Air Quality Report

Air quality in Vietnam in 2017

GreenID is a member of the Vietnam Sustainable Energy Alliance
EXECUTIVE SUMMARY

Air pollution is likely to have a major impact on human health in Vietnam. Serious air pollution has increased rapidly in major cities and is now a major concern in a number of areas. According to data from the MONRE’s automatic monitoring stations, both Ho Chi Minh City and Hanoi have experienced an increase in the number of days with the airborne dust concentration measurements in excess of government standards. In response to this situation, government, organizations, and individuals have made numerous efforts to improve air quality. In June 2016, the Government of Vietnam released the “National Action Plan for Air Quality Management Until 2020”. This plan is designed to improve air quality and ensure people’s well-being through controlling emissions and monitoring air pollution. As part of this plan, an additional 70 air quality monitoring stations will be installed throughout Hanoi.

To contribute to these efforts, GreenID publishes periodic reports on air quality to raise public awareness and contribute solutions and initiatives for air quality improvement. This report is one of GreenID’s efforts to build and maintain a public database for the community. Previous GreenID reports have documented the sources of pollution, explored the effects of pollution on public health, and analyzed changes in air quality for different time periods in Hanoi and Ho Chi Minh City. These reports have also covered challenges in air quality management, compared Vietnamese laws and standards to other countries, and assessed the implementation of air quality policy in Vietnam.

In 2017, GreenID continued to report on air quality, offering opinions and analysis from experts and media outlets. GreenID has also analyzed problems with Vietnamese air quality control and regulation.

Indoor air quality was also analyzed, guidelines and information on indoor air pollution were issued, and suggestions for reducing indoor air pollution, such as the use of air purifiers, were offered.

This report is a summary of current information and opinion on air quality, and was compiled using current literature, data analysis, modeling, online public surveys, and expert interviews. Some of the key findings include:

1. Particulate concentration in 2017 in Hanoi was a serious concern. While PM2.5 concentration levels remain high, overall air quality is higher than in 2016. Air quality in Ho Chi Minh City is better than in Hanoi; however, pollution levels have increased slightly from 2016.

2. PM2.5 levels in Hanoi exhibit strong seasonality, with winter months (November-February) having higher levels than summer months. In contrast, average pollution levels on different hours of the day vary relatively little. An analysis of the four days with the lowest air quality between November 2017 and the end of December 2017 was performed. On each of these days, PM2.5 levels exceeded 100µg/m³. After revealing that in three out of the four days nearly all of the polluted air masses passed through Quang Ninh, an area which is likely to have the highest levels of industrial air pollution in Vietnam, the study concluded that Quang Ninh has a major influence on Hanoi air pollution.

3. PM2.5 pollution levels in Ho Chi Minh City exhibited a strong hourly variation, but relatively little seasonal variation. PM2.5 pollution level spikes were associated with movement of air masses down the coastline, accumulating pollutants from cities, vehicles, power plants and industrial facilities in the area. The inland region the the south-southwest of Ho Chi Minh City was...
also identified as a significant regional source of air pollution.

4. Air quality management in Vietnam has not been properly addressed. Specific regulations, policies, and guidelines on air quality control are still largely lacking. An overall assessment of current air quality is not available due to insufficient monitoring data.

5. Vietnam’s air quality standards pertaining to emissions and ambient air quality are low compared to international standards.

6. Public interest in air quality is high; however, public knowledge of air quality is very low. For example, most Vietnamese people are not familiar with terminology such as AQI - Air Quality Index. The public is also largely unaware of temporary and effective measures that can be taken to minimize the effects of air pollution, such as the use of specialized respirators or home air purifiers. Such measures have yet to be applied on a significant scale.

To ensure a more comprehensive summary of air quality in Vietnam, more air quality monitoring stations should be established and hourly historical data should be provided. Therefore, GreenID recommends more action and support from Government Ministries, international partners, and other organizations in Vietnam to develop a better and more comprehensive understanding of current air quality in major cities throughout Vietnam. There are a number of actions which can be taken now to address the issue of air pollution. GreenID has the following recommendations:

• Focus on addressing the sources of pollution
• Develop effective policies for air quality control
• Strengthen existing policies on air quality
• Greater enforcement of existing policies and regulations
• There should be specific laws addressing air pollution control
• Adopt international standards for emissions and ambient air quality
• Greater emphasis should be placed on renewable energy, industrial emissions control, urban planning, and transportation
• Develop a public relations campaign to encourage community actions, raise public awareness and promote a healthy environment
There are many factors that determine air quality. Although pollutants play a major role in determining air quality and pollution levels, other factors also have an effect:

- topography, such as mountains and valleys
- weather, such as wind, temperature, air turbulence, air pressure, rainfall and cloud cover
- the physical and chemical properties of pollutants
- the amount of exposure to pollutants
- the weather conditions

Poor air quality can result from a combination of factors. Regional air quality is affected by how air behaves as a result of the interaction of topography and weather, and by the emission sources themselves.

