

CHAPTER 1:

Rationale

Stabilizing and reducing atmospheric greenhouse gas concentrations are essential to global sustainability. Intensified and ongoing efforts and a shift from fossil fuels to non-carbon energy sources will be required to increase overall global energy efficiency. The improvements in global energy efficiency need to be achieved in a context of a growing population and economy. In July 2005, the Group of Eight (G8) adopted the Gleneagles' Action Plan on Climate Change, Clean Energy and Sustainable Development. This action plan called for substantial improvements in energy efficiency and aims to shift a growing share of investment toward cleaner or more efficient energy technologies. Within this framework, the Asian Development Bank (ADB) has undertaken analytical work that will eventually lead to the formulation of a policy framework to guide investments and address energy efficiency and climate change in the transport sector in Asia. This paper is the first step in the formulation of such a policy framework.¹

A. RELEVANCE OF ENERGY EFFICIENCY AND CLIMATE CHANGE FOR ON-ROAD TRANSPORTATION IN ASIA

The extensive evidence that the world is getting warmer, with an increase in global average surface temperature of about 0.6°C over the 20th century (Pachauri 2006) (Figure 1), is now accepted by the international scientific community. The atmospheric concentration of carbon dioxide (CO₂) has

increased by 31% since 1750 to levels that have not been exceeded during at least the past 420,000 years.

While such a temperature change may seem modest, it is now accepted that this is producing changes in our climate system that include an increase in precipitation in the Northern Hemisphere over most mid- and high latitudes, accompanied by a decrease in rainfall over much of the subtropical land area.² Warm episodes of the El Niño-Southern Oscillation phenomenon have been more frequent, persistent, and intense since the mid-1970s, compared with the previous 100 years. These changes, which affect sustainable development and have severe equity implications, have been demonstrably and strongly linked to increasing anthropogenic activity and greenhouse gas (GhG) emissions³ that principally derive from an unprecedented increase in carbon-based energy consumption. In Asia, these impacts on rainfall and agriculture are believed to be significant, in addition to the overall threats for low-lying islands and coastal areas, some of which are densely populated. Recognition is also increasing on the need to examine the linkages between mitigation policies for climate change and air quality (United Kingdom [UK] Air Quality Expert Group 2005).

The transport sector in 2002 used 21% of the worldwide all-sector total energy consumption and is projected to generate over 60% of the increase in total energy use through 2025. The emerging Asian nations⁴ are projected to provide much of that future growth in oil consumption—and GhG emissions—due to their strong economic and population growth. Emerging Asia (including

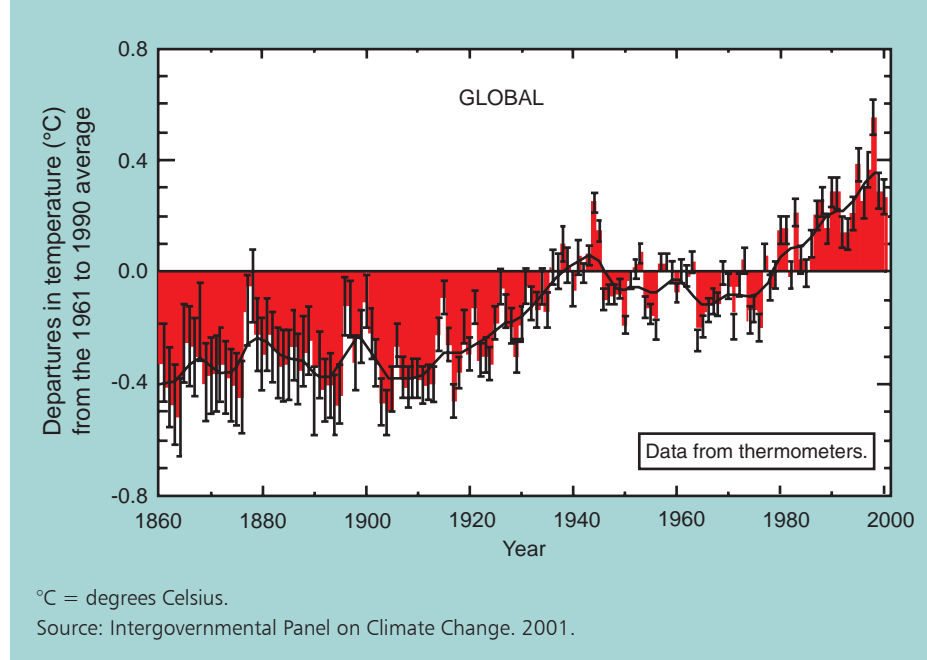
¹ ADB acknowledges the support that the Department for International Development provided for the formulation of this paper.

