

Before the Clouds Gather : Protecting Clean Air in Vietnam

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Foreword

One area of focus for the Vietnam program of the United States-Asia Environmental Partnership (US-AEP) a US Agency for International Development (USAID) initiative air quality. US-AEP has thus far assisted Vietnam in the phase out of lead in gasoline and capacity development in air quality monitoring. US-AEP has also supported Vietnam's participation in the Clean Air Initiative for Asian Cities (CAI Asia). In this context, we began drafting this report to be merely a simple compilation of donors and projects relating to air quality in Vietnam. But as more research was done, we realized that a general report on air quality issues in Vietnam was not readily available and decided that we should attempt to begin to fill this gap. And begin was all that we could hope for, since there is a great lack of information available on both data and what relevant actors are doing in this field.

Nevertheless, the following report tries to encompass as much information as possible on air quality issues that can fit into a thirty-page report, which strives to be both comprehensive and informative.

The primary author was Ms. Tran Thien Trang, who spent a significant portion of her summer 2002 internship with us working on this report.

In the end, however, this report was a collaborative effort of all the staff of US-AEP Vietnam and our partners, most of whom we acknowledge below.

Lastly, we would like to thank Dan Siskin for his careful editing and proofreading of the final draft.

Jim Carlson and Phung Thi Thanh Van
US-AEP Vietnam

List of Acknowledgements

Before the final draft of the general report was written, US-AEP hosted a workshop in Hanoi, Vietnam, on the 8th of August 2002, to discuss the current air situation and the report and, most importantly, receive comments, suggestions, and information from the audience about the report. The finalized version of this report tries to incorporate the suggestions of the audience, which includes representatives from the following organizations, in no particular order:

National Institute of Occupational and Environmental Health
Department of Medicine Preventive, Ministry of Health
Institute of Metrology and Hydrology
Center for Environmental Engineering of Towns and Industrial Areas (CEETIA)
Hanoi Department of Science, Technology and Environment (DOSTE)
Directorate for Standard and Quality (STAMEQ)
Swiss Embassy/Agency for Development and Cooperation (SDC)
United National Development Programme (UNDP)
Vision and Associates
Environmental Information Division (INFORTERA)
Vietnam Register (VR)
Center for Environmental and Chemical Engineering (CECO)
Asia Foundation
Louis Berger Group
Asia Development Bank (ADB)

Special thanks to STAMEQ for their written input on the sections “Established Laws and Regulations,” “Standards” and “MOSTE” in part III, “Current Government Management.”

US-AEP would like to thank the above members for attending the workshop and sharing their expertise and ideas with us on ways to improve this report. We greatly appreciate the interest of the attending organizations on this topic and hope that this report can inform a larger audience about air-related issues in Vietnam.

Before the Clouds Gather: Protecting Clean Air in Vietnam

I. Introduction

Vietnam is not plagued with a brown cloud over its cities, at least not yet, and thus air pollution may not seem to be a serious issue at present. Nonetheless, with widespread use of old vehicles, coal stoves, uncontrolled incineration, rampant construction and poor quality roads, it is not difficult in Vietnam to find oneself breathing harmful air.

The easiest form of pollution to identify is caused by persistent ambient particulate matter that is related to the level of development. The industrialization and modernization of Vietnam is increasing at such a rapid pace, that air pollution will indeed become a severe problem in the future. It is fortunate, however, that Vietnam has taken a significant first step toward making its air safer to breathe by completely phasing out the use of lead in gasoline on July 1, 2001.

The purpose of this proposal for an integrated action plan is build on this initial success by addressing the practices that create pockets of poor air and to begin tackling sources that will eventually make Vietnam's urban ambient air quality as bad as it is in cities of other, more developed, Asian countries.

Vietnam's Social and Economic Trends

Since the adoption of *doi moi*, ["Renovation"] Vietnam has experienced significant economic changes as the country moved from a centrally planned economy to a market economy. Over the decade 1991-2000, the country's GDP growth averaged over 7% while the industrial sector grew at approximately 13% per year. The industrialization of Vietnam has caused major changes in industry and population. Industries, such as oil, gas, steel and chemicals, grew over 20% each year and are expected to become an even larger percentage of GDP in the years to come. The growth of the urban population has increased with the industrialization of the country. Starting in 2001, the urban population is expected to grow at around 3% per year.¹ By 2010, 40% of Vietnam's population is expected to live in the cities.²

Table 1: GDP and Industrial Growth 1993-2000³

Year	1993	1994	1995	1996	1997	1998	1999	2000
GDP growth (%)	8.1	8.8	9.5	9.3	8.8	5.8	4.8	6.7
Industrial growth (%)	13.2	14.0	13.9	14.4	13.2	11.0	10.4	15.4

(Source: IMF, 1999; EIU, 2000; Asia Pulse, 2000)

Table 2: Expected GDP Breakdown⁴

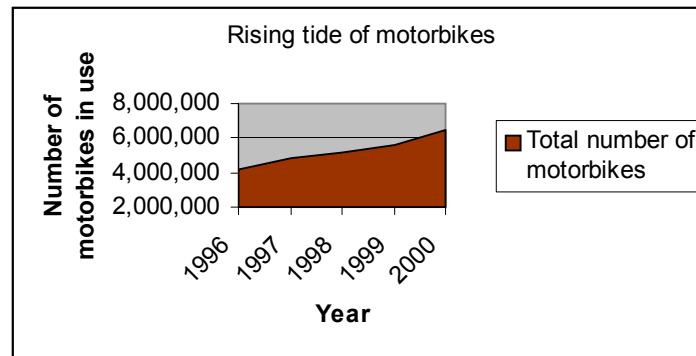
Year	1996	2010
Agriculture (%)	26.2	17
Industry (%)	31.3	37
Service (%)	42.5	45

(Source: EIU, 1998; Development Strategy Institute, 1998)

The industrialization and urbanization of Vietnam which will increase the number of factories, automobiles, motorcycles, and households in the cities, will eventually have negative environmental effects, including more air and noise pollution.

Currently the nation's vehicle fleet, especially motorcycles, is increasing rapidly. The year 2000 alone saw a 14.25% increase in the number of motorcycles in the nation (see Figure 1).

Figure 1: Number of Motorbikes from 1996-2000



This growth is expected to continue. According to a report by Petrolimex, from 2000 to 2005, the annual growth rate of fuel demand in Hanoi and Ho Chi Minh City (HCMC) is expected to be approximately 12%, increasing to 15% in 2005-2010 period. A demand boom is expected after 2006, especially in the consumer sector where people with higher incomes will invest more on transportation (automobiles and motorbikes for example), as prices for motorbikes decrease. At the same time, people are expected to travel with considerably more frequency. Already, the imports of motorbikes and vehicles have increased 87.6% and 146.5%, respectively.⁵ In addition, the Ministry of Transport plans to invest US\$ 3.78 billion to modernize the roads in Vietnam over the next five years, and currently, the Hai Van Tunnel is being built to facilitate easier travel between North and South, which will produce even more traffic and pollution.⁶ According to statistics from the MOT, the total number of vehicles in Hanoi is forecasted to grow at 8.5% per year from 2000 to 2010. This growth will be the main cause of air pollution in both Hanoi and HCMC in the years to come.

Most of the increases will occur in Hanoi and HCMC, where the vehicle fleet growth rate is expected to increase around 6% a year.

Table 3: Vehicle Type and Population 1996-2000⁷

Type	1996	1997	1998	1999	2000
Cars	105,050	117,230	129,140	89,120	99,022
Buses				47,806	53,118
Motorcycles	4,208,247	4,827,218	5,200,000	5,600,000	6,478,954
Trucks	131,350	135,770	149,560	126,246	140,274
Specialized Vehicles				32,283	37,981
Others				19,450	22,375
Total	4,444,647	5,080,218	5,478,700	5,914,905	6,831,686

(Source: Vietnam Register)

Box: Four Strokes in Vietnam

One unique characteristic of Vietnam is that the vast majority of motorcycles is powered by 4-stroke engines. This most likely reflects the history of the introduction of motorbikes into Vietnam and the consumer demand.

During the decade of the 1980s, under COMECON [the Soviet Union-led trading system among communist countries], 2-stroke bikes were imported from Eastern Europe and the Soviet Union. Although the reform program opened Vietnam to other trade and citizens were allowed to import western goods, a high tariff still remained on non-COMECON motorbikes.

Nonetheless, an important loop-hole allowed any citizen who went abroad to import one motorbike duty-free. This facilitated the importation of higher quality motorbikes. The preferred bikes then were very small (50cc) and could easily be modified to carry small children and goods from the market. They were made for short trips and were easy to use (no clutch, no fuel mixing). The middle-aged, highly educated elite had on the best access to this market and gave the impression that the "Honda" was the best. Even back in the late 1980s people called UNDP and other donor study tours as trips to "buy Honda Cubs." Secondary markets developed as the elite found ways to make very large profits (100-150%) for themselves. The only alternative to these Hondas, however, was the large, bulky, loud, basic and crude 2-strokes from East Germany (MZ), Soviet Union (Minsk) and other Eastern European countries. These vehicles which were prone to breaking down, were not something any official would want to rely on to go to work or take his/her family around.

Air Pollution in Selected Asian Countries

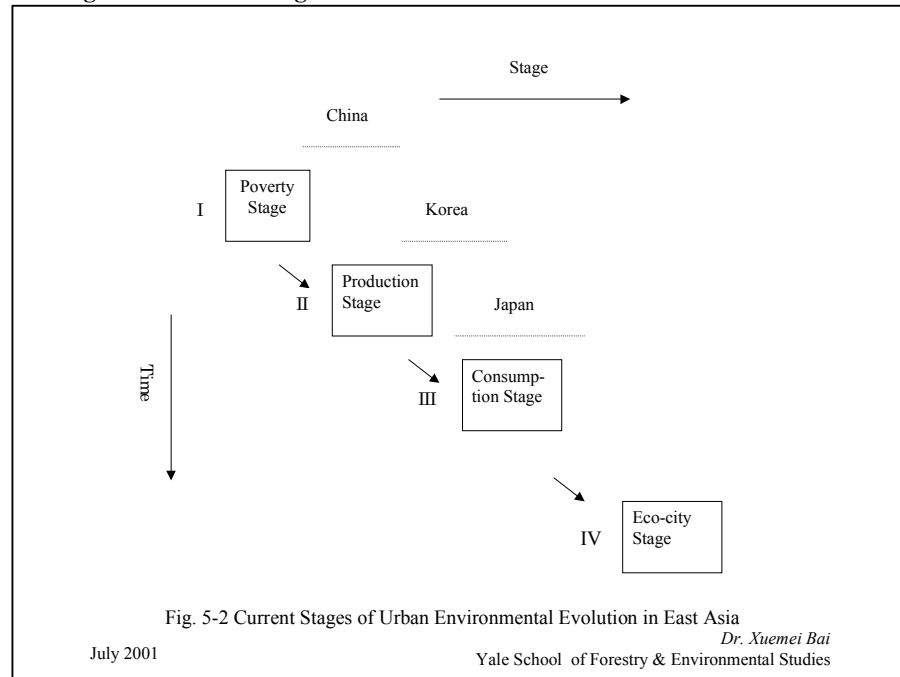
With the high growth rates of vehicles and the urban population and the rapid integration of Vietnam into the global community, Vietnam will face pressure to deal with worsening environmental problems, including air and noise pollution. Already, the more developed Asian countries experience serious environmental problems along with economic growth and rising energy consumption. Many of the Asia-Pacific countries, including China, India, Indonesia, and Malaysia, exceed the World Health Organization's ambient concentration levels of suspended particulate matter (SPM) and sulfur dioxide (SO₂).