Weather, Wind and Geography

Once pollutants are emitted into the air, the weather largely determines how well they disperse. Turbulence mixes pollutants into the surrounding air. For example, during a hot summer day, the air near the surface can be much warmer than the air above. Sometimes large volumes of this warm air will rise to great heights. This results in vigorous mixing.

Wind speed also contributes to how quickly pollutants are carried away from their original source. However, strong winds don’t always disperse the pollutants. They can transport pollutants to a larger area. For example, smoke from open burning or forest fires often travels in this way.

The level of diffusion depends very much on atmospheric stability. The atmospheric stability is classified into six levels: A, B, C, D, E, F in order of decreasing atmospheric stability, meaning decreasing diffusion. Transport and diffusion rates are very weak when the wind speed is weak and there is a high temperature rise (in the case of heat). At the same time, pollutants emitted near the ground will not be diluted, radiation to the surrounding environment can lead to increased concentrations of pollutants leading to air pollution. This sometimes happens in northern Vietnam during the winter season.

Emission Sources

Pollutants are classified into two categories: point and nonpoint sources. Point source pollution comes from a single source, whereas nonpoint source pollution comes from many different sources. These sources can be either natural or human made. The number and size of emission sources in each area, along with weather conditions and topography, determine the level of pollutants in the air within an airshed.

Many pollutants undergo chemical reactions when they encounter other pollutants in the air. The products of these chemical reactions are called secondary pollutants, as opposed to primary pollutants, which are emitted directly into the atmosphere. Ground-level ozone is an example of a secondary pollutant that forms when nitrogen dioxide (NO2) and volatile organic compounds (VOCs) mix in the presence of sunlight.

### Air Quality Index (AQI)

The AQI (Air Quality Index) is an index for reporting daily air quality established by the U.S. Environmental Protection Agency. The AQI focuses on health effects that public experience within few hours or days after breathing unhealthy air. The AQI is calculated for four major air pollutants regulated by the U.S. Clean Air Act and mentioned above. To make it easier to read and understand the AQI is divided into six levels of health concerns. More information: www.airnow.gov

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**PM** stands for particulate matter: the term for a mixture of solid particles and liquid droplets found in the air. Particle pollution includes: PM10: inhalable particles, with diameters that are generally 10 micrometers and smaller; and PM2.5: fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller.

**AIR** is a gaseous mixture of about 78% nitrogen, 21% oxygen, and less than 1% of argon, carbon dioxide, and other gases. Air is invisible and odorless. Adults breathe about 10-20 cubic meters of air every day. Children breathe almost twice that amount.
AIR QUALITY IN URBAN VIETNAM

Brief on current status

According to the National Environmental Status Report (MONRE, 2017), most of the major cities in Vietnam are facing an increase in pollution levels, especially particulate levels. Monitoring station data collected between 2012 and 2016 indicated that dust concentration levels in urban areas remain high and that these levels show no signs of reduction in the last 5 years. In Hanoi and Ho Chi Minh City there has also been an increase in the number of days each year with daily average PM2.5 and PM10 levels in excess of national requirements on ambient air quality.

Air Quality Report 2016, published by GreenID, provided general information for the public on air pollution and related issues. In this report, GreenID analyzed data on PM2.5 and AQI collected from air monitoring stations located at the U.S. Embassy and Consulate offices in Hanoi and Ho Chi Minh City. The results showed that air quality in Hanoi in 2017 was considered unhealthy, with daily average PM2.5 levels of 50.5 µg/m³, which is 2 times higher than Vietnamese regulations and nearly 5 times higher than WHO guidelines. AQI levels were considered unhealthy by international standards, meaning AQI rating exceeded 100, on 209 days. The first and last quarters of 2016 saw the greatest number of unhealthy days. In 2016 an analysis of the high pollution episodes in Hanoi indicated that in 7 out of the 8 episodes, predominant wind direction was from the East, indicating that upwind sources east of Hanoi, particularly the large industrial sources, were likely to be major contributors to air pollution in Hanoi.

Air quality in Ho Chi Minh City was still stable and better than Hanoi, with the U.S. Consulate in Ho Chi Minh City recording a daily average PM2.5 of 28.3 µg/m³. According to international standards, average daily AQI was considered “healthy” about 75% of the year.