² Snow cover and ice extent have decreased; global average sea level has risen and ocean heat content has increased, leading to increasing precipitation in the Northern Hemisphere over most mid- and high latitudes by a statistically significant 0.5–1% per decade, accompanied by a decrease in rainfall over much of the subtropical land areas by about 0.3% per decade during the 20th century.

³ Particularly carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O), halocarbon gases (e.g., CFC₃ and CF₂Cl₂), and some other synthetic compounds (e.g., perfluorocarbons).

⁴ Emerging Asia is used in this review to include Bangladesh, Bhutan, Cambodia, People's Republic of China (PRC), India, Indonesia, Lao People's Democratic Republic, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka, Thailand, and Viet Nam.

Figure 1: Variations in the Surface Temperature of the Planet over the Last 140 Years



technologies and policies, which hurts both global and local environmental sustainability.

Increasing energy efficiency in the road transportation sector—and the GhG emissions that it produces—is crucial to resolving these issues. This document discusses four complementary approaches to achieving this in Asia. These approaches for the short, medium, and long term⁸ are situated against a backdrop of rapidly increasing population and wealth and accompanied by the pressure of increasing personal mobility and the urgent need to eradicate poverty:

the People's Republic of China [PRC] and India) is expected to account for 45% of the total world increase in oil use through 2025 as the gap between their economies and the mature market economies substantially narrows. The PRC's energy use for transportation is projected to grow by 6–9% per year; in India, energy demand in the transportation sector is projected to grow at 5–8% a year over this period.⁵

The emerging Asian economies are a net oil importer: In 2004, more than half of their consumption was imported.⁶ Until recently, several governments in the region did not reflect the true increase in fuel prices to protect consumers from the impact of soaring oil costs but this has placed increasing pressure on their national budgets and balance of payments. The continued use of fuel subsidies in Asian countries, apart from their direct costs,⁷ has the side effect of retarding the development and diffusion of more fuel-efficient and cleaner

- Improve the energy efficiency of individual vehicles to increase the distance traveled per unit of fuel;
- Initiate modal shift that promotes lower fuel consumption per passenger- or freight-kilometer traveled;
- Promote urban design that reduces the need to travel, requiring fewer passenger- or freight-kilometers; and
- Adopt fuels with a lower GhG-emissions footprint.

B. RATIONALE FOR THE DEVELOPMENT COMMUNITY

The overarching agenda of the international development community⁹ is poverty reduction. Economic growth is essential to overcome poverty.

⁵ Lower growth forecasts by the United States (US) Energy Information Administration's *International Energy Outlook 2005*; higher growth forecasts are shown in Appendixes 2 and 3, which are available at www.adb.org/documents/reports/energy-efficiency-transport/.

⁶ Oil production, 2004: 7,176 thousand barrels daily (8.9% of the world total) and consumption 14,870 thousand barrels daily (18.4% of the world total). British Petroleum, *Statistical Review of World Energy 2005*.

⁷ In Malaysia, despite increasing retail prices and a reduction in subsidy levels, the Government expects fuel subsidies to have cost almost \$2.2 billion in 2005, compared with \$4.8 billion in 2004.

⁸ This document refers to "short term" as a period of up to 5 years, "medium term" as 6–10 years, and "long term" as more than 10 years.

