



LTMASTERPLAN

A People-Centred Land Transport System

LAND TRANSPORT MASTERPLAN

MINISTER'S FOREWORD

For Singapore to realise its aspirations to be a thriving global city, its transport infrastructure is critical. Over the next 10 to 15 years, the transport system must support economic growth, a bigger population, higher expectations and more diverse lifestyles.

With this in mind, we embarked on a comprehensive Land Transport Review in October 2006. We solicited and benefited from contributions from a broad spectrum of people including students, workers, employers, commuters, transport operators, ordinary Singaporeans and experts; at home and abroad. In total, more than 4,500 people contributed their time, energies and ideas to this review.

The culmination of this effort is a Land Transport Masterplan that strives to make Singapore a great city to live, work and play in. This calls for major changes to vastly improve our land transport system. It is a plan to build and develop a more people-centred transport system that is technologically intelligent, yet engagingly human.

Singaporeans can look forward to a more integrated and user-friendly public transport system. Fast and reliable bus services will complement a greatly expanded rail network to bring people where they want to go quickly. Tree-lined sheltered walkways in the heartlands and bustling underground walkways filled with shops in the city will ensure a pleasant walk to bus and train stations for all commuters. Varied transport choices like premium buses, taxis and cycling will help to cater to different needs.

With the construction of new expressways, island-wide connectivity will also be significantly improved. The enhanced ERP system will help to keep traffic free flowing, enabling our city to reap the benefits of growth and vibrancy.

Ultimately, our aim is for a land transport system that places people at its heart. This requires a continual process of planning and adjustments as our economy and society will change over time. In doing so, we will plan with our people firmly in mind and actively engage the community in shaping transport policies and plans.

RAYMOND LIM
Minister for Transport



CHAIRMAN'S MESSAGE

This Land Transport Masterplan is the result of the exciting work we began in October 2006, when LTA undertook the Land Transport Review in consultation with the Ministry of Transport.

The Review brought LTA's Board members, management and staff together with members of the public, other government agencies and private stakeholders to discuss the many issues we face in our land transport policy. The focus group discussions, the online feedback on our Talk2LTA portal, the insights gained of those who played 'The Great Transport Challenge 2020' e-game and more have contributed to our Masterplan for the next 10 to 15 years, picking up where the 1996 White Paper on A World Class Land Transport System has brought us.

Since 1996, LTA has delivered on many of its goals. But the next 10 to 15 years will be more challenging: a growing population, expanding economy and the public's higher expectations will test our mettle to make public transport predominant, manage congestion and meet the many needs of our people.

These goals are achievable and are essential to the long-term, overall success of Singapore and our economy. The Masterplan maps the road ahead for our land transport system and prioritises the work for LTA. Delivering the desired outcomes by 2020 will not be easy, but LTA's board members, management and staff are fully committed to make every resource available to making a people-centred land transport system a reality.

MICHAEL LIM CHOO SAN

Chairman, Land Transport Authority

ABBREVIATIONS

ARF	Additional Registration Fee	MCE	Marina Coastal Expressway
ALS	Area Licensing Scheme	MEWR	Ministry of the Environment and Water Resources
AYE	Ayer Rajah Expressway	MOT	Ministry of Transport
BCR	Benefit Cost Ratio	MRT	Mass Rapid Transit
BKE	Bukit Timah Expressway	MTR	MTR Corporation
BRT	Bus Rapid Transit	NEA	National Environment Agency
CBA	Cost-Benefit Analysis	NETS	Network for Electronic Transfers
CBD	Central Business District	NParks	National Parks Board
CCTV	Closed Circuit Television	NPV	Net Present Value
CNG	Compressed Natural Gas	NSCS	National Safety Council of Singapore
CO ₂	Carbon Dioxide	NSE	North-South Expressway
COE	Certificate of Entitlement	NSEW	North-South and East-West Lines
CPF	Central Provident Fund	NSL	North-South Line
CTE	Central Expressway	OMV	Open Market Value
ECP	East Coast Parkway	PCU	Passenger Car Unit
EMAS	Expressway Monitoring Advisory System	PGS	Parking Guidance System
ERL	Eastern Region Line	PIE	Pan-Island Expressway
ERP	Electronic Road Pricing	POB	Pedestrian Overhead Bridge
EWL	East-West Line	PPP	Purchasing Power Parity
FDBL	Full Day Bus Lane	PTO	Public Transport Operator
GLIDE	Green Link Determining System	PTC	Public Transport Council
GNSS	Global Navigation Satellite System	QoS	Quality of Service
GPS	Global Positioning System	RCPS	Range-based Car Parking Standard
GPV	Goods-cum-passenger Vehicle	RTS	Rapid Transit System
GFA	Gross Floor Area	RZ	Restricted Zone
GVR	Green Vehicle Rebate	SBST	SBS Transit Ltd
HDB	Housing and Development Board	SLE	Seletar Expressway
IMTI	Integrated Multi-modal Travel Information System	SMRT	SMRT Corporation Ltd
IRR	Internal Rate of Return	SPRING	Standards, Productivity and Innovation Board
ITS	Intelligent Transport System	SURS	Singapore Underground Road System
IU	In-vehicle Unit	TPE	Tampines Expressway
LRT	Light Rapid Transit	TSL	Thomson Line
LTA	Land Transport Authority	UITP	Union Internationale des Transports Publics (International Association of Public Transport)
J-Eyes	Junction Electronic Eyes System	USEPA	United States Environment Protection Agency
JIE	Jurong Industrial Estate	VQS	Vehicle Quota System
KJE	Kranji Expressway	WHO	World Health Organisation
KPE	Kallang-Paya Lebar Expressway	WIS	Workfare Income Supplement Scheme