Data and research reports indicate that air pollutants in Hanoi and major urban areas include:

- Transportation, such as cars and motorbike
- Construction, especially highrise buildings and large apartment complexes
- Industrial activities
- Household emissions
- Burning of garbage and agricultural waste
- Outside sources

A complete assessment of air quality in major cities requires more data. There should be more monitoring stations installed in Hanoi. There are currently about 13 automatic monitoring stations in Hanoi, including 1 managed by the Center for Environmental Monitoring, 10 managed by the People’s Committee of Hanoi (consisting of 2 automatic monitoring systems and 8 sensor stations), 1 managed by U.S. Embassy and Consulate office, and 1 observation post at the United Nations International School of Hanoi. In order to improve the collection of monitoring data, GreenID recommends the government adopt policies to encourage individuals, organizations and other stakeholders to invest in scientific monitoring equipment.
**PARTICULATE MATTER**

*Air Quality Index in Hanoi and Ho Chi Minh City*

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### Data availability

The Ministry of Natural Resources and Environment (MONRE) measures the main pollutant in some cities (Viet Tri, Ha Long, Hanoi, Hue, Da Nang) by having one stationary system for each city. Some provinces also self-invest in automatic air monitoring stations such as Dong Nai, Vinh Phuc, Quang Ninh, Hanoi. Since January 2017, Hanoi People Committee also published the AQI data of their 10 monitoring stations. The data are available online and accessible for public. However, until now, MONRE and Hanoi’s People Committee does not provide a historical data on an hourly based and public to download online. The U.S. Embassy in Hanoi (No.7 Lang Ha street) and the U.S. Consulate in Ho Chi Minh City (No.4 Le Duan street) are measuring the PM2.5 concentrations on an hourly base and provide public access to the historical data under its Air Now program. Besides, some institutions such as United Nations International School of Hanoi share their measurement results with public mainly focusing on AQI. A limited amount of private initiatives gives online access to their hourly data. Thus, an analysis of air quality is not available for the entire country. However, by covering Hanoi and Ho Chi Minh City, the available data and the analysis is still relevant for almost 16 million inhabitants equal to around 18% of Vietnam’s population. GreenID together with its partners form the Vietnam Sustainable Energy Alliance (VSEA) is working on a wider coverage in the country to provide a comprehensive picture of Vietnam’s air quality for the future. Furthermore, the data availability for Ozone (O3), Nitrogen dioxide (NO2), Benz[a]pyrene (BaP) and other pollutants such as Sulphur dioxide, carbon monoxide, toxic metals and benzene is not given yet. The historical track record for each of this pollutant is measured by MONRE but is not accessible to the public so far. Therefore, this report focuses on particulate matter concentration and AQI\(^1\) for Hanoi and Ho Chi Minh City, using data from these two air monitoring device of GreenID in some locations of Hanoi in order to give a more comprehensive picture about the particulate problem in Hanoi. Furthermore, cross-sectional data were collected from at least five sites with high population density and means of transport to provide timely warning evidence. Although we do not confirm that the data obtained is fully representative of the city-wide air quality, we still expect more air monitoring station to be established and hourly historical data needs to be provided. However, this report can give a warning about the air quality in the two most important cities of our country, and air pollutants can spread within a city is easy to notice.

### National regulation compared with international limits

The National Technical Regulation on Ambient Air Quality (Gov. Vietnam, 2013) sets limit values for both short-term (24 hours) and long-term (annual) PM10 and PM2.5 concentrations. Compared to international standards such as the EU Air Quality Directives (EU, 2004; EU, 2008) or air quality guidelines set by WHO (AQGs), Vietnam’s air quality regulation for PM (Table 1) are comparatively low. Regarding PM10, the WHO and EU standards are three times lower than the ones in Vietnam. However, the recommended WHO AQGs should be considered as an acceptable and achievable objective to minimize health effects. However, for economic development purpose, it may initially be acceptable to use this level of quality.

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\(^1\) This report use the US EPA method to calculate AQI.
According to data from the US embassy’s monitoring station, particulate levels in Hanoi remained high in 2017. The annual average PM2.5 concentration reached 42.68 μg/m3, which exceeds the limit established in the National Technical Regulation on Ambient Air QCVN 05/2013-BTNMT of 25 μg/m3, and is about four times higher than the WHO guidelines.

In 2017, there were 99 days in which average PM2.5 concentrations in 24 hours exceeded the daily National Regulation of 50 μg/m3. In this same period, WHO guidelines were exceeded on 275 days. Days with high concentration of PM2.5 were concentrated in the first and fourth quarters of 2017. December had the most days with PM2.5 levels in excess of national and WHO guidelines. In December, national guidelines for PM2.5 were exceeded on 24 days; WHO guidelines were exceeded on 31 days.

Hourly average concentration of PM2.5 peaked at 10 a.m. on 15 February 2017 with values of 234 μg/m3 and a max AQI of 284 (very healthy, table 2). This was followed by 26 December 2017, which saw a peak PM2.5 of 230.7 μg/m3 and a max AQI of 280 (very unhealthy).

The national limit of PM2.5 concentration is 50 μg/m3. Based on hourly analysis, there were 124 hours where this limit was exceeded by more than 3 times (150 μg/m3 or above), and 660 hours where the limit was exceeded by more than 2 times (100 μg/m3 or above).

