CHAPTER 3:

Vision and Policy Framework

A. THE VISION

Asia has to promote economic growth—necessary for poverty reduction and improving the quality of life—and account for a rapidly growing transport demand within the overall context of social development with improved equity and zero environmental impact.

This will require accelerated urban reform, together with innovative traffic and infrastructure management and travel demand management (access-and-mobility planning) that respects the differences between countries, cultures, and cities and integrates a specific vision and action plan for each one. Faster implementation of new technology is needed, both regionally developed and adopted, with improved sharing of knowledge on a regular basis both North-South and South-South.

Future efforts in urban planning (to reduce the need to travel and promote NMT), combined with structural changes to the transportation system and improvements in the fuel economy of vehicles, could cause the accelerating growth rate of GhG emissions in Asia to slow. However, GhGs from the transport sector in Asia are assumed to continue to grow. This means that overall global climate goals can only be accomplished if absolute reductions are achieved either in other sectors in Asia or in other parts of the world.

B. BARRIERS

Accomplishing a reduction in the growth of GhGs in the transport sector will require substantial barriers to change to be overcome. The relative unavailability of congruent and consistent knowledge of international best practices on climate change and sustainable transport for national, state, and local government planners and decision makers is one of the greatest barriers to change.

The currently weak empowerment and linkages in many metropolitan areas between urban planning; transport planning; traffic management; and enforcement of planning, environmental, and other transport-related regulations constitute a substantial barrier to effective changes that are focused, among other things, on reducing the climate change effects of transportation.

The inadequacy of accounting tools that fail to take into consideration the true cost of the externalities of on-road transport (congestion, pollution, climate change, travel cost, and time, etc.) severely limit corrective actions. Charging the externalities of private motorized transport and achieving a modal shift to public transport will require restraint of private transport demand and, in many cases, legislative reform that may be opposed by many current or potential private vehicle owners unless consultation and awareness programs are implemented with positive outcomes.

The lack of information to the consumer about the true per-km cost of private transport (including the components of vehicle depreciation and replacement, interest value of capital, insurance, taxes, maintenance, parking, etc.) restricts his/her ability to make rational choices. Awareness among different stakeholders about the need for urban reform and a paradigm shift in transportation planning contributes to a lack of grass-roots support for urban and transport reform that can negate its inclusion in the political agenda at the highest level.

Access to capital is also a barrier, especially where different administrative areas need to collaborate within the same transport development program. Lack of incentives to invest in better transport systems and new technology delay the adoption of new technologies and contribute to a continued lagging behind of certain countries in emerging Asia compared with Europe and other parts of the world. Difficulties in developing an optimum investment framework for more climate-friendly transport systems are augmented by the currently limited relevance of the CDMs for transport-related projects.

C. PRINCIPAL POLICY INTERVENTIONS TO REDUCE GHG EMISSIONS

If policy interventions to reduce GhG emissions from on-road transport were adopted, these would improve access to goods and services while requiring fewer passenger- or freight-kilometer, reduce fuel consumption per passenger- or freight-kilometer traveled, increase the distance traveled per unit of fuel for individual vehicles, and require the adoption of fuels with lower GhG emissions. This requires the emerging Asian countries to recognize that GhG emissions are a problem and that they should strengthen their effective planning to mitigate these emissions. Outreach from the international development community to governments and other stakeholders is required to help them design fuel-efficiency policies.

To accomplish this vision, an integrated set of policy interventions needs to be implemented. Policy interventions are required at the long, medium, and short terms, as summed up in Table 4. The principal policy approaches can be divided in four categories:

- promote urban reform and land use planning to ensure the development of urban design that reduces the need to travel, requiring fewer passenger- or freight-kilometers;
- adopt integrated transportation planning to ensure a modal shift that promotes lower fuel consumption per passenger- or freight-kilometer traveled;
- improve vehicle engines and fuel technology to increase the energy efficiency of individual vehicles, to increase the distance traveled per unit of fuel; and
- introduce biofuels with lower GhG emissions.

Only if all these policy interventions are implemented will Asia be able to reduce the growth in GhGs from the transport sector. In other words, decision makers do not have the luxury of choice but need to develop the support and capacity to take on all the policy interventions discussed here.

While all the policies need to be adopted within the short term, the time required for successful implementation and in which impacts start to materialize in a sizable manner varies among the policy options identified. Changing the urban design is the most challenging priority and will take the longest, while improving the maintenance of in-use vehicles can be introduced immediately, producing a measurable impact.

The interventions need to be strengthened by emphasizing the co-benefits of linked programs to facilitate the buy-in of national governments, local governments, and civil society even though each has different priorities including energy security, congestion, air quality, and equality of access.

An important contribution of the development community to the adoption and implementation of these four policy approaches would be the strengthening of a continually updated shared knowledge base as input into these decision processes and the development of common tools so that surrogate regional default parameters can be evaluated for hard- or costly-to-measure variables and for intercomparison and accumulation of cities and countries. The development community also has an important role to play in the accelerated implementation of new technology (closing the gap) by encouraging technology development by areas and the adoption of leading worldwide standards. It can assist the emerging Asian countries to share technology development and knowledge on a regular basis both North-South and South-South.

1. Urban Reform and Land-use Planning

The greatest GhG mitigation can be achieved in the long term through travel demand management linking urban development and land use with transportation planning to improve access to goods and services while minimizing the need to travel. The village concept of high-density urban planning within the region's megacities can—by integrating residential, business, commercial, and light industrial areas—improve the quality of life and substantially reduce the need to travel. Linking villages with fast public transport and promoting electronic communities can enhance economic and social development while reducing consumption of transport fuels. For this to happen, long-term inter-sector regional policy frameworks need to be established.

Within the framework of an exploding urban population, Asia needs to more actively promote the development of livable and sustainable, community- and health-centric green cities that reduce the demand for personal motorized transport. Many inner cities would benefit from being revitalized to create a livable mixed-land-use environment that focuses on reducing emissions (including GhGs), facilitating the new economy, saving landscapes, and rebuilding communities through equity of access to goods and services, education, and

environmental empowerment. Electronic, networked communities that alleviate the need to travel should also be further promoted.

2. Transportation Planning

a. Integrate Urban Transportation Planning with Land Use Planning

Urban transportation planning has to be well integrated with land use planning and community and educational development to promote increased mobility and a reduced demand for cars, through greater use of intelligent transport systems and market instruments that equitably internalize the cost of public infrastructure usage (e.g., roads and parking), pollution, and congestion. These may include tax reform and deregulation, road and congestion pricing, active traffic management with car-free zones and cities, modal shift, and the promotion of car sharing.

This is the component that can generate the largest GhG mitigation in the medium term. It involves charging the true cost of externalities such as congestion, pollution, climate change, and use of public infrastructure—roads and parking—to the use of private motorized transportation (cars and motorcycles). It involves providing efficient and high-quality public mass and nonmotorized alternative transport. Reducing subsidies to the private vehicle provides an important incentive to promote change and offsets some of the

Box 6: Market-based Traffic Demand Management

The road to sustainable urban travel will increasingly require investment in public transport and in infrastructure for nonmotorized transport (NMT) and pedestrians, accompanied by restrictive measures for private, motorized transport that traditionally has not had to pay for the substantial externalities of road traffic—congestion, pollution, climate change, and use of public infrastructure—that it causes compared with the majority of urban passengers who travel by other means.

The cost of traffic congestion alone is very high, representing nearly 3% of gross domestic product (GDP) ($810 billion) in the countries of the Organisation for Economic Co-operation and Development and even more in many Asian nations (4.4% of GDP in the Republic of Korea and as high as 6% of GDP in Thailand) (Ng Wei-Shuien 2006). The low elasticity of fuel prices make this, by itself, an ineffective tool for controlling traffic demand.

Market mechanisms offer an attractive means of internalizing transport cost in a fair and equitable manner, whereby price mechanisms accompanied by subsidies or incentives can provide a tool for policy enforcement that has an immediate effect on travel cost and modal distribution. These promote increased mobility, together with a reduced demand for personal transport usage, and generate local revenue that can be used to improve public transport and urban infrastructure.

Road pricing enables traffic demand to be managed both spatially and temporally.[a] This can take the form of road tolls, congestion pricing, cordon fees, high-occupancy vehicle lanes, vehicle use fees and road-space rationing. Since charges are based on usage, those who contribute more to the congestion pay more and those who use the roads less frequently or who travel during nonpeak hours will pay less or need not pay at all.

Parking policies also play an important role in traffic demand management: private vehicles spend up to 95% of the time parked and the provision of inadequately priced curbside or off-street parking space promotes more congestion as drivers cruise looking for a parking spot and may also attract additional traffic. Many industrial country cities use parking pricing and availability as a demand-restraint measure. The amount of parking in any area is then limited to the maximum level considered necessary to support an "optimal" amount of road use (Gwilliam, Kojima, and Johnson 2005). Setting the right price, using a variable-pricing policy to achieve a 15% curb-space vacancy rate can balance this demand.

