



АГЕНТСТВО МЕЖДУНАРОДНЫХ ИССЛЕДОВАНИЙ

ИННОВАЦИОННЫЕ ПОДХОДЫ К РЕШЕНИЮ СОВРЕМЕННЫХ ПРОБЛЕМ: КОМПЛЕКСНЫЙ АНАЛИЗ И ПРАКТИЧЕСКАЯ РЕАЛИЗАЦИЯ

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ASSESSMENT OF THE IMPACT ON THE AIR ENVIRONMENT BY MOTORBIKE EMISSIONS IN HANOI AND PROPOSED REDUCTION MEASURES

Annotation

Climate change is also a pressing issue not only in Vietnam but also an urgent global issue. Greenhouse gas emissions from motorbikes (especially CO₂) contribute to the greenhouse effect and global climate change. Controlling emissions from motorbikes is part of the national emission reduction effort (NDC) according to the COP26 commitment. According to many studies, motorbike emissions also affect public health. The results of air sample analysis at intersections with many motorbikes show that the average hourly TSP concentration is 364 µg / m³, 1.21 times higher than QCVN (300 µg / m³). In addition, according to the current survey, motorbikes are still the main means of transport for people in Hanoi, the number of motorbikes purchased before 2015 (10 years old) accounts for nearly 1 / 3 of the number of motorbikes moving in the city without being strictly controlled, causing a waste of fossil fuels every year and creating emissions mainly in the current traffic infrastructure. Pollutants from motorbikes cause many diseases such as asthma, pneumonia, cardiovascular disease, lung cancer. The most vulnerable groups are children, the elderly and people with underlying diseases. Research on motorbike emissions in Hanoi is the basis for policy and technology. Emission research also helps to develop emission control policies, such as periodic emission inspection, eliminating old vehicles, encouraging electric vehicles, and vehicles with reduced emissions. It is the basis for developing cleaner engine technology, biofuels, or switching to other more environmentally friendly forms of transport.

Keywords

Emissions, motorbikes, AQI, air pollution, Hanoi.

1. Introduction

Hanoi City is located in the center of the Red River Delta of Vietnam, with a natural area of about 3,344.7 km², ranking in the top 20 largest capitals in the world. As of April 1, 2024, Hanoi's population reached 8,685,607 people, ranking second in the country, accounting for about 8.59 % in Vietnam. Hanoi is currently facing serious air pollution, especially the concentration of fine dust PM_{2.5} often exceeding the permissible threshold. This is the result of the rapid increase in population and means of transport, of which motorbikes account for the majority. With millions of motorbikes operating every day, toxic emissions such as CO, NO_x and HC from motorbike engines are one of the main causes of air quality decline. Motorcycle emissions have a strong impact not only on the environment causing acid rain, soil and water pollution and increasing the greenhouse effect, but also on our own health, increasing the risk of respiratory and cardiovascular

diseases, even the risk of cancer, especially children and the elderly who are the most vulnerable. Excessive motorcycle emissions also pollute the living space, affect the national position, and even directly affect tourism development in Vietnam.

In the context of Hanoi's accelerated urbanization, research and finding solutions to reduce emissions from motorbikes is extremely necessary. This not only helps improve air quality, protect public health but also contributes to achieving sustainable development goals, in line with global trends. In addition, the research also supports the development of effective public policies, promoting the transition to green transportation.

1.1 2. Research methods

2.1 Method of collecting documents

The data collection method used to collect the following data:

- Domestic and foreign documents related to air pollution caused by motorbike emissions, green transport conversion models and applied technologies;
- Documents and data on air pollution levels caused by motorbike emissions in Hanoi;
- Documents related to geographical location, population characteristics and statistics on the number of motorbikes in Hanoi over the years.

1.1.1 2.2 Field survey

- Survey purpose: Monitor the air around the area, measure parameters CO, NO₂, Total suspended dust (TSP), HC and compare with QCVN 05:2023 / BTNMT.
- Monitoring location: Duy Tien - Nguyen Trai - Nguyen Xien intersection, Thanh Xuan, Hanoi city.
- Monitoring time: Measured at 8:00 a.m. and 5:00 p.m.



Figure 1. The positions mind survey close real land

1.1.2 2.3. Sample collection and analysis

a. Sample

* First time

- Monitoring location: Children's Palace Park, near My Dinh bus station, Nam Tu Liem district, Hanoi city.
- Monitoring time: 16:30 - 17:30, April 2025.
- Monitoring parameters: CO, NO_x, HC.

* 2nd time

- Monitoring location: Nguyen Xien - Khat Duy Tien intersection, Thanh Xuan district, Hanoi city.