In fact, according to US EPA, the AQI would be calculated base on 24hr average PM2.5 concentration. That means, at least after 24hr, we have enough data for AQI formula. Thus to give a timelier warning, US EPA calculates a temporary 2.5 “PM” dust concentration to generate an AQI warning hourly at the time of measurement.

PM2.5 remains high. Days with the lowest air quality tend to concentrate in the first and fourth quarter of the year. This concentration may be due to the effect of weather conditions during summer and winter on the spread and diffusion of air pollutants. During winter, Hanoi is affected by the northeast monsoon and strong northeast wind currents that are believed to carry pollutants and dust from industrial parks in the northeast to Hanoi.

According to data gathered at monitoring stations, PM2.5 pollution levels are the lowest in Tran Thai Tong (Cau Giay), with an average PM2.5 of 37.9 μg/m3 and average AQI of 97.7, placing the air at moderate pollution levels. Air quality was considered good about 65% of the time. Air quality was considered very unhealthy about 0.2% of the time.

In other measurement points, such as To Hieu (Ha Dong), Phuong Dinh (Thanh Xuan) and Cau Dien, air quality was considered the good approximately 20% of the time. In Hoang Dao Thanh, air quality was classified as very unhealthy up to 17% of times measured.

When compared to the stricter WHO guidelines, there were 2400 hours with PM2.5 levels in excess of 2 times the recommended limit.

AQI is divided into 6 levels relating to health impacts. In 2017, the AQI recorded at the US Embassy monitoring station was 103 (unhealthy for sensitive groups). Data from 2016 and 2017 were compared to track changes in the air quality year-on-year, and an analysis of the hourly averages was performed. Although overall air quality in Hanoi in 2017 was considered unhealthy, there was some improvement when compared to 2016. In 2016, unhealthy hours (AQI in excess of 100) were recorded 29,8% of the time, whereas, this figure decreased to 20.7% in 2017. In 2016, hours of moderate or good air quality were recorded at 36.2%, while in 2017 this figure increased to 55.6%.

In a nutshell, although there are signs of improvement compared to 2016, the quality of air in Hanoi in 2017 is still considered unhealthy, and the concentration of

**Overview on air quality in Hanoi in 2017**

<table>
<thead>
<tr>
<th>Category</th>
<th>2017 Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>April</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
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<tbody>
<tr>
<td>Average AQI</td>
<td>103</td>
<td>136</td>
<td>122</td>
<td>113</td>
<td>102</td>
<td>88</td>
<td>74</td>
<td>67</td>
<td>74</td>
<td>86</td>
<td>103</td>
<td>129</td>
</tr>
<tr>
<td>Level of AQI</td>
<td>Unhealthy for sensitive group</td>
<td>Moderate</td>
<td>Unhealthy for sensitive group</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Average PM2.5 concentration</td>
<td>42.6</td>
<td>66.1</td>
<td>52.5</td>
<td>44.9</td>
<td>36.8</td>
<td>30.3</td>
<td>24.9</td>
<td>21.3</td>
<td>24.4</td>
<td>30.2</td>
<td>44.9</td>
<td>61.3</td>
</tr>
<tr>
<td>Number of days violating QCVN</td>
<td>257</td>
<td>29</td>
<td>26</td>
<td>23</td>
<td>26</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>14</td>
<td>17</td>
<td>20</td>
<td>26</td>
</tr>
<tr>
<td>Number of days violating WHO</td>
<td></td>
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</tr>
</tbody>
</table>
In 2017, in Ho Chi Minh City, the annual PM2.5 concentration reached 29.6 µg/m³, exceeding the National Regulation limit of (25 µg/m³ for PM2.5, and 3 times higher than the WHO guideline of 10 µg/m³). In 2017, PM2.5 levels were in violation of Vietnamese regulations on 14 days, roughly 4% of the time, compared to 85 days in Hanoi. However, there were up to 222 days in which WHO air quality guidelines for PM2.5 were exceeded.

The hourly average concentration of PM2.5 peaked at 10 a.m. on 17 December 2017 with values of 94.9 µg/m³ and AQI of 171 - very unhealthy (table 4). There were 124 hours which had hourly average PM 2.5 concentration levels at least three times higher (150 µg/m³ or above) and 660 hours at least 2 times higher than Vietnamese National Requirement (50 µg/m³).

Air quality in Ho Chi Minh City compared favorably to air quality in Hanoi, with measurements falling within acceptable limits more than 70% of the time. We also compared the air quality index in Ho Chi Minh City in 2017 to 2016 to estimate the trend of change. In contrast to Hanoi, air quality in Ho Chi Minh City decreased during this time. In 2017 air quality was considered "unhealthy" about 28% of the time, amounting to an increase of about 3% from 2016.
ANALYZING THE SOURCES OF AIR POLLUTION EPISODES IN HANOI AND HCMC

In Vietnam and in other countries, urban air pollution episodes are generally the result of a combination of locally emitted air pollutants and pollutants transported from areas outside the city with moving air masses. One indicator of the importance of regional sources is that the highest PM2.5 peaks in the second half of 2017 did not take place during completely still conditions, but during slow winds, as was the case the case for Hanoi.