Singapore has used congestion pricing in the Central Business District (CBD) since 1975 to manage traffic demand, first manually and then electronically since 1998 (Loh Chow Kuang 2006). Its Area Licensing Scheme, introduced in 1998, reduced traffic volume by more than 50% and almost doubled average speed in the CBD. Electronic Road Pricing (ERP) is used to decrease traffic volume in the CBD by 7–8% during morning peak and off-peak hours; and in 2004, an average of 260,000 ERP transactions per day generated

revenues of $55 million per year. ERP has been effective in maintaining an optimal speed range of 45–65 km/h for expressways and 20–30 km/h for arterial roads, despite a doubling of population and a tripling of travel demand over the last 25 years (Singapore Government Land Transport Authority 2005).

In London, a flat fee of £5 per day for vehicles entering the congestion-charging zone between 0700 and 1830 hours on weekdays has reduced congestion by 30% and increased traffic speed by 37%, with 65,000 to 70,000 fewer car trips per day entering the zone and with little direct effect on business activity. The revenue that is generated is retained locally to fund improvements in local transport (Transport for London 2005).

A new congestion-charging zone in the inner city of Stockholm started in January 2006 in which vehicles are charged $1.27–$2.54 per trip. It has resulted in traffic volume decreasing by 25%, removing 100,000 vehicles during peak hours and increasing daily public transit ridership by 40,000. The public was to vote in September 2006 to decide if the system should be made permanent. The project encountered initial resistance, but current polls are very favorable.

Three major cities in Norway (Bergen, Oslo, and Trondheim) use cordon charges to manage traffic entering the downtown areas. In France, since 1992, variable tolls have been used to spread peak-period traffic on congested portions of major intercity tollways; in Toronto, Ontario variable pricing has been in force since 1997 to reduce congestion on a toll road (Highway 407).

[a] "Spatial" control affects specific roads or geographical areas while "temporal" control allows price differentiation for peak and off-peak travel.

Source: Author.

costs of improvements to public transport (rolling stock and infrastructure) (Box 6).

The appropriateness of using transport models, both strategic and operational, for developing world conditions still raises a major concern. Most assumptions underlying these models (both people's travel behavioral characteristics and traffic behavior and road use) are inappropriate for developing world conditions. Furthermore, most transport models are not able to do a full economic and environmental appraisal (including emissions, safety analysis, and impact on NMT) necessary to estimate the environmental and economic impacts of measures. Research and development should be aimed at calibrating existing traffic flow modeling as well as developing new and appropriate modeling and data collection and analysis techniques, particularly for Asian conditions. Such modeling could be detailed and disaggregated for better understanding of travel behavior, as well as made more strategic for policy appraisal and prediction of impact of demand management policies (Vasconcellos 2001).

b. Charge the Externalities of Private Motorized Transport

Traffic demand management with a fiscal package that combines increased fuel taxes, carbon-based annual road charge (where low-powered, low-emissions, hybrid and newer vehicles pay less than the higher-powered, higher-emissions, and older vehicles), and parking charges, together with variable road-use pricing (congestion charging), is a tool that can be charged the private vehicle owner for the climate change, local emissions, congestion, and infrastructure externalities that the vehicle's operation creates or uses. Additional up-front private vehicle registration fees, coupled with purchase limitations—such as the publicly managed open-bid vehicle quota system operating in Singapore—can further stimulate a market-priced, efficient use of public road space. The creation of an urban transport fund can ensure that the charges and fees collected are used to improve public transport, which considerably enhances the public acceptance of the policies and accelerates the change process.

c. Improve Public Transport

Safe, secure, rapid, and user-friendly public transport systems (including paratransit, buses, metro, rail, and new alternatives such as BRT) need to be further developed to promote a modal shift from private transport and integrate with pedestrian traffic and NMT to equitably provide efficient door-to-door connectivity.

Bus, metro, and elevated light rail have traditionally been seen as the public transport alternatives to private transport, but increasingly the low-investment, low-operating-cost alternative provided by BRT, operating on segregated roadways, is gaining adherence. BRT can offer substantially higher-speed, user-friendly mass transit at

high carrying capacities[45] than traditional buses, but with a considerable reduction in per-km investment than metro or light rail that allows substantially more routes to be developed for subsidy-free operation within a politically accessible time frame.[46]

In many Asian cities, the significant GhG and emissions reductions that can be achieved through modal shift from private vehicles to high-occupancy public transport vehicles can be incremented substantially from improved traffic flow for the other private vehicles on the main route due to the elimination of interference from local bus or paratransit operation. Not only is travel time important to users; accessibility, reliability, safety, and security issues need to be addressed. Where effective mass public transport crosses political jurisdictions, a regional policy framework is essential for development to occur.

Public transport systems need to provide door-to-door solutions for end users; thus, the feeder bus and paratransit routes into the main mass transit routes are equally important components of the overall system and need to receive the same attention to detail.

d. Maintain or Increase Nonmotorized Transport

NMT infrastructure and safe, secure, user-friendly modern rickshaws, together with pedestrian zones and walkways, segregated cycle paths, and park-and-ride car and bike parks, need to be created as an integral part of the transport system to cater to both rich and poor, although each has different needs.

e. Address Increased Freight Transport

Economic growth generates and requires greater long-distance connectivity in the supplier and distribution chains, which should be further promoted through improved intra- and intercity infrastructure (roads and depots) for efficient larger-capacity long-distance carriers. Fiscal measures and fine-tuned freight transport management policies should encourage modal shift to proficient, less-GhG-intensive transport channels (such as waterways and railways). More control needs to be imposed in urban areas, with well-defined trucking routes, distribution centers outside the metropolitan areas, and spatial and temporal truck restrictions in other zones.

f. Integrate Intercity Road Passenger Transport with Urban Transport Systems

Long-distance passenger travel needs to be closely integrated into the urban environment, facilitating fast, traveler-friendly mass-transport access to well-located terminals and airports. Carefully planned highway system improvements are required to reduce travel times for goods and passengers, while improving road safety, congestion, fuel consumption, and emissions.

3. Vehicle, Engine, and Fuels Technology

Vehicles that are sold today will contribute local and GhG emissions to the atmosphere during the next 10–15 years or more. The pathway to sustained improvement in local air quality and reduction in GhG production requires consideration of vehicles and fuels as an integrated system. Asia would benefit by minimizing the time lags in implementing the current and forthcoming vehicle and fuel combinations to accelerate the incorporation of clean vehicle technologies into the active fleet.

a. Improve Energy Efficiency

GhG emissions would be reduced if energy efficiency standards were implemented (or improved) throughout emerging Asia for all forms of motorized personal transport following the PRC's lead.[47] The implementation timetable and cost structure of the technical changes could be optimized if country-specific development were not required from the vehicle manufacturers and their supply chains. The logic to adopting uniform "worldwide" standards is powerful, even though the implementation schedule may differ on a per-country basis due to limitations in fuel supply. As can be seen in Figure 9, the fleet-averaged fuel economy of EU vehicles is now approaching a more than 60% improvement over US fleets and they believe that considerable further improvement is both possible and cost-effective.

[45] On a two-lane-per-direction corridor in Bogotá, Colombia 36,000 peak passengers per hour per direction has been achieved.

[46] A study for Bangkok showed that an investment of $1 billion could buy 7 km of subway or metro, 14 km of elevated rail, or 426 km of BRT (Wright and Hook 2006).

[47] The PRC has fuel economy standards in place for light-duty vehicles; standards for light-duty trucks will come later in 2006 or in early 2007, closely followed by fuel efficiency standards for heavy-duty vehicles and agricultural vehicles.

b. Fuel and Emissions Standards

Synergy is achieved when the introduction of vehicle fuel economy standards is directly linked with vehicle and engine emissions standards. Emerging Asia would do well to issue vehicle technological requirements in line with the EURO specifications, with implementation time frames that depend on fuel availability, among other considerations. "Worldwide" standards should be adopted completely, including any durability requirements, etc., so as not to provide a perverse incentive to manufacturers to cut costs and deliver a substandard product in terms of emissions. A medium-term objective for emerging Asia would be to reduce the implementation gap to zero.

Vehicle energy efficiency and emissions standards are intrinsically linked to fuel standards. Introducing tighter energy efficiency and emissions standards requires sufficient unleaded and low-sulfur fuel to supply new vehicle consumption (i.e., for the growth component of automotive fuel sales), accompanied by a fiscal policy that does not promote cross-fueling.[48] Policies should be established to influence fuel use on differential pricing terms and environmental grounds.

If emerging Asia were to adopt EURO energy efficiency and emissions standards for light and heavy-duty vehicles, it would benefit directly from the worldwide automotive industry's research and development efforts, minimizing both development costs and implementation time frames while improving its competitive position as a manufacturing base in the international vehicle market.