⁹ The development community includes multilateral and bilateral development organizations as well as international foundations and NGOs with a mandate to assist developing countries in their economic and social development.

This should, however, not be at the expense of the environment and the chances of future generations to utilize Asia's natural resources. Emerging Asian economies are trying to cope with high energy demands and oil prices, which threaten to slow down economic growth. At the same time, as outlined above, the growing energy use by the transport sector is increasingly contributing to climate change. A major effort is needed in Asia from all stakeholders, including the international development community, to promote on-road transport energy efficiency and fuel diversity. Such an effort must include the goal of reducing the Asian growth-induced pressure on climate change.

Promoting energy efficiency, fuel diversity, and climate change-friendly actions transcends the boundaries of energy policy. Policies on transportation, technology, environment, finance, competition, and investment all have an important role to play. While funding for economic development is dominated by private investment, the international development community is an important source of policy and technical advice to developing countries on these issues and functions as a catalyst for improving the use of resources in responding to the energy development challenge and dealing with climate change and adaptation. It has a particularly important role to play in enabling private participation by assisting client country governments establish and maintain clear and comprehensive legislative and regulatory systems that bring financial and technical rigor to these projects and reduce the risk to potential lenders and investors. To support efforts by emerging Asian countries, the international development community must focus more systematically on energy efficiency and climate change and step up its initiatives to strengthen its technical capacity and better align its lending framework.

In recognition of this situation, ADB has already initiated substantive initiatives in the areas of energy efficiency and clean air (i.e., the Energy Efficiency Initiative and Clean Air Initiative for Asian Cities [CAI-Asia]) and has made good progress in starting to address energy efficiency in the industrial and power sector (ADB 2003, CAI-Asia 2006a). However, when ADB lending of \$11.228 billion to the transport sector over 2000–2005 is analyzed, it can be seen that only limited specific attention was given to the climate impacts of transport.

C. RATIONALE FOR THE DEVELOPING COUNTRIES IN ASIA

Countries in emerging Asia are all pursuing policies to achieve economic growth—which is essential to overcome poverty—led by the PRC and India. If these two countries are able to fulfill their potential, they are likely to become a dominant force in generating spending growth over the next few decades possibly even exceeding the gross national product of the United States (US) and Japan (for the PRC and India, respectively) in less than a generation. This, however, should not be at the expense of the environment and the chances of future generations to utilize each country's natural resources.

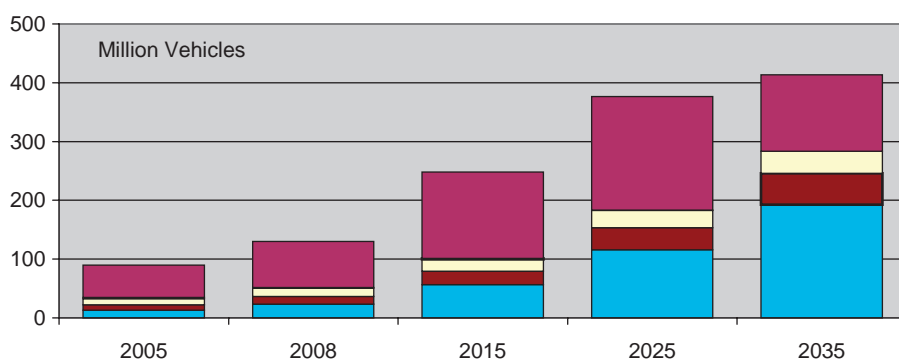
At present, all countries in emerging Asia have low levels of personal motorization (which in many cases comprises mostly 2-wheelers). These levels are likely to increase drastically as they achieve this economic growth due to a marked increase in urban population and an increasing ability to buy 4 wheelers (cars and sport utility vehicles [SUVs]). The increase in demand for 4-wheelers in Asian cities is expected to grow faster than gross domestic product (GDP).