To understand the sources of high air pollution episodes in Hanoi and HCMC, the highest air pollution peaks in the second half of 2017 were selected for analysis. For comparison, the times with lowest air pollution concentrations were also analyzed. The analysis is carried out using the U.S. NOAA HYSPLIT model (v. 5.4, January 2017). The model uses global meteorological data to predict the 3-dimensional trajectories of air masses over time. Importantly, the model can be run in so-called ‘back trajectory’ mode to trace the movement of air masses back in time from an observation point, enabling the user to identify the origin of air masses arriving in a city or other location at a specific time. The model is commonly used in scientific literature to identify the likely origins of observed pollution. GDAS meteorological data in 0.5-degree horizontal resolution was used for the analysis.

The trajectories were overlaid with maps of estimated PM2.5 emissions (in tonnes per year) from the EDGAR emission database (v4.3), and with the locations of operating coal-fired power plants, to identify areas likely to contribute to the episodes. The trajectories were overlaid with maps of estimated PM2.5 emissions (in tonnes per year) from the EDGAR emission database (v4.3), and with the locations of operating coal-fired power plants, to identify areas likely to contribute to the episodes. In the trajectory plots, the arrowheads are plotted every three hours, with the distance between the arrows indicating wind speed. When an air mass spends a longer time moving over an area, it will accumulate more pollution from that area. This analysis highlights the importance of addressing both local and remote upwind sources, requiring regional co-operation, and points out the most important remote sources of air pollution to address to improve air quality in Vietnam’s major cities.

HANOI

PM2.5 pollution in Hanoi exhibits strong seasonality, with winter months (November-February) being more highly polluted than summer months. In contrast, average pollution levels on different hours of the day showed relatively little variance. Hanoi experienced a number of occasions where PM2.5 levels exceeded 100ug/m3 for multiple days in a row. To identify the source regions contributing to these episodes, the most serious episodes in November-December 2017 were selected for analysis and the HYSPLIT backward trajectory model simulation was carried out for each 3-hour period during these episodes. These results were compared to model simulations for all relatively clean 3-hour periods with PM2.5 levels below 25ug/m3 in November-December. Hanoi is surrounded by dense rural and urban populations in the southeast, and Vietnam’s largest concentration of power plants and industrial facilities lies approximately 100 km to the east of the city. The EDGAR emissions database identifies the delta area to the southeast as a major source of residential fuel-burning emissions, while both the EDGAR emissions database and analysis of NASA OMI satellite imagery show that the industrial cluster in Quang Ninh is the largest hotspot of NO2 and SO2 emissions in Vietnam, and a major source of PM2.5 emissions. NO2 and SO2 emissions contribute to the formation of secondary PM2.5 (nitrate and sulfate aerosols, respectively), which play an important role in air pollution episodes. In three of the four analysed high pollution episodes, almost all of the polluted air masses passed through the Quang Ninh area, while none of the ‘clean’ air masses analysed passed over that area. This indicates that emissions from Quang Ninh, a major industrial center and significant source of industrial emissions, may have a significant impact on air quality in Hanoi. Most ‘clean’ air masses were associated with high winds arriving from the sea or from remote parts of Yunnan in China and not affected by major pollution source regions in Vietnam.

The episode occurring from November 28-30 appears different from the other three episodes in that it was associated with a very stagnant local air mass that accumulated pollution from the urban area and immediate surrounding areas.

HCMC

PM2.5 levels in Ho Chi Minh City varied widely according to hour of the day, but exhibited relatively little seasonal variation. The city regularly experiences PM2.5 peaks lasting several hours with concentrations above 75ug/m3; however, multi-day episodes are rare. All PM2.5 peaks above 75ug/m3 were selected for analysis, with 3-hour periods with PM2.5 level below 10ug/m3 analyzed for comparison. Besides the HCMC area itself being a significant hotspot of transport and industrial emissions, the coastline to the north is characterized by dense population and significant residential, transport, and small industry emissions. The area to the south of the city has a large rural population with both residential and transport emissions being important. There are two large coal-fired power plant sites, one to the northeast and one to the south of the city, and a smaller power plant immediately to the east. The majority of the analyzed PM2.5 peaks was associated with air masses traveling down the coastline, accumulating pollution from other cities, transportation, power plants, and industrial facilities in the area. The other important source region was the inland region to the south-southwest of Ho Chi Minh City. Clean air masses were generally fast-moving air masses arriving from the south, with little time to accumulate pollution from land areas.