Table 4: Ambient Concentrations of SPM and SO₂ in Selected Asian Cities in 1997⁸

Country	City	SPM (annual mean micrograms/m ³)	SO ₂ (annual mean micrograms/m ³)
China	Beijing	(*) 370	(*) 115
India	Calcutta	(*) 393	54
Indonesia	Jakarta	(*) 271	N/A
Japan	Tokyo	50	20
Malaysia	Kuala Lumpur	(*) 119	24
Philippines	Manila	(*) 90	34
Thailand	Bangkok	(*) 105	14

Note: (*) exceeds the World Health Organization's guideline
Source: World Health Organization

One framework to look at the future of major Vietnamese cities is the stage model of urban environmental evolution as developed by Xuemei Bai. The model is based on a group of cities in Japan, China, and South Korea, defining four stages as given in the diagram below:

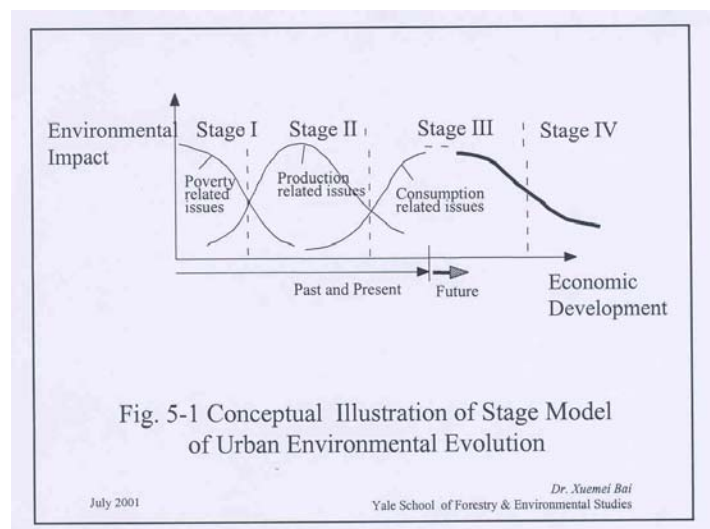
Figure 2: Current Stages of Urban Environmental Evolution in East Asia

Xuemei Bai bases these stages on per capita GDP and the pollutants characteristic of each stage:

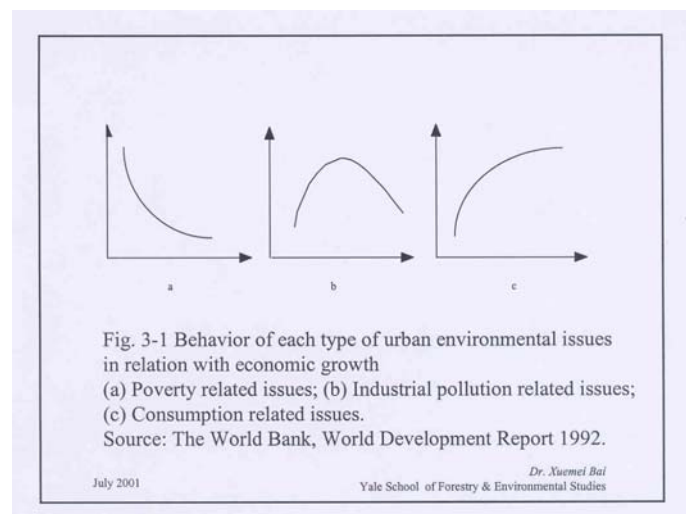
- *Poverty Stage*: A city in the poverty stage is characterized by urban environmental issues, which include low access to clean water and sanitation facilities, low per-capita income levels, income disparities and city slums. The city cannot provide basic services, supplies, jobs and homes to all the inhabitants because of the rapid migration from rural to urban areas. Many inhabitants in the city slums suffer from infectious diseases and other health problems due to the poor environmental conditions of the area but do not have the financial means to move. Currently, many cities in China—and in Vietnam endure poverty-associated problems, but some cities have moved to the next stage.
- *Production Stage*: This stage deals with the urbanization and industrialization of a city. As the country's economy grows at a rapid rate, the expansion in industry takes a toll on the environment. The industries release particulate matter, sulfur dioxide, waste water, solid waste and other pollutants in the surrounding areas and negatively affect the air, land, water, health and quality of life in the areas. The lack of environment-friendly technology and government regulation means there is little effective pressure on the industries to seek cleaner production methods to the result is serious industrial pollution. Cities in Eastern China and Republic of Korea can be considered to be in this stage.
- *Consumption Stage*: After a city has surpassed the poverty and production stage, the city enters the consumption stage where there is mass production, mass consumption and mass disposal which eventually results in over-consumption of resources, loss of bio-diversity, more municipal waste, and increased carbon dioxide emissions. Nevertheless, this increased level of development also begins to bring about new solutions often new technologies to confront industrial and municipal pollution and waste.

- *Eco-city Stage*: This is the final stage where a city advances to where solutions are in place to deal not only with poverty and industrial pollution, but also consumption-related environmental problems. Recycling practices are widespread.

The four stages that Dr. Xuemei Bai developed clearly show the link between economic development and environmental degradation. As a city's economy grows, there is a natural tendency for stage-specific environmental problems to occur, although the actual situation varies depending on the direction the city takes. Policies can be put in place to mitigate these common tendencies. The spatial extent of the environmental impacts changes from local to regional to global as the city undergoes the first three stages. If the city realizes the environmental impact of a growing economy, the city can still experience both economic growth while sustaining the environment, but this depends on the city's awareness of the environmental problems, management education, investment in the environment and efficient use of resources.



At present, Vietnam is best described as transitioning from the poverty stage to the production stage in certain major cities.⁹



II. Main Pollutants, Effects, Sources and Trends in Vietnam

The main air pollutants in less developed countries are primarily particulate matter, sulfur and sulfates. In addition, NO_x, CO and air toxins are of great concern near high traffic areas.

Suspended Particulate Matter

Vietnam's main air quality problem is particulate matter (PM). This is consistent with the stage of the country's development under the framework introduced above.

Particulate matter really only matters when it becomes "inhalable particles," most commonly defined as particles with an aerodynamic diameter of less than 10 µm. This in turn is further subdivided at 2.5 µm to isolate out fine-particulate air pollution, usually resulting from combustion of fossil fuels, in transportation and industry. Thus, air quality monitoring in other countries focuses mainly on determining the level of PM₁₀ or PM_{2.5}. However, in Vietnam, PM₂₅ and PM₁₀ are usually measured because of the large amount of PM with diameters greater than 10 µm.

Fine particles that consist of toxic chemicals are arguably most dangerous to health. Indeed, this is consistent with the conclusion of an extensive prospective cohort study of 8,111 adults in six US cities from 1974 to 1991, the now famous "Harvard Six Cities Study:"

"City-specific mortality rates, adjusted for a variety of health risk factors, were associated with the average levels of air pollutants in the cities....Mortality was more strongly associated with the levels of inhalable, fine, and sulfate particles..."¹⁰

The most common causes of death could be identified as either respiratory (lung cancer and other non-cancer illnesses) and cardiovascular diseases.

Measured PM concentration in various cities is one to five times higher than that allowed by Vietnamese Environmental Standards (TCVN), which are already more lenient than those of the World Health Organization.¹¹ Unfortunately, little analysis of the character of the PM has been done to date. Despite this lack of specific knowledge, it is known that industries, such as the thermoelectricity, chemical, cement and construction, generate the highest volumes of PM.

Sulfur Dioxide (SO₂)

Even though sulfur dioxide is currently below or around the standard level, the increase in the industrialization of the country will cause an increase in the concentration of this pollutant. Diesel-powered vehicles are the major source of SO₂ in Vietnam,¹² and household coal consumption also emits the gas. The SO₂ emission from household sources, such as cooking, has decreased as urban residents switch to gas stoves from coal or kerosene stoves.¹³ Areas surrounding power plants, thermoelectric plants, cement companies, coal mines and chemical industries, which have high SO₂ emissions have to endure acid rain, vegetation and crop damage and health risks, including respiratory diseases and pneumoconiosis. Exposure to SO₂ can increase asthma attacks and chronic

bronchitis. The effect of acid rain can also lead to acidification of the land and climate change in the country and the neighboring countries.

Carbon Monoxide (CO)

Mobile emission sources are the major cause of carbon monoxide. According to the national monitoring system, daily CO levels are below the standard, but the concentration exceeds the standard at some large intersections in the larger cities.¹⁴ The increasing number of vehicles and the use of old vehicles contribute to the harmful emission of CO, which causes respiratory diseases and affects the circulatory system.¹⁵ High levels of CO may even cause death because continuous exposure to CO may block oxygen to the heart and the brain. Even at low levels of CO, people with coronary artery disease may suffer more occurrences of angina, and chest pain.¹⁶ A person may even get CO poisoning which can result in headaches, dizziness, drowsiness and nausea.¹⁷ Thermoelectric, cement, and construction material companies also emit CO into the air.

Nitrogen Oxides (NO_x)

Nitrogen oxides are the resultant pollutants of fuel combustion. These pollutants damage the ozone layer and cause acid rain. The main pollutant in this group is nitrogen dioxide (NO₂), which dissolves in water to form nitric acid, causes acid rain, and reacts with sunlight to form ozone. Polluted urban air during heavy traffic flow contains large amounts of NO₂, which damages the linings in the lungs and causes respiratory diseases, like emphysema and chronic bronchitis.

Ozone (O₃)

The ozone layer may protect humans from UV rays, but once it enters the lower atmosphere, it can cause harmful health effects and environmental problems. Exposure to O₃ causes coughing, chest pain, eye, nose and throat irritation, and weaken lung systems. These oxidants also cause damage to crops and forests. O₃ comes from the reaction of volatile organic compounds, which are released from automobiles, gas stations, power plants and chemical plants, and NO₂.

Toxic Air Pollutants

Toxic air pollutants cause serious health problems, such as cancer and birth defects as well as environmental effects. These toxins come from vehicles and industries. The toxic air pollutants include the following toxins:

Benzene, which is used in fuel, paints, cleaning supplies and many other products, can cause leukemia, skin and eye irritation and weakens the nervous system. Vehicle emissions, industrial waste discharge and, especially, cigarette smoke release this toxin. With the phase-out of leaded gasoline, the use of benzene in fuel has increased.

1,3 butadiene is a product of fuel combustion and used to make synthetic rubber. Areas near industrial and gasoline sites have high concentrations of 1,3 butadiene. Studies show that 1,3 butadiene has carcinogenic and reproductive effects. High levels of 1,3-butadiene can cause damage to the central nervous system, blurred vision, nausea, fatigue, headache, decreased blood pressure and pulse rate, and unconsciousness. Breathing lower levels may cause irritation of the eyes, nose, and throat.