Since emerging Asia is the largest producer and consumer of motorcycles of less than 150 cc engine displacement and 3-wheelers, further promotion of research and development through advanced energy efficiency and emissions standards that drive technology could increase its leadership in these market segments. The most important of these steps is the shift from 2-stroke to 4-stroke engines and the future application of advanced emissions standards to both. Two-stroke engines are traditionally more polluting and less fuel-efficient than 4-stroke engines, but new developments could possibly achieve similar levels over the next 5 years through improved combustion and scavenging, better catalytic converters with secondary air injection, and air-assisted direct injection. Such a shift would produce a significant improvement in fuel efficiency and in emissions performance.

c. Inspection, Certification, and Maintenance

If in-use vehicles do not receive maintenance that is adequate in quality and frequency, their emissions, both local and global, will suffer. Most of emerging Asia does not have a solid maintenance ethic. In many countries, formal workshops staffed with trained mechanics equipped with diagnostics equipment are hard to find for out-of-warranty vehicles and a wide variety of replacement parts that are readily available for their repair do not meet original equipment manufacturers' specifications.

Strict visual-smoke rules empower traffic police to issue fines to smoking gross emitters and have catalyzed improvements in engine maintenance, defueling, and down-speeding engines and "earlier" replacement of the oldest vehicles, all of which have led to fuel economy improvements in many fleets in developing countries.[49] Vehicle inspection programs that are correctly implemented and rigorously enforced can detect the gross emitters and ensure that they are repaired. Such I&C programs are particularly well-suited to include fitness and safety inspection of the older vehicle, with a resulting reduction in road accidents. Such programs can be beneficially linked to accelerated scrapping programs that remove older, less-efficient, contaminating, and/or unsafe vehicles from the fleet and promote their substitution with new technology vehicles.

These benefits can be accompanied by substantially reduced local emissions, especially from older diesel and gasoline-fueled, carbureted vehicles. It is important to incorporate used vehicles that are imported into this framework.

d. Retrofit

Tightened emissions, safety, and fuel economy control on older vehicles also provides an important incentive to fleet renewal. Modern heavy-duty trucks are substantially more fuel efficient than units produced 15 years ago. Operators in Mexico have reported that the fuel saved is sufficient to cover the cost of the monthly interest payments on the new truck (Montiel 2003). Particularly for heavy-duty vehicles, retrofitting a new engine into an existing vehicle can provide important fuel consumption and emissions benefits. Direct-injection retrofit options are being developed for 2-stroke 2- and 3-wheelers that provide substantial fuel economy benefits.

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[48] If "dirty" fuel is cheaper than clean fuel, it provides a perverse incentive for users of new vehicles to permanently damage their vehicles by using an inadequate fuel. On the other hand, if the "clean" fuel is cheaper, demand can outstrip supply.

[49] According to interviews with Pearl Travel and Ladkrabang Bus Lines in Bangkok, Thailand – 2003.

These fuel economy improvements for in-use vehicles will not occur unless governments provide incentives, establish inspection requirements, and empower enforcement.

4. Biofuels

Unless a paradigm shift in current tendencies occurs, the transport sector in emerging Asia is forecast to demonstrate almost unmanageable growth over the next 25 years in private vehicle populations, fuel consumption, and GhG emissions. Even in Europe, with relatively stable vehicle fleets, 90% of the increase in GhG emissions between 1990 and 2010 is expected to be attributable to transport. This is one of the main reasons that EU is failing to meet its Kyoto targets (BIOFRAC 2006).

An ambitious, congruent, and realistic vision in emerging Asia to convert a substantial portion of on-road transport into clean and CO_2-efficient biofuel provided by competitive private industry would assuage part of the fuel security and GhG pressures. However, the required scale of production to make a significant difference is far greater than that proposed in other continents.

The EU proposal provided for in EU (2003)—of providing 5.75% of its transport fuel needs by 2010 from biofuels requiring 4–18% of the total agricultural land to be dedicated to this use—pales in comparison to the vision that "by 2030, the EU covers as much as one quarter of its road transport fuel needs by clean and CO2-efficient biofuels" (BIOFRAC 2006) and even more, in comparison to the long-term GDP-growth-driven increase in personal mobility in emerging Asia and its accompanying fuel requirements. Co-benefits such as additional rural employment need to be balanced against potential competition with food production, sustainable forestry, and the impact on the environment of substantial crop changes.

For biofuels to supply a significant proportion of fuel for on-road transport, governments need to provide a clearly marked road map, driven by market incentives and assurances, in which a premium is established for those feedstock/process combinations that generate the largest LCA GhG emissions reductions relative to conventional fuels. Policies should not limit development to one crop and process type but should create an environment in which diversity in crops and technologies can evolve.

If this is to occur, a move to flex-fuel vehicles, as in Brazil, that can operate on any bio- and conventional fuel mix frees users from being locked into the price and supply variations of any specific fuel mix.

D. SCENARIO ANALYSIS OF THE POLICY INTERVENTIONS

Four countries—PRC, India, Indonesia, and Thailand—were analyzed to evaluate the possible impacts of these policy interventions.

1. Vehicle Population Forecasts

Segment Y Ltd. forecast vehicle populations for each country (Box 7). Figure 15 shows the forecast in-use vehicle populations by type of vehicle for each country. The PRC is forecast to have the largest vehicle population (413.6 million vehicles in 2035, of which 60% are cars, SUVs, and light commercial vehicles), followed by India (372.7 million vehicles in 2035, of which 63% are 2-wheelers and only 29% are cars, SUVs, and light commercial vehicles). Although Indonesia has a smaller population (77.8 million in 2035), it has the relatively largest fleet of 2-wheelers (68%) while by 2035 Thailand is projected to have a vehicle fleet just under half the size of Indonesia's.

Box 7: Forecast Rationale for the Vehicle Fleet Projections

Segment Y Automotive Intelligence Pvt Ltd developed the vehicle fleet projections used in this document by taking into consideration a number of criteria for each of the emerging markets in Asia. The expected growth in gross domestic product (GDP) per capita, in population, vehicle density per capita, vehicle density in relation to the road network, segment shifts driven by income and government policy, and acceleration in vehicle scrappage are all important elements in projecting future in-use vehicle populations.

While for short-term forecasts, vehicle sales are principally driven by the availability of credit, interest rates, and fuel prices, other elements require deeper scrutiny over the longer term:

GDP per capita development: While the past may not be the best guide for the future, past performance was analyzed together with the projections presented in Goldman Sachs' "Dreaming with BRICs" report[a] to arrive at plausible rates of GDP growth.

Population growth and vehicle density per capita: This GDP growth was combined with population growth forecasts based on United Nations (UN)'s projections and the assumption that as GDP grows, vehicle sales in emerging markets will follow similar trends to those in more developed markets and will rise for at least the next 30 years. The current vehicle density in these emerging markets is still very low; for example, the vehicle density in India is only 7 vehicles per 1,000 persons, compared to 550 in Germany. Taking into account interest rates and retail prices, a broad correlation exists between development in GDP and vehicle populations. This applies both to passenger cars and motorcycles.

Vehicle density in relation to the road network: Infrastructure is also a driver, and while it is hard to predict changes over the long term, there are clear pointers to the future with countries such as the People's Republic of China (PRC) and India investing substantially in comparison to, for example, Indonesia or the Philippines.

Better roads promote ease of transit and longer drives, which in turn lead to increased vehicle sales, higher mileages, and earlier scrapping. Statistics on road networks were obtained from the UN Asian Highway Database.

Segment shifts driven by income and government policy: The future will see a number of changes in terms of segment shifts, driven by larger incomes, desire for safety and comfort and government regulations. City dwellers in Thailand are increasingly opting for smaller cars, and hence growth in the pickup segment will be more confined to the rural areas. But a lot of growth will come from those parts as the rural to urban gap narrows. The Thai Government is also toying with the idea to develop a second pillar of expertise in small cars to reduce its dependency on oil imports. This will probably also contribute to a shift from pickups to small cars.

Income development also drives the shift from 2-wheelers to cars. In most Asian countries, the point at which motorcycle sales start tailing off and cars sales increase is at a GDP per capita of about $3,000 per annum. This point is yet to be reached in India and Indonesia but the PRC is getting close. What will accelerate this trend in the PRC is the tendency to spend more on status symbols, in comparison to Indians, for example, who tend to live more frugally.

This information is borne out by the sales statistics from the trade associations in the various countries and confirmed by motorcycle companies such as Yamaha and Honda.

Acceleration in scrappage: Another factor that is taken into consideration is the accelerated vehicle scrappage as markets mature. The average age in the PRC is currently quite low, as so many vehicles have been added in recent years. The same applies in Indonesia, where record sales in recent years have substantially rejuvenated the current parc. In comparison, the parc in India is much older as the sales have developed more gradually, and private vehicle ownership prolongs life through better maintenance.

Official scrappage statistics in Asia are generally unreliable, as records are not scrupulously maintained and registered users generally have no incentive to report scrappage. Scrappage rates have therefore been derived from data from the Center for Transportation Analysis at the Oak Ridge National Laboratory in the United States, the Society of Motor Manufacturers and Traders in the United Kingdom (SMMT), the Rijwiel-en Automobiel Instelling in the Netherlands, which is the Dutch equivalent of the SMMT, and the Japanese Automobile Manufacturers Association.