Under a business-as-usual (BAU) scenario, the active population of cars and SUVs in the PRC is forecast to grow to 15 times its present size in 30 years (from 12.9 million in 2005 to around 193 million in 2035 [Figure 2]); in India, the expected increase is a mere 13 times (from 6.2 million in 2005 to around 80 million in 2035 [Figure 3]). However, India is expected to have a population of 236 million motorcycles (2-W) in 2035, up from 35.8 million in 2005, which reflects a larger increase than that in the PRC (6.6 times for India vs. 2.4 times for PRC) which grows from 55.3 million to 130 million in the same period. This difference reflects both the cultural and purchasing power differences between the two economies.

Such a projected increase in the number of vehicles of a greater than order-of-magnitude increase in car population will add significantly to the current congestion in the major metropolitan areas and will add to GHG production, urban air pollution, and a lack of road safety. Even if investment and land¹⁰ were available, it is not feasible to consider building road infrastructure at a rate that matches the forecast growth of urban vehicle populations. Moreover, the practice of constructing multilayered

¹⁰ Land availability is particularly seen as a constraint to road construction.

Figure 2: Forecast of Vehicle Populations in the People’s Republic of China

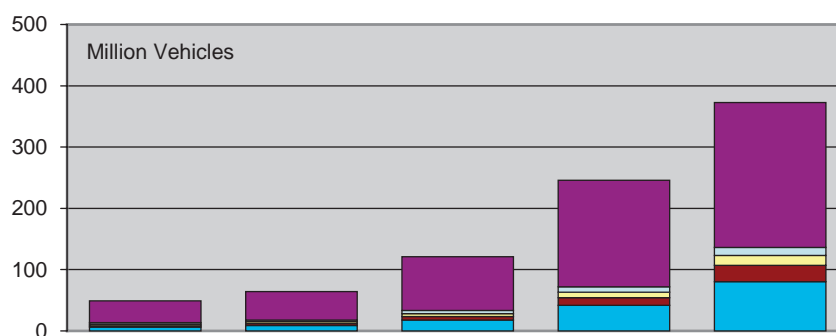


Population	2005	2008	2015	2025	2035
2-W	55.3	78.1	146.7	193.2	130.4
3-W	2.0	1.5	1.7	0.3	0.0
HCV	10.4	13.9	19.9	29.3	37.5
LCV	9.4	13.1	22.8	37.7	52.9
Car, SUV	12.9	23.4	56.8	115.8	192.7
Grand Total	90.0	130.0	248.0	376.4	413.6

2-W = motorcycle; 3-W = 3-wheeler; HCV = heavy-duty commercial vehicle; LCV = light-duty commercial vehicle; SUV = sport utility vehicle.

Source: Segment Y Ltd.

Figure 3: Forecast of Vehicle Populations in India



Population	2005	2008	2015	2025	2035
2-W	35.8	46.1	87.7	174.1	236.4
3-W	2.3	3.0	5.3	8.8	13.1
HCV	2.4	2.9	4.6	9.1	16.2
LCV	2.4	3.2	5.7	12.5	26.9
Car, SUV	6.2	8.8	18.0	41.6	80.1
Grand Total	49.1	63.9	121.3	246.1	372.7

2-W = motorcycle; 3-W = 3-wheeler; HCV = heavy-duty commercial vehicle; LCV = light-duty commercial vehicle; SUV = sport utility vehicle.

Note: Total may not add due to rounding.

Source: Segment Y Ltd.

expressways is increasingly seen as negatively affecting the quality of life and thereby also the economic attractiveness of such cities.

Economic growth that includes stimulated internal demand requires lengthening supplier and distribution chains and most of this increased required capacity in passenger and freight intercity movement will be delivered by road transport. Thus, emerging Asian economies will be faced with increasing energy demands from on-road transport that is based almost exclusively on petroleum fuels, whose high prices place an increasingly heavy burden on growth and concerns for energy security.

