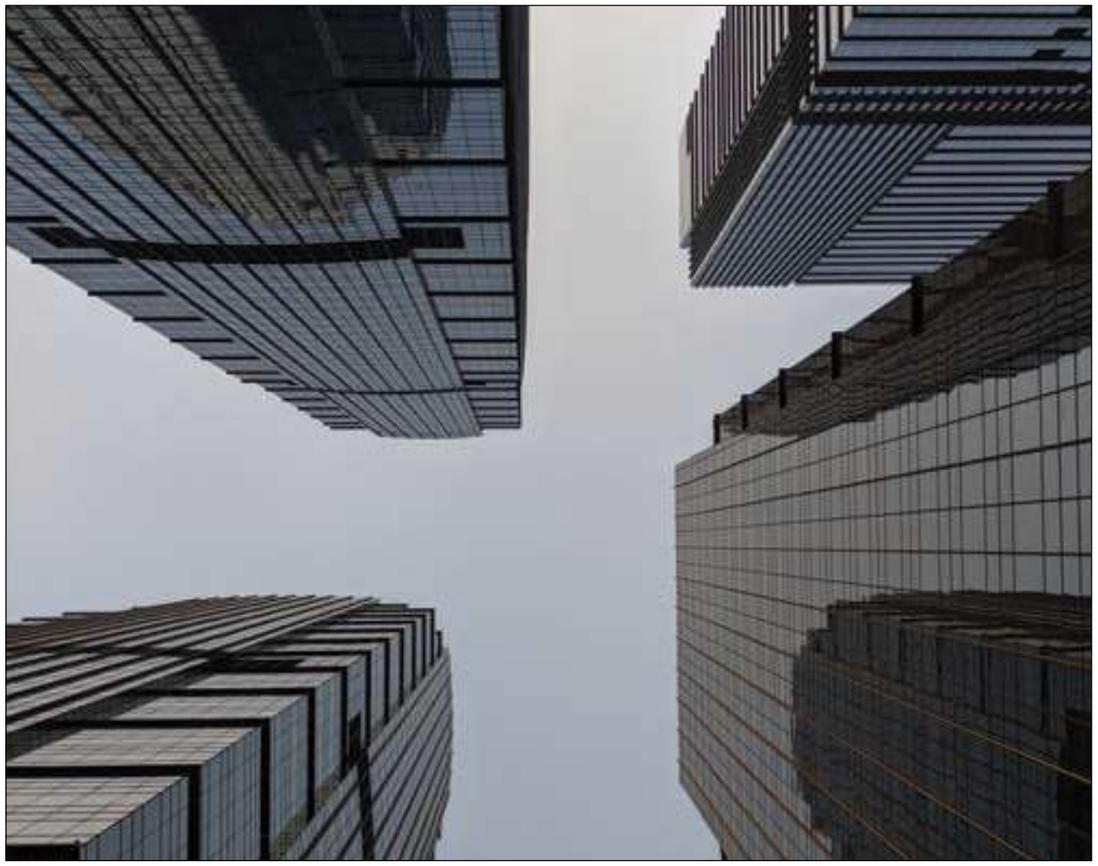
Jakarta
kota kolaborasi

Strategy for Air Pollution Control

Good air quality is a critical factor for human health. In addition, it significantly increases the productivity of the people living in the area/city. As the capital of Indonesia, Jakarta is the center of economic, political, and social activities that lead to the intensification of urbanization, financial activities, and development in the city. Unfortunately, more economic activities mean more environmental problems. One of which is air pollution resulting from emissions produced by transportation, industry, domestic activities, and others.

The human population and the number of motorized vehicles in Jakarta have increased in the past decade. As a result, it is followed by rising fuel consumption, especially Jakarta's private vehicle/transportation sector, creating more greenhouse gas emissions. Moreover, the low number of public transport ridership has also contributed to the surge of emissions from the sector. On the other hand, fuel consumption from the industrial sector has also continued to climb with increased production demand from process manufacturing in Jakarta. All those factors further impact the capital's air quality.

For three years in a row since 2019, the Indonesia Environmental Quality Index has reported that Jakarta has had the lowest provincial "Indeks Kualitas Udara" (IKU/ Environmental Quality Index). The index indicated the need for a more optimum air pollution control, so that the people living in Jakarta can have a more stable livelihood. Therefore, the Jakarta Provincial Government has formulated a comprehensive plan in the form of a Strategy document to improve the air quality in Jakarta, which was also a follow up to a September 16, 2021 court ruling issued in favor of a Citizen Lawsuit against Air Pollution in Jakarta.



Strategy for Air Pollution Control

"Strategi Pengendalian Pencemaran Udara (SPPU)" is a comprehensive plan to control air pollution and provide integrated directive and focus for a multi-sector effort to improve air quality. It is also a reference for formulating an effective action plan up to the year 2030. In developing SPPU, Jakarta Environmental Agency has worked with the Fakultas Teknik Sipil dan Lingkungan (FTSL/Civil and Environmental Engineering Faculty) of Institut Teknologi Bandung (ITB/Bandung Institute of Technology) and National Institute of Technology (ITENAS/ Institut Teknologi Nasional) in a partnership with Vital Strategies to frame a data and evidence-based action plan.

