

2. WG Structure

Members are supposed to be outstanding researchers in the field of automotive and environment research, and lead supporting studies in respective fields. The member list of the WG is shown in Table 1. Country reports have been prepared as supporting studies to share up-to-date information on the progress. In order to draw viable policy recommendations, the project coordinator will work closely with the ASEAN secretariat.

Table 1: ERIA WG research members

| Country | Organization | Name | Research Field | Title |
|------------------------------------|--------------------------------------|-------------------------|-----------------------------|-----------------------------|
| The Republic of Indonesia | LPEM-FEUI University of Indonesia | □ Arianto Patunru | Economics | Research Director |
| Japan | JARI | ○ Kiyoyuki Minato | Environment | Senior Chief Researcher |
| Australia | Murdoch University | Frank Murray | Engineering | Associate Prof. |
| The People's Republic of China | Tsinghua University | Lixin Fu | Air pollution | Professor |
| The People's Republic of China | CATARC | Li Wei | Engine/ Environment | Director |
| The Republic of India | NEERI | Nitin Labhsetwar | Air Pollution | Senior Researcher |
| The Republic of India | ARAI | Amita Baikerikar | Automotive Engineering | Senior Assistant Director |
| The Republic of Indonesia | ITB | Iman K. Reksowardojo | Engine | Professor |
| Japan | Chuo University | Shigeru Kashima | Traffic Planning | Professor |
| The Republic of Korea | Soeul National University | Seung Young Kho | System Engineering | Professor |
| Malaysia | National University of Malaysia | Mazrura Sahani | Health Sciences | Program coordinator |
| The Republic of the Philippines | University of Philippines | Crispin Diaz | Urban and Regional Planning | Associate Prof. |
| The Republic of Singapore | LTA | George Sun | Traffic Engineering | Deputy Director |
| The Kingdom of Thailand | MTEC | Nuwong Chollacoop | Traffic/ Environment | Researcher |
| The Kingdom of Thailand | TAI | Threepol Boonyamarn | Engine | Engineering Section Manager |
| The Socialist Republic of Viet Nam | Hanoi University of Science | Nguyen Thi Ha | Traffic/ Environment | Associate Prof. |
| Japan | ERIA WG Secretariat | Masahiko Hori | | |
| Japan | ERIA WG Secretariat | Kiyomi Okiyama | | |
| Japan | ERIA WG Secretariat | Keiko Hirota | | |

□ Leader ○Sub-leader

Supporting study has been conducted to support and encourage the WS. An analytical measure to improve air pollution in Asian big cities that is data collection, evaluation of emissions from each category of vehicle and estimation of air pollution, has been conducted as supporting study in 2008. The trial study conducted by Japan Automobile Research Institute (JARI) was introduced at the second WS held in Bangkok during February 18, 19, 2009. Information about vehicles, traffic flow, regulations, standards, statistical data, evaluation method and others were provided by members as a part of country reports and technical presentations. However, these data were different from each country and in some cases, there was lack of data and analytical methods, and it appeared that common and precise data, statistical treatments and analytical measures are needed to plan appropriate strategies to improve air quality in Asian big cities.

3. Approach to Clean Air in Asia (Based on the supporting study)

3.1 Summary on Air Pollution in Asia

Global environment issues are being addressed as a pressing matter these days, and tackling them is considered to be an urgent need. However, difficult global challenges such as global warming are not the only current environmental issues making the daily lives of people at stake. Air pollution, a serious social issue as one of the environmental problems on a rather local scale, has been aggravated yet further, rather than solved.

Most human activities nowadays are performed in urban areas, and urbanization is a worldwide trend. Increasing activities in cities and the advances of urbanization have caused harmful effects on various local and city environments and even brought about severe health problems. The nature and manner of the advances of these city activities differ among countries, and the resulting environmental issues vary as well.

The improvement of living and income standards, among others, has encouraged the use of automobiles, and accelerated rapid motorization. On the other hand, poor public transportation systems have increased private use of cars (personalized transport), which has significantly contributed towards deterioration of the urban environment. Emission from motor vehicles is certainly affecting public health. Asian countries have a responsibility to improve urban environments in order to sustain and develop a motorized society, to regenerate environment friendly cities and to preserve the healthy and productive environment in society.