Aldehydes also come from fuel combustion. Exposure to these toxins will cause eye and nose irritation and also respiratory problems. Studies have shown that aldehydes are carcinogenic.

Greenhouse Gases (GHG)

Much attention around the world has been paid to greenhouse gases. These gases not only affect the country, but the surrounding countries as well. GHG trap heat emitted from the Earth's surface and raise overall climate temperature. Two such GHG are carbon dioxide (CO₂), which is released while burning fossil fuels and coal, and methane (CH₄), which comes mainly from rice paddies and biomass.¹⁸

Odors

Canal sludges, waste dumping, and lack of disposal systems have contributed to odor pollution, which makes living in certain areas unpleasant. Many of the inhabitants in these areas do not have the financial ability to move.

Noise

Not only do the residents near industrialized and high-traffic areas have to bear dust and other pollutants, the workers and the near-by residents have to bear noise levels that range from 98 to 116 decibels. The standard for maximum noise level is only 90 decibels.¹⁹ One result of high noise levels in Vietnam is that 11% of industrial workers become deaf.²⁰

Table 5: Pollutants, Sources and Effects

Pollutant English Name (Chemical Name)	Form and Persistence in Ambient Air	Common Source(s)	Assumed effects	Presence in Vietnam
Particulate matter (PM, SPM)	Settles, but is often disturbed by vehicles	Industry Area sources Vehicles/roads	Fine particles are particularly dangerous Dust pollution Respiratory diseases	Often exceeds standards
Sulfur Dioxide (SO ₂)	Gas	Industry Coal burning Diesel	Respiratory diseases Acid rain Vegetation damage Ozone damage	Below standards
Carbon monoxide (CO)	Gas	Vehicles Industry	Respiratory diseases Circulatory diseases Hinder oxygen transport CO poisoning	Exceed standards in major cities
Ozone (O ₃)	Gas	Industry	Crop, forest damage Respiratory diseases Weaken lung function Chest pain	Low volume
Nitrates (usually NO ₂)	Gas	Vehicles Industry	Ozone damage Acid Rain Respiratory diseases	Below standards

Air Toxins	Gas	Vehicles Other sources	Leukemia Cancer Eye/Nose irritation Weaken nervous system Reproductive defects	
Carbon Dioxide (CO ₂)	Gas	Coal Consumption	Greenhouse effect	
Methane (CH ₄)	Gas	Biomass Rice paddies	Greenhouse effect	
Environmental Tobacco Smoke	Indoor	Ignited cigarettes	Respiratory diseases Cancer	Highest rate of male smokers in the world ²¹

Most of the above pollutants are linked to various respiratory diseases. With the increasing release of pollutants and smoke into the air, more and more people in HCM suffer from poor health, in general, and respiratory diseases in particular.

Table 6: Respiratory illness and cancer cases in HCMC²²

Year	1997	1998	1999	2000
Respiratory illness cases	82,060	83,625	84,197	87,439
Cancer	17,567	18,339	20,375	21,952

(Source: DOSTE)

Past and Current Pollution Levels in Vietnam

Among the pollutants, PM probably requires the most attention. A graph from the *State of the Environment Vietnam 2001* Report displays the high concentration of PM in different cities. Concentration levels have been decreasing greatly in recent years, but the levels are still above the PM standard. Just how far above this standard is unclear, because different data sources vary significantly.

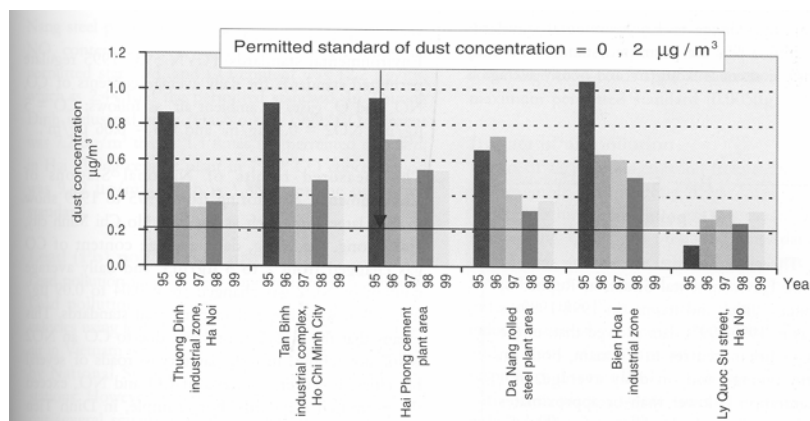


Figure 5.1 Change of yearly average concentration of suspended dust [$\mu\text{g}/\text{m}^3$]

(average of daily average concentration measured with frequency of 4 times/ year) in areas next to Thuong Dinh industrial zone (Ha Noi), Tan Binh industrial zone (Ho Chi Minh city), Bien Hoa I industrial zone, Hai Phong cement plant area, Da Nang rolled steel plant and Ly Quoc Su street (Ha Noi) during period from 1995 to 1999.

Source : NEA - Annual Report from environmental monitoring stations of 1995 - 1999 [1,2,3]

Note: The units in this graph are incorrect. The units $\mu\text{g}/\text{m}^3$ should be mg/m^3 .

From the above graph, it seems obvious that PM is over the limit in many cities, such as HCMC. But the data for ambient monitoring results for HCMC for 1999 reads only .53 – 1.96 mg/m³.²³ These numbers are below the PM standard. If one looks at the annual average concentration at Hang Xanh in HCMC, the results are much higher at .99 mg/ m³ in 1999.²⁴ Some data sets show that PM greatly exceeds the allowable concentration, but other sets are below the standard. All three sets of data are for HCMC, they differ greatly and it is unclear which is most reliable. This is the problem with data collection in Vietnam. Getting a handle on reliable and representative data is not a simple task outside of the areas currently monitored in HCMC, which at least has a network system for the air monitoring stations. There is a national monitoring system, but the methods of data collection may differ among the stations. Any monitoring is only done sporadically on occasion. Indeed, some cities monitor air twice a year by collecting samples at pre-assigned intersections, one day for each. The section *Issues in Project Implementation* discusses data collection and monitoring in more detail.

The following tables show pollutant concentrations, but the numbers may not be reliable or representative of the area. The data do, however, demonstrate the need for air quality improvement.

HCMC:

Table 7: Results of Ambient Air Monitoring in HCMC in 2000

Values	Concentrations (mg/m ³)		
	PM	SO ₂	NO _x
Average	0,28	0,055	0,030
Min	0,27	0,042	0,014
Max	0,29	0,074	0,049
Vietnam Standard	0,30	0,500	0,400

Source: HCMC DOSTE

Table 8: Ambient Monitoring Results in HCMC

Pollutant	Measured value	Vietnam standard
Pb	0.002 - 0.005	0.005
SO ₂	-	0.5
CO _x	43.2 - 55.6 ²	40
NO _x	0.404 - 0.608 ³	0.4
SPM	0.771 - 3.801	0.3
HC _x	N/A	5

Source: HCM-DOSTE

Hanoi:

Table 9: Average Hourly Concentration of Pollutants at Hanoi Traffic Intersections (mg/m³)

Location	Date	CO _x	SO ₂	HC _s	NO _x	SPM	Pb
Standards		5	0.3	-	0.1	0.2	0.005
Nga Tu So	8/97	5.320	0.752	-	0.145	1.121	0.032
Nga Tu Vong	8/97	5.822	0.792	-	0.239	1.239	0.028
Nga Tu So	11/98	5.320	0.742	-	0.205	1.151	0.028
Nga Tu Vong	11/98	5.478	0.839	-	0.221	1.237	0.026
Nga Tu So	1999	5.44	0.8	-	0.21	1.191	0.029
Nga Tu Vong	1999	5.0	0.8	-	0.13	0.8	0.023
Date : 8/2000							

Source: Hanoi DOSTE

Hai Phong:

Table 10: National Air Quality Monitoring Results – Hai Phong

Table 4. National Air Quality Monitoring Results (Continued)

PARAMETERS		Nha may Xi Mang			Van My Commune			Cau Rao			Stds	
		1998	1999	2000	1998	1999	2000	1998	1999	2000		
SO ₂ (mg/m ³)	1	1h Max	0.224	0.410	0.040	0.042	0.034	0.066	0.048	0.036	0.033	1hr – 0.5 mg/m ³ 24hr – 0.3 mg/m ³
		24h Avg	0.162	0.371	0.032	0.033	0.033	0.030	0.024	0.032	0.025	
	2	1h Max	0.315	0.320	0.052	0.018	0.029	0.527	0.034	0.011	0.030	
		24h Avg	0.282	0.302	0.042	0.013	0.022	0.256	0.029	0.010	0.024	
	3	1h Max	0.362	0.150	0.041	0.017	0.012	0.055	0.031	0.010	0.034	
		24h Avg	0.181	0.122	0.036	0.012	0.009	0.040	0.020	0.007	0.029	
	4	1h Max	0.180	0.140	0.047	0.036	0.002	0.320	0.007	N/a	0.040	
		24h Avg	0.142	0.102	0.029	0.020	0.001	0.134	0.001		0.027	
NO ₂ (mg/m ³)	1	1h Max	0.039	0.040	0.025	0.311	0.050	0.019	0.017	0.031	0.006	1hr – 0.4 mg/m ³ 24hr – 0.1 mg/m ³
		24h Avg	0.017	0.034	0.018	0.145	0.035	0.008	0.007	0.025	0.003	
	2	1h Max	0.130	0.112	0.059	0.023	0.024	0.080	0.026	0.006	0.010	
		24h Avg	0.064	0.093	0.030	0.014	0.020	0.034	0.018	0.005	0.002	
	3	1h Max	0.083	0.066	0.019	0.092	0.055	0.039	0.084	0.010	0.039	
		24h Avg	0.078	0.060	0.017	0.019	0.040	0.028	0.054	0.009	0.028	
	4	1h Max	0.249	0.043	0.017	0.023	0.030	0.032	0.013	0.016	0.032	
		24h Avg	0.088	0.028	0.014	0.019	0.020	0.023	0.012	0.008	0.025	
CO (mg/m ³)	1	1h Max	1.672	2.867	9.801	4.060	3.737	3.339	1.078	2.253	5.458	1hr – 40 mg/m ³ 24hr – 5 mg/m ³
		24h Avg	1.324	2.453	6.814	1.660	2.936	2.145	0.653	1.875	3.411	
	2	1h Max	3.025	9.032	4.390	2.136	5.336	4.077	2.022	2.953	2.357	
		24h Avg	1.980	5.597	2.712	1.580	3.654	2.201	1.507	1.892	1.176	
	3	1h Max	1.833	12.91	6.265	2.099	5.916	4.385	1.515	5.454	4.970	
		24h Avg	1.467	9.452	5.132	1.645	4.817	3.251	1.276	4.549	3.120	
	4	1h Max	2.148	5.725	5.712	2.548	3.132	2.688	1.340	2.598	5.040	
		24h Avg	1.482	3.687	3.234	1.294	3.064	1.932	1.032	1.531	2.100	
TSP (mg/m ³)	1	1h Max	0.564	0.727	0.385	0.387	0.631	0.257	0.341	0.425	0.196	1hr – 0.3 mg/m ³ 24hr – 0.2 mg/m ³
		24h Avg	0.373	0.569	0.307	0.225	0.490	0.244	0.250	0.346	0.182	
	2	1h Max	0.812	0.587	0.051	0.320	0.265	0.585	0.187	0.205	0.216	
		24h Avg	0.658	0.457	0.368	0.247	0.256	0.383	0.176	0.194	0.195	
	3	1h Max	0.512	0.580	0.434	0.310	0.390	0.436	0.280	0.220	0.285	
		24h Avg	0.423	0.557	0.324	0.220	0.318	0.394	0.227	0.206	0.270	
	4	1h Max	0.654	0.848	0.476	0.336	0.315	0.322	0.317	0.238	0.327	
		24h Avg	0.377	0.602	0.349	0.266	0.284	0.274	0.280	0.202	0.279	

Source: Center of Environmental Engineering of Towns and Industrial Areas (CEETIA)

III. Current Government Management

With the impending need for environmental protection, the Vietnamese government has introduced laws and projects to regulate pollution, including air quality and noise level.