This analysis emphasizes the importance of controlling pollution in the immediate vicinity of Ho Chi Minh City, such as Bien Hoa and Binh Duong, as well as on the coastal areas in places like Ba Ria-Vung Tau to the north and the rural inland areas to the south.
DIFFERENT PERSPECTIVES ON AIR QUALITY

PhD. Hoang Duong Tung
Former Deputy Director of General of Environmental Department

According to published data from the automatic observation stations, there was an increase in the number of days with PM2.5 and PM10 average daily dust concentrations in excess of the ambient air quality standard QCVN 05 in both Hanoi and Ho Chi Minh City. This shows that the air pollution in these two cities is worrying, requiring special attention before it is too late. In order to determine the sources of pollutants, it is necessary to carry out more research on emissions. A plan of action should be developed to set priorities for the upcoming years. In recent years, a number of policies and regulations have been issued to strengthen the management and control of emissions and improve air quality in Vietnam. Many solutions have been applied to improve air quality, especially in Hanoi and Ho Chi Minh City. However, there are still many challenges for the coming years and there is a need for stronger measures.

Doctor Le Ngoc Huy
Department of Chronic Lung Diseases, Central Lung Institute

As a doctor specializing in the respiratory system, I feel very worried about the quality of the air in Hanoi. Air pollution has serious effects on human health, and causes respiratory disease and heart disease. Studies show that there is a connection between air pollution and respiratory disease, especially diseases such as asthma and bronchopulmonary dysplasia, and lung congestion and blockage. It causes an increase in the number of people hospitalized for these diseases and increases the risk of death. Air pollution also causes cardiovascular diseases like hypertension and stroke. Air pollution has the greatest impact on children and the elderly. A report on chronic obstructive pulmonary disease in 2017 (GOLD COPD 2017) demonstrated that exposure to SO2 and PM2.5 caused respiratory impairment in young children and reduced respiratory function.

Dr. Le Viet Phu
Fulbright University Vietnam
Author of “Estimating health and economic effects of air pollution: a case study of HCMC”

There is a dynamic relationship and two-way causality between pollution and economic growth, especially in certain economic periods, which results in more serious pollution, and more serious pollution has severe economic impacts on future growth. For example, in slow developing countries, increased use of fossil fuels, industrialization, transportation, mining and construction contribute significantly to economic growth. These industries are also the most polluting sectors, including for air pollution. As the economy shifts from manufacturing to services, heavy polluting industries are gradually replaced. It proves that pollution is a consequence of economic growth in certain periods. However, this does not mean that every country should grow at all costs and expect pollution to automatically decrease in the future when the economy has surpassed the high-income threshold. The problem is how to balance the current needs for economic growth and the damage it causes to the environment. The assumption that current resource-based economic growth in Vietnam has ensured economic restructuring and environmental protection needs to be tested. There is evidence that air pollution has increased sharply, resulting in major economic losses. But solutions to reduce pollution and environment damages, as well as the potential for implementation, do not have enough scientific evidence. For example, there is a ban on motorcycles in urban areas of Addis Ababa, Ethiopia, and only cars are allowed, but banning the motorcycles is not the answer to the problem of air pollution.

Over 90% of major economic losses like health problems, illness and premature death, are mainly caused by air pollution. Losses in property or production capacity are difficult to estimated due to the non-market value of pollution. Other damages include indirect damage related to acid rain (impacts on property and the ecosystems), devaluing landscapes and property in polluted areas. Total economic cost is significant, from 5-7 percent GDP in 2013.

In terms of solutions, economic solutions are very important, but there is a need for a better vision and more transparency, for example in raising the price of polluting goods such as electricity from fossil fuels, or gasoline taxes. The policy on electricity prices and the development of renewable energy sources also needs to be reformed. Vietnam remains dependent on coal power (low cost but high pollution) due to its unreasonable retail electricity tariff policy, which is too low compared to other countries. The evolution in electricity price requires huge changes from the institution and from the role of state-owned enterprises. Corporate social responsibility (e.g EVN) is inherently counterproductive and entails major implications for the economy.

The role of community and society is also important. There are solutions that cannot be used for macro-level regulatory tools, such as traffic, or saving behavior. Community involvement in action programs, or other solutions (car sharing, public transportation) has contributed to individual savings and to the whole society in general.
In December 2016, when the topic of air quality in Vietnam appeared on the media, GreenID conducted an online survey and collected public comments. Recently, air pollution has become a hot topic, attracting the attention of government, society and the community. In order to continue collecting information related to this topic, in January 2018, GreenID conducted another online survey consisting of twelve questions on air quality and the environment.

Over a two weeks’ period, we received nearly 1,000 responses. Approximately 24.6% of respondents had participated in the first survey in 2016. Most of the participants live in the South (95.4%), the rest are foreigners living in Vietnam. The number of participants living and working in Hanoi was 62.1%, while 29.7% of participants lived in Ho Chi Minh City, and 8.2% lived in other provinces.