If the motorization enters into its full-scale stage and things are left as they are, aggravated energy problems and deteriorated urban environments will bear heavily in Asia. The main factors that motor vehicles cause the environment are air pollution, noise problems, and waste materials. Especially, Air pollution has become a serious issue in many Asian cities. It is important to immediately address this issue and implement environment-friendly transportation systems. Under the progress of motorization, Asian countries share similar problems related to automobiles. The main issues are as follows:

- (1) Worsening air pollution and increasing health impacts
- (2) Deterioration of living environment due to traffic noise and road

vibration.

- (3) Increasing deaths and injuries from traffic accidents
- (4) Traffic congestion from increasing traffic demands, leading to indirect health impacts and loss of man-hours.

We propose various technical and non-technical measures for tackling the present problem. These are based on some surveys and discussions during the various meetings of experts. To build up better automobile society in Asia, we should work on these issues:

Technical measures:

- (1) Reduction of emissions from motor vehicles by upgrading inspection and maintenance systems
- (2) Reduction of emissions from motor vehicles by improving the quality of fuels
- (3) Strengthening the restriction on emissions from motor vehicles
- (4) Popularizing clean energy and clean-energy vehicles
- (5) Promotion of harmonization of technical regulations.

Non technical measures:

- (1) Promotion of environmental education and awareness campaigns
- (2) Upgrading air pollution monitoring systems.

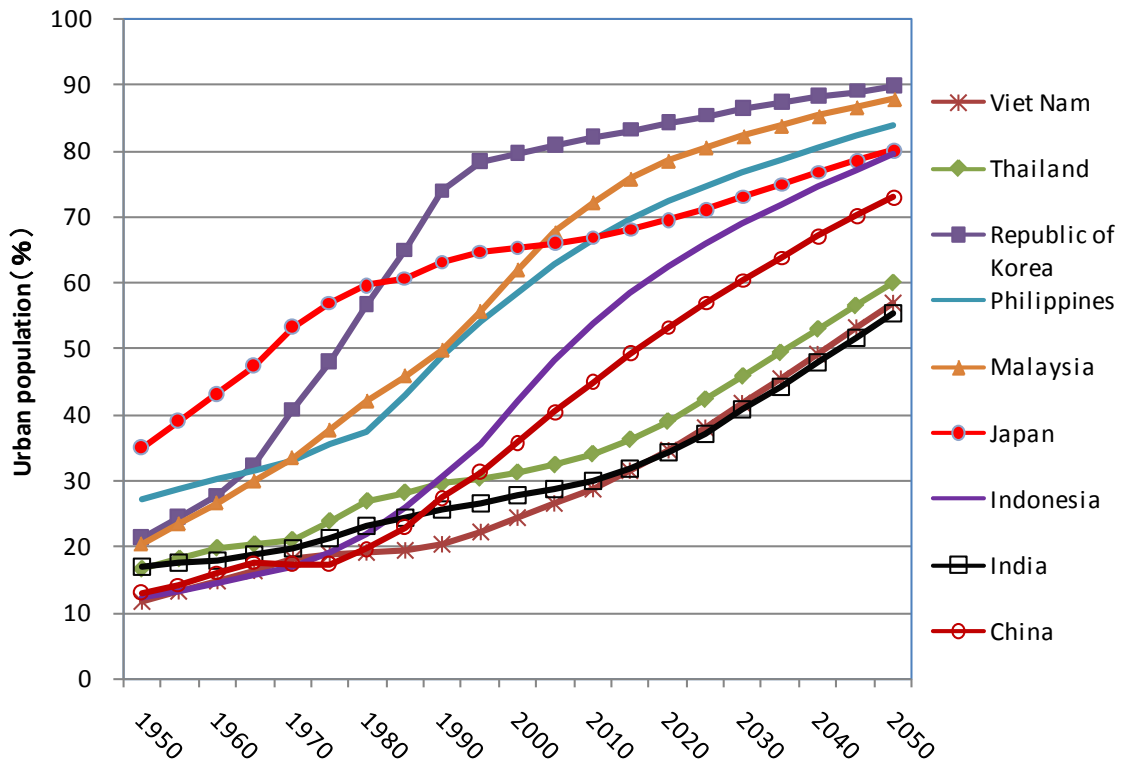
To deal with urban environments, it is essential to implement effective means such as accurate understanding of real traffic conditions and exact problems in each city and country. The measures stated above may show excellent cost effectiveness for Asian countries, and these policies and measures could prove techno-economically effective in improving urban air pollution. They need to grasp the current conditions, to predict future changes accompanied by the economic growth accurately and to examine measurements, which would work most effectively if conducted with simultaneous coalition and cooperation in the area. One of the most important objectives of this WG is to understand the success and failure of different measures to control the automobile pollution in different Asian countries and learn better implementation. This could be the first systematic exercise of its kind, dealing with the exploitation of experience from various Asian developing countries, rather than developed countries, which has so far been the trend in auto-emission management.