Under this BAU scenario, the total fuel consumption of on-road vehicles in the PRC can be expected to grow three-and-a-half times over the next 30 years, while India's fuel consumption in 2035 will be over six times that in 2005 (Figure 4). These growth rates are smaller than those of the in-use population itself due to the anticipated improvement in vehicle fuel efficiency.¹¹

Correspondingly, the CO₂ emissions from on-road transport can be expected to increase by 3.4 times for PRC and 5.8 times for India over the 30-year period to 2035 (Figure 5).

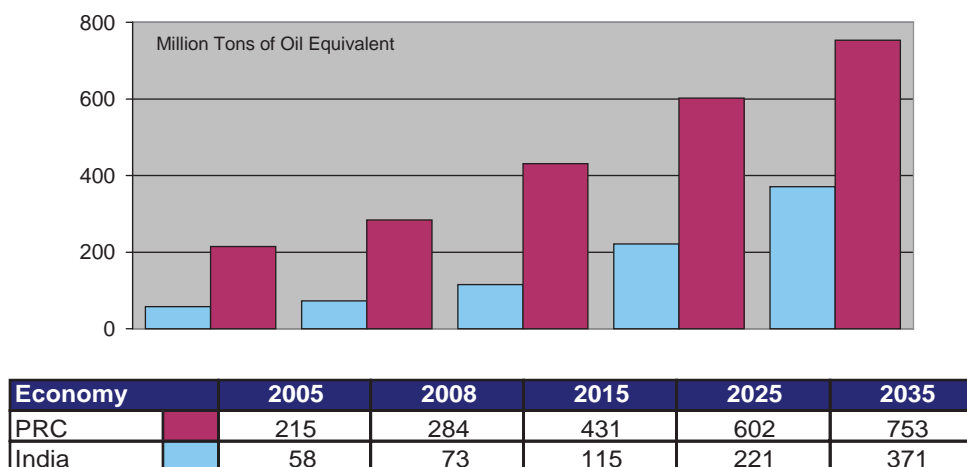
Expected changes in vehicle technology, however, are manifested in the reduction of particulate matter (PM)

and nitrogen oxide (NO_x) emissions over this period as evident in Figures 6 and 7.

Such considerable increases in the number of vehicles, congestion, and consumed fuel threaten to severely limit the quality of life and economic growth of emerging Asia unless a different on-road transport development scenario is applied. A major effort will be required in emerging Asian countries to promote the use of more efficient transport systems and fuel diversity to reduce this growth-induced pressure on both their national and metropolitan levels. At the same time, as outlined above, the growing energy use by the transport sector is increasingly contributing to climate change, which will have severe implications for low-lying areas in the region and will require substantial adaptation in many other areas.

None of these issues can be solved by one measure alone. A broad range of policies and actions with complementary co-benefits will be required to address these energy efficiency and climate change concerns systematically. The overriding rationale for most Asian countries at their national level will be energy security although the larger countries in emerging Asia are duly concerned about climate change; at the metropolitan area, municipal, and local levels, it will be congestion, air quality, and traffic safety.

Figure 4: Total On-road Vehicle Fuel Consumption (mtoe)

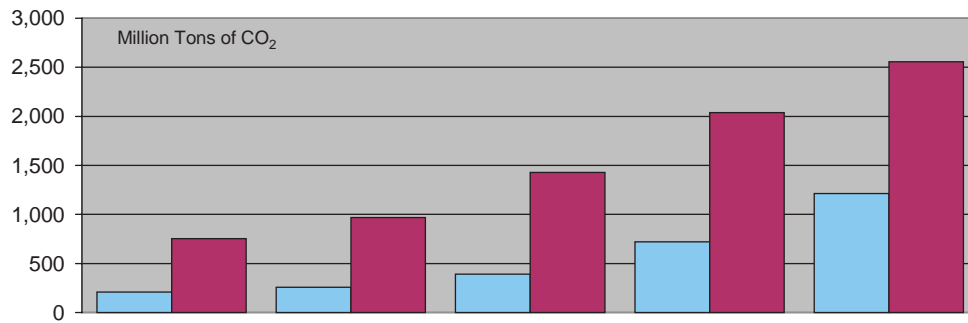


Mtoe = million tons of oil equivalent; PRC = People's Republic of China.