Established Laws and Regulations

Since the 1990s, the government has taken on more roles in environmental management and protection. The Law on Environmental Protection was passed by the National Assembly on December 27th, 1993, in conjunction with the promulgation of or amendment of other legal texts relating to different components of the environment, namely the Ordinance on Aquatic Resources (1988), the Law on Land (1989), Law on Mineral Resources (1989) and Law on Forest Conservation and Development (1991). The other environment-related statutory instruments and regulations have been elaborated and promulgated, making up a systematic body of legal texts that apply at all levels of government in Vietnam, from the central to the local level. The legal texts institutionalize and codify state policies and principles provided for under the Law on Environmental Protection and serve as effective governmental tools for environmental management and protection. The establishment of these laws is a turning point for environmental management and protection for the country.

In 1994, Decree 175/CP was issued to ensure the effective enforcement of the Law on Environmental Protection, where the roles of the Vietnamese Standards (TCVN) on the environment, especially emission and discharge standards, were emphasized as important instruments for environmental management. These standards specify the requirements of ambient air quality and monitoring of the air pollutants, and under the Law of Environmental Protection, the National Air Environmental Monitoring and Analysis System provides basic air quality information to institutions responsible for developing environmental policies and standards. And with the creation of the No. 36-CT/TW directive in 1998, the government has committed itself to environmental protection through research, international cooperation, prevention strategies, awareness raising, regulation of enterprises and disincentives to pollute, such as fines, “Black Book” listing, or relocations outside the city.

Standards

Vietnamese environmental standards are developed and issued by the Ministry of Science, Technology and Environment (MOSTE) according to the requirements of the Environmental Protection Law and related government decrees. The Directorate for Standards and Quality (STAMEQ), which belongs to MOSTE (has been changed to the Ministry of Science & Technology (MOST)) is the National Standards Body responsible for organizing technical committees for the development of the environmental standards, providing technical-legislative expertise and submitting TCVN drafts to the Minister of MOST for approval.

One of the differences between Vietnam and other countries is its standards-setting process, as well as discharge and emission standards development. Although the standards-setting process is considered under law regulations and compulsory implementation documents, the process is not in accordance with other legislative documents and law development procedures, but actually follows the standards development process, which was promulgated in Decision No 248/TDC-QD issued by STAMEQ in 1993. According to this decision, the standards development process undergoes a five-step-process: (1) draft standard proposal or working draft; (2) technical Committee's draft; (3) TCVN's draft; (4) TCVN approval and (5) TCVN publication. There are 7 technical committees working for environmental standards development, including the technical committee on ambient air quality – TCVN/TC146.

The standards project proposal must be approved by STAMEQ before the technical committee writes the drafts. The technical committee is comprised of researchers, scientists from universities and research institutes, managing experts from government agencies, representatives from industry, consumers, etc. The technical committee's draft becomes a TCVN draft only if the majority of the technical committee approves it. The TCVN draft is subjected for outside viewers, circulating for comments. And finally, the draft must be passed by the technical-legislative expertise of STAMEQ before submitting it to the Minister of MOST for approval.

Some air quality standards have been developed and issued since 1995 and are as follows:

- TCVN 5937: 1995 - Air quality - Ambient air quality
- TCVN 5938: 1995 - Air quality - maximum permitted concentration for toxic components in the air

- TCVN 5939: 1995 - Air quality - Industrial emission standards - inorganic substances and dust
- TCVN 5940: 1995 - Air quality - Industrial emission standards - organic substances
- TCVN 6438: 1998 - Air quality - Road vehicles emission - maximum permitted limits
- Some more than 50 TCVN on analysis methods for air quality standards and air emission

Although the process of setting standards goes through a very bureaucratic and time-consuming system, the standards themselves are not always observed because weak enforcement and the lack of non-government participation policy making. Maintaining standards also depends on the environmental objectives and the economic costs of pursuing those levels.²⁵ There are some difficulties in the methodology of emission standards development, especially when developing emission standards relating, not only to concentration, but load as well.

Some pollutant guidelines are listed below, although some of the standards are much higher than the World Health Organization's (WHO) air quality guidelines. For example, the Vietnamese standard allows twice the amount of sulfur dioxide as WHO, and WHO sets standards where there would be no adverse effect to human health due to the pollutants below that level. Therefore existing standards on air quality need to be revised in the near future.

Table 11: Vietnamese and World Health Organization Pollutant Standards²⁶

Pollutant	VN Standard	WHO Standard	Time Period
Particulate Matter	200 $\mu\text{g}/\text{m}^3$	150 $\mu\text{g}/\text{m}^3$	24 hours
Sulfur Dioxide	300 $\mu\text{g}/\text{m}^3$	125 $\mu\text{g}/\text{m}^3$	24 hours
Nitrogen Dioxide	100 $\mu\text{g}/\text{m}^3$	150 $\mu\text{g}/\text{m}^3$	24 hours
Carbon Monoxide	10 mg/m^3	10 mg/m^3	8 hours

(Source: DOSTE of HCMC and World Health Organization)

Management Structure

Under current laws, the Vietnamese government oversees state environmental protection, while the people's committees of provinces and central cities are responsible for the environmental protection of their localities. At the commune and district level, it is unclear if an environmental protection system exists.²⁷ The governmental agencies that play key roles in environmental protection are listed below.

The Former Ministry of Science, Technology and Environment (MOSTE) now the new Ministry of Natural Resources and Environment (MONRE)

MONRE has been responsible for industrial protection, the EIAs, monitoring and inspecting vehicles and industries, and setting environmental policies and emissions standards. It has coordinated with the ministries, ministerial-level agencies, and government bodies in the management of the environmental protection of their sectors and branches. Along with the Ministry of Transportation (MOT), Ministry of Natural Resources and Environment (MONRE), and Directorate for Standards and Quality (STAMEQ) set, approved, and issued emissions and fuel standards. Other environmental work that has fallen under the National Environment Agency (NEA) will be moved to the newly established Ministry of Natural Resources and the Environment. Completion of this administrative reform will likely take time and the provincial Departments of Science,

Technology and Environment (DOSTE) remain key players in charge of monitoring industries' adherence to the Law of Environment Protection. Particularly, the DOSTE of HCMC has been active and has implemented air quality projects and data collection.

The Ministry of Transportation (MOT)

MOT is responsible for Vietnam's transportation planning and management, which include infrastructure, roads, intersections, and traffic control. The ministry has the authority to determine the types, quality, and technical safety standards and inspections for operating vehicles. It participates in preparing drafts for road vehicle emissions standards and stipulates compulsory application of the standards for vehicles. In coordination with MOST, MOT reviews and approves the vehicle emissions standards. Under MOT is the Vietnam Register, which collects data on the vehicle fleet, such as age, growth rates, types, etc. The register also inspects the quality and safety of vehicles and prepares the drafts of the TCVN's.

The Ministry of Construction (MOC)

MOC manages the building regulations and guidelines for houses, public works, and construction activities. The policies cover areas such as drainage and sanitation, waste management, slum improvement, and urban planning.

The Ministry of Industry (MOI)

MOI prepares industrial development strategies. It also manages and regulates the emissions of pollution from factories. The agency provides technical assistance for pollution reduction and partly funds environmental projects implemented within different industrial enterprises.

The Ministry of Planning and Investment (MPI)

The MPI distributes environmental aid from the Official Development Assistance (ODA) to the agencies and environmental projects, of which MPI must first approve. This ministry is also involved in the decision-making, development and implementation of the ODA projects.

Issues in Project Implementation

Allocating Responsibilities

Unfortunately, there are no guidelines that define the responsibilities of each ministry. Therefore, many ministries work on one project, and "it is sometimes unclear who has official responsibility for a specific problem, who has the capacity to respond to it, and who has the ability to lead and coordinate other agencies on an issue."²⁸ For example, a construction project may have to pass through a handful of agencies, like MONRE, MOI, MOC and MPI. In order to address this problem, Ho Chi Minh City and the French Agency for Environment and Energy Management (ADEME) formed a partnership and committed themselves to certain responsibilities before beginning a project on city traffic management. Its ETAP project, started in 1999, has given concrete suggestions on how HCMC should plan its traffic networks in order to minimize future pollution effects.

Data Collection and Monitoring Services

More monitoring stations have been set up, but the inspection and maintenance of vehicles are still weak. The number of monitoring stations in Vietnam total 53. Some are under the control of MONRE while others are under the local People's Committees.²⁹ Data on the major cities are collected but are not easily accessible to the public. Moreover, the data that is collected may not be reliable due to calibration inconsistencies and different methods of collection at each station. Because there are few automatic air monitoring stations in Hanoi, Haiphong and Ho Chi Minh City, the other stations measure the air quality only four times a year and for only one or two days during each collection period.³⁰ The data collected may not be representative of the country's situation, or even a given city because the sample frequency and geographic coverage are minimal. Establishing permanent air quality monitoring stations will improve the measurement of long-term trends in air pollution and lead to effective air quality management. In addition, having daily information regarding air pollution levels can inform those at risk on high pollution days.

Many vehicles in use are old and sub-standard. Monitoring systems do not have the capability to monitor different vehicle type emissions and have weak enforcement mechanisms.³¹ Even the collection of data on the health effects of polluting industries has not been done by the government. Only the labor unions and health organizations have looked at the health effects of industrial pollution. Otherwise, statistics on air pollution and effects are meager. Overall, environmental protection and monitoring in Vietnam have not been very effective.

In 1998 through 1999, the Vietnam Canada Environment Project (VCEP) conducted an instructive demonstration project on air pollution with the city of Hai Phong. This project trained the Hai Phong DOSTE staff on air monitoring and analysis and provided the city with air sampling equipment. A method of data collection and data analysis was designed for collectors and a detailed report was written afterwards. The report includes the project objectives, parties' responsibilities, site selections, frequency of sampling, method and process of sampling, analytic methods, hydro-meteorological conditions, outcomes of the project, comparison to the national monitoring samples of the city, evaluation of the project and recommendations for the DOSTE staff. The report also explained why sampling may not be representative of a given area. For example, the distance from the sampling area to a factory or street; changing wind directions; and the way the data were analyzed statistically would affect results. (Please refer to Appendix D for the data table on air monitoring in Hai Phong.) This report allows interested readers to learn about the sampling method and increases the reliability and usefulness of the data.