3.2 Asian scenario

(1) Urbanization in Asia

Indicators of air quality in the largest cities of Asia show that although many of these cities are among the most polluted in the world, air quality in many cities has generally been improving over the past few years. To improve air quality further, Asian cities must respond to the combined pressures of rapid growth in urban population, motorization, economic development, and energy consumption. Asia is expected to account for most of the growth in world economic activity by 2030. Asia currently has about 1.5 billion people living in urban areas, and this number is growing at an average of 4% per

year. Increasing urbanization presents considerable problems in Asia. Growing numbers of people are being attracted from rural areas to towns and cities with growing populations, where emissions are concentrated and air quality is most degraded. This results in increased exposure of population to air pollutants. The future urban population growth in most Asian countries will drive increasing motorization and will have serious consequences for urban road congestion and air pollution as vehicle numbers continue to grow.



Source: <http://esa.un.org/unpp/p2k0data.asp>

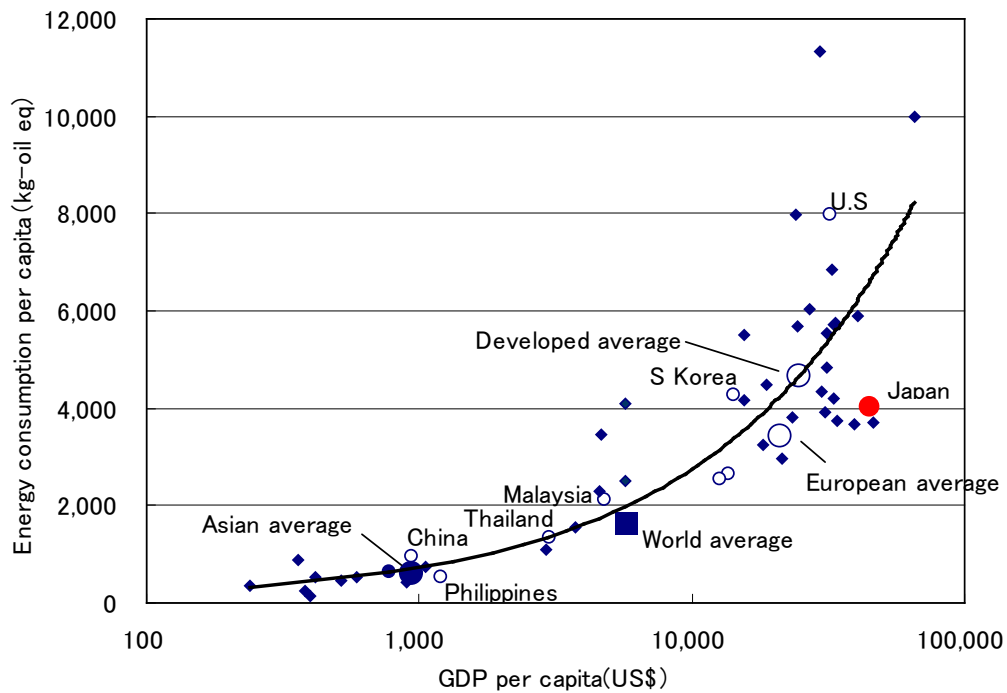
Figure 1: Urbanization in Asia

(2) Economic growth and energy consumption

As the populations of large cities is rapidly growing, increased demand is placed on the capacity of the city to provide energy, housing, employment, resources, and transportation (generally motor vehicle)—with potential to further increase emission load to already deteriorated air quality. Much growth in the world’s economic activity in 2030 is expected to be in Asia. The gross domestic product (GDP) in Asia has increased at a rapid pace over the last years and is expected to expand at an annual average rate of 5.7% compared with 3.3% per year for the world as a whole(IEA World Energy Outlook 2008).