- Monitoring time: 07:30 – 08:30, April 29, 2025.

- Monitoring parameters: CO, NO_x, HC and Benzene.

* 3rd time

- Monitoring location: Nguyen Xien - Khat Duy Tien intersection, Thanh Xuan district, Hanoi city.

- Time space mandarin Measurement: 07:30 – 08:30, 03 / 05 / 2025.

- The information number mandarin measurement: CO, NO_x, TSP and Benzene

b. Sampling

* Nitrogen Oxide gas sample (NO_x):

- Step 1: Install the sample pump on the stand, ensuring the pump height is 1.5m from the ground.
- Step 2: Place the impingers on the bracket and attach to the pump.
- Step 3: Pour 20ml of solution into impingers 1 and 2, each impinger has 10ml of solution.



Figure 2. Monitoring device for NO₂ and Benzene

* Hydrocarbon (HC) gas sample:

- Step 1: Install the sample pump on the stand, ensuring the height of the pump is 1.5m from the ground.
- Step 2: Use a needle to break the two ends of the activated carbon tube.
- Step 3: Insert the activated carbon tube into the connecting tube in the direction of the arrow marked on the body of the carbon tube.
- Step 4: Install the activated carbon tube into the gas sampling device.
- Step 5: Turn on the pump, set the pump mode with flow rate ≤ 0.2 liters / minute. The suction volume is from 1 liter to 30 liters.
- Step 6: After taking the sample, turn off the pump, remove the activated carbon tube, use a plastic cap to seal both ends of the carbon tube, label the sample and put it in a storage box.
- Step 7: Turn off the machine.



Figure 3. CO monitor and TSP monitor

* Total suspended particulate matter (TSP):

- Step 1: Start the sampling device and record the sampling start time in the record.
- Step 2: Label the sample on the double bag. Sampling time is 1 hour continuously with a flow rate of 500 - 700 liters / minute. After every 10 minutes, record the suction flow of the sampling device.
- Step 3: Finish sampling, turn off the machine and record the end time of sampling in the minutes, record the phenomena recorded during sampling in the field minutes.
- Step 4: Collect and store equipment and tools in containers and record the location, sampling time, meteorological factors, and filter number in the sample history.

* Carbon Monoxide gas sample: Use the displacement method / method of replacing the volume of air available in the bottle with the sampling air.

- Step 1: Add 3ml of distilled water to the bottle.
- Step 2: Use a vacuum cleaner with a dust filter to suck the air through.
- Step 3: Stop drawing in 1ml of absorbent solution into the bottle. Close the cap tightly and record the relevant parameters in the observation log.

c. Sample preservation and transportation:

Store samples in specialized boxes to avoid contact with outside air to ensure QA / QC standards.

+ Nitrogen Oxide (NO_x): according to TCVN 5068

+ Hydrocarbon (HC): according to TCVN 6134:2009, ISO 9486:1991

+ Total suspended dust (TSP): according to TCVN 9468:2012

+ Carbon Monoxide (CO): according to TCVN 5977:2009

1.1.3 2.2.4 Consultation

Using direct consultation method with questionnaire combined with online consultation. Random consultation method combined with systematic consultation sampling. The content of the survey on motorbikes in Hanoi aims to survey the popular motorbike models circulating in Hanoi, the type of gasoline used, the distance traveled and the time of registration to buy the motorbike.

Formula for calculating the number of survey samples to collect:

$$n = \frac{N}{1 + N \times e^2}$$

In there:

- n: size ruler sample need body determined
- N: rule tissue total (total number of motorbikes currently in Hanoi).
- e: error give permission.

According to the statistics of Hanoi Population Department in 2024, Hanoi's population reached nearly 8.5 million people. This is the total to determine the scale:

$$n = \frac{8500000}{1 + 8500000 \times 0.05^2} = 399.98$$

Thus, the minimum sample size required for the study is 400 votes.

3. Results

1.2 3.1 Assessment of current status of air environment in the study area

The results obtained after 3 air quality monitoring sessions are as follows:

Table 1 - First monitoring results

No.	Parameter	Unit	Analytical method	Result	QCVN 05:2023 / BTNMT
				KX01	Average 1 hour
1	TSP	µg / Nm ³	TCVN 5067:1995	173	300
2	CO	µg / Nm ³	HETC / SOP - QTTN - KX03	< 9000*	30000
3	NO ₂	µg / Nm ³	TCVN 6137:2009	114	200

Note:

- QCVN 05:2023 / BTNMT: National technical regulation on air quality (average in one hour);
- (*): The analysis result is less than the method limit.