Momentum for Action to Improve Air Quality

The action plan is divided into eight categories to cover all elements correlated to air pollution. Those categories are multisectoral and regulation collaboration; emission and air quality data inventory as a basis for policy on air quality management; emission control in the transportation sector; eco-friendly fuel; eco-infrastructure and "Green" building development; emission control in the industry sector; public education and participation; and law enforcement.

1. The Driving Forces of Emission Increase in Jakarta

Several factors are responsible for the decline of air quality in Jakarta: growth of **urban population**, **transportation and motorization**, and **energy consumption**.

1a Growth of Urban Population

Based on a census by the Jakarta Provincial Government in 2019, the population density in the province reached 118 times more than the national average. The population data for Jakarta between 2010-2020 showed an escalating trend, with the average population growth rate at 0.92%. In 2020, 10.8 million lives inhabited the capital.

Figure 1 showed that even with the national capital relocation scenario in 2024, which predicted could trigger the migration of around 1.5 million people **(green line)**, and using the assumption of a fixed population growth rate, the projection for the total population and population density in 2030 remains high.

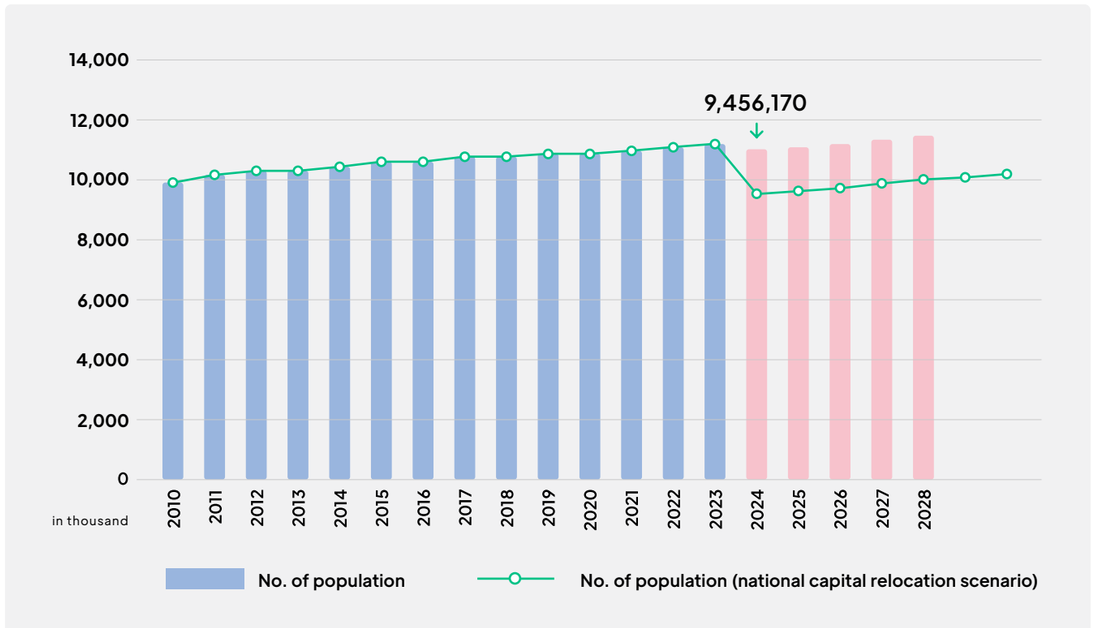


Figure 1. Jakarta Population Growth Projection for 2010-2030
(Jakarta Statistics Agency/BPS, 2021)

1b The Increase in Transportation and Motorization

The mobility of the people in Jakarta continues to increase, as reflected by the number of registered ownerships of motorized vehicles. In 2020, the total number of motorized vehicles was 20,223,821 units, as shown in Figure 2. The vehicle growth rate from 2009 to 2020 is 4.9% for motorcycles, 7.01% for passenger cars, 5.3% for load-carrying vehicles, and 4.7% for buses. The ratio for motorcycles and passenger cars against the total population were 1.5 and 0.38, respectively, which means that the number of motorcycles has exceeded the human population. Figure 2 showed that all vehicle ownerships continued their upward trend in terms of growth, with motorcycles leading with 75% over time.