[a] Goldman Sachs' *Global Economics Papers* No. 99. Dreaming with BRICs: The Path to 2050; No. 118 The BRIC and Global Markets: Crude, Cars and Capital.

Note: Brazil, Russia, India, and PRC are the BRIC economies.

Source: Author.

2. Scenario Analysis

The following scenarios are not forecasts; they are a consistent formulation for estimating the likely levels (and ranges) of fuel consumption and GhG emissions under different assumed conditions. They have been constructed around the Segment Y vehicle population forecasts for each of the four countries (Box 8). The base case scenario uses the vehicle fleet forecasts in Figure 15, together with the assumptions for fuel mix, fuel efficiency, and annual per-vehicle distance traveled contained in the International Energy Agency Sustainable Mobility Project model for on-road transport (Fulton and Eads 2004).[50]

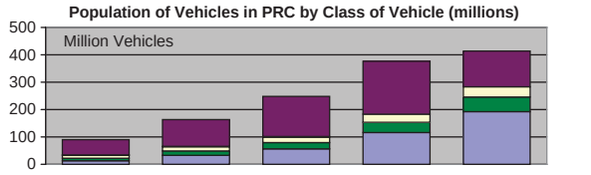
The two scenarios that have been constructed demonstrate the level of effort that could be required to achieve a 25% reduction in on-road vehicle fuel consumption (Scenario 3x) and a 50% reduction (Scenario 2x). Since in both cases the reduction is compared with the base case of rapidly expanding economies and personal motorization, a 25% reduction (Scenario 3x) represents a threefold increase in fuel consumed by on-road transport in real terms. The 50% reduction shown in Scenario 2x requires only double the amount of fuel in real terms over this 30-year period.

a. Base Case Scenario 4x

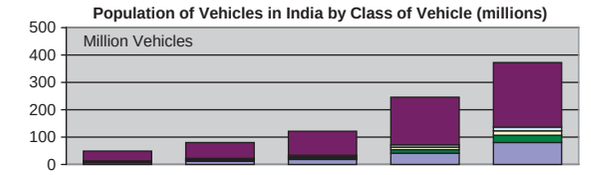
The base case scenario assumes that vehicle fuel efficiency will improve over the 2005–2035 time frame from the current, relatively inefficient levels by approximately 18% for cars and 24% for other 4- or more-wheeled vehicles. It assumes that the distance traveled per vehicle per year remains constant and that only India would have a significant biofuels program with a cap of no more than 5% of ethanol blend-share into gasoline over this period. No biodiesel is considered.

The base case scenario generates a forecast fuel consumption for the four countries that rises from 420 million metric tons of oil equivalent (Mmtoe) in 2005 by a factor of 4.1 times to 1,702 Mmtoe in 2035 (Figure 16). The PRC's on-road fuel requirement accounts for up to 58% of this figure.

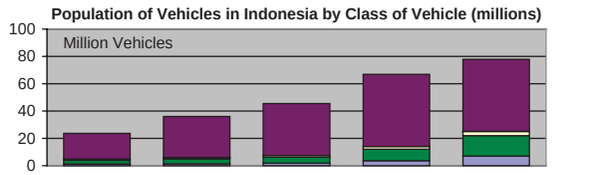
Figure 15: On-road Vehicle Population Forecasts for the People's Republic of China, India, Indonesia, and Thailand



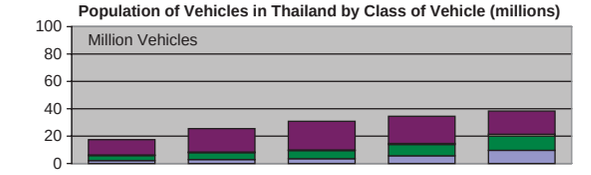
Population	2005	2010	2015	2025	2035
2-W	55.3	97.7	146.7	193.2	130.4
3-W	2.0	1.6	1.7	0.3	0.0
HCV	10.4	15.6	19.9	29.3	37.5
LCV	9.4	15.9	22.8	37.7	52.9
Car, SUV	12.9	33.0	56.8	115.8	192.7
Grand Total	90.0	163.7	248.0	376.4	413.6



Population	2005	2010	2015	2025	2035
2-W	35.8	58.0	87.7	174.1	236.4
3-W	2.3	3.7	5.3	8.8	13.1
HCV	2.4	3.4	4.6	9.1	16.2
LCV	2.4	3.9	5.7	12.5	26.9
Car, SUV	6.2	11.4	18.0	41.6	80.1
Grand Total	49.1	80.3	121.3	246.1	372.7



Population	2005	2010	2015	2025	2035
2-W	18.8	30.0	38.0	52.9	52.7
3-W	0.0	0.0	0.0	0.1	0.1
HCV	0.8	1.0	1.2	1.9	3.0
LCV	2.9	3.6	4.4	8.4	15.1
Car, SUV	1.2	1.4	1.8	3.6	7.0
Grand Total	23.7	36.0	45.5	66.9	77.8

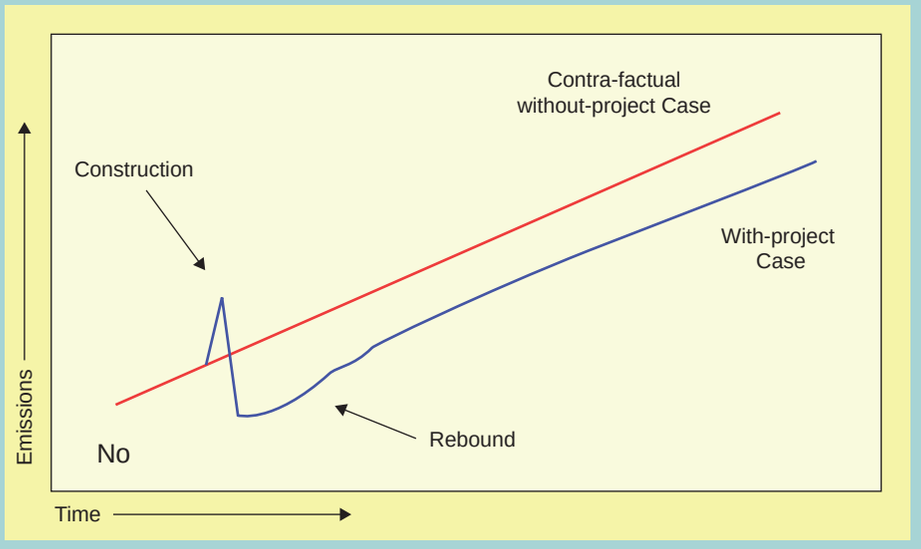


Population	2005	2010	2015	2025	2035
2-W	11.2	17.0	20.9	19.8	16.9
3-W	0.0	0.0	0.0	0.0	0.0
HCV	0.4	0.4	0.5	0.8	1.1
LCV	3.7	5.0	5.9	8.2	10.6
Car, SUV	2.2	2.9	3.5	5.7	9.6
Grand Total	17.4	25.4	30.8	34.5	38.3

2-W = 2-wheeler (motorcycle, etc.); 3-W = 3-wheeler (tricycle, etc.); HCV = heavy-duty commercial vehicle; LCV = light-duty commercial vehicle; PRC = People's Republic of China; SUV = sport utility vehicle.
Source: Segment Y Ltd.

[50] The model contains specific references to the PRC and India; Indonesia and Thailand were taken to be the same as their "Other Asia" figures.

Box 8: Dynamic Baseline



Any transportation project will be but one of many (current and future) projects that affect transport patterns and intensities—and GhG emissions—within the complex, swiftly evolving transport structure of any modern economy or metropolis. Many individual projects will have interactions and dependencies; all of them will be affected by the other multiple dynamic changes that constantly occur. Thus, the impact of a project cannot be evaluated against an as-is base case, "the ***now*** moment-in-time," since this also will change over time.

For the impact of a project to be evaluated, a dynamic baseline needs to be constructed showing what can be expected to have happened if the project had been implemented (the counterfactual without-project case in the figure). This requires evaluating many factors that would have caused changes even without the project. The project's measured results can then be compared at a future point in time against this counterfactual baseline case.

If, for example, growing motorization is causing increasing congestion, a project designed to alleviate traffic could be judged a success if it reduces congestion compared to what would have occurred without the project, even though the average travel time in 10 years is greater than at present.

At any moment in time, the dynamic baseline must adjust the numbers in accordance with the changes that really occur in population, vehicle-technology mix, and vehicle-kilometers-traveled, etc., so that emissions factors and fuel economy numbers are automatically updated. This counterfactual baseline case should not be a mere projection of historic trends; it needs to take into account all the changes that would have occurred in the absence of the project.