Data processing:

- $AQI_{CO} = \frac{50-0}{10000-0} \times (9000 - 0) + 0 = 45$
- $AQI_{NO_2} = \frac{100-50}{200-100} \times (114 - 100) + 50 = 57$
- AQI_{TSP} (1 hour) not specified.

$\Rightarrow AQI = 57$

Thus, according to the first monitoring results at Mai Dich - Pham Hung Street Intersection, My Dinh Ward, Nam Tu Liem District, Hanoi City (April 9, 2025), the air quality is relatively clean, the indexes are below the allowable threshold according to QCVN 05:2023 / BTNMT, the total suspended dust index (TSP) slightly exceeds the threshold but the $AQI = 57$: acceptable air level.

Table 2 - Second monitoring results

No.	Parameter	Unit	Analytical method	Result	QCVN 05:2023 / BTNMT
				KX01	Average 1 hour
1	TSP	$\mu\text{g} / \text{Nm}^3$	TCVN 5067:1995	348	300
2	CO	$\mu\text{g} / \text{Nm}^3$	HETC / SOP - QTTN - KX03	< 9000*	30000
3	NO ₂	$\mu\text{g} / \text{Nm}^3$	TCVN 6137:2009	128	200
4	Benzene	$\mu\text{g} / \text{Nm}^3$	NIOSH Method 1501	<18*	22

⇒AQI = 64.

According to the second monitoring results at the Nguyen Xien - Khuat Duy Tien intersection, Thanh Xuan district, Hanoi city on April 29, 2025, in general, the air quality is relatively clean, the indexes are below the allowable threshold according to QCVN 05:2023 / BTNMT, TSP slightly exceeds the threshold, but the AQI = 64: acceptable air level.

Table 3 – Third monitoring results

No.	Parameter	Unit	Analytical method	Result	QCVN 05:2023 / BTNMT
				KX01	Average 1 hour
1	TSP	$\mu\text{g} / \text{Nm}^3$	TCVN 5067:1995	365	300
2	CO	$\mu\text{g} / \text{Nm}^3$	HETC / SOP - QTTN - KX03	< 9000*	30000
3	NO ₂	$\mu\text{g} / \text{Nm}^3$	TCVN 6137:2009	218	200
4	Benzene	$\mu\text{g} / \text{Nm}^3$	NIOSH Method 1501	<18*	22

⇒AQI = 101.8

Thus, through the third monitoring results at the Nguyen Xien - Khuat Duy Tien intersection, Thanh Xuan district, Hanoi city on May 3, 2025, when still subject to external impacts, the monitoring results have characterized the current air status in the inner city of Hanoi.

In general, air quality is not too polluted, the indexes are below the allowable threshold according to QCVN 05:2023 / BTNMT, there are more than the standard thresholds: TSP, NO₂ both slightly exceed the threshold with AQI = 101.8: air level in warning state.

1.3 3.2 Assessment of current vehicle usage

According to the survey results collected in Hanoi, Honda Wave Alpha motorbike accounting for a large proportion, nearly 50 % and the most commonly used gasoline is RON95. On average, on a stretch of road, every 5 minutes there are 820 motorbikes circulating, so in 1 hour there are about 9840 motorbikes moving. This is a large number, reflecting the dense traffic density in inner - city areas, especially during rush hours.

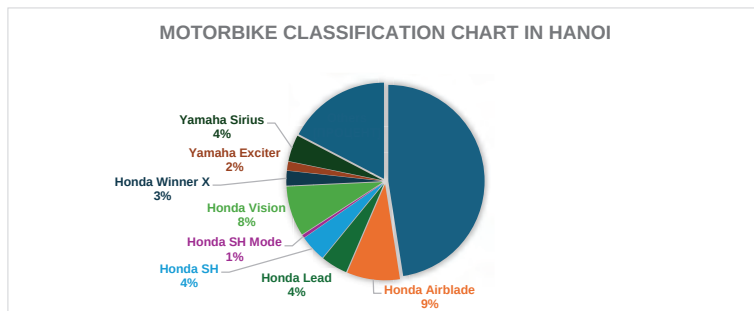


Figure 4. Statistical chart based on survey form of motorbikes circulating

Looking at the chart above, we can see that the motorbikes circulating in Hanoi are currently mainly popular models such as: Honda Wave Alpha (48 %), Honda Airblade (9 %), Honda Vision (8 %), Yamaha (4 %) and other models (accounting for ~ 14 %). Although a large number of vehicles use engines with a compression ratio of less than 9,5:1, which is most suitable for RON92 gasoline, up to 79 % of motorbike users in Hanoi use RON95 gasoline. Using the right type of gasoline for the motorbike's engine compression ratio can optimize fuel combustion, maintain engine life and ensure stable operation. At the same time, using the right type of gasoline suitable for the motorbike engine not only helps reduce fuel consumption but also minimizes the amount of emissions such as: CO, NO_x, HC, fine dust, soot... from the incomplete fuel combustion process in the motorbike engine.