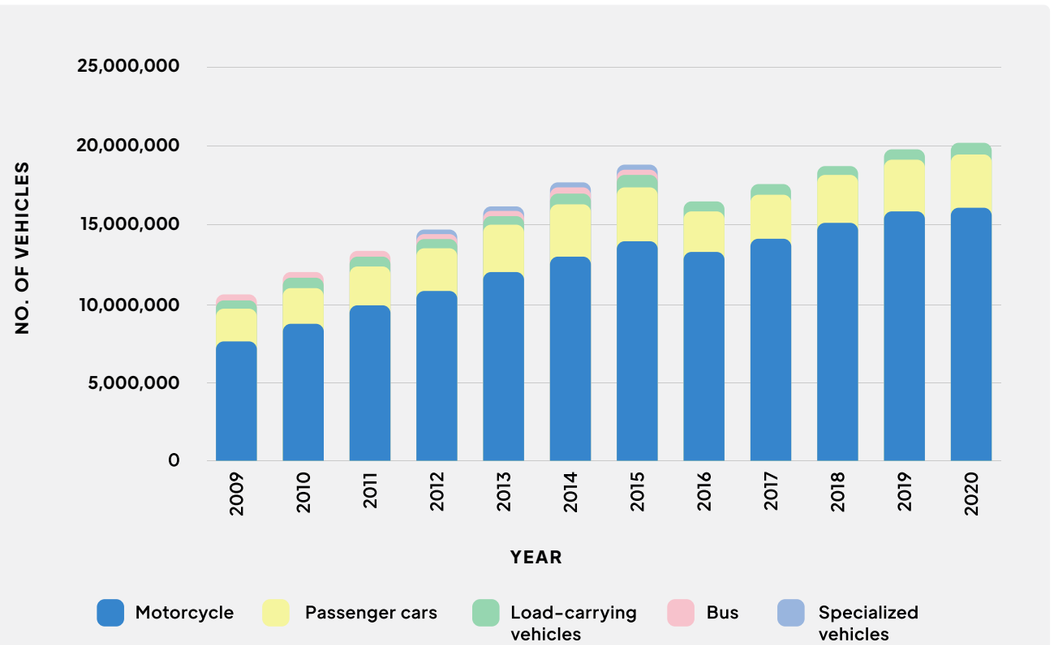


Figure 2. The number of motor vehicles according to their classes
(BPS Jakarta, 2009-2021)

1c Rising Energy Consumption

In line with the increasing economic activity in the Capital City, the trend of energy consumption in Jakarta was also increased. According to the energy consumption data as the basis of the Green House Gas (GHG) emission calculation conducted by the Environmental Agency (DLH) of DKI Jakarta, Jakarta's energy consumption increased 45.3% from 2010 compared to 2018. The biggest portion of the energy consumption is consistently dominated by transportation sector (see Figure 3).

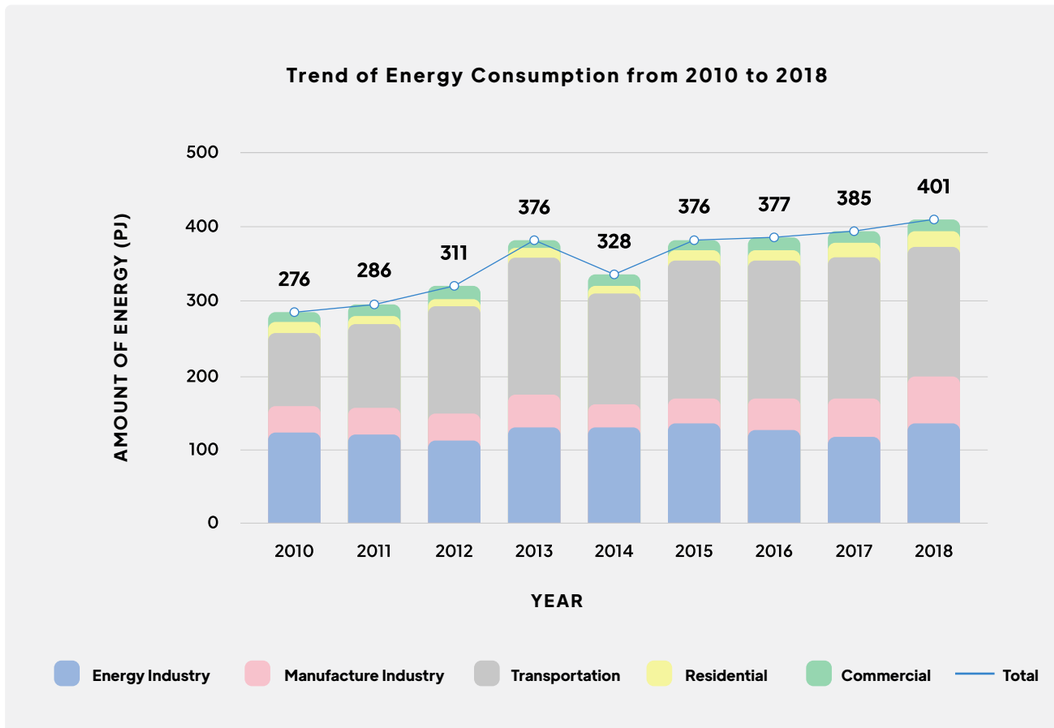


Figure 3. Total Fuel Consumption in Large and Medium-Scale Industries
According to Industry Classification Year 2010-2020
(BPS Jakarta, 2012-2021)

2. Analysis of Emission Inventory Result

According to several studies, Jakarta's highest and primary pollutants are NO_x, $PM_{2.5}$ (and PM_{10}), and SO_2. Figure 4 below shows the inventory of emissions from air pollutants in Jakarta.