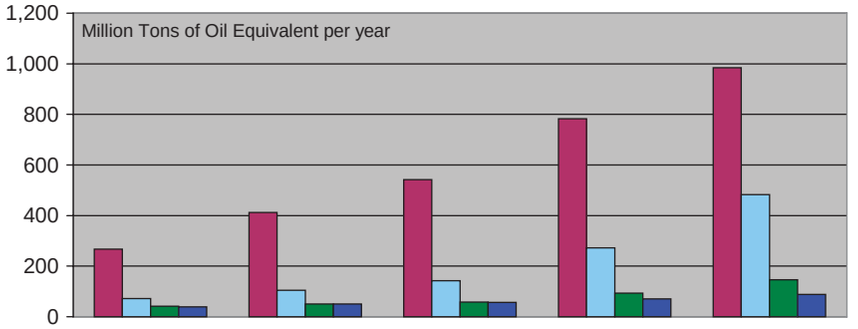
Source: Author.

This base-case fuel consumption results in CO_2 emissions from on-road vehicles increasing from 1,269 million tons of CO_2 per year in 2005 to 5,138 million tons per year in 2035—four times the 2005 value (Figure 17). These figures are for CO_2 only; when other combustion-based GhGs are included, the CO_2-equivalent emissions are expected to be up to 3–5% higher.

3. Policy Intervention Scenarios

Scenarios were analyzed, with the changes to this base case as shown in Table 3. It can be seen that many of these changes would require a considerable degree of effort: national, provincial/state, and municipal governments would have to establish and consistently support policy initiatives and attract both public and private investments.

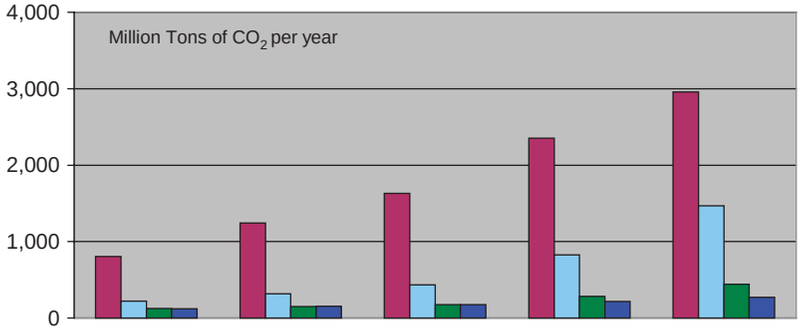
Figure 16: Base Case Scenario 4x—Fuel Consumption



Economy		2005	2010	2015	2025	2035
PRC		267	412	541	783	985
India		72	104	143	272	482
Indonesia		42	50	58	94	146
Thailand		39	50	56	71	88
Total		420	616	799	1,219	1,702

PRC = People's Republic of China.
Source: Segment Y Ltd.

Figure 17: Base Case Scenario 4x—CO_2 Emissions



Economy		2005	2010	2015	2025	2035
PRC		805	1,241	1,629	2,353	2,958
India		219	316	432	825	1,467
Indonesia		125	148	175	283	443
Thailand		120	154	174	219	270
Total		1,269	1,859	2,409	3,680	5,138

CO_2 = carbon dioxide; PRC = People's Republic of China.
Source: Segment Y Ltd.

For ease of comparison, in most cases, a 25% improvement in each indicator between 2005 and 2035 has been used, even though in some cases it could be considered feasible but highly optimistic.

For the biofuels policy intervention, a 25% substitution by 2035 was considered most unlikely. Here, a logistic market penetration technique was used for both bioethanol and biodiesel as a function of time, considering that it could take 30 years to go from 10% to 50% penetration in each specific market. Given the currently low levels of biofuel penetration, this logistic market penetration "S" curve projects that ethanol could replace

9% of gasoline and biodiesel could replace 4.5% of diesel by 2035 in Scenario 3x, in which it is assumed that the potential markets for capture by bioethanol or biodiesel are 50% of the total on-road vehicle fuels markets.

In Scenario 2x, it is assumed that bioethanol and biodiesel could potentially capture 100% of the total on-road vehicle fuels markets. In this scenario, ethanol could replace 18% of gasoline and biodiesel replace 9% of diesel by 2035.

a. Scenario 3x—Fuel Consumption

The combined impact of the Scenario 3x Policy interventions (Figure 18) is a 25% reduction in on-road vehicle fuel consumption between 2005 and 2035. The Figure 18 scenario projects a fuel consumption for the four countries that rises from 420 Mmtoe in 2005 by a factor of 3 to 1,271 Mmtoe in 2035.

Table 3: Policy Interventions in Each Scenario

Policy Intervention	Assumed changes to the base case	
	"Scenario 3x"	"Scenario 2x"
Vehicle Fuel Efficiency Improve the energy efficiency of individual vehicles	Starting in 2010, all cars, SUVs, and heavy commercial vehicles have fuel economies similar to OECD Europe and all light commercial vehicles have fuel economies similar to OECD Pacific.	As in Scenario 1x, plus an additional fuel economy improvement of 1.1% per year for all vehicles. (Additional 25% fuel economy improvement between 2010 and 2035)
Transport Demand Management Institute integrated transportation planning to achieve modal shift from cars to public transport and to manage demand for private transport	Undertake modal shift of 1.1% per year from 2010 from cars and 2-wheelers to buses, to achieve a 25% reduction in projected car and 2-wheeler use between 2010 and 2035. The number of buses increases to account for increased ridership.	As in Scenario 1x, plus an additional reduction of 1.1% per year in the personal transport fleet (cars, SUVs and 2-wheelers) to obtain an additional 25% reduction in projected car use between 2010 and 2035. Part of the reduction in fuel consumed due to this policy intervention will come from decreasing congestion and improving traffic flows.
Transport and Land Use Planning Undertake urban reform and land use planning to reduce the need to travel	Reduce total travel distance per vehicle for cars, SUVs, light commercial vehicles and 2-wheelers of 1.1% per year between 2010 and 2035 (25% reduction over 25 years).	As in Scenario 1x, plus a 1.1% reduction in total travel distance per year from 2015 for all other vehicles.
Biofuels Introduce biofuels with lower GhG emissions	Potential markets for capture by bioethanol or biodiesel are assumed to be 50% of the total markets. Logistic market penetration scenario is used for bioethanol and biodiesel as a function of time, starting with 1.4% for ethanol and 0.3% for biodiesel in 2010 (global) and taking 30 years to go from 10% to 50% penetration. Biodiesel lags ethanol in terms of market capture fraction by 10 years.	Potential markets for capture by bioethanol or biodiesel are assumed to be 100% of the total markets. Logistic market penetration scenario is used for bioethanol and biodiesel as a function of time, starting with 2.9% for ethanol and 0.9% for biodiesel in 2010 and taking 30 years to go from 10% to 50% penetration. Biodiesel lags ethanol in terms of market capture fraction by 10 years.

GhG = greenhouse gas; OECD = Organisation for Economic Co-operation and Development; SUV = sport utility vehicle.
Source: Author.

The contribution of each policy is shown in Figure 19. It can be seen that reducing total travel distance per vehicle for cars, SUVs, light commercial vehicles, and 2-wheelers through urban reform and land use planning has the greatest impact, while modal shift from cars and 2-wheelers to buses has the smallest relative impact—but is probably one of the easiest to achieve.

It will be noted that the total reduction due to applying all four policy interventions together is less than the sum of the reductions achieved by each policy intervention alone. This is because if the size of the vehicle fleet is reduced, an improvement in fuel efficiency will have a lower impact (in tons) than if the fleet size had not changed. This is true for all the graphs in this section.

b. Scenario 3x—CO_2 emissions

The combined impact of the Scenario 3x Policy interventions on CO_2 emissions (Figure 20) is a 29% reduction between 2005 and 2035. Figure 20 scenario projects CO_2 emissions for the four countries that rise from 1,269 million metric tons of CO_2 per year ($MmtcCO_2$) in 2005 by a factor of 2.9 times to 3,668 $MmtcCO_2$ in 2035.

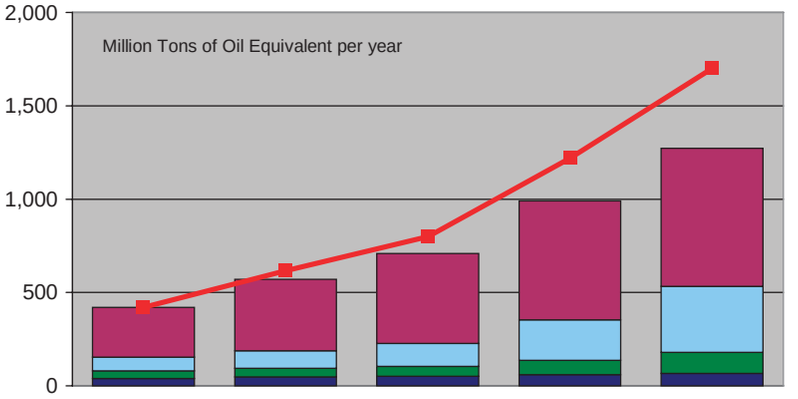
While the slow introduction of biofuels does not change the oil-equivalent fuel consumption, it does impact GhG emissions (Figure 21).

c. Scenario 2x—Fuel Consumption

The combined impact of the Scenario 2x Policy interventions (Figure 22) is a 50% reduction in on-road vehicle fuel consumption between 2005 and 2035. Even with this considerable effort, the on-road vehicle fuel consumption of these four emerging Asian nations doubles over this 30-year period. The scenario projects a fuel consumption for the four countries that rises from 420 Mmtoe in 2005 by a factor of two to 847 Mmtoe in 2035.

