Wide-scale odd-even number plate schemes may affect the mode of travel in the short term but may have unforeseen adverse effects, including the retention of older, more polluting vehicles. While these schemes may bring temporary relief, they are unlikely to provide the basis for an appropriate long-term solution. If there is temporary relief from congestion, then the opportunity should be used to implement schemes with long-term beneficial effects,[8] such as the implementation of bus lanes in streets where traffic volumes have declined.

These policy guidelines on travel demand management are recommended:

- Public transport is desired as the dominant mode, but this cannot be achieved without the implementation of sound and comprehensive TDM policies. Policies should restrain car ownership and reduce the demand for private car and motorcycle use, and at the same time promote increased public transport use.
- TDM should not be implemented in isolation, but in conjunction with other transport planning, TSM and transport pricing measures. User needs and safety should be considered in the design of TDM measures even when these measures are directed to air quality improvements.
- Parking policies formulated across the metropolitan area should aim to control car use, and ensure that the car parking provided is allocated to promote sound and equitable development.

Transport systems management and regulation

Traffic management

All Asian cities have some form of traffic management system in place. To date, the emphasis has been on the "hardware" rather than the "software."

A key issue in many cities is the variability of vehicle speeds arising from the interaction of various vehicle types with different acceleration characteristics. There are numerous low-cost, fast-acting management measures that can address this. There are many examples of segregated bus stops, bus and NMV lanes, and other similar treatments in many cities. Many simple measures, such as the segregation of NMV lanes, provide benefits to NMVs directly as well as other traffic.

Traffic management schemes should be designed to deal with Asia's unique traffic flow characteristics. Low cost and quickly implemented schemes catering to the specific needs of each vehicle type, including NMVs and pedestrians, are needed

In urban road networks, the junctions are the determinants of road network capacity. Grade junctions also play an important role in providing safe pedestrian road crossing. Traffic delays at junctions contribute greatly to air pollution because the emission rates (for almost all pollutants) of idling vehicles are much higher than at free flow. Well-designed junctions that support modern traffic signal control systems can minimize delays and traffic stoppages and so, reduce emissions.

Effective and sustained implementation relies on good planning, adequate technical capacity and appropriate cooperation between the traffic police and agencies (usually local government) that install traffic management equipment such as traffic lights, barriers, and others. Not all of these elements are always present in Asian cities, and such deficiencies can affect implementation success. A critical issue concerns the traffic police who play a role in enforcement, but are rarely equipped with the appropriate training for planning, implementation, and management of the traffic management measures they are entrusted with. A second important issue is the pervasive corruption that thwarts efforts at improving traffic management in many cities.

The economic and network effects of traffic management interventions can be complex and, at times, counterintuitive. Traffic flow improvements may or may not improve air quality, and even if they do, such investments may or may not be justified economically. For example, in a congested city where there is

significant suppressed demand, the removal of a bottleneck may not reduce congestion or reduce air pollution due to the effect of induced traffic. Simplistic solutions without solid, context-based technical and economic analysis should be resisted.

The enforcement of traffic laws and regulations can achieve significant traffic flow improvements. Improved safety is often an important outcome of enforcement.

A critical issue concerns the traffic police who play a role in enforcement, but are rarely equipped with the appropriate training for planning, implementation, and management of the traffic management measures they are entrusted with

Proper enforcement is best implemented when the traffic code is clear and traffic management measures support desirable driving behavior. Motorist and road user education is essential to maximize the benefits of good traffic management works.[9]

In many cities, poorly-planned road improvements may themselves contribute significantly to congestion. Yet most congestion could be avoided through careful planning, good on-site management of road works, and the provision of appropriate information on construction sites and alternative routes.

In traffic management plans, these principles should be considered:

- Traffic management schemes should be designed to deal with Asia's unique traffic flow characteristics. Low cost and quickly implemented schemes catering to the specific needs of each vehicle type, including NMVs and pedestrians, are needed.
- Traffic management schemes, whether permanent or temporary, should be designed to promote transparency and improved governance of the sector, thereby limiting the opportunities for corruption. Proper enforcement and user education are essential supporting elements.

Public transport

The role of public transport varies widely in Asian cities. Although in some Asian cities public transport's mode share is less than 5%, in most Asian cities, public transport vehicles (usually buses, but also other indigenous modes) operating on fixed routes and powered by diesel engines, carry the majority of public transport trips. These diesel-powered public transport vehicles are a major source of PM and NO_x emissions.