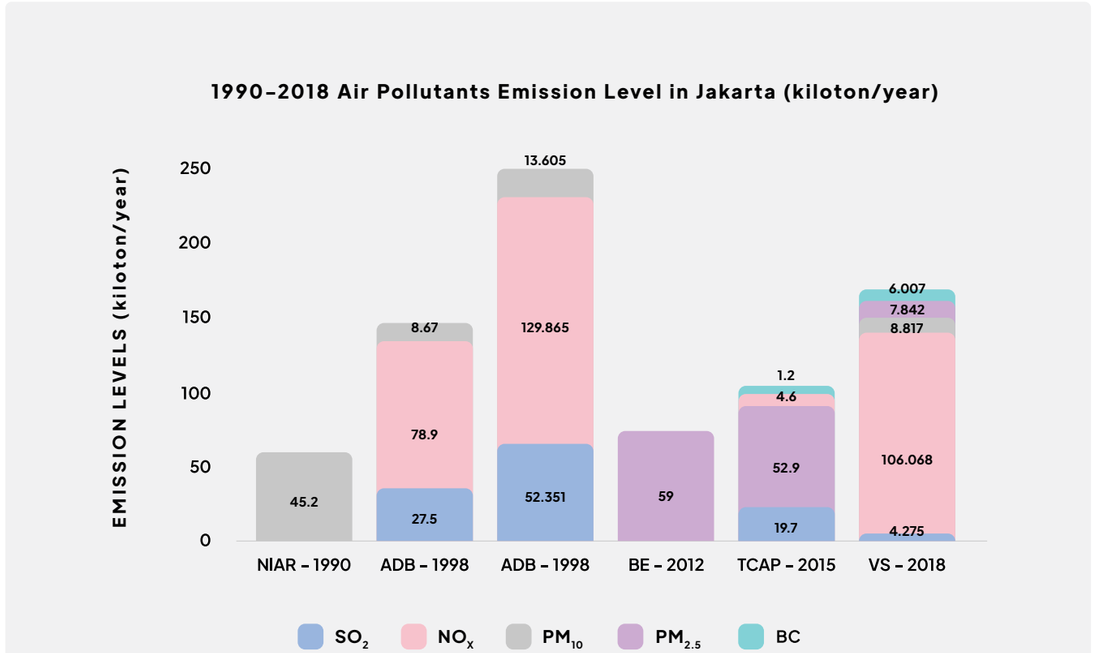


Figure 4. Emission Levels of Air Pollutants in Jakarta Year 1990-2018 (kiloton/year) (FTSL ITB Analysis, 2021)

According to an emission inventory study conducted from 1990 to 2018, the sectors contributing to Jakarta's emission are the energy industry, manufacturing industry, transportation, residential, and commercial. The level of emission from each air pollutant varies. However, they have almost similar sectoral contribution patterns.

The largest NO_x source is transportation, with more than 57% yearly average. Meanwhile, the largest SO_2 emitter is the manufacturing industry at more than 62%, in which their use of fossil fuels such as coal and oil generate the most Sulfur. Particulates, including $PM_{2.5}$ and PM_{10}, are emitted mainly by the transportation

and industrial sectors at more than 46%, where both sectors consume quite significant oil and coal fuels.

Aside from transportation and industry, Breatheasy (BE-2012) study showed that the $PM_{2.5}$ contribution from waste incineration and commercial sectors in Jakarta is significant, at 5% each. In commercial sectors, the study found the use of coal and biomass in food services sectors, including restaurants.

2a Emission Sources by Sectors in Jakarta

According to the Air Pollutant Emission Inventory by Jakarta Environmental Agency in 2020 (using 2018 data), the transportation and industrial sectors are Jakarta's primary air pollution sources. Since Jakarta's rapidly growing economy has helped drive both sectors up, fuel consumption by motorized vehicles has also increased. Furthermore, whether Jakarta residents or commuters own them, all have contributed to the air pollution in Jakarta.