The contribution of each policy is shown in Figure 23. Here it can be seen that reducing total travel distance per vehicle through urban reform and land use planning together with increasing vehicle fuel efficiency to the forefront of technology—keeping at the same level of the most advanced nations—are the policies that generate the overall reduction.

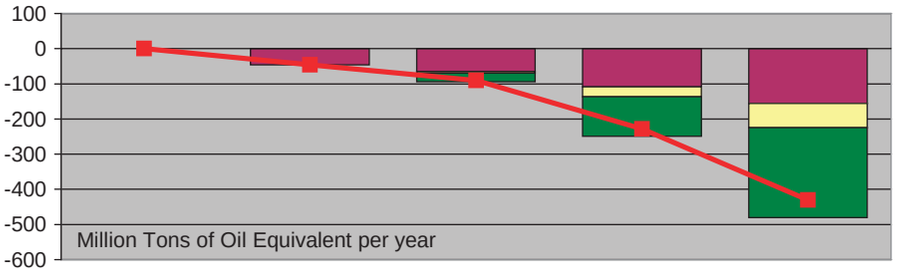
Figure 18: Scenario 3x—Fuel Consumption



Economy		2005	2010	2015	2025	2035
Baseline		420	616	799	1,219	1,702
PRC		267	382	481	638	739
India		72	94	123	216	353
Indonesia		42	47	53	78	113
Thailand		39	47	51	59	67
Total		**420**	**570**	**708**	**991**	**1,271**
Improvement		**0%**	**7%**	**11%**	**19%**	**25%**

PRC = People's Republic of China.
Source: Segment Y Ltd.

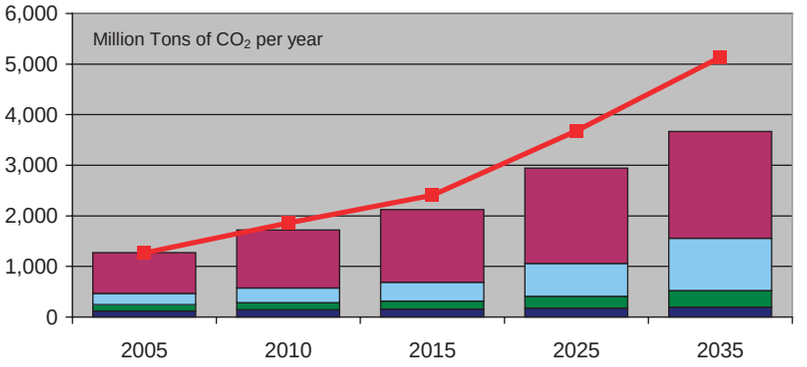
Figure 19: Scenario 3x—Reduction in Fuel Consumption by Policy Intervention



Improvement	2005	2010	2015	2025	2035
Baseline	420	616	799	1,219	1,702
Vehicle Fuel Efficiency	0	-46	-65	-108	-156
Transport Demand Management	0	0	-5	-29	-69
Transport and Land Use Planning	0	0	-24	-112	-256
Biofuels	0	0	0	0	0
Total Reduction	0	-46	-90	-228	-430
Percent Total Reduction	0%	-7%	-11%	-19%	-25%

Source: Segment Y Ltd.

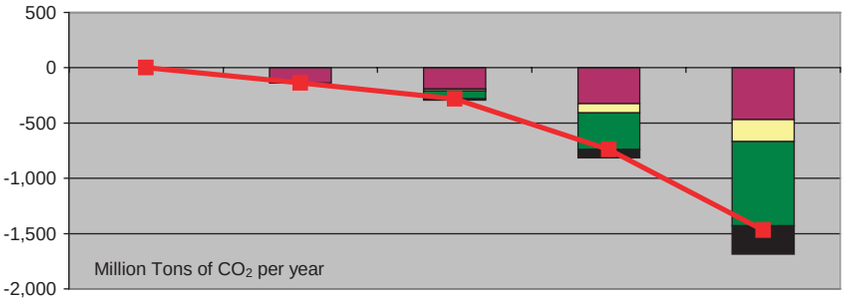
Figure 20: Scenario 3x—CO_2 Emissions



Economy	2005	2010	2015	2025	2035
Baseline	1,269	1,859	2,409	3,679	5,137
PRC	805	1,149	1,438	1,880	2,110
India	220	287	375	652	1,037
Indonesia	125	140	157	231	324
Thailand	120	146	157	178	197
Total	**1,269**	**1,721**	**2,127**	**2,941**	**3,668**
Improvement	**0%**	**7%**	**12%**	**20%**	**29%**

CO_2 = carbon dioxide; PRC = People's Republic of China.
Note: Total may not add due to rounding.
Source: Segment Y Ltd.

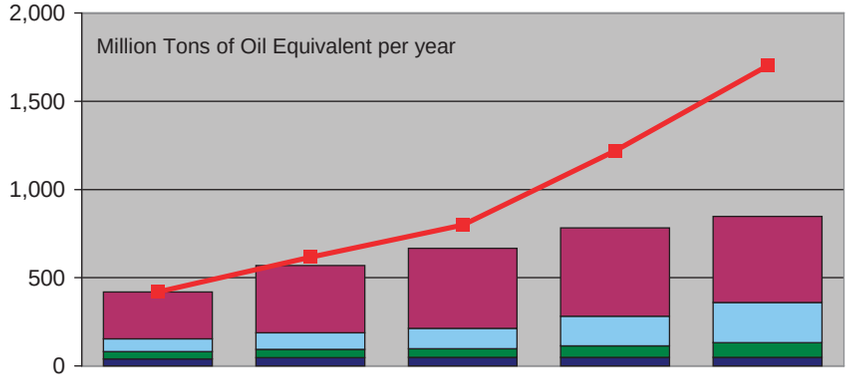
Figure 21: Scenario 3x—Reduction in CO_2 Emissions by Policy Intervention



Improvement	2005	2010	2015	2025	2035
Baseline	1,269	1,859	2,409	3,679	5,137
Vehicle Fuel Efficiency	0	-137	-193	-325	-470
Transport Demand Management	0	0	-15	-83	-198
Transport and Land Use Planning	0	0	-72	-331	-761
Biofuels	0	-1	-14	-75	-256
Total Reduction	**0**	**-138**	**-282**	**-739**	**-1,469**
Percent Total Reduction	**0%**	**-7%**	**-12%**	**-20%**	**-29%**

Source: Segment Y Ltd.

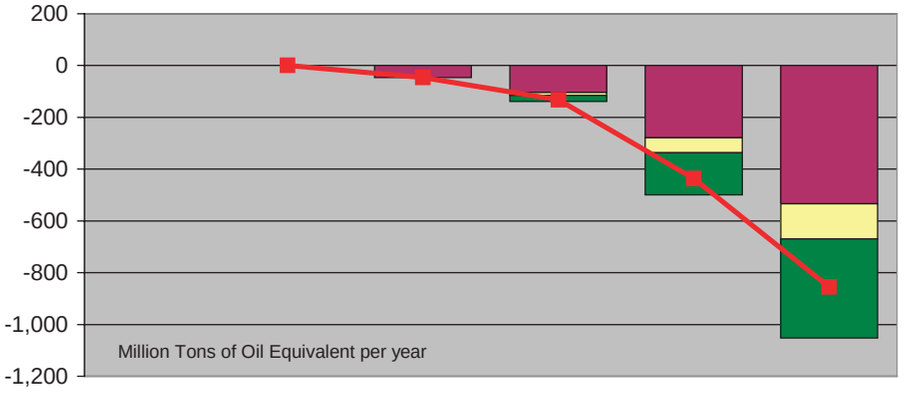
Figure 22: Scenario 2x—Fuel Consumption



Economy	2005	2010	2015	2025	2035
Baseline	420	616	799	1,219	1,702
PRC	267	382	453	502	488
India	72	94	116	168	228
Indonesia	42	47	50	64	82
Thailand	39	47	48	49	49
Total	**420**	**570**	**666**	**783**	**847**
Improvement	**0%**	**7%**	**17%**	**36%**	**50%**

PRC = People's Republic of China.
Source: Segment Y Ltd.

Figure 23: Scenario 2x—Reduction in Fuel Consumption by Policy Intervention



Improvement	2005	2010	2015	2025	2035
Baseline	420	616	799	1,219	1,702
Vehicle Fuel Efficiency	0	-46	-104	-279	-534
Transport Demand Management	0	0	-11	-58	-135
Transport and Land Use Planning	0	0	-24	-163	-383
Biofuels	0	0	0	0	0
Total Reduction	**0**	**-46**	**-132**	**-436**	**-855**
Percent Total Reduction	**0%**	**-7%**	**-17%**	**-36%**	**-50%**

Source: Segment Y Ltd.

d. Scenario 2x—CO_2 emissions

The combined impact of the Scenario 2x policy interventions on CO_2 emissions (Figure 24) is a 55% reduction between 2005 and 2035. The scenario projects CO_2 emissions for the four countries that rise from 1,269 MmtcCO_2 in 2005 by a factor of 1.8 times to 2,331 MmtcCO_2 in 2035.