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An aerial photograph of a complex multi-level highway interchange. The elevated roadways are supported by numerous concrete pillars and curve through a lush green landscape. A wide, green grassy median separates the elevated sections. Below the interchange, a multi-lane road with white lane markings and red-and-white striped curbs is visible. Several vehicles, including cars and trucks, are captured in motion on this lower road, appearing as blurred streaks. The scene is set in a tropical environment with palm trees and other greenery. In the background, some urban buildings are visible on a hillside.

EXECUTIVE SUMMARY

INTRODUCTION

The 1996 White Paper on A World Class Land Transport System has guided our land transport development over the past decade. It has delivered a land transport system that has served Singaporeans well. However, our population has increased significantly in the intervening years and become more diverse. Expectations have also risen with growing affluence.

By 2020, we expect that travel demand would increase from the current 8.9 million journeys a day to about 14.3 million journeys a day. Given the land constraint of our small island state, the projected increase in travel demand must be met largely by public transport as it is the most space-efficient means of carrying large numbers of people.

However, the public transport mode share during the morning peak hours has declined from 67% in 1997 to 63% in 2004. The challenge is not just to reverse this declining trend but to raise it and to ensure that our public transport system can cater to the significant increase in travel demand. We also need to re-examine our policies to better meet the needs of the greying population, the higher expectations of our people as well as the less privileged and lower income group.

It is therefore timely for us to review our current strategies in the light of the new challenges to meet our people's needs and aspirations.

A PEOPLE-CENTRED LAND TRANSPORT SYSTEM

Our vision is to work towards a more people-centred land transport system that will meet the diverse needs of an inclusive, liveable and vibrant global city. We have identified three key strategic thrusts that will shape our land transport policies and development for the next 10 to 15 years. They are:

- Making public transport a choice mode
- Managing road usage
- Meeting the diverse needs of the people

MAKING PUBLIC TRANSPORT A CHOICE MODE

Today, the public transport mode share stands at 63% during morning peak hours. We target to increase this to 70% by 2020. To achieve this, we have to transform our public transport system to make it more attractive to Singaporeans and competitive with the car. In particular, we must overcome the principal problems of long waiting times, long journey times and overcrowding by strengthening the integration of our public transport system. Our buses and rail network must be well integrated as a unified system from the commuters' perspective where transfers are seamless and convenient; services are easily accessible, reliable and comfortable; journey time is competitive relative to cars; and fares remain affordable. Our public transport system must be attractive not just to existing users, but also people who have access to cars so that they will embrace the bus or train as "my other car".



By 2020, we aim for at least 85% of public transport commuters to complete their journey within 60 minutes during the morning peak hours, from the time they set out on their journey to their destination (i.e. 'door-to-door' journey time), up from 71% today. Average public transport journey times will be reduced from 1.7 times of that by car today to 1.5 times by 2020.