Awareness

Not much has been done for public awareness of environmental protection. Information regarding pollution, health impacts, and environmental policies is not readily accessible to the public. Moreover, most information remains confidential. The lack of environmental awareness has led authorities to be lenient on industries for fear of economic losses. Also, the public does not participate in environmental policy-making or implementation. Setting standards requires the involvement of all stakeholders-- the government, business, NGOs and donors--in order for the standards to be effective and be followed.

Funding

Agencies cannot fulfill their duties without adequate funds. Only limited funding comes from the national budget because environmental issues are not on the priority list of the Vietnamese government. For example, efforts to inspect old vehicles and monitor air pollution have been minimal. The incentives for both government and industry are weak because of the high cost of treating pollution and the small fine for offenders. Various mechanisms to share the costs of treating pollution appear to be a promising way to address this issue, as was done in the case of eliminating lead from gasoline.

Funding issues also affect the area of focus. If there are projects lacking in certain areas, for example research on indoor air quality, there most likely has not been much financial support in that area. There is little money for environmental projects and of that amount, only a small proportion goes to air-related issues. If more donors and governmental agencies could provide resources, there will be more research and effective policy interventions in areas that have lacked attention.

Education and Training

Many projects cannot be implemented effectively because there is a very small cadre of qualified environmental specialists in governmental agencies. Nonetheless, there are some highly-qualified technical and environmental experts in Vietnam who are active in research on air pollution issues. With more financial support, these individuals and the technical institutions they belong to could educate and train others about the environment.

Communication and Coordination

Communication and coordination among agencies and donors are undeveloped. As a result, many efforts have been duplicated. Some coordination does take place, however. The VCEP Demo project in Hai Phong developed good relationships among the Hai Phong DOSTE, Center for Environmental Engineering of Towns and Industrial Areas (CEETIA), and Center for Preventive Medicine. These participants had assigned responsibilities in the Demo project and are required to coordinate with each other to continue with follow-up projects.

Enforcement

Enforcement of emissions standards and building regulations is weak. The agencies that monitor regulations have disincentives to enforce the policies because of opposition from industry managers and factory owners, who may be the government officials themselves. Industries do not feel compelled to follow regulations because the penalty is not severe. For example, upon inspection a factory might be found to be sub-standards. In such cases the authorities would normally give the factory a certain time period to comply with the regulations. The length of the time period depends on the severity of the pollution and the factory's technology. If the factory did not conform to the regulations, it would pay a fine, but this fine would be small compared to the high pollution treatment cost. Finally, if the factory still continued to operate in the same way, the authorities could order it to shut down or relocate. Unfortunately, the few instances where a company has been ordered to relocate have not worked because the authorities did not have enough power to force the company to move. In addition, they concerned about the potential social and economic

impacts of shutting down a factory. The tradeoff between economic and environmental demands must be considered. The lack of power and the lack of incentives prevent active enforcement. Enforcement, then, is very difficult. It requires funding, power, education, awareness and technology.

IV. “Civil Society” Involvement

No government can handle the country’s air quality issues on its own. There needs to be the involvement of non-governmental agencies. Non-governmental groups--industries, donors, mass organizations and citizens--need to have an active role, and they must understand that their participation is crucial to improve Vietnam’s air quality.

Citizen Groups

Even though Vietnamese society has little input in environmental policies, citizens in some towns have demonstrated the potential power the people have in environmental policy. Pressure from communities through protests, letter-writing, and petitions regarding the pollution from Dona Bochang Textiles, Lam Thao Fertilizer Company, Viet Tri Chemicals, Ba Nhat Chemicals and Tan Mai Paper Mill pushed the local government into action on environmental regulations.³² Vietnamese citizens do not realize they have the right to participate in projects and to have access to information regarding the environment. Again, encouraging public participation strengthens the projects and standards and motivates the public to observe the laws, which they help develop. But these mass organizations need to take it upon themselves to deal with the situation and not wait until the government or someone else to solve problem.

Donors

Non-governmental organizations, universities, and development agencies have participated in promoting and funding environmental protection in Vietnam. Even though there are many international NGOs in Vietnam, most focus on poverty alleviation and socio-economic issues. Agencies cannot fulfill their duties without adequate funds. Only limited funding comes from the national budget because environmental issues are not on the priority list of the Vietnamese government. For example, efforts to inspect oil vehicles and monitor air pollution have been minimal. The incentives for both government and industry are weak because of the high cost of treating pollution and the small fine for offenders. Various mechanisms to share the costs of treating pollution appear to be a promising way to address this issue, as was done in the case of eliminating lead from gasoline.

Funding issues also affect the area of focus. If there are projects lacking in certain areas, for example research on indoor air quality, there most likely has not been much financial support.

The technical institutions and donors listed below are many, but they need to coordinate more with each other to avoid duplication of efforts. There have already been sixteen projects dealing with cleaner production (please see table below). These projects may be under the same subject heading, but each deals with a different industry or production method. On the other hand, there are still many projects that promote cleaner production while there are only a few on indoor air.

Table 12: Current Cleaner Production Projects³³

Project	Donors
Vietnam Cleaner Production Centre	Swiss/UNIDO
Promoting Clean Production Investments in Developing Countries	Norway/UNEP
Industrial Pollution Prevention Pilot Project	World Bank
Vietnam Canada Environment Project	Canada
Industrial Pollution Reduction in Viet Tri	UNDP/UNIDO
Industrial Pollution Reduction in Dong Nai	UNDP/UNIDO
Reduction of Industrial Pollution in Ho Chi Minh City	Sida/ UNEP
Cleaner Production in the Pulp and Paper Industry	Sida/UNEP
Pollution Prevention in the Textiles Industry	Canada/VISED
Pollution Prevention Training Course	Sweden
Ho Chi Minh City Environmental Management Project	UNDP/UNIDO
Waste water treatment technology transfer and CP demonstration	Australia
Clean Production and Waste Management for SMEs	Canada
Industrial Environmental Protection Policies	UNDP/UNIDO
Pollution Prevention Policy Development	Australia
National Pollution Reduction and Control Strategy	Denmark

(Source: UNDP, MPI)

Asian Development Bank (ADB)

The ADB intends to identify key air pollution sources by developing an air pollution tracking database. The results will be used to develop air quality legislation and action plans for reducing air emissions. The ADB has funded projects in the climate change sector, such as the Least-cost Greenhouse Gas Abatement Strategy for Asia, the Economics aspects of GHG emission mitigation, and an initiative to make the distribution of electricity more efficient. The ADB is assisting Vietnam in developing an action plan to reduce emissions from mobile sources.

The Asia Foundation

The Asia Foundation collaborates with US-AEP to provide grants for environmental projects administered by civil society organizations. One of the projects will involve improving the environmental management and awareness of the transport industry in Hanoi.

Canadian International Development Agency (CIDA)

CIDA is currently involved in the Vietnam Canada Environment Project, which tries to strengthen environmental management authority in Vietnam.

Global Environment Facility (GEF)

GEF has also been involved with the climate change sector in Vietnam. Along with UNDP and UNITAR, GEF assists Vietnam in implementing the UNFCCC and climate change control. Two GEF projects are the Least-cost Greenhouse Gas Abatement Strategy for Asia and the Economics aspects of GHG emission mitigation.

Norwegian Agency for International Development (NORAD)

The Norwegian Government, through NORAD, will be funding the Air Quality Monitoring (AQM) Project in HCMC to set up a network of stations with adequate software and training packages.

Sweden International Development Assistance (SIDA)

SIDA is collaborating with the Government of England in the climate change impact analysis.

United Nations Development Program (UNDP)

The UNDP initiated the first air-quality monitoring project in Ho Chi Minh City. The project will measure ambient air, urban background, and residential and industrial air pollution levels. Among the projects are the conversion to hydrocarbon aerosol propellant technology at a cosmetics company and the CFC-recycling and emissions reductions in refrigeration.

United Nations Industrial Development Organization (UNIDO)

UNIDO funds the Demonstration Project, which determines alternatives to the use of methyl bromide at the Vietnam Fumigation Company. The agency is involved with the phase-out of ODS at two industrial refrigeration plants.

United States-Asia Environmental Partnership (US-AEP)

USAEP has engaged experts to develop a pollution prevention strategy to be carried out with the Ministry of Industry. Cleaner production practices are also being introduced into small and medium enterprises in villages surrounding Hanoi through a grant from the Colorado Business Alliance. In Ho Chi Minh City, an air monitoring capacity project with the California Air Resources Board (CARB) is underway.

World Bank

The World Bank has been developing industrial pollution prevention (IPP) policies. The project is about to begin the fourth phase: pilot projects in two provinces. The provinces have not been determined yet because the Bank needs the government's approval for the pollution policy. However, the project already has held meetings and workshops to discuss pollution prevention policies, has conducted a policy study on pollution prevention, held workshops for government officials and factory managers, and has presented the results of the research done and possible proposals for pollution prevention policies.³⁴

Technical Institutions and Experts

Vietnam has numerous technical institutions, experts, and university departments in the environmental field. Universities have departments that collect data and perform research on environmental issues. These local organizations have a great deal of experience, but they need to build their management capacity. Some of the national environmental NGOs are listed below:

Institute of Environment and Natural Resources - National University of Ho Chi Minh City - a research and development institution primarily focuses on three major areas: research, training and transfer of technology in the field of environmental protection, including air quality improvement.

Center for Environmental Engineering of Towns and Industrial Areas (CEETIA), Hanoi University of Civil Engineering, provides its northern clients with a wide variety of consultations and environmental services in the fields of urban and industrial air and noise pollution control and monitoring, including field sampling and lab analysis.

Center for Environmental Science and Technology (CEFINEA) conducts air pollution research. It is located in Ho Chi Minh City and sells air treatment equipment to industries.³⁵

Center for Environment Research, Education and Development (CERED) conducts research on climate change and is involved with the International Geosphere, Biosphere Programme.

The Environmental Protection Center (EPC) is an environmental consulting company involved in EIA, pollution surveys, and environmental studies. EPC monitors and environmental issues and provides information for public consumption.

The Vietnam Association for Conservation of Nature and Environment (VACNE) focuses on awareness activities and training. The organization publishes the Green Vietnam magazine.

In addition, there are many other organizations and agencies, those we are lacking information.

Industries

A number of private corporations are becoming more involved in air quality efforts. Companies, such as Vietnam National Petroleum Corporation and Vietnam Gas Company, are conducting feasibility and pilot studies on technology and production methods to improve air emissions.

Foreign-owned companies in Vietnam tend to have more advanced technology and do not pollute as much as the state-owned enterprises (SOEs), which usually use old, out-dated technology. These corporations set environmental standards for their companies and invest in new technology, such as dust collectors and filters. Unilever in Vietnam has invested VND 2.5 billion in environmental protection for the Hanoi site. Some foreign companies have implemented environmental training and education projects, such as the Ford Visiting Engineer and Scientist Program, which supports the training of engineers and scientists on safety, environmental regulations, etc.

Industries can also help raise awareness by funding environment activities, like the support for Green Day and the phase-out of lead. By establishing a corporate policy or commitment to environmental protection, companies can raise the workers' concerns about the working environment and improved air quality.