The growth in GDP is leading to even stronger growth in energy consumption, with Asia expected to account for 40% of the total projected increase in world energy

consumption and 70% of the increase in developing country consumption by 2030. Population and economic growth have the potential to increase emissions in the absence of increasingly stringent measures to control these emissions. However, the most rapidly growing economies are generating the economic wealth and specialized knowledge needed for effective air quality management, fuel quality, emissions control technologies, and industrial restructuring, etc.



Source: IEA Energy Balances of Non-OECD Countries

Figure 2: Energy consumption and GDP

(3) Air pollution in Asian cities

The major sources of air pollution in Asian cities are motor vehicles, large stationary sources such as power stations and other major industries. Public demand for motorization in Asian countries is growing at different but usually at rapid rates. The types of motor vehicles in Asia are diverse, which affect the setting of emission regulations. Action to control emissions from motor vehicles has been impressive in many countries of Asia, but considerable challenges remain in some countries with the proliferation of old vehicles. The growth in vehicle population and the relatively large emission rates from certain types of vehicles in Asia represent particular challenges. The growth in motorization has the potential to increase emissions of HC, NO_x and particulate matter (PM) (See: Appendix 2-1, Table A 2.1), including particles with diameter not more than 2.5 microns (PM_{2.5}) if not effectively controlled. This can then lead to the production of photochemical smog and other air pollution as well as health problems extending far beyond the boundaries of cities. This would potentially have severe effects on food security

and biodiversity in agricultural and natural areas.

(4) Major issues to be implemented

(a) Reduction of motor vehicle emissions by upgrading Inspection and Maintenance (I&M) system

Combustion-powered vehicles naturally tend to deteriorate with age and usage, and as a result emission levels can rise significantly. Relatively inferior fuel quality and cheaper vehicle technology further contribute to I&M requirements. Good maintenance is required to keep emissions levels at or near design levels. Targeted I&M programs, however, can identify problem vehicles and assure their repair, thereby contributing substantially to lower emissions and improved air quality.

Without appropriate maintenance and check-ups, the performance and safety of motor vehicles will inevitably deteriorate, which will increase the environmental pollution. In Asia the ratio of used motor vehicles is high, and the longer a motor vehicle is used the more emissions it emits. While trading in used vehicles for new ones may be an effective solution, a motor vehicle I&M system or restrictions on motor vehicles emitting excess emissions can also reduce generation of emissions by 30 or 40%, at a much lower cost. Governments should establish at least the minimum number of items for motor vehicle I&M to ensure the safety of motor vehicles in use and prevent pollution. It has been identified during the present study that there are several issues and possible improvements with respect to I&M in many Asian countries. This could be an immediate recommendation towards achieving a Sustainable Automobile Society.