Attracting car and motorcycle drivers to switch to public transport is not easy in view of the status and convenience which private vehicle ownership confers. But, high-quality, fast and accessible public transport services—whether rail or bus—have proven to be quite successful in attracting ordinary bus users and users of para-transit modes such as public utility tricycles in the Philippines. Some new high-quality rail mass transit systems in the region such as the Bangkok Transit System in Thailand have shown that they can attract a significant diversion from private car use.

In many Asian cities, the public transport sector is dominated by a single or by several state-owned bus operators that monopolize the provision of public transport services. In some cases, they may subcontract operations to private sector companies; while in other cases, they may compete with them. Usually, the state-owned operators, and in many cases, the private operators, are heavily constrained by the regulatory system within which they operate.

Governments usually seek to restrain fares for basic services. Too often unnecessary regulations discourage innovation, which results in limiting the range and quality of transport services pro-

Cars in heavy traffic, which have to stop repeatedly because of traffic congestion, pollute considerably more than cars which operate in free flow conditions. This traffic condition is typical for most Asian cities particularly during peak hours

vided. In this environment, the financial position of public transport operators is often weak and does not allow for proper maintenance and depreciation of vehicles to ensure they can be replaced on a regular basis.

In many cases, fare restrictions disadvantage passengers because operators are unable to provide faster, more direct, and comfortable services. The lack of these services may prevent passengers from making essential trips, require them to use more costly alternatives such as taxis, or make longer, more costly journeys requiring several different transport forms. Passengers are, however, often willing to pay a higher fare for greater convenience and quality.

Public transport systems in all cities are in a continual state of evolution. Very few cities conduct regular reviews of the organization and route structure of their public transport systems. As these systems are intended to serve people, well-designed travel surveys are required to provide a sound basis to design future improvements. Public involvement in the planning process is also valuable to ensure that what is proposed actually meets peoples' needs.

Public transport improvements proposed to reduce emissions should be implemented in an environment where the operations are efficient and financially sustainable

Public transport policies aimed at improving air quality either focus directly on making cleaner vehicles (e.g. engine upgrades, use of alternative fuels, etc.) or indirectly seek to influence modal shifts (i.e. increase switching to public transport). Public transport improvements proposed to reduce emissions should be imple-

mented in an environment where the operations are efficient and financially sustainable. This presents a challenge to responsible agencies to design regulatory and contracting arrangements that facilitate the financial sustainability of public transport operators while ensuring affordable fares.

Physical measures such as bus lanes and larger-scale segregated busways increase efficiency, and thus can contribute to financial sustainability. Many cities resist busways since they are not as sophisticated as rail systems. However, high-quality, exclusive busways with segregated rights of way, modern stations, and clean, comfortable vehicles can achieve high acceptance ratings from the traveling public. A positive image of exclusive busways may pave the way for increased investment and further technological upgrading of the fleet.

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If public transport operators are unresponsive to their patrons and outside influences, then much of the potential gain from these measures could be lost. Hence, measures to improve efficiencies should also include some element of competition. Competition "for the market", backed up by appropriate regulation, is usually better for air quality than competition "in the market". The latter is often associated with unruly operations because public transport vehicles compete with each other for passengers on the street.[10]

The inadequate provision of public transport services to areas of low demand, such as newly-developing areas, may force people to purchase a private vehicle even if they prefer not to.

Many Asian cities, including Manila, Bangkok, Kuala Lumpur, and Shanghai recently introduced new urban rail systems. Modern urban rail transit systems may have a role in the busiest corridors of Asia's largest cities, where demand for public transport movement exceeds 15,000 to 20,000 passengers per hour per direction on peak hours, which is the limit for sustainable busway operations. An issue that requires careful consideration is whether local communities can afford expensive urban rail systems.

Integrated feeder public transport services, facilities, common ticketing, and information systems, support "seamless" connections to rail and busway systems. Many developed or near-developed cities including Singapore, Seoul, and Taipei,China have well-integrated public transport systems. Other cities in Asia are lagging behind in this regard.