But not all companies willingly adhere to environmental standards. The problem is due to weak enforcement, low environmental protection incentives, low fines, economic tradeoffs, and the company's reluctance to spend money for a better environment. It is important for companies to take part in the improvement of air because the government and other organizations cannot oversee all the industries in the country.

V. Current Projects

Appendix A lists of some current air quality projects; and Appendix B lists some agencies' contact information. According to DOSTE in HCMC, there are few projects on air quality. Of these, most deal with air monitoring. Four air monitoring stations have already been installed in HCMC, and five new will be added within the next two years. Many more projects listed in Appendix A table relate to climate change. Here needs a little explanation of the focus on climate change projects. In 1992 Vietnam signed the United Nations Framework Convention on Climate Change (UNFCCC), which seeks to limit the amount of greenhouse gas emissions. To fulfill the UNFCCC objectives, Vietnam has been measuring greenhouse gas emissions and implementing projects on climate change. In addition, many countries view climate change as a serious threat to the global environment. Even though Vietnam may not release as many greenhouse gases as other developed countries, some donors probably feel it is necessary to decrease all emissions before more damage is done to the ozone layer. As a result, areas dealing with climate change and air monitoring have active projects, projects that deal with public awareness, environmental education, regulations and enforcement lack resources. The Official Development Assistance (ODA) Fund provides very little to air pollution projects. ODA projects focus on these five areas: agriculture and rural development; industrial development; national road improvement; human and institutional development; and social and cultural development. Those that do deal with environmental protection are classified in the "green" field. Only 2.7 percent of environmental funds support the urban environment.³⁶

VI. Components of an Integrated Air Quality Action Plan

Objective

To monitor and control air quality in order to reduce the negative impacts on health, productivity and the eco-system in Vietnam.

To implement and enforce efficient and effective pollution reduction and prevention strategies.

Mobile Source Emissions

Pollution from motor vehicles has caused a huge increase in dust and SO₂ pollutants. The increasing number of vehicles in the cities requires stricter standards and monitoring to curb the growth of air pollution.

Institutional Structure and Management

The Asian Development Bank has proposed an action plan to reduce vehicle emissions in Vietnam. (See Appendix C for a detailed description of the action plan). This plan requires the involvement and support of all stakeholders: national and local governments, development organizations, businesses and NGOs. The plan tries to strengthen the involvement of stakeholders, assign responsibilities to agencies involved with air protection, and decrease the bribery and corruption of enforcers. Currently, numerous agencies have roles in mobile source pollution management. MONRE, MOST, MOT,

DOSTE, the Vietnam Register, and development agencies are some of the involved participants. The following table indicates the agencies responsible for certain actions before and after the action plan.

Table 13: Current and Suggested Institutional Structure for Mobile Source Pollution

Action	Current Responsible Agency	Suggested Responsible Agency
Emissions standards	MONRE, MOST, MOT, MOI, Vietnam Register	MONRE, MOST, MOT
Fuel standards	MONRE, MOST, MOT	MONRE, MOST, MOT
Inspection and maintenance	MOT, Vietnam Register, NEA	Government, MONRE, MOST, MOT, Vietnam Register
Transport management	Government, MONRE, MOST, MOT, People's Committees	MOT, Public Transport Authority
Awareness raising and information-sharing	Vietnam Register, Traffic Police, DOSTE	MONRE, MOST, MOT, People's Committees, DOSTE

Economic Incentives and the Enforcement of Environmental Law

Over the past decade, laws have been drafted and projects established to protect the environment. Unfortunately, the implementation and enforcement of such policies have been ineffective. Air pollution from mobile sources has not yet been reduced through these programs. Therefore, it is necessary to tighten standards and enforce the laws. Coordination and communication among all the involved agencies must improve for the plan to work. Decision-makers also need to be educated on environmental issues and their impact on health, productivity, and the environment. Only then will they realize the importance of protecting air quality.

Public Participation and Education

A serious effort to limit air pollution in Vietnam requires public awareness of pollution and its consequences. Environmental information must be distributed more widely among the public and government officials and government agencies must do their part to encourage environmental awareness and action among the public.

Stationary Source Emissions

Factories, especially the cement and chemical industries, emit high volumes of dust, SO₂, CO, and other pollutants. Residents living in the vicinity have to endure air and other types of pollution where agricultural land has been damaged to the point where the productivity of rice has been reduced by 20 to 50 percent.³⁷ Hence, it is necessary to set standards for industrial emissions and require stricter enforcement of the standards. Industries must apply air pollution reduction and prevention measures by using more environmentally efficient technology.

Indoor Air Pollution

Industries and households need to be aware of the effects of indoor air pollution. Factories with poor ventilation and filtration systems can cause workers to become ill and less productive. Cooking in homes also contributes to indoor air pollution. The smoke and

other fumes from cooking linger in the homes and cause negative health conditions. Therefore, stricter building standards and monitoring must be applied to improve indoor air quality.

VII. Conclusion

Air pollution will become a serious problem throughout Vietnam if action is not taken. This report reviews previous projects and integrates the suggestions to improve air quality from mobile sources, stationary sources and indoor locations. Communication, cooperation, education, funding and enforcement are vital in the implementation of this plan.

Research on air pollution reveals that vehicles emit most of the harmful pollutants. Therefore, it is necessary to reduce the vehicle emissions. However, even if the newer vehicles release fewer pollutants, the rapid increase in the number of vehicles will cancel out the lower emissions rate. Consequently, both vehicle emissions and the growth rate of vehicles need to be reduced.

Industrial pollution needs to be dealt with in a different way. Stationary source emissions can be reduced through stricter policies, stronger enforcement, better technology and heightened awareness for both companies and government. The knowledge that cleaner production today can lead to a lasting and more economically feasible future has to be realized in order for companies to comply with the environmental standards. Clean air policies require the participation of all stakeholders if they are to be implemented successfully.

Vietnam already has shown that it is possible to improve air quality. The country has successfully phased out lead in gasoline and has moved several steps forward in the areas of air monitoring and climate change. Numerous projects and research in those two specific areas have taken place. This progress demonstrates that it is also possible for the country to address all issues relating to air quality.

The environment and the economy can have a positive relationship. When the environment improves, the economy can still grow. The government, companies and public need to realize that fact. Air plays an important role in everyday life. With cleaner air, the Vietnamese people will have fewer health problems, better working conditions and higher quality of life. It is worth the time, effort, and resources to protect clean air and stop the clouds from gathering over Vietnam.

¹ The United Nations. *World Urbanization Prospects: The 1999 Revision*.

² Dana O'Rourke's Community-Driven Regulation: New Strategies for Balancing Development and the Environment in Vietnam (Cambridge, MA: MIT Press, 2001), 60-61.

³ IMF, 1998.

⁴ Development Strategy Institute, 1998.

⁵ Intellasia. <http://www.intellasia.com/pdf_stats/trade.htm>, cited 11 July 2002.

⁶ Vietnam Business News. <http://www.vacch.org/VBN_112200.htm>, cited on 11 July 2002.

⁷ Multisectoral Action Plan Group. Integrated Action Plan to Reduce Vehicle Emissions in Viet Nam. 16

May 2002, 11-12.

⁸ Alternative Policy Study: Reducing Air Pollution in Asia and the Pacific

<<http://www.unep.org/Geo2000/aps-asiapacific/>> cited on 7 June 2002.

⁹ Xuemei Bai. "A Comparative Study of Urban Environment in East Asia: Stage Model of urban Environmental Evolution." *International Review for Environmental Strategies*. Vol. 1, No. 1, 2000, 135-158.

¹⁰ "An Association Between Air Pollution and Mortality in Six US Cities". *New England Journal of Medicine*. 329:1753-1759 (December 9), 1993, pp. 281-282.

¹¹ "Air Pollution". State of the Environment Vietnam 2001. UNEP, 79.

¹² Integrated Action Plan to Reduce Vehicle Emissions in Viet Nam, 7.

¹³ "Air Pollution," 80.

¹⁴ "Air Pollution," 80.

¹⁵ Integrated Action Plan to Reduce Vehicle Emissions in Viet Nam, 9.

¹⁶ Daniel S. Greenbaum. The Health Effects of Motor Vehicle Emissions. Action Plan for Reducing Vehicle Emissions Regional Workshop.

¹⁷ John Harte et al. Toxics A to Z. (Berkeley, CA: University of California Press, 1991), 257.

¹⁸ Methane emissions from rice fields in South-East Asia.

<http://www.silsoe.cranfield.ac.uk/iwe/research/methane.htm>, cited on 20 July 2002.

¹⁹ "Air Pollution," 83.

²⁰ "Air Pollution," 83.

²¹ Blue Cross Foundation Helps Continue Anti-Smoking Program for Vietnamese Minnesotans.

<http://www.mcf.org/mcf/whatsnew/archives/Feb2001/bcbs010213.htm>, cited on 20 July 2002.

²² Air Quality Management in Ho Chi Minh City, 5 and 7.

²³ "Air Quality Management Strategy," Ho Chi Minh City Environmental Strategy, 1.

²⁴ Air Quality Management in Ho Chi Minh City, 3

²⁵ Dang Viet Khoa. Development of Environmental Standards in Vietnam.

²⁶ Integrated Action Plan to Reduce Vehicle Emissions in Viet Nam, 4.

²⁷ "State Management System of Environment Protection," Enhancing the Roles of Businesses in Environmental Protection Forum. 27 November 2001.

²⁸ A Study on Aid to the Environment Sector in Vietnam. (Thailand: Dyna Print Limited, 1999), 110.

²⁹ Integrated Action Plan to Reduce Vehicle Emissions in Viet Nam, 4.

³⁰ Integrated Action Plan to Reduce Vehicle Emissions in Viet Nam, 5.

³¹ Integrated Action Plan to Reduce Vehicle Emissions in Viet Nam, 21.

³² O'Rourke, 79-108.

³³ A Study on Aid to the Environment Sector in Vietnam, 120.

³⁴ A Study on Aid to the Environment Sector in Vietnam, 113.

³⁵ U.S. Department of Commerce. Vietnam Environmental Technologies Export Market Plan. Washington, D.C.

³⁶ A Study on Aid to the Environment Sector in Vietnam, xiv.

³⁷ "Air Pollution," 81.