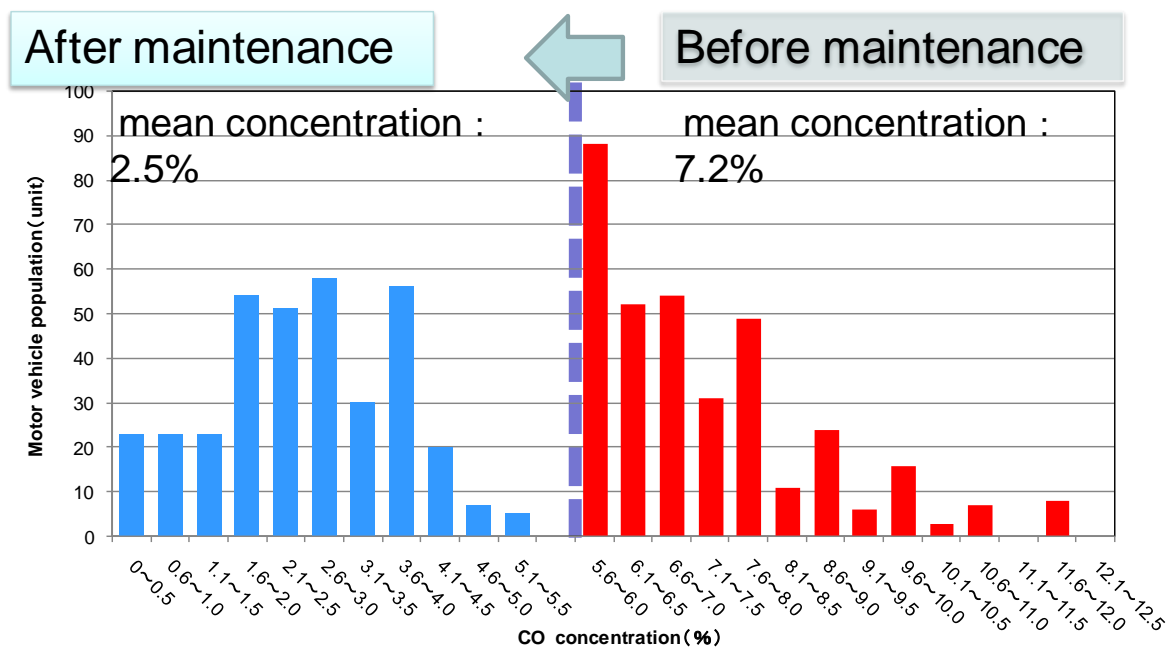


Figure 3: Non-I&M vehicles vs. I&M vehicles (CO)

(b) Strengthening the restriction on emission from motor vehicles

In Asia, motorization has caused air pollution in vast areas and has deteriorated living conditions. It is expected that the further increase of population and motor vehicles could make the level of air pollution much worse than at present. To lower the level of air pollution and to prevent damage to people's health, it is necessary to enforce a strict restriction of motor vehicle emissions.

Though several countries have been addressing this issue aggressively, Asian countries at present do not have harmonized emission regulations. Many countries began to develop emission regulations in the 1990s, some countries, especially the smaller ones, do not yet have emission regulations for new vehicles. The emphasis thus far has been on the development of emission regulations for light-duty four-wheeled vehicles, followed by emission regulations for heavy-duty vehicles. Table 2 indicates that the average lag time between Asia and Europe is gradually being reduced to less than 5 years for countries such as China, India; and Thailand. It may also be important to start implementing tougher regulations with respect to CO₂ emissions, considering the importance of global warming challenge.

Table 2: Current and proposed emission standards for new vehicles in Asia

| Country | 95 | 96 | 97 | 98 | 99 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 |
|-------------------------|-------------------------------------|--------|----|--------|--------|--------|--------|--------|--------|--------|-----------|---------------------|--------|--------|----|------------------------------|----|----|----|----|
| European Union | E1 | Euro 2 | | Euro 3 | | | Euro 4 | | | Euro 5 | | | E6 | | | | | | | |
| Bangladesh ^a | | | | | | | | | | | Euro 2 | | | | | | | | | |
| Bangladesh ^b | | | | | | | | | | | Euro 1 | | | | | | | | | |
| PRC ^a | | | | | | Euro 1 | | Euro 2 | | Euro 3 | | Euro 4 | | | | | | | | |
| PRC ^c | | | | | | Euro 1 | | Euro 2 | | Euro 3 | | Euro 4 Beijing only | | | | | | | | |
| Hong Kong, China | Euro 1 | Euro 2 | | Euro 3 | | | Euro 4 | | | Euro 5 | | | | | | | | | | |
| India ^d | | | | | | Euro 1 | | Euro 2 | | | Euro 3 | | | | | | | | | |
| India ^e | | | | E1 | Euro 2 | | Euro 3 | | | Euro 4 | | | | | | | | | | |
| Indonesia | | | | | | | | | | | Euro 2 | | | | | | | | | |
| Republic of Korea | | | | | | | | | | | Euro 4 | | Euro 5 | | | | | | | |
| Malaysia | | | | Euro 1 | | | | | | | Euro 2 | | | Euro 4 | | | | | | |
| Nepal | | | | | | Euro 1 | | | | | | | | | | | | | | |
| Pakistan | No conclusive information available | | | | | | | | | | | | | | | | | | | |
| Philippines | | | | | | | | | Euro 1 | | Euro 2 | | | | | | | | | |
| Singapore ^a | Euro 1 | | | | | Euro 2 | | | | | | | | | | | | | | |
| Singapore ^b | Euro 1 | | | | | Euro 2 | | | | | Euro 4 | | | | | | | | | |
| Sri Lanka | | | | | | | | | Euro 1 | | Euro 2 | | | | | | | | | |
| Taipei, China | | | | | | | | | | | US Tier 1 | | | | | US Tier 2 Bin 7 ^f | | | | |
| Thailand | Euro 1 | | | | | Euro 2 | | Euro 3 | | | Euro 4 | | | | | | | | | |
| Viet Nam | | | | | | | | | | | Euro 2 | | | | | | | | | |

Source: ADB A Road Map for Cleaner Fuels and Vehicles in Asia, 2008

(c) Reduction of motor vehicle emissions by improving the quality of fuel

Over the course of the past 30 years, pollution control experts around the world have come to realize that cleaner fuels must be a critical component of an effective clean air strategy. Fuel quality is now seen as not only necessary to reduce or eliminate certain pollutants (e.g., lead) directly, but also a precondition for the introduction of much important pollution control technologies.