The guidelines to be considered in improving public transport are:

Modern urban rail transit systems may have a role in the busiest corridors of Asia's largest cities, where demand for public transport movement exceeds 15,000 to 20,000 passengers per hour per direction on peak hours, which is the limit for sustainable busway operations

- The long-term viability of public transport should be protected by encouraging efficient operations. Efficient operations can be achieved by increasing operational speed through physical improvements and by implementing appropriate regulatory and franchising arrangements.
- Reforms to the public transport planning and regulation system should be aimed at improving public transport and enhancing its role as an alternative to private vehicle use. Several reforms merit consideration and should be implemented in combination,[11] including the:
  - establishment of new institutional arrangements within responsible local agencies for planning, regulating and monitoring bus services;
  - restructuring bus routes to provide more convenient and efficient services;
  - development of new procedures for bus service regulation and franchising to raise bus operator quality, to provide a mechanism for ensuring that essential bus services can be provided to all areas, to reduce service provision costs, and to ensure quality vehicles are provided and can meet in-use emission standards; and
  - establishment of mechanisms to provide passenger input to the planning process.
- Urban rail systems play a valuable role in high-demand corridors in larger cities, but should only be implemented where economically and financially viable.
- Appropriate integration of feeder transport services, interchange facilities, ticketing and information systems should be implemented. Ideally, these systems should be multimodal in scope.
- Common ticketing systems should use fare structures that do not penalize passengers for changing modes.

The inadequate provision of public transport services to areas of low demand, such as newly-developing areas, may force people to purchase a private vehicle even if they prefer not to

Nonmotorized vehicles (NMVs) and pedestrians

NMVs, such as bicycles and pedal-powered vehicles, and pedestrians do not pollute the air. In many developing Asian countries, NMVs are a major transport mode and source of employment. With rising incomes also comes an oft-prevailing view that NMVs are inferior transport modes that degrade the particular society's image. As a result, attempts are often made to ban or severely restrict NMV use.

It is essential that major new transport investments provide overall community benefits and do not unfairly disadvantage NMVs, pedestrians and low-income groups

However, NMVs often cater to a high proportion of daily urban area trips (such as transport to local schools and shopping) and freight transport, particularly in old town centers with narrow streets. Most cities with high NMV use have ample space to inexpensively segregate NMVs and provide integrated NMV networks, thus achieving high economic returns. Several Asian cities have demonstrated that schemes to promote NMVs are cost effective and contribute a positive environmental impact.

Once traffic volumes increase, the usual response is to allocate as much road space as possible to vehicles at the expense of NMVs and pedestrians. NMVs and pedestrians often fare badly when new roads are constructed or when existing roads are widened. The space they formerly used for movement and parking is often allocated to traffic, without any consideration of how to mitigate NMV displacement. Good planning requires that essential NMV movements be catered for with well-designed, safe and convenient facilities.

Low-cost investments to enhance pedestrian movements are similarly very beneficial. Public transport that is accessible to housing, shopping and employment locations with good quality connecting linkages has been shown to reduce the dependency on private transport modes.

Many transport planning models applied in Asian cities do not include NMVs in their consideration of vehicle types. Traffic flow models and their parameters are not normally designed and calibrated for use in Asian mixed flow traffic conditions.

The general guidelines relating to NMVs and pedestrians are:

- NMVs and pedestrians should be treated as modes whose potential should be enhanced and integrated in overall transport planning. It is essential that major new transport investments provide overall community benefits and do not unfairly disadvantage NMVs, pedestrians and low-income groups.
- Active formulation and implementation of low-cost measures that will provide significant benefits to NMVs and other traffic should be vigorously pursued. These should be implemented before traffic volumes increase and all road space is allocated to vehicular traffic.
- Transport and traffic flow models should incorporate the characteristics of NMVs, pedestrians and other indigenous modes in a policy-relevant way to support good decision-making.

Resource mobilization, taxation, pricing and subsidy

In Asia's developing cities, there are many needs for investment within and outside the transport sector. Good data and rational priority setting are needed to take into account all relevant health, environmental and transport benefits and costs.

Pricing and taxation

Private vehicles, including cars and motorcycles, should pay their full external costs. However, in some Asian countries, motorcycle and car ownership is seen as desirable and to be promoted at all cost. Coupled with this perception is the common view that development and support of the automobile and motorcycle manufacturing industry is good for a country's economic development. For these reasons, policymakers often implement policies that artificially lower the cost of vehicle ownership through very low