Source: Author, utilizing Fulton and Eads. 2004.

¹¹ The BAU calculations were performed using the IEA/SMP Reference Case Projection Model (Fulton and Eads 2004), together with the Segment Y Ltd population projections.

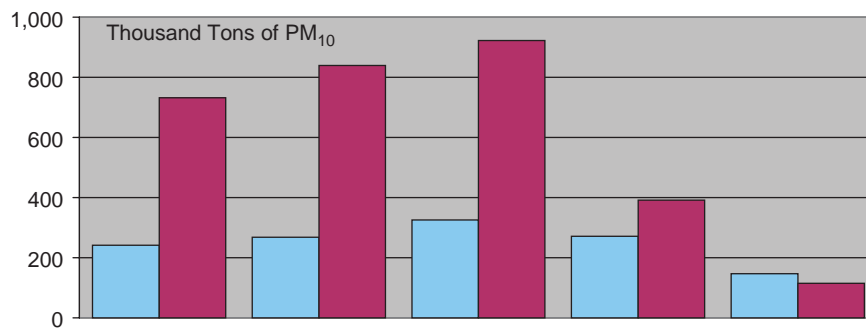
Figure 5: Total CO₂ Emissions (Well to Exhaust) from On-road Vehicles



Economy	2005	2008	2015	2025	2035
PRC	752	967	1,429	2,039	2,557
India	208	256	391	721	1,212

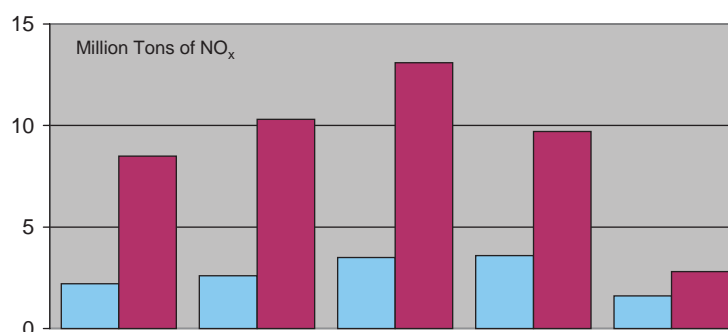
CO₂ = carbon dioxide; PRC = People's Republic of China.
 Source: Author, utilizing Fulton and Eads. 2004.

Figure 6: Total PM₁₀ Emissions from On-road Vehicles



Economy	2005	2008	2015	2025	2035
PRC	732	839	922	392	115
India	241	268	326	271	147

PM₁₀ = particulate matter whose particles have an aerodynamic diameter of 10 micrometers or less;
 PRC = People's Republic of China.
 Source: Author, utilizing Fulton and Eads. 2004.

Figure 7: Total NO_x Emissions from On-road Vehicles

Economy	2005	2008	2015	2025	2035
PRC	8.5	10.3	13.1	9.7	2.8
India	2.2	2.6	3.5	3.6	1.6

NO_x = nitrogen oxide; PRC = People's Republic of China.

Source: Author, utilizing Fulton and Eads. 2004.

D. RATIONALE FOR THE PRIVATE SECTOR

Most of the investment in the transport sector in Asia and many of the actions required to reduce the climate change effects of on-road transport will be made by the private sector. Thus, it is essential that a clear long-term signal be given for the way forward, with predictable and transparent regulations

and policies. The analysis presented in this report indicates that policies and regulations for the transport sector in Asia cannot be incremental in nature and that a paradigm shift is required in the thinking on mobility. Only by eliminating or reducing the risk associated with the paradigm shifts needed to systematically resolve all the problems associated with growing motorization will the private sector be in a position to invest and act in a timely manner and to the required extent.