The most important impediment to adopting state-of-the-art new vehicle emission technology (equivalent to Euro 3 and 4) in Asia is the fuel quality, especially the level of lead and sulfur in gasoline and the level of sulfur in diesel. These parameters should receive highest priority in the development of medium- and long term strategies for fuel standards. The long-term vehicle emissions regulations strategy is to adopt Euro 4 regulations for light duty vehicles, and Euro 4 and 5 regulations for light duty and heavy duty diesel vehicles, respectively.

Setting fuel standards will require institutional mechanisms that actively include a variety of stakeholders (government, private sector, and civil society) and extensive consultations to discuss on various aspects. In countries where such an institutional mechanism is not yet in place, it should be created. With respect to the involvement of the private sector, it is important that both the oil and the auto industry are fully involved in such discussions. Because the environment and public health concerns are the driving force behind improvements in fuel quality, the Government should have a major role in setting fuel standards. In order to implement stricter fuel standards and increase the acceptability of the associated costs to consumers, countries should institute more and better awareness campaigns. Such campaigns must emphasize the public health consequences of not improving fuel quality.

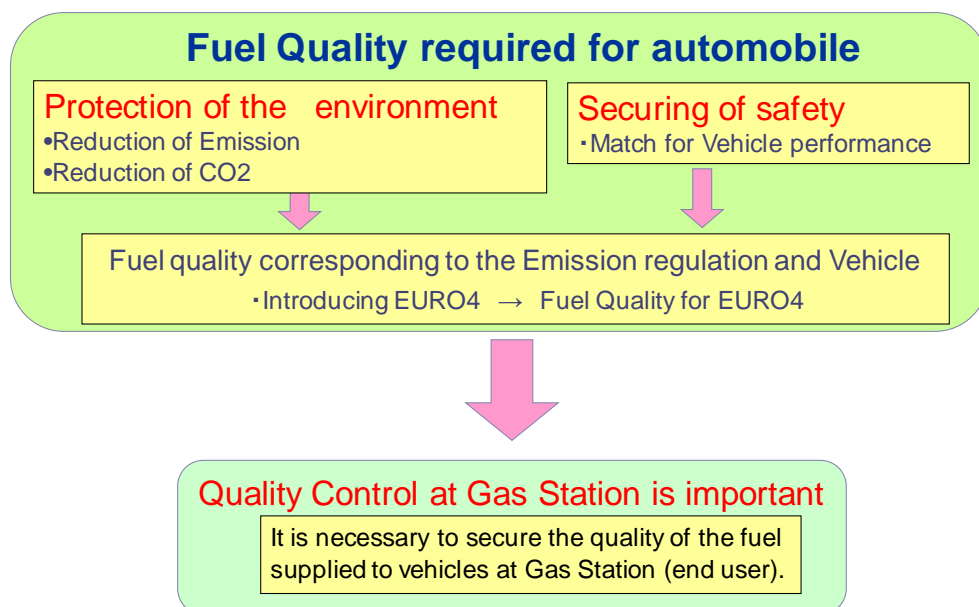


Figure 4: Requirement of automotive fuel quality control

Table 3: Current and proposed sulfur levels in Diesel in Asia, EU

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|----------------------------------|--------|------|-------|------|-------|-------|--------------------|--------------------|-------|---------------------|-------|-----------------|------|------|-----------------|------|-----------------|
| European Union | | | | | 500 | | | | | 50(10) ^a | | | | 10 | | | |
| United States | 500 | | | | | | | | | | 15 | | | | | | |
| Bangladesh | | | | | | | 5,000 | | | | | | | | | | |
| Cambodia | | | | | 2,000 | | | | 1,500 | | | | | | | | |
| PRC (nationwide) ^{a, b} | 5,000 | | | | | | 2,000 | | | 500 | | | | | | | |
| PRC - Beijing | 5,000 | | | | | | 2,000 | | 500 | 350 | | | 50 | | | | |
| Hong Kong, China | | 500 | | | | | 50 | | | | | 10 ^c | | | | | |
| India (nationwide) | 5,000 | | | | 2,500 | | | | | 500 | | | | | 350 | | |
| India (metros) | 5,000 | | | | 2,500 | 500 | | | | 350 ^c | | | | | 50 ^c | | |
| Indonesia | 5,000 | | | | | | | | | | 3,500 | | | | | 350 | |
| Japan ^d | 500 | | | | | | | | | 50 | | 10 | | | | | |
| Republic of Korea | 500 | | | | | | | 430 | 100 | | 30 | 10 | | | | | |
| Malaysia | 5,000 | | 3,000 | | | | 500 ^e | | | 500 ^f | | | | | | | 50 ^c |
| Pakistan | 10,000 | | | | | | 7,000 ^e | | | | | | | | | | |
| Philippines | 5,000 | | | | | 2,000 | | | 500 | | | | | | | | |
| Singapore | 3,000 | | 500 | | | | | | | | 50 | | | | | | |
| Sri Lanka | 10,000 | | | | | | | 5,000 ^d | | | 500 | | | | | | |
| Taipei, China | 3,000 | | | 500 | | | 350 | | 100 | | | | 50 | | | | |
| Thailand | 2,500 | | | 500 | | | | | 350 | | 150 | | | | 50 | | |
| Viet Nam | 10,000 | | | | | | | | | | | 500 | | | | | |

Source: ADB A Road Map for Cleaner Fuels and Vehicles in Asia, 2008

(d) Monitoring system for air pollution