Even over this 30-year period, biofuels do not seem to represent the large contributor to reduced CO_2 emissions in this scenario (Figure 25), but could make an ever-increasing difference over the following decades.

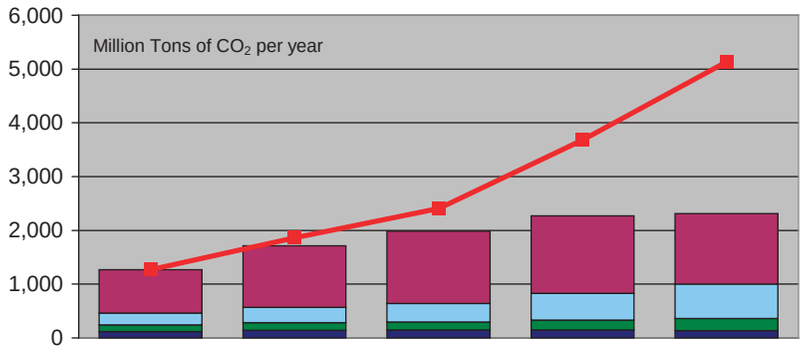
E. THE CO-BENEFITS OF CLIMATE CHANGE MITIGATION

In moving toward this vision, most development and poverty alleviation goals directly impact on-road transportation and hence GhG emissions from this sector. Adding to the complexity is the reality of a highly dynamic moving baseline powered by population and economic growth that places heavier burdens on the road-transport system. This sector currently uses around 21% of the world's total energy consumption; over the short and medium term, it is the sector most tied to petroleum products, and emerging Asia by itself is expected to account for 45% of the total world increase in oil use through 2025. Despite this, many see the GhG potential of on-road transport in emerging Asia as a priority area within itself for sector reform and development.

An effective and sustainable transport system for people and goods is a prerequisite for consistent long-term economic growth. Equity and poverty alleviation both require such a sustainable system. Asian countries and cities urgently need a policy reorientation that develops new institutional capacities and bridges between sectors to improve land-use planning and promote integrated transport infrastructure schemes based on affordable, environment-friendly public transport and NMT. Moreover, the co-benefit linkages within this framework that inextricably relate economic, efficient, and quality-of-life enhancements to improvements in GhG emissions are many.

All policy interventions shown in Table 4 that are required to mitigate climate change have important co-benefits at the regional and local levels. Improvements in air quality and health, traffic and congestion, quality of life, economic development, road safety, and transport

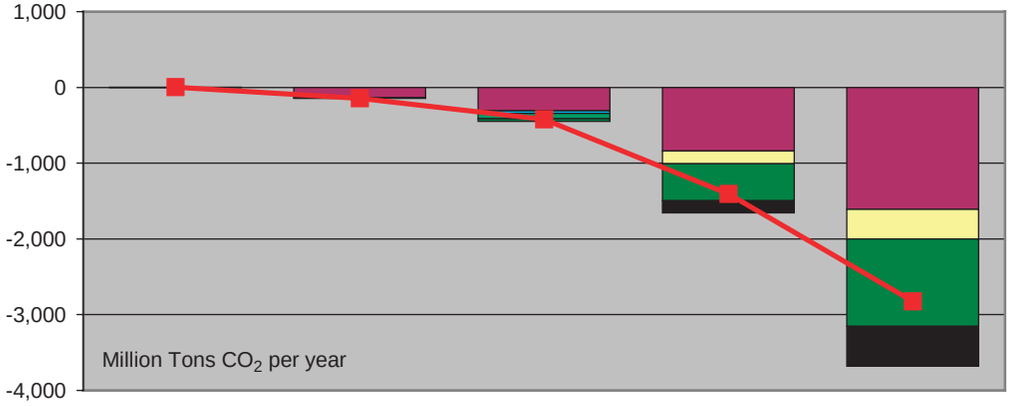
Figure 24: Scenario 2x—CO_2 Emissions



Economy	2005	2010	2015	2025	2035
Baseline	1,269	1,859	2,409	3,679	5,137
PRC	805	1,144	1,343	1,443	1,308
India	220	286	349	497	643
Indonesia	125	140	147	185	221
Thailand	120	145	147	147	139
Total	**1,269**	**1,715**	**1,986**	**2,272**	**2,311**
Improvement	**0%**	**8%**	**18%**	**38%**	**55%**

CO_2 = carbon dioxide; PRC = People's Republic of China.
Source: Segment Y Ltd.

Figure 25: Scenario 2x—Reduction in CO_2 Emissions by Policy Intervention



Improvement	2005	2010	2015	2025	2035
Baseline	1,269	1,859	2,409	3,679	5,137
Vehicle Fuel Efficiency	0	-137	-311	-840	-1,611
Transport Demand Management	0	0	-31	-168	-389
Transport and Land Use Planning	0	0	-72	-490	-1,155
Biofuels	0	-8	-33	-157	-525
Total Reduction	0	-144	-422	-1,408	-2,826
Percent Total Reduction	**0%**	**-8%**	**-18%**	**-38%**	**-55%**

CO_2 = carbon dioxide.
Source: Segment Y Ltd.

Table 4: Co-benefits and Principal Stakeholders

Effectiveness[a]	Policies	Co-benefits							Principal Stakeholders					Investments by the International Development Community
		Climate Change	Air Quality and Health	Traffic and Congestion	Quality of Life	Economic Development	Road Safety	Transport Efficiency	Int'l. Development Community	National, State, Provincial Gov't	Local, City, Municipal Gov't	Community Groups and NGOs	Private Enterprise and Investors	
Continuous	Strengthen continually updated shared knowledge bases and common tools to assist emerging Asian countries in optimizing their climate change decisions for urban development, transport systems, and biofuels	★★★	★★★	★★★	★★★	★★★	★★★	★★★	✓	✓				Provide nonlending regional assistance to develop and maintain a climate-change-focused shared knowledge base and tools (models) for optimizing option selection in urban development, transport systems, and biofuels
Long Term	Improve access to goods and services through integrated urban planning and travel demand management	★★★	★★★	★★★	★★★	★★★	★★★	★★★	✓	✓	✓	✓	✓	Provide TA to strengthen and promote governance; legal, structural, and institutional reform; and awareness building
Medium Term	Reduce the fuel consumed per passenger- or freight-kilometer traveled through traffic demand management: 1. Charge the externalities of private motorized transport 2. Mass-transit improvements 3. Nonmotorized transport	★★★	★★★	★★★	★★★	★★★	★★★	★★★	✓	✓	✓	✓	✓	Strengthen administrative and functional linkages at the city and municipal levels. Develop standards and sustainable indicators Large investment is required in urban development and transport systems
Medium Term	Adopt fuel efficiency standards for new vehicles: 1. Energy efficiency standards 2. Emissions standards 3. Fuel standards 4. R&D	★★★	★★★		★★	★★	★★	★★	✓	✓		✓	✓	Provide TA to advance the technological automotive road map and promote the development of new vehicle energy efficiency, emissions, and fuel standards Reinforce R&D to use non-carbon-based fuels (hydrogen, etc.) and in technology for 2-wheelers Large investment is required for clean fuel production capacity

Table 4: Co-benefits and Principal Stakeholders

Effectiveness[a]	Policies	Co-benefits							Principal Stakeholders					Investments by the International Development Community
		Climate Change	Air Quality and Health	Traffic and Congestion	Quality of Life	Economic Development	Road Safety	Transport Efficiency	Int'l. Development Community	National, State, Provincial Gov't	Local, City, Municipal Gov't	Community Groups and NGOs	Private Enterprise and Investors	
Medium Term	Provide a substantial part of on-road transport's fuel requirements with clean and GhG-efficient biofuels	★★★	★★★		★★	★★			✓	✓	✓		✓	Provide technical, policy, and focused financial assistance to promote the large-scale production, distribution, and use of biofuels and biofuel-compatible vehicles Support R&D to create an environment in which diversity in crops and technologies can evolve to large-scale biofuel production
Short Term	Improve fuel efficiency in existing vehicles: 1. Inspection, certification and maintenance 2. Retrofit	★★★	★★★		★★	★	★★	★★	✓	✓	✓	✓	✓	Provide TA to promote governance, capacity, and awareness building and to establish and effectively enforce in-use vehicle emissions standards Provide TA support for pilot demonstration projects

GhG = greenhouse gas; NGO = nongovernment organization; R&D = research and development; TA = technical assistance.

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

Source: Author.

efficiency will be generated to a greater or lesser degree by most climate change interventions. These provide an important opportunity to tailor the proposals to each stakeholder's constituents and interests.

Policy changes in urban development and awareness campaigns are needed for longer-term benefits to be seen. Most of these changes will be initiated based on this series of co-benefits relating to equity and quality of life; very few will be based solely on global environmental concerns. The emerging Asian countries would benefit from a strengthening of common modeling tools using continually updated and shared knowledge bases in their decision-making processes to optimize their climate change mitigation efforts from on-road transport.