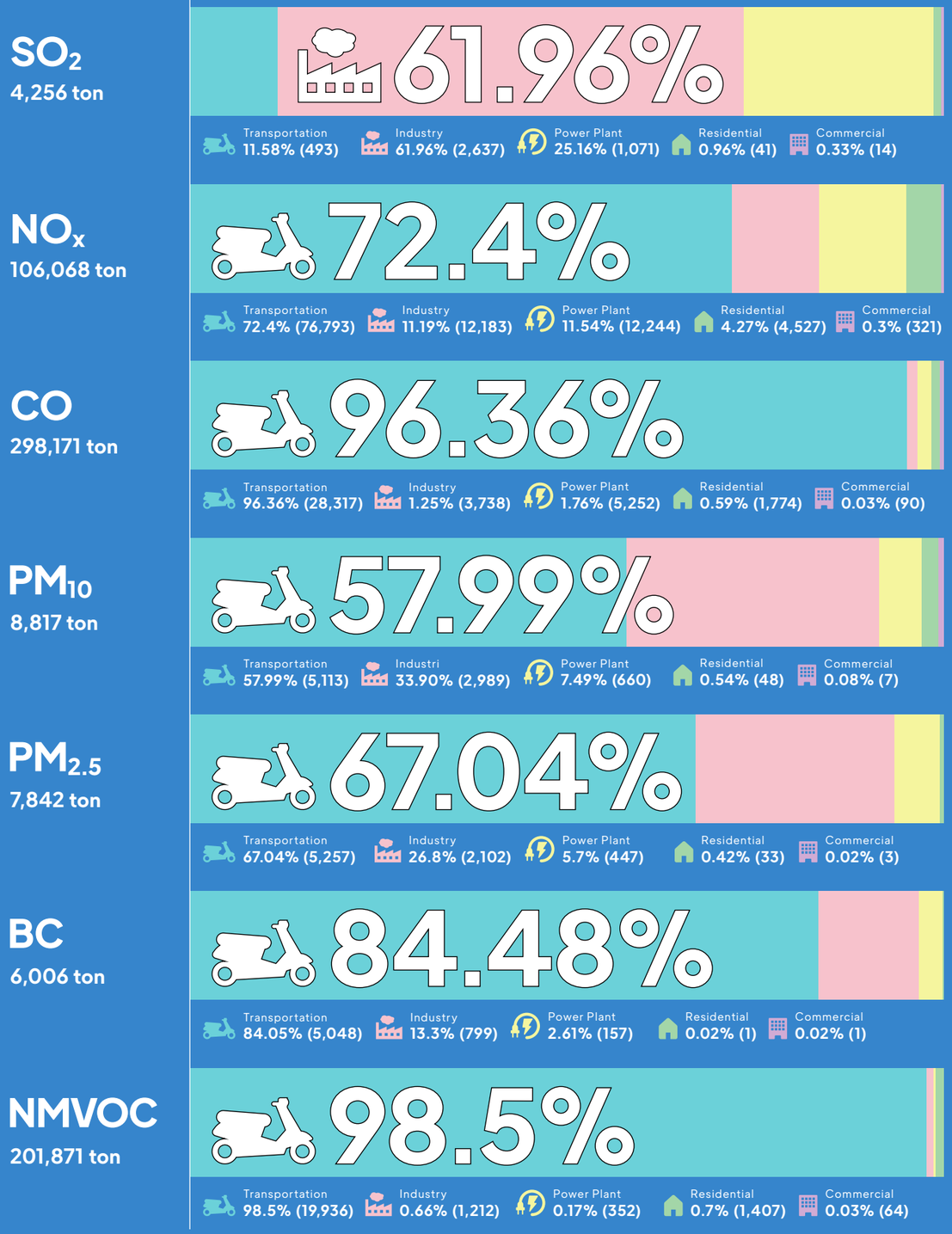
The industrial sector is the second largest contributor to air pollution because most factories in the Greater Jakarta area consume gasoline and diesel fuels to power their electricity and heating. In addition, even though power plants in Jakarta are now using natural gas as their energy source, those in its surrounding area still use coal.

Air Pollution Emission Inventory Result in Jakarta

Emission Levels

Emission
(Emission Total-Ton)

Jakarta Environmental Agency-
Vital Strategies, 2020



3. Jakarta Air Quality in the Past Decade

To measure the air quality in Jakarta, the Provincial Administration utilizes two methods: automatic active monitoring (Air Quality Monitoring System/AQMS installations) and passive sampler. The automatic "Stasiun Pemantauan Kualitas Udara" (SPKUs/Air Quality Monitoring Stations) are located in five strategic positions as marked by the map in Figure 5 and work continuously (24 hours) to measure pollutant concentration. The five locations are representative of land use and administrational area, which are the City Center (City Center/DKI1), commercial area (Kelapa Gading, North Jakarta/DKI2, Lubang Buaya, East Jakarta/DKI4, Kebon Jeruk, West Jakarta/DKI5), and residential (Jagakarsa, South Jakarta/DKI3). Meanwhile, air quality monitoring using the passive method—as per the Ministry of Environment guideline—is conducted in several locations within the five administrative regions and the Thousand Islands (Kepulauan Seribu). Aside from the Environmental Agency's SPKUs, several stations are also in operation under the management of the US Embassy (for Central Jakarta and South Jakarta area), the Meteorology, Climatology, and Geophysics Agency/BMKG (Kemayoran area, Central Jakarta), and the Ministry of Environment and Forestry/KLHK (GBK/Gelora Bung Karno Sports Complex, Central Jakarta).