There is no organized information collection system for danger and direct effects of air pollution to the health. This is generally because of the lack of monitoring networks and data processing capacities to monitor appropriate data on the air quality, and composition of pollutants or epidemiological data in relation to sources of pollution. Measures against automobile emissions must contribute to reduction of air pollutant concentration, but without appropriate data, it is impossible to assess, which measure is preferable being most effective. Epidemiologic research and basic observation of the atmosphere are necessary.

4. Measures for Sustainable Future

In future, increase of motor vehicle use can negate the effort towards emission reduction in Asia. It is important to introduce an integrated policy for sustainable transport system in Asia. When we introduce a strict emission regulation, without availability of fuel of adequate quality for the technology to correspond to the level of regulation, it is difficult to maintain the better air quality. If we do not maintain or exclude high emitter vehicles that emit harmful gases in volumes several fold (gross polluters), than that of latest car air quality will not be improved to the desired level. If we do not monitor air quality in urban settlements continuously, we can not reliably evaluate the impact of implementation of environmental policies. If environmental and energy policy, regulations and standard are introduced already; lack of awareness of people to implement these policy can lead to ineffective implementation. In order to implement

these policies, it is very important to collect common data such as vehicles, traffic conditions, other fundamentals, to have common measure to statistical analysis and also to introduce effective education for administrators and technocrats. We, therefore, propose the integrated policy as shown below:

- **Build up appropriate I&M programs**
- **Improving Fuel Quality**
- **Strengthen Emission Regulations**
- **Proper Air Quality Monitoring**
- **Public Campaign and Education for Environmental Awareness**
- **Establishment of Common Data Base.**

Air with good quality brings people to a healthy society

5. Summary and Conclusion:

ERIA WG on Project toward the "Sustainable Automobile Society" in East Asia" has discussed the environment and energy situation in Asian countries, and has collected vehicle related data from the member countries. Additional data were supplied to the supporting study by Japan Automobile Research Institute (JARI), while JARI has also estimated air pollution in Bangkok using these data and their own data. The results of the supporting study were reported at the 2nd ERIA WS and an analytical method recommended by JARI has been discussed for next year collaborative research project, when the project is adopted. However, it was clear that the data base concerning vehicles and other related items is insufficient to assess the air quality in all Asian countries with reasonable reliability. We, therefore, propose to the ERIA for a data collection system and establishment of a common automobile data base in Asia.

Many policies have been proposed until now, but effective and feasible plan has not been often implemented, which made these policies ineffective. We, therefore, propose an integrated policy to establish environmentally sustainable development to improve upon both air pollution and economics. This includes improved I&M (Inspection and Maintenance) system, FQM (Fuel Quality Management) system, Emission Regulation, AQM (Air Quality Management) system and POE (Public Campaign and Education).

ERIA Initiatives for Better Air Quality in Asia

- **Needs Effective Policies**
- **Needs Consensus**
- **Needs Public Awareness.**
- **Needs better implementation.**