F. STAKEHOLDERS

The accelerated growth in Asia of urban population, motorization, congestion, road safety concerns, and pollution, including the GhG component, urgently requires a change in focus for most Asian metropolises in their approach to urban and transportation planning. The actions required to face these problems are the same actions required to reduce the accelerated impact of Asian on-road transport on climate change.

The major stakeholders in this process are the following:

- **The international development community,** whose overriding interest is poverty alleviation and social development through sustainable economic growth with a reduced carbon footprint;
- **National, state, and provincial governments,** which share the international development community's concerns about poverty alleviation and social and economic development, combined with concerns about energy security in the light of increasing demand and costs with an ever-greater imported component;
- **Local, city, and municipal governments,** faced with unfettered urban growth and sprawl and with growing congestion, pollution, and safety concerns that restrict their ability to attract business and improve the quality of life;
- **NGOs and community groups,** which will be faced with a lowering of expectations toward the "common good" unless paradigm shifts are achieved;
- **Private enterprise,** depending on the availability of well-functioning and affordable transport systems to generate further economic growth; and
- **Investors,** in need of clearly defined regulations and long-term policies to reduce the risk and enable the paradigm shift changes that they must promote.

Of these, the development community and some NGOs are most likely to buy into the proposed action plans purely because of their climate change implications; however, the identified co-benefits of all proposed action plans directly impact major problem areas that countries and cities in Asia are currently facing. The development community has an important role in outreach to governments and other stakeholders to help them design fuel efficiency policy formulation.

Public awareness raising to improve the understanding and knowledge of the different stakeholders and a willingness to work together in partnership are very important for climate change in general and transport-related climate change in particular; this needs to be promoted by the development community as well as by national and local stakeholders. Separate strategies are required for each stakeholder to inform and promote the co-benefits associated with each policy intervention.

An area of special concern needs to be the limited capacity among all stakeholders in analyzing current trends, developing integrated policies for transport and climate change, and effectively implementing and monitoring the policy approaches outlined in this report. Establishing priorities for climate and transport is still relatively new for both the development community and Asian countries and cities. In those few cases where such priorities have been established, it has been within units with an environmental mandate rather than urban development or transport. This implies that before large training programs are initiated, the institutional mandates of different government agencies at both the national and local levels need to be adjusted. Since this is a new topic, sufficient capacity also be created in the private sector, both to guide decision making in the private sector and so that it can act as a consultant to governments and the international development community. To promote a regional approach, such capacity should not be limited to individual cities or countries, but also be consistent at the regional level.

Capacity building is also required on the use of financing options such as CDM and GEF IV (country-based allocation) programs that can facilitate the implementation of climate-friendly measures.

For stakeholders to engage in a productive dialogue and implement common programs and projects, a better set of tools and instruments that can be used to identify and analyze trends and plan for the future should be developed. The lack of comparative data for Asian countries (for example, modal split) and the overall absence of reliable data in specific areas, such as the number of different vehicle types in use and the number of people making use of NMT, hampered the development of the policy recommendations in this report.

G. INVESTMENT

Urban development and expansion of the transport systems in emerging Asian countries will require large amounts of funding. A joint ADB-Japan Bank for International Cooperation-World Bank study in 2005 estimated that the creation of additional required infrastructure for Asia would cost $165 billion per year for the next 5 years (2006–2010), out of which $37 billion comprises investments required for road and rail subsectors.

Investments are required for the short, medium, and long term. In general, most of these investments would be needed in any case (e.g., for urban expansion, infrastructure generation, public transport, and fuel supply). Ensuring the right type of investments so that GhG emissions are minimized can prevent economic damage through health impacts, congestion, and road accidents. Since all these investments have important co-benefits—including air quality and health, traffic and congestion, quality of life, road safety, transport efficiency, and economic development—over the long term, similar investments would probably be required even if the climate change component were not considered. It is encouraging that key components of the policy approaches identified as being more climate-friendly also are less costly to implement. For example, a BRT is in many cities a more appropriate solution than a metro and far less expensive to construct, operate, and maintain.

The economic benefits of investments in reducing air pollution in the transport sector or improving road safety have been well established. The limited financial returns often prevent the quick adoption of cleaner technologies, such as low sulfur fuels. For such measures to be taken, a willingness–to-pay attitude should be promoted among the general public by undertaking extensive awareness-raising campaigns. This will help increase the possibility for consumer financing. At the same time, the externalities of transport should be well understood and reflected in any type of incentives and disincentives used in the transport sector. The PRC recently modified the sales tax on light-duty vehicles and introduced a system of six classes whereby cars with a small engine displacement (and low GhG emissions) are more lightly taxed than cars with larger engine displacement.

To develop a medium- to long-term investment plan for transport in Asian cities will require addressing the status of the informal sector. As described in this report, the informal sector provides a large part of the public transport in many cities. The time perspective of this sector is limited: it does not generate enough cash internally to modernize fleets and it does not have established linkages with formal external sources of capital. If this sector is not regulated and reformed, developing integrated investment strategies and plans will be difficult.

Introducing a climate change priority requires refocusing many investment components and this demands an additional effort from the development community to build awareness, develop capacities and technical expertise, strengthen linkages, and promote inter-sector collaboration and technology development. It requires an increased knowledge base to encourage enlightened decision making that proactively evaluates the GhG implications of corelated projects.

Close monitoring of the results from research and development conducted by internationally or commercially-supported efforts outside emerging Asia can allow the countries in emerging Asia and the development community to optimize their funding within the region as a whole and within individual countries to catalyze investments in areas that remain behind and threaten to undermine the overall success in implementing the action plan. Informed decision making when selecting future action plans to mitigate climate change from this sector will thus require a knowledge base that closely monitors worldwide technological pathways and best practices.

To catalyze investment to support the policy approaches proposed in this paper, dedicated funds, in addition to regular funding for urban development and transport as described above, should be available. Such funds can help in overcoming the institutional, technological, and knowledge-related barriers and help finance pilot projects. Such special funds are not expected to take over the role of regular financing of urban development and transport, which as stated is

in many cases undertaken by the private sector. Such dedicated funds could be financed from a range of sources, including the following:

- Earmarked funds from special user charges such as a congestion charge. The London congestion charge has helped fund the expansion and modernization of the bus fleet and has resulted in a modest modal shift away from private cars toward public transport. Other possibilities that can be introduced more rapidly and widely include road user charges and fuel taxes. Both are already fairly widely used and can be redirected, most likely in part, toward providing incentives for more sustainable transport systems. This would require that governments, especially ministries of finance, no longer regard such charges as instruments to raise the general revenues, but as targeted policy instruments that both aim to restrain private car use and at the same time promote integrated land use and transport planning and the expansion and improvement of public transport. Another instrument that is not yet widely used in Asian countries is parking charges. Parking policies at present are in most cases ad hoc and, as in the case of other user charges, do not have a transport-related policy objective.
- Linkages to GEF and CDM mechanisms could help raise interest. Currently no dedicated funding windows are available for financing energy efficiency in transport, unlike other areas where a range of special funds is available. If the global community is serious about moving forward with energy efficiency in the transport sector, it will have to create similar funds to catalyze knowledge management, capacity building, and policy development.
- Development agencies have over the last years either formally or informally adopted targets on, for example, renewable energy or water and sanitation. Embracing such targets, which are usually the outcome of international discussions, have helped prioritize funding in development agencies. Encouraging the adoption of targets on urban development and transport, e.g., improving share of trips undertaken by public transport and/or NMT, could be encouraged. At present, less than 10% of ADB's transport-related lending is for developing urban transport systems and the large majority of funding is for road construction.

The danger of dedicated funding is that a dependency develops that prevents a wide-scale replication and dissemination of successful, sustainable transport solutions. A financial model where international financial institution financing is required as bridge financing might be attractive in the short term, but needs to be avoided for the medium and long term.

Stakeholders who are expected to lead in formulating and implementing transport programs and projects should know what support the national government will provide. Few countries in emerging Asia have come out with a clear policy on this. A notable exception is the recent National Urban Transport Policy in India, in which the national Government formulated clear criteria for the support to be provided:

- 50% of the cost of preparing comprehensive city transport plans and detailed project reports;
- equity participation and/or viability gap funding to the extent of 20% of the capital cost of public transport systems; and
- 50% of the cost of project development whenever such projects seek to be taken up through PPPs, so that a sound basis for attracting private partners can be established, whereby the remaining funds would have to come from the city development authority (MUD-GOI 2006).

Most of the investment requirement for the international development community, and to a lesser extent the governments in Asia, is in institutional development and knowledge management. The private sector will be the source of the greater proportion of implementation investment, and for this to occur in the time frame and to the required extent, very clear and transparent regulations and long-term policies need to be established. PPPs are expected to increase, especially with respect to the provision of urban public transport. This will require establishing or improving a regulatory institutional framework. At present, few countries in emerging Asia have in place effective, independent regulators for public transport.