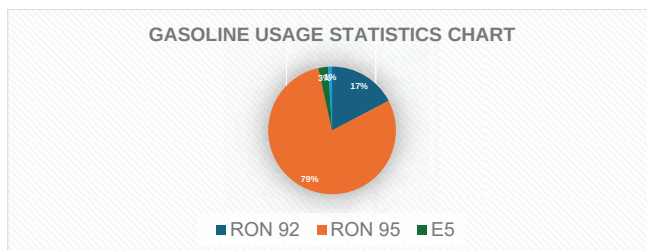


Figure 5. Statistical chart of gasoline types used by motorbikes circulating in Hanoi (April 15, 2025)

Benzene can enter the human body through breathing, swallowing or through skin contact. When breathing air containing high levels of benzene, about 50 % of this gas can be absorbed through the lungs and into the bloodstream. In daily life, almost everyone can be exposed to small amounts of benzene. After entering the blood, benzene is distributed to many different organs and can temporarily accumulate in fatty tissue or bone marrow. The level of benzene's impact on health depends on the duration of exposure as well as the exposure concentration. Inhaling extremely high concentrations of benzene in a short period of time (from 10,000 to 20,000 ppm within 5 to 10 minutes) can be fatal. If the concentration is lower (about 700 to 3000 ppm), the exposed person may experience symptoms such as dizziness, drowsiness, headache, heart rhythm disturbances, hand tremors, confusion and possibly unconsciousness.

1.5 3.4. Proposed solutions

Old motorbikes (over 10 years old) emit toxic gases (CO, HC, NO_x) are higher 4 times than new motorbikes due to degraded engines and outdated exhaust treatment systems. In Germany in 2024, the old vehicle collection program reduced 1 / 3 of CO₂ emissions in the transport sector, combined with a subsidy of 3,000 - 6,000 EUR for those switching to electric vehicles. Or in India, the policy of eliminating old vehicles reduced PM 2.5 emissions by 30 % in Delhi, with a 4,000 - 5,000 INR incentive for those who changed vehicles.

EPR (Extensions Produce Demand) is a policy that ensures product management from design to end - of - life (collection, recycling, treatment), forcing the manufacturer / importer to take primary or material responsibility for the product after it is discarded by the consumer, including collection, recycling or final treatment. The main goal of EPR is to reduce environmental impact through providing a circular economy and sharing the burden of waste management with the government.

In terms of socio - economics, the removal of 1 million old vehicles helps reduce 15,000 tons of CO₂ / year, equivalent to planting 2.5 million trees. Changing the composition of transport means also contributes to stimulating market demand, creating a growth momentum of 10 - 15 % for the motorbike industry, attracting investment in electric vehicles (VinFast, Dat Bike). At the same time, reducing annual average emissions thereby improving human health and quality of life (reducing 30 % of hospitalizations due to respiratory diseases in large cities (according to WHO, 2023).

4. Conclusion

Based on the results of 3 measurements and actual surveys in the Hanoi city area, the ambient air quality has reached a fairly polluted level (ranked at the top of the global pollution list, with AQI = 101 at typical daily times. At hot spots such as the intersection of Khuat Duy Tien and Nguyen Xien streets, TSP can reach up to 364 µg / m³, exceeding 20 % compared to QCVN). Up to now, motorbikes are still the main means of transport for people in the capital, the number of motorbikes purchased before 2015 (10 years old) accounts for nearly 1 / 3 of the number of motorbikes moving in the city without being strictly controlled, causing annual waste of fossil fuels and creating emissions mainly in the current traffic infrastructure. Based on the survey database of 400 motorbikes, it

shows that 72 % of motorbikes are over 10 years old, emitting 2 - 4 times more than new motorbikes. Modelling predicts that removing 500,000 old vehicles would reduce 15,000 tonnes of CO₂ / year, reducing TSP emissions from transport by 30–40 % by 2030.

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ENVIRONMENTAL IMPACT ASSESSMENT OF LAND EXPLOITATION FOR LANDFILL MATERIAL IN QUAN CHU TOWN, DAI TU DISTRICT, THAI NGUYEN PROVINCE

Annotation

Economic development is an inevitable need of each locality and country. To meet the demand for landfill materials for constructions in Thai Nguyen province, as well as create jobs and stable income for local workers as well as develop the socio - economy; contribute to increasing the State budget through paying taxes and prescribed fees, land

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