Data analysis showed that the proportion of people who have concerns about air quality is very high (99%). This number was the same in the first survey in 2016. When asked about their personal feelings about air quality, 73.7% thought that the air quality in their place had declined in the past three years. A majority of participants, 63.6%, were not satisfied with the quality of the air. However, compared to results from the first survey (85.6%), this was an improvement.

Most participants said they had not been fully informed about air quality issues, about 24.6% did not have access to any information regarding air quality (this rate was only 17% in the 2016 survey). The percentage of people who reported that they were provided with information but did not get enough decreased from 68.1% in 2016 to 67.3%.

Still, a large portion of participants were unaware of the AQI: 43.1%, down from 48.3% in 2016. While a small number of people were aware of the AQI, most were unaware of specific actions to prevent pollution exposure. Only 12% observed AQI regularly, while the rest observing AQI occasionally or never. 92.2% of respondents were aware that poor air quality is a major factor in their health and wellbeing. The percentage of people who believe that respiratory illnesses has increased over the past three years is 57.2%. However, measures to avoid the effects of air pollution have not been applied by many people. Most respondents (79.8%) reported using cloth or medical facemasks that do not filter toxins or dust when outside of their home. Only a minority used specialized respirators (19.9%) or indoor air purifiers (6.8%).

At the time of the 2016 survey, the majority of respondents (74%) blamed industry for the air pollution, followed by vehicles (71.3%) and energy production (54.2%). This year’s survey also shows the same results in the view of people about the three main sources of pollution, but the ranking has changed. Approximately 83% of participants rated transportation as the biggest cause of air pollution, followed by industrial production with 79%. Energy production from thermal power plants continued to be in third place with a high rate of 71.4%. Pollution from construction is a new source that we added to the survey this year and was immediately voted as the major source of air pollution (60.9%). Vehicle emissions were a high concern to 66.7% of respondents, followed by pollution from energy production (50.5%) and industry (49.6%). Farm contamination was also a major concern, receiving 47.3%. This can be explained by the fact that in recent years, the burning of straw from rice fields has had a serious impact on air quality, although there are prohibitions and penalties for these.

Nearly 81.7% of participants thought that the current regulations and measures of the government on air pollution needed to be improved. However, with the efforts of addressing the issues recently, it seems that our government has left a good impression to the public, because this number has decreased significantly compared to 2016 survey (90.7%). Participants of the survey also contributed a number of ideas to help addressing issues related to air pollution. Stricter control is the preferred option of three quarters (75%) of people. Other solutions that were advocated included special laws on the environment and air quality (Clean Air Act) (55.7%) and awareness campaigns (56.2%). Besides, 45.4% of people believed in increasing taxes for air pollution activities, 26.9% choosing to have financial support for low emission products.

From the results of the two surveys in December 2016 (approximately 1400 participants) and January 2018 (approximately 1000 participants), the key points are: The public is very concerned about air quality. Most feel that the quality of air has decreased significantly during recent years, leading to many health effects on them and on their families. People still lack basic knowledge about air quality, such as the AQI or the serious consequences of poor air quality on the living condition. Temporary but effective measures to minimize the impact of air pollution, such as using specialized masks or air purifiers, are not well known. A large proportion of respondents said that the current regulations and policies of the government relating to air pollution are insufficient and need to be enforced. Solutions advocated included: policy improvement, new policy implementation and awareness raising.
China is home to some of the highest levels of air pollution in the world. The Chinese government has made significant efforts to control air pollution. In 2016, China issued the Law on Air Pollution Prevention and Control, which contains an entire article devoted to coal-fired power plants. Article 41 mandates that “Coal-fired power plants and other coal-burning units shall adopt cleaner production techniques, such as dust removal, and the construction of desulfurization and denitrification facilities, or other measures to control air pollutant emissions.” To help implement the Law on Air pollution Prevention and Control, a range of policy measures has been released in the past several years to help the power sector comply with the new, stringent emission standards. These measures range from technical assistance, financial support and the imposition of penalties for violations, to the promotion of renewable energy. To have permission for construction, all the new coal-fired power plants must apply ultra-low emission technologies, as established by the Power Master Plan of China. Financial support for air quality equipment installation is promoted. Subsidies on renewable energy are increased.\(^1\)

In addition to these measures, China has stopped the construction of 300,000 MW of new coal-fired power plants; reduced the number of permits for new coal-fired power plants by 85%; stopped approval of new plants in 13 provinces as of March of 2016; announced it will not build any new coal-fired power plants in 15 provinces. The “traffic light” mechanism was deployed; issuance of new construction permits was completely stopped in 26 provinces; a plan to close older coal-fired power plants was adopted in April of 2016; 15 new projects were cancelled in September of 2016; the “provincial self-consumption” project was halted in October of 2016; the “Electric Power Development 13th Five-Year Plan” in November of 2016; set a limitation of 1,100,000 MW on coal-fired power; and cancelled 85 planned plants in 13 provinces.\(^2\)

According to a recent study of Beijing-Tianjin-Hebei (BTH) on air pollution sources in Beijing, emissions from coal burned to heat homes during winter is a main source of air pollution. To reduce this practice, China is undertaking a variety of efforts to encourage the use of clean technologies. Reduction in the amount of coal burned by households has contributed significantly to improvement in air quality. Additionally, practices to reduce emissions in industrial production, including in coal-fired power plant, are being implemented. China has encouraged improved air management techniques. The government has also supported additional laboratory modeling and research, and created incentives to promote the use of environmental equipment in cities. China has also made data available to the public.