Appendix A: Some Current Air Quality Projects in Vietnam

Subject	Project	Working Area	Partners
Awareness	Community Environmental Health Improvements for the Provincial Towns	Develop a community environmental health program to target (1) women & children; (2) households in areas with greatest disease burden and risk of disease from lack of water and sanitation facilities; (3) public areas such as markets and schools	Vietnam's Women Union, ADB
Awareness	Support of SMEs through Radio	To support Small and Medium Enterprises through radio training	SIDA
Awareness	Energy Policy Systems Analysis Project	Part of a regional project to enhance awareness of technical and policy options for environmentally friendly power sector, to transfer model and skills to identify solutions to environment problems and to promote policy cooperation and information sharing	AUSAID
Climate Change	Demonstration Project	Developing alternatives to the use of methyl bromide on stacked bags of rice, grain in silos and timber at the Vietnam Fumigation Company	Vietnam Fumigation Company, UNIDO
Climate Change	Least-Cost Greenhouse Abatement Strategy for Asia		GEF, ADB, HMS, IAPD, IOE, ISF, MOT
Climate Change	Economic aspects of GHG emission mitigation		GEF, ADB, HMS, IAPD, IOE, ISF, MOT
Climate Change	Analysis of climate change impacts		Center for Environment, Education and Development Research, the Government of England, SIDA
Climate Change	Phasing out ODS	Phase-out ODS at industrial refrigeration plants	Searefico and Searee companies, UNIDO
Climate Change	Conversion to hydrocarbon aerosol propellant technology	Convert to hydrocarbon aerosol propellant technology in the cosmetics industry	Saigon Cosmetics Company, Daso Company, CP&T, UNDP
Climate Change	CFC-Recycling and emissions reductions	CFC-Recycling and emissions reductions in the commercial refrigeration sector	Food Industry Research Center, UNDP, Australia
Climate Change	CFC emission reductions	CFC emissions reductions in spinning halls air conditioning systems in Vietnam	VINATEX, AFD
Climate Change	Capacity Building Adapt to Climate Change	To contribute to reducing vulnerability to loss of life and economic loss from the adverse impacts of climate change in the flood prone areas of Central Vietnam by improving capacity at the national and local level to develop adaptation strategies	CECI
Emissions Tightening	CNG	Pilot study and feasibility plan for nationwide consumption of LPG and the use of CNG for small vehicles	Vietnam Gas Company

Emissions Tightening	CNG compressors	Project to import CNG compressors	Petro Vietnam
Emissions Tightening	Motor vehicle pollution reduction	Checking the motor vehicle emissions, regulating time schedules for motor vehicles, reducing traffic congestion	Department of Transport and Public Works, Department of Public Security Police
Finance	Bilateral Mixed Financing Agreement (Financing Assistance to Infrastructural and Industrial Projects)	To finance the infrastructure and industrial projects of the public sector. Sectors of priority: energy, telecommunications, transport, textile, food industry, etc.	MOF, State Secretariat for Economic Affairs, Switzerland (SECO)
Finance	Environmental Fund, phase II	To support initiatives and activities for environmental protection by community groups and organizations	SIDA
Finance	Credit Line for Environmental Investments	To support small-scale environmental investments	SIDA
Fuel Standards	Phasing out lead from gasoline	To assist Vietnam in switching from lead gasoline to unleaded gasoline through	World Bank, US-AEP, Ford, International Bank for Reconstruction and Development
Health	Environmental Health and Urban Development		WHO, MOH
Health	Acute Respiratory Infections	(1) Expand the program throughout the country, aiming at providing access to correct case management of ARI to 100% of under-five children by the year 2000; (2) Improve and appropriately alter mother's or caretaker's attitudes to ARI	MOH, UNICEF
Health	National Strategy on Non-Communicable Diseases		WHO
Industrial Pollution	Industrial Pollution Reduction Program	List of seriously polluting industries, establishment of the revolving and supporting funds for pollution reduction, and implementation of cleaner production demonstration projects.	HCMC DOSTE, Department of Industry, Department of Planning and Investment, HIFU
Industrial Pollution	Industry Relocation	Remove polluting industries from residential areas	HCMC DOSTE, Ministry of Industry, HIFU, Management Board of Ips and EPZs
Industrial Pollution	Industrial Pollution Management-Action Plan	Minimize, reduce and better manage the industrial pollution in Haiphong	Haiphong DOSTE, World Bank
Industrial Pollution	Industrial Pollution Prevention Pilot Project		World Bank
Industrial Pollution	Vietnam National Cleaner Production Center, phase II	To facilitate application of cleaner production in Vietnam industry	SDC, Ministry of Education and Training (MET)
Industrial Pollution	Reduction of Industrial Pollution	To assist DOSTE in HCMC in institutionalizing the success of the past	DOSTE, SIDA, UNIDO

	in HCMC, Phase II	demonstration project by transferring and adapting international state-of-the-art know-how. Thereby, it is envisaged that mechanism and technical capacity can be developed to promote large scale application of cleaner production in the industrial sector in HCMC	
Infrastructure	Road Improvement	(1) Rehabilitate the project road to an economically maintainable condition; (2) To improve rural accessibility and agricultural incomes; (3) Reduce transport costs by facilitating more efficient transport services; (4) Improve road safety; (5) To strengthen the institutions concerned with road management and administration	MOTAC, ADB
Infrastructure	Proposed Urban Transport Improvement Project	To increase operational efficiency and safety on selected corridors and in the central areas of Hanoi and Ho Chi Minh City. To improve the traffic flows, it will introduce a package of traffic engineering and management measures that will redesign junctions, provide new traffic signals and controls, segregate 2 and 4 wheeled traffic, and improve facilities for pedestrians.	World Bank, HCMC People's Committees
Infrastructure	Hanoi Urban Infrastructure Development Project	To provide basic infrastructure for urban development in Thang Long North Area: road systems, water supply, drainage, waste water treatment, and power supply.	Hanoi People's Committee, JBIC
Infrastructure, Management and Capacity Building	HCMC Environmental Improvement	To improve the urban environment through appropriate urban infrastructure and development and the effective and sustainable management of urban service	HCMC People's Committee, ADB
Management and Capacity Building	Air Quality Management Plan	Air pollution plan to improve the air quality in Haiphong through emissions strengthening and monitoring, capacity building, public awareness, energy conservation, air pollution treatment, traffic management, and vehicle inspection and management	Haiphong DOSTE, World Bank
Management and Capacity Building	VCEP	Vietnam Canada Environment Project support the NEA and DOSTE staff trainings	DOSTE, NEA, CIDA
Management and Capacity Building	Localizing agenda 21: Action planning for sustainable development in Vinh City	To strengthen local Government planning and management capacity in secondary cities	People's Committees of Vinh City, Belgian Administration for Development Cooperation, MOC
Management and Capacity Building	To establish a business support center	To develop and strengthen environmentally sustainable vocational entrepreneur activities in 10 communes spreading over 4 districts in HCMC	Council of Industrial Cooperative and Non-State Enterprises, Netherlands Development Organization (SNV)
Management and Capacity Building	Capacity Building Center for Sustainable development	Supporting SMEs to integrate environmental issues into their business and developing strategy	SNV, MOI

Management and Capacity Building	VIE/ENY/0149 SRV-0020 Petrovietnam/SFT/OD Oil Industry	To develop management systems on safety and working environment, and pollution control in the Vietnamese petroleum industry through institutional support from the Norwegian Petroleum Directorate and the Norwegian state Pollution Board	PetroVietnam, NORAD
Management and Capacity Building	Vietnam Transportation Development Strategy to the year 2020	To formulate a long term development strategy of national transport system to the year 2000	JICA, MTP
Management and Capacity Building	Capacity Building to Urban Management in Hanoi	Assist the municipal authorities to expand and adapt the current capacity to manage change in a climate of growing pressure in responding to investment offer while attempting to construct a people-centered and cost-effective development framework.	Hanoi People's Committees, UNDP
Management and Capacity Building	Strengthening the Capacity for Urban Management and Planning in Ho Chi Minh City	To enhance HCMC management and planning capacity to rehabilitate and expand infrastructure while at the same time deliver affordable and equitable social services	HCMC People's Committee, UNDP
Management and Capacity Building	Improved urban Industrial Environment	To assist the government to develop sound environmental policy and execution. Component of 2 program include improved urban environmental management and increase technology transfer	MOSTE, USAID/ (US-AEP)
Management and Capacity Building	Strengthening of environmental management	To strengthen the capacity and competence for environmental management in Vietnam	MOSTE, SIDA
Management and Capacity Building	Urban Environmental Planning Program	Study to prepare an environmental planning program in 3 medium-size cities in Vietnam.	EU
Monitoring	HCMC-CARB	Air monitor capacity	US-AEP, CARB
Monitoring	Air Quality Monitoring Network	Air quality monitoring network in HCMC	NORAD, DOSTE
Monitoring	Environmental Management in HCMC	Install 4 air quality monitoring stations in HCMC	HCMC People's Committee, UNDP
Regulations	Regulatory framework in environmental protection	Environmental laws and regulations	MOSTE, USAEP
Regulations	Chemical Safety		WHO
	Nam Dinh Urban Development	(1) First stage improvement to drainage and sewerage; (2) design and implementation of a solid waste collection system; (3) Support to water supply distribution; (4) First stage implementation of PAR	Nam Dinh People's Committee, SDC

(Source: Vietnam INGO Directory, 2001-2002)

Appendix B: Some Agencies' Contact Information:

Agency	Address	Telephone number, fax number and e-mail
Asia Development Bank (ADB)	Unit 701 - 706, Sun Red River Bldg. 23 Phan Chu Trinh Street Hanoi, Viet Nam	Tel: 84-4 933 1374 Fax: 84-4 933 1373 Email: adbvrm@adb.org
Australian Agency for International Development (AUSAID)	Australian Embassy Van Phuc Compound, Hanoi	Tel: 84-4 831 7754 Fax: 84-4 831 7706
Canadian International Development Agency (CIDA)	Embassy of Canada 31 Hung Vuong St. Hanoi, Viet Nam	Tel: 84-4 823 5500, 823 5759 Fax: 84-4 823 5333
Danish International Development Assistance (DANIDA)	Embassy of the Kingdom of Denmark 19 Dien Bien Phu Hanoi, Vietnam	Tel.: 84-4 823 1888 Fax: 84-4 823 1999 Email: AMBADANE@netnam.org.vn
Global Environment Facility (GEF)	GEF/SGP National Coordinator UNDP 25-29 Phan Boi Chau, Hanoi	Tel: 84-4 825 7495 Fax: 84-4 825 9267
Haiphong DOSTE	1 Pham Ngo Lo, Q. Ngo Quyen Haiphong, Vietnam	Tel: 84-31 846 475 Fax: 84-31 845 183
Hanoi DOSTE	2 Phan Chu Trinh Alley, Hanoi, Vietnam	Tel: 84-4 934 5686 Fax: 84-4 927 1159
Ho Chi Minh City DOSTE	244 Dien Bien Phu Street District 3 Ho Chi Minh City, Vietnam	Tel: 84-8 932 6709 Fax: 84-8 932 5711
Japan Bank for International Cooperation (JBIC)	6th Floor, 63 Ly Thai To Street Hanoi, Viet Nam	Tel.: 84-4 824 8934 Fax: 84-4 824 8937
Japan International Cooperation Agency (JICA)	C2 Thanh Cong, Giang Vo Hanoi, Viet Nam	Tel: 84-4 831 0004 Fax: 84-4 835 5633
Ministry of Education and Training	49 Dai Co Viet Str., Hai Ba Trung Dist. Hanoi, Vietnam	Tel. 84-4 869 2396 869 4904; 869 4795. Fax: 84-4 869 4085
Ministry of Finance (MOF)	8 Phan Huy Chu Hanoi, Vietnam	Tel: 84-4 826 4872 Fax: 84-4 826 2266
Ministry of Health (MOH)	138A Giang Vo Str., Ba Dinh Dist. Hanoi, Vietnam	Tel.: 84-4 846 4051 Fax: 84-4 846 4051
Ministry of Industry (MOI)	54 Hai Ba Trung Str., Hoan Kiem Dist. Hanoi, Vietnam	Tel. 84-4 826 7870 Fax: 84-4 826 9033