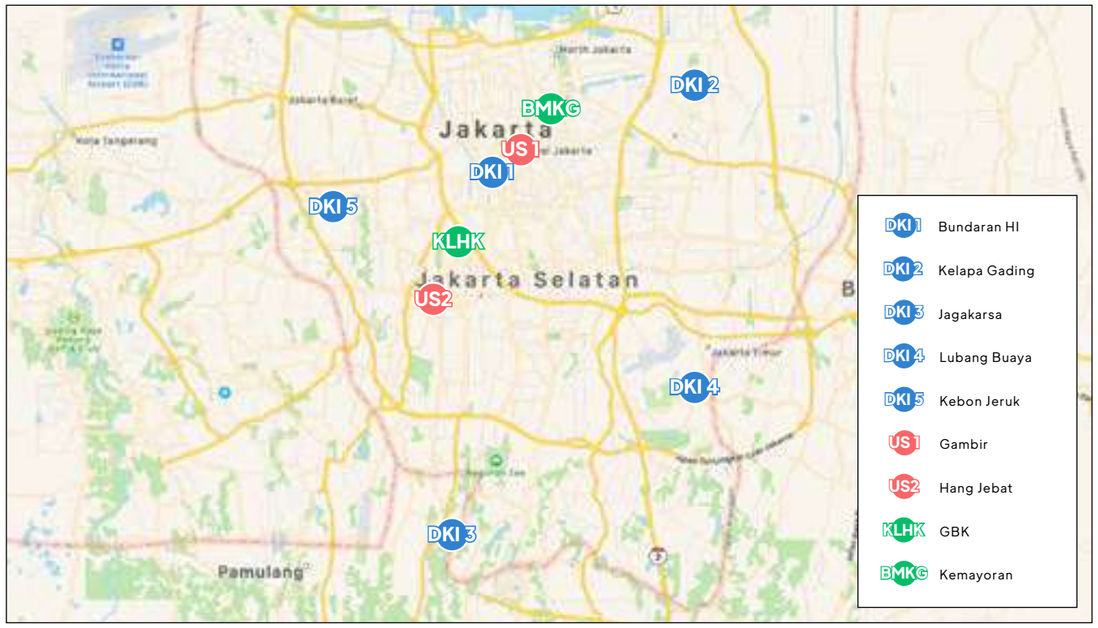


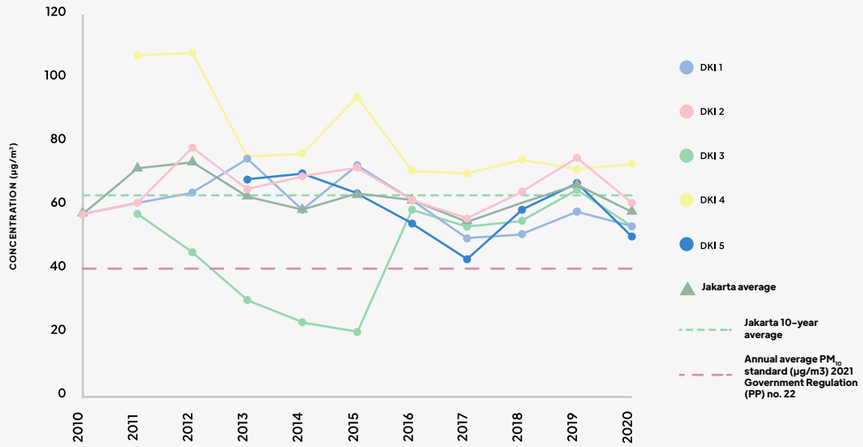
Figure 5. The Locations of the 24-Hours Automatic Air Quality Monitoring Stations (SPKU) Owned by Jakarta Environmental Agency (DLH, 2021)

3a $PM_{2.5}$, PM_{10}, NO_2 and SO_2 trends

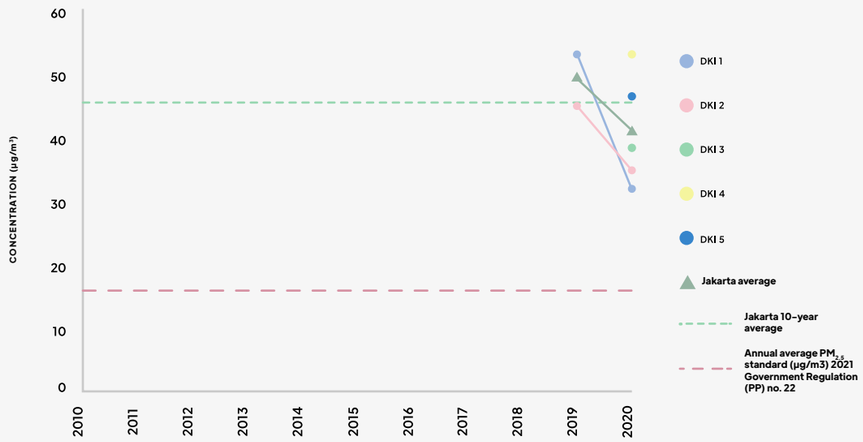
Without realizing it, people have been inhaling dangerous air pollutants, including micro-sized particulate matter (PM). With a name that denotes their respective sizes, the PM_{10} and $PM_{2.5}$ can infiltrate our lungs. The "Indeks Kualitas Udara" (IKU/Air Quality Index) measures particulate matter and other dangerous pollutants. Its parameters include nitrogen dioxide (NO_2) and sulfur dioxide (SO_2).

The data for air pollutants in Jakarta for the past ten years—especially PM_{10} and $PM_{2.5}$ parameters, showed an upward trend even though they are statistically insignificant. The data trend for SO_2 parameters also showed an increase, while NO_2 parameters are slowly declining. Both trends are statistically significant. Figure 6 shows the average concentration of ambient air pollutants in Jakarta.

PM_{10} Annual Average

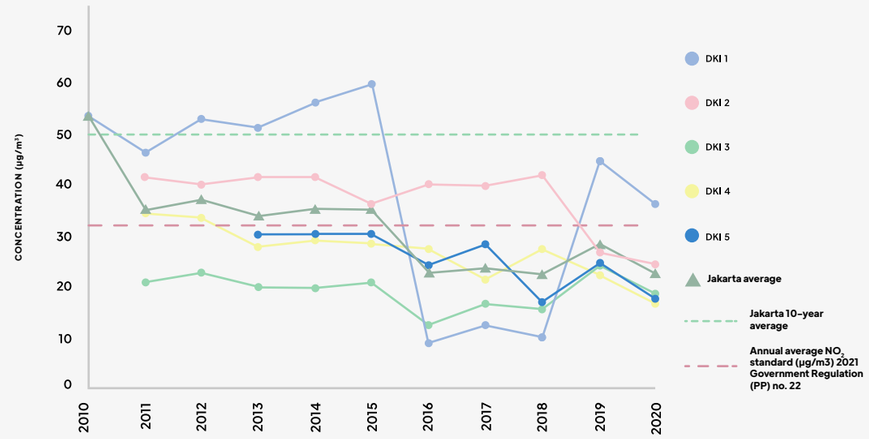


$PM_{2.5}$ Annual Average



* Alat pemantau $PM_{2.5}$ baru dipasang pada akhir tahun 2019.