Over the last 20 years, Beijing has reduced the amount of coal that is burned in 6 districts and established coal-free areas in the middle of the city. In 2017, the percent of households using gas heaters increased to 37%, and 80% of households used clean energy. Ha Bac province began promoting energy transition in 2014. By the end of 2016, 600,000 improved stoves had been installed in rural areas. These stoves rely on clean energy, instead of coal.\(^3\)

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\(^1\) Chinese Coal-Based Thermal Power Sector, Compliance of Environmental Standards – Rock Environment and Energy Institute

\(^2\) Boom&Bust report, 2015

\(^3\) http://bit.ly/2FE32UN
RECOMMENDATIONS

For better air quality

1. More research is needed on sources of air pollution

Air pollution levels in major urban areas are thought to be affected by six main pollution sources. These sources are: transportation, construction, industrial production, burning waste, transboundary air pollution, and vehicle emissions. For effective control and management of these sources, it’s necessary to have more studies to assess the contribution of each source to air quality and identify the main causes of pollution.

2. Set up more automatic air monitoring stations

There is a lack of monitoring data in Vietnam, and this lack of data has hampered efforts to reduce air pollution. Having more and better data would allow a more comprehensive analysis of air quality. Therefore, more air monitoring points should be set up. Monitoring stations must be properly maintained. Historical data should be published and made available to researchers, citizens and interested organizations. Interested parties should be encouraged to work with the government to achieve better monitoring results.

3. Specific laws to address Air Quality (a Clean Air Act)

Compared to water resource protection and solid waste management, air quality control is lacking in awareness, human resources and management tools. Specific air quality legislation is needed. Such legislation could be modeled after other countries. Many countries have had success by placing air quality legislation in the framework of basic environmental law, and then writing special laws to address individual components. Legislation should specify the responsibilities and coordination of stakeholders, particularly the responsibility of local and municipal authorities for implementing measures to protect and improve air quality.

4. Strengthen regulation on emissions and ambient air quality

Regulations and standards on ambient air quality should be strengthened and should be aligned with national standards, such as WHO guidelines. Better emissions control measures are needed for industries with high emissions, such as coal, cement, steel and chemical manufacturing. Economic tools to control emissions should be improved. Emissions fees and tax policies should be clarified.

5. Raise awareness on indoor air pollution

Indoor air pollution in Vietnam receives far less attention than ambient air pollution. Studies on indoor air quality are not yet well-known, even though indoor air pollution poses significant risks to health.

6. Promote the development of renewable energy

Clean and zero emissions technologies should be promoted. Coal-fired power plants should be gradually replaced by low- and zero-emission plants, such as wind farms and solar arrays, depending on the energy potential of the area. The policy on electricity prices and the development of renewable energy sources should be adjusted. Vietnam is too dependent on coal power due to unreasonable retail electricity prices. Electricity prices in Vietnam are very low compared to other countries. This situation leads to higher levels of pollution. It is estimated that by 2030, at least 60 new coal-fired power plants will be commissioned and operated in Vietnam, causing a significant deterioration in air quality. The Power Development Master Plan should be revised to focus more on clean and renewable energy and reduce the use of fossil fuels.

7. Reduce transportation emissions

Expand public transportation. Reduce the number of personal vehicles. Public transportation infrastructure should be improved. In order to reduce emissions, incentives should be given for the use of clean fuels in transportation. This can include the use of subsidies for low-emission and electric vehicles. Emission control standards for automobiles, scooters, and other personal vehicles should be strengthened. These new standards should be aligned with international standards. A sustainable transportation strategy aimed at large cities should be developed.

8. Improve urban planning

Urban planning affects the quality of the air, so too many high-rise buildings in the inner city also affects the dispersion of pollutants. Poor urban planning also affects the transportation system, which makes public transport systems harder to operate. Strengthening urban planning with an eye to transportation and construction can help reduce air pollution. More trees should be planted, and more land should be set aside for public parks.

9. Raise awareness to change public behavior

The public should be provided with more information on the sources of air pollution and the impact of air pollution on human health. This can be done through community media campaigns by local organizations such as the Women’s Union, the Youth Union, and civil society organizations. More information on pollution levels and the daily AQI should be made available. People should be encouraged to protect themselves from pollution. The public should be encouraged to participate in the development and implementation of air quality initiatives.
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