Ministry of Planning and Investment (MPI)	49 Dai Co Viet Str., Hai Ba Trung Dist. Hanoi, Vietnam	Tel.: 84-4 869 2396 869 4904; 869 4795 Fax: 84-4 869 4085
Ministry of Planning and Investment (MPI)	2 Hoang Van Thu Str., Ba Dinh Dist. Hanoi, Vietnam	Tel.: 84-4 845 5298 Fax: 84-4 823 2494
Ministry of Science and Technology (MOST)	39 Tran Hung Dao Hanoi, Vietnam	Tel: 84-4 943 9731 Fax: 84-4 825 2733
Ministry of Natural Resources and Environment (MONRE)	83 Nguyen Chi Thanh Str., Hanoi, Vietnam	Tel.: 84-4 834 5709 Fax: 84-4 835 2191
Ministry of Transportation and Communication (MOTAC)	80 Tran Hung Dao Str. Hanoi, Vietnam	Tel. 84-4-8254012, 8252925, 8252309 Fax: 84-4-8267291
National Environment Agency	67 Nguyen Du Hanoi, Vietnam	Fax: 84-4 822 8750
Norwegian Agency for International Development (NORAD)	NORAD P.O. Box 8034 Dep. 0030 Oslo, Norway	Tel. (47) 22 31 44 00 Fax. (47) 22 31 44 01
Swedish International Development Authority (SIDA)	2 - Nui Truc Str., Van Phuc Quarter Hanoi, Vietnam	Tel: (84-4) 845 4824~5 823 5853~4 Fax: (84-4) 823 2195
Swiss Embassy/Agency for Development and Cooperation	16/F, 44B Ly Thuong Kiet Hanoi, Vietnam	Tel: (84-4) 934 6627 Fax: (84-4) 934 6633
The United Nations Industrial Development Organization (UNIDO)	UNIDO Country Director 25-29 Phan Boi Chau Hanoi, Vietnam	Tel: (84-4) 825 7495 Fax: (84-4) 825 9267
United Nations Children's Funds (UNICEF)	72 Ly Thuong Kiet St. Hanoi, Vietnam	Tel.: (84-4) 826 1170 Fax: (84-4) 826 2641 Email: unicef@netnam.org.vn
United Nations Development Programme (UNDP)	25-29 Phan Boi Chau Str., Hanoi, Viet Nam	Tel: (84-4) 825 7495 Fax: (84-4) 825 9267 Email: fo.vnm@undp.org or webmanager@undp.org.vn
United States-Asia Environmental Partnership (US-AEP)	3/F, Rose Garden Tower 6 Ngoc Khanh, Ba Dinh District Hanoi, Viet Nam	Tel: (84-4) 831 4580 Fax: (84-4) 831 4535
World Bank Group (WB)	Chief of Mission World Bank Resident Mission 63 Ly Thai To, Hanoi	Tel (84-4) 934 6600 Fax (84-4) 934 6597 Email: wbhanoi@netnam.org.vn

World Health Organization (WHO)	2A Van Phuc, Box 52, Hanoi	Tel: (84-4) 845 7901 Fax: (84-4) 823 3301 E-mail: who@netnam.org.vn
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Appendix C: Integrated Action Plan to Reduce Vehicle Emissions

Below is the Vietnam Register's action plan for vehicle emission reductions.

Action	Description	Responsible Agency	Donor	Expenses
Tightening Vehicle Emissions Standards	<ul style="list-style-type: none"> Issue tighter emissions standards for motor vehicles Issue sector standards and regulate the compulsory application of TCNVs for automobiles and motorcycles Set up emissions laboratory for light diesel and gasoline powered autos Set up emissions laboratory for heavy autos Set up emissions laboratory for motorcycle 	<ul style="list-style-type: none"> MOST, MORE MOT Government, MPI, MOT, MOF Government, MPI, MOT, MOF 	<ul style="list-style-type: none"> MOST, MORE ODA, state budget, bank loan, self-raised capital ODA, state budget, bank loan, self-raised capital 	<ul style="list-style-type: none"> \$8 million \$5 million \$2 million
Strengthening Vehicle Inspection	<ul style="list-style-type: none"> Expand the scope of compulsory emissions testing to the automobiles registered outside the four central cities Improve the applicable standards through step by step tightening the standards, which include reducing smoke level from automobiles and increasing emissions testing laboratories Develop roadside vehicle emission testing using remote sensing technology Conduct pilot study of advanced emission testing methods using loaded tests Develop a project for periodic inspection of motorcycle emissions and roadside testing Inspect periodically motorcycle emissions and invest in emission measurement equipment 	<ul style="list-style-type: none"> MOT, Vietnam Register MOT, Vietnam Register Vietnam Register, The Road and Rail police Department Vietnam Register Vietnam Register, Water and Road Transportation Police Department Government, MOT, MOST, MORE, Vietnam Register 	<ul style="list-style-type: none"> MOT 	<ul style="list-style-type: none"> \$1 million \$75,000-125,000 \$200,000-300,000

Strengthening Vehicle Maintenance	<ul style="list-style-type: none"> • Research and improve maintenance systems • Establish a plan to regulate compulsory maintenance of vehicles in between inspections • Enforce laws against owners of substandard vehicles 	<ul style="list-style-type: none"> • MOT • MOT, VN Road administration, Vietnam Register • Government, Water and Road Transportation Department 	<ul style="list-style-type: none"> • Foreign aid 	<ul style="list-style-type: none"> • \$100,000
Stricter Fuel Composition Standards	<ul style="list-style-type: none"> • Reduce benzene content and sulphur content gasoline and diesel • Improve quality of fuel: gasoline and diesel 	<ul style="list-style-type: none"> • MOST, MORE • MOT, Petro Vietnam 	<ul style="list-style-type: none"> • Petro Vietnam, MOST, MORE 	
Alternative Fuel Consumption	<ul style="list-style-type: none"> • Conduct pilot study on LPG consumption in gasoline powered vehicles • Set up emissions standards for LPG powered vehicles • Reduce VAT and corporate income tax with the use of LPG for taxis • Use LPG trucks in Hanoi and HCMC • Encourage cleaner fuel use 	<ul style="list-style-type: none"> • MOT • MOT, MOST, MORE • MOF • People's Committees, Departments for Transportation and Public Works • MOT 	<ul style="list-style-type: none"> • ADB, CAI 	<ul style="list-style-type: none"> • \$200,000
Increased Traffic Management	<ul style="list-style-type: none"> • Improve transport infrastructure, public transport, traffic flow • Reduce traffic density in Hanoi and HCMC • Limit use of motorcycles 	<ul style="list-style-type: none"> • MOT • Public Transport Authority 	<ul style="list-style-type: none"> • JICA 	
Raise Environmental Awareness	<ul style="list-style-type: none"> • Raise environmental awareness through conferences and seminars on environmental pollution for central and local leaders and policy-makers • Create and disseminate mass programs on vehicle emission properties and health and environmental threats • Create and disseminate mass programs on technical vehicle emissions issues, such as vehicle types, maintenance regimes, effect of fuel use, vehicle use regimes, and suitable measures for owners to reduce vehicle emissions • Develop a web site on vehicle emissions. Include information such as vehicle fleet growth, mobile source air pollution, measures of emission reduction, and new domestic and regional policies 	<ul style="list-style-type: none"> • MONRE, MOT, DOSTE, People's Committee • MONRE, Ministry of Culture, DOSTE, People's Committee • MONRE, Ministry of Culture, DOSTE, People's Committee • MOT, MONRE, DOSTE, People's Committees 	<ul style="list-style-type: none"> • ADB 	<ul style="list-style-type: none"> • \$50,000 • \$70,000 • \$70,000 • \$30,000

<p>Raise Public Awareness</p>	<ul style="list-style-type: none"> • Distribute information via the mass media about the rapid increase in Vietnam’s vehicle fleet, the necessity to reduce it, and owner’s responsibility regarding vehicle inspection and maintenance and retiring old vehicles • Organize mass media forums about public transportation and encourage investment in public transport services • Organize multi-sector seminars and workshops on urban transport pollution and transport planning 	<ul style="list-style-type: none"> • MONRE, MOT, Ministry of Culture, DOSTE, People’s Committees • MONRE, MOT, DOSTE, People’s Committees • MONRE, MOT 	<ul style="list-style-type: none"> • Foreign Aid and Government 	<ul style="list-style-type: none"> • \$50,000 • \$50,000 • \$50,000
<p>Water Spray and Road Sweeping</p>	<ul style="list-style-type: none"> • Implement water spraying and road sweeping to reduce dust. Invest in water trucks for spraying. 	<ul style="list-style-type: none"> • Departments for transportation and public works 		<ul style="list-style-type: none"> • \$5 million

**Appendix D: Summary of TSP and PM10 sampling results during the pilot study (1998)
in Hai Phong conducted between the Hai Phong DOSTE and VCEP**

Date	TSP (mg/m ³)					PM10 (mg/m ³)		
	DOSTE	Ngo Quyen	Lach Tray Street	Nguyen Trai School	Dang Hai	Health Center	Ngo Quyen	Ha Ly
20/02						0.085	-	0.066
26/02	0.260	0.660	0.410	0.320	0.160			
27/02						0.159	0.018	0.059
05/03	0.035		0.109	0.094	0.094			
06/03		0.350				0.273	0.117	0.184
12/03	0.196		0.700	0.180	0.145			
13/03		0.480				0.318	0.098	0.295
19/03		0.680	0.230	0.520	0.150			
20/03	0.110					0.070	0.037	0.076
26/03			0.243	0.304	0.120			
27/03	0.091	0.019				0.133	0.062	0.073
02/04	0.138		0.350	0.360	0.150			
03/04		0.420				0.148	0.077	0.098
09/04			0.260	0.129	0.112			
10/04	0.067	0.042				0.093	0.050	0.048
16/04			0.540	0.360	0.040			
17/04	0.448	0.388				0.247	0.179	0.174
23/04			0.200	0.560	0.070			
24/04	0.040	0.369				0.069	0.048	0.049
01/05						0.094	0.045	0.027
02/05		0.240		0.650	0.070			
03/05	0.132		0.200					
07/05	0.085	0.100	0.470	0.041	0.028			
08/05						0.053	0.031	-
14/05	0.055	0.110	0.300	0.350	0.130			
15/05						0.060	0.026	0.036
Mean	0.138	0.322	0.334	0.322	0.106	0.139	0.066	0.099
Geo Mean	0.105	0.215	0.298	0.255	0.094	0.117	0.054	0.077
Min	0.035	0.019	0.109	0.041	0.028	0.053	0.018	0.027
Max	0.448	0.680	0.700	0.650	0.160	0.318	0.179	0.295
N	12	12	12	12	12	13	12	12
N above STD	2	8	9	8	0	9	4	6
Standards 24 hours	0.200 mg/m ³ TCVN standard (TSP)					0.070 mg/m ³ WHO Guideline (PM10)		

Notes: A bold value represents an exceedance of the applicable standard or guideline
Date usually refer to the starting date of a 24 hour period

Source: Report on Demo Project on Air Pollution in Haiphong. DOSTE Hai Phong City and VCEP. 1999.