NO_2 Annual Average



SO_2 Annual Average

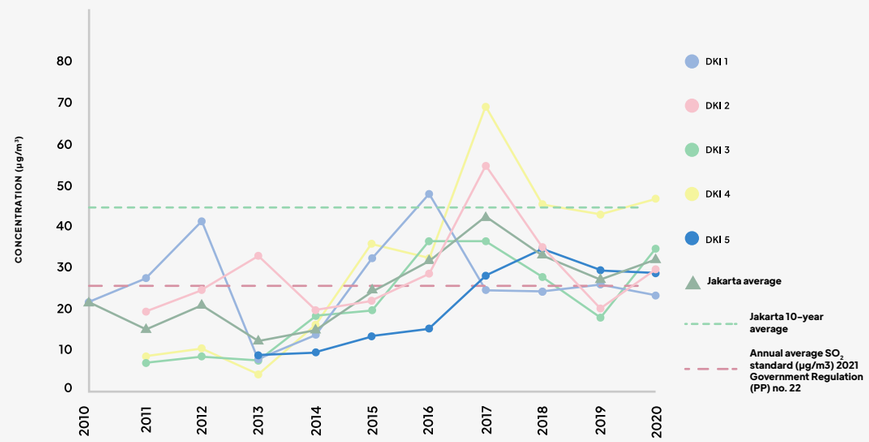


Figure 6. (a) Annual Average PM_{10} Concentration; (b) Annual Average $PM_{2.5}$ Concentration; (c) Annual Average NO_2 Concentration; (d) Annual Average SO_2 Concentration in Jakarta (FTSL ITB Analysis, 2021)

Air Quality in Jakarta for the past decade

- The annual average of PM_{10} and $PM_{2.5}$ concentrations have exceeded the national average standard in all SPKU locations.
- The annual average of NO_x concentration frequently exceeded the national average standard in DKI4 (Lubang Buaya), while SO_2 concentration is often high in DKI2 (Kelapa Gading)
- $PM_{2.5}$ concentration is relatively higher during the dry season (El Niño Southern Oscillation), resulting in a daily concentration that frequently exceeds the average standard. Regardless of activity restrictions during the pandemic.

3b "Indeks Kualitas Udara" (IKU/Air Quality Index) and "Indeks Standar Pencemar Udara" (ISPU/Air Pollutant Standards Index) Trends

"Indeks Kualitas Udara" (IKU/Air Quality Index) as a part of the "Indeks Kualitas Lingkungan Hidup" (IKLH/Environment Quality Index) is mandated as one of the indicators to measure the performance of air pollution control and environmental quality in an area. KLHK is responsible for issuing the IKU and must monitor them at the national, provincial, and municipal levels. The Ministry calculated the IKU using two parameters, NO_2 and SO_2. The IKU trend in Jakarta tended to be stable in 2018-2020 and indexed at 66.69 for 2020.

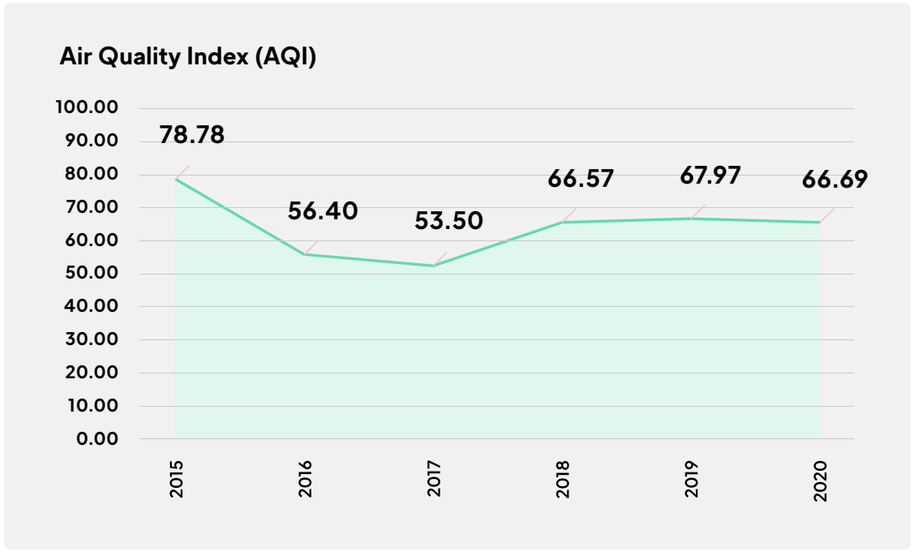


Figure 7. "Indeks Kualitas Udara" (IKU/Air Quality Index) trend in Jakarta (KLHK, 2021)

In contrast to the IKU, the "Indeks Standar Pencemar Udara" (ISPU/Air Pollutant Standards Index) provides information on the daily ambient air quality at the SPKUs based on its impact on human health, aesthetic value, and other living organisms. In 2020, there were more 'Good' and 'Moderate' days and fewer 'Unhealthy' days than the previous year.