An integrated public transport system

To enhance the integration and efficiency of public transport services, the Land Transport Authority (LTA) will take on the role of a central bus network planner by 2009. It will plan the public transport network from the commuters' perspective, focusing on the 'total journey' experience of the commuters. LTA will enhance our hub-and-spoke system, so that our bus and rail services work in partnership. There will be more frequent and direct feeder bus services so that commuters can reach the transfer hubs quickly, and enjoy seamless and efficient transfers to the Mass Rapid Transit (MRT) or trunk buses to continue with their journeys.

To facilitate transfers, a distance-based through-fare structure will be adopted by 2009 so that commuters will be charged a fare based on the total distance travelled in a journey, without incurring a transfer penalty when they switch between buses or between the bus and MRT. This will encourage commuters to take the most efficient routes.

By December 2008, an integrated season pass will be introduced to allow unlimited travel on our public transport services. This will provide convenience and value-for-money for frequent commuters.

Overall, transfers will be seamless with no transfer fare penalty, and journey time on public transport will improve.

Buses will enjoy greater priority on the roads

We will give greater priority to buses on the roads. Our target is to improve average bus speeds to 20 – 25kph by 2009, up from 16kph and 19kph for feeder and trunk buses respectively today. By June 2008, we will increase the network of bus lanes from 120km to 150km, and treble full day bus lanes (FDBL) from 7.6km to 23km. It will be mandatory for motorists to give way so that buses can come out of bus bays without delay, and buses will enjoy signal priority over other vehicles at major junctions in the city. With these measures, commuters can expect a speedier and smoother ride on the bus. The reliability of bus travel will also improve as buses enjoy greater right of way on the roads.

Expand the Rapid Transit System (RTS) network and capacity

As we improve bus services and enhance their integration with the train services, we will expand significantly the RTS network. By 2020, we will double the RTS network from 138km today to 278km. We will make major investments in new lines and extensions, namely, the Thomson Line (TSL), the Eastern Region Line (ERL), the Tuas Extension to East-West Line (EWL), and the North-South Line (NSL) Extension in the Marina Bay area. The vastly

expanded and much denser rail network will extend the reach of the RTS to many more people and places. Within the Central Area, a commuter will be able to access a RTS station within five minutes walk on average. Capacity on the existing lines will also be enhanced by increasing the frequency of trains. Commuters can look forward to better connectivity and a more comfortable ride on the trains.

Greater contestability in the public transport industry

To encourage greater efficiency and service improvements for the benefit of commuters, we will introduce greater contestability in the RTS industry by issuing shorter operating licences for future RTS lines, compared to the 30-year licences today. The basic bus service market will also be gradually opened up to allow competition for the bus market i.e. competitive tendering for the right to operate a package of bus services.

Enhance travel experience and safety

To provide pedestrians with a more comfortable and conducive walking environment, more covered linkways and pedestrian overhead bridges will be provided. This will also improve the connectivity and accessibility of our public transport system for our commuters. We will also build more fully integrated transport hubs where bus interchanges and RTS stations are co-located with retail and commercial activities. Real time public transport travel information will be available through various mobile platforms to help commuters plan their journeys. Platform screen doors will also be installed at above-ground MRT stations to enhance the safety of commuters and minimise inconvenience caused by service disruptions.

MANAGING ROAD USAGE

We face increasing constraints in road building as Singapore becomes more densely built up. Our vehicle population now stands at 850,000 and continues to grow. Rising affluence has also increased the propensity to drive. Between 1997 and 2004, our car population grew by 10% but the number of car trips increased by 23%. To keep traffic flowing smoothly on our roads, we have to adopt a holistic approach that includes road expansion as well as managing demand for road use by controlling vehicle growth and restraining usage.

A more effective Electronic Road Pricing (ERP) system

The ERP has served us well in maintaining smooth-flowing traffic on our roads. More cities around the world are also beginning to embrace road pricing as an effective congestion management tool. Our ERP system has remained essentially unchanged since its introduction in 1998. A decade on, a larger vehicle population and a greater propensity for car use have resulted in more prevalent congestion on the roads. It is therefore critical that we review and enhance the effectiveness of the ERP to better address current and future traffic conditions. The following changes to the ERP system will take effect progressively from July 2008:

- Refine the method of measuring traffic speeds. The 85th percentile speed measurement method will be used to



determine whether ERP rate changes on an expressway or road are necessary. With this change, at least 85% of motorists will generally be assured of smooth travel on ERP-priced roads, as opposed to using average speeds today where a significant proportion of motorists may, on some routes, travel at speeds below the