ISPU	2014		2015		2016		2017		2018		2019		2020	
	Σ Day	%	Σ Day	%	Σ Day	%	Σ Day	%	Σ Day	%	Σ Day	%	Σ Day	%
Good	12	3%	43	12%	26	7%	43	12%	11	3%	2	1%	29	8%
Moderate	256	70%	258	71%	245	67%	212	58%	140	38%	172	50%	244	67%
Unhealty	89	24%	64	18%	93	25%	110	30%	187	51%	183	48%	90	24%
Very Unhealty	8	2%	0	0%	1	0%	0	0%	27	7%	8	2%	3	1%
Hazardous	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Total	365	100%	365	100%	365	100%	365	100%	365	100%	365	100%	365	100%

Figure 8. "Indeks Standar Pencemaran Udara" (ISPU/Air Pollutant Standards Index) Levels in Jakarta (DLH DKI, 2021)

4. Impacts of Air Pollution

Air pollution has dangerous effects on human health and environmental damage, with implications leading to economic loss.

Particulate exposure, such as PM_{10} and $PM_{2.5}$, is closely related to an increased risk of death or illness. Air pollution can cause various health problems, for example, asthma, lung cancer, stroke, heart diseases, diabetes, and chronic to acute respiratory problems. The smaller the particles, the more they spread from the lungs to other organs, such as the heart, brain, and placenta. The effects of particle infiltrations are chronic illness and death caused by cardiovascular or respiratory diseases, cancer,and diabetes. $PM_{2.5}$ also causes adverse birth outcomes and health problems in children. One of the examples is stunting, which has a potentially damaging and lifelong impact on welfare and productivity. The effects of air pollution on the conditions mentioned earlier were analyzed using Global Burden Disease (GBD) estimates.

In 2016, air pollution had caused more than 6.1 million symptoms of cardio-respiratory diseases in Jakarta, or about 12 symptoms per minute. In addition, it cost an estimated Rp51.2 trillion (USD 3.9 billion) in medical care fees, not including the loss in productivity due to sick leave and premature death.

In 2021, Jakarta Environmental Agency in collaboration with Vital Strategies conducted a health impact assessment on air pollution in Jakarta. The assessment results concluded that air pollution contributed to more than 7,000 ill-health conditions in children, over 10,000 deaths, and more than 5,000 hospitalizations. The estimated annual cost of the health burden is about IDR 41.2 trillion (USD 2,943.42 million), approximately 2.2% of Jakarta's Gross Regional Domestic Product (GRDP).

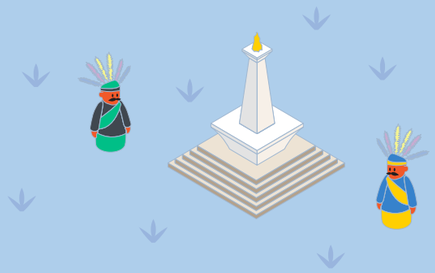
Source: Cost-Benefit Analysis for Fuel Quality and Fuel Economy Initiative in Indonesia. 2013

5. The Main Issues on Air Pollution in Jakarta

1. Until 2020, various organizations have developed their own emission inventory with different purposes and, unfortunately, different inventory sectors. **Therefore, there needs to be a guideline and a database system to determine the priorities for control**.
2. Air quality data monitoring and archiving are very well-managed; Data captures came up to standard; Data quality has been verified and enables long-term trend analysis; **However, the spatial scope is still very minimal, so spatial research for air quality is still needed.**
3. Air quality control needs to focus on the transportation sector as the leading emitter of PM, SO_2, and NO_x **by promoting eco-friendly fuel and reducing personal mobility; and the industrial sector as the top emitter of SO_2**.
4. Planning and policies need to accommodate **the latest regulations, paying specific attention to the evolution of national laws and decrees**.
5. **The importance of multi-sector cooperation** in managing air pollution and compliance with air quality regulations.
6. **The importance of public participation** in air quality management.

Vision

Cleaner Jakarta Air 2030



Missions

1. Transition to clean energy use for transportation and industries
2. Expansion of air monitoring and rendering of emission and air database for policy development and evaluation
3. Increase data utilization by undertaking evaluation and studies

6. Air Pollution Control Strategies

Improvement of Air Pollution Control Governance

1. Improvement of the quality and quantity of sustainable emission inventorization
2. Improvement of air quality monitoring and evaluation system
3. Assessment for air pollution's health, social, and economic impacts
4. Establishment of multi-sectoral working group on Air Pollution Control
5. Development of regulations and policies on Air Pollution Control
6. Surveillance and law enforcement on the violations related to air pollution

Reduction of Air Pollution Emission from Mobile Sources

7. Renewal and development of public transportation fleets and development of environmentally friendly public transportation
8. Implementation of emission test for vehicles
9. Development of low-emission zones
10. Emission control through reducing mobility within the cooperation framework among the government, private sector, and civil society pillars
11. Improvement of connecting infrastructure to public transportation facilities
12. Development of Traffic Engineering Management
13. Improvement of public participation in improving air quality

Reduction of Air Pollution Emission from Stationary Sources

14. Improvement of green open spaces and buildings
15. Improvement of solar panel roofs installation
16. Emission control through environmentally friendly infrastructure
17. Control of air pollution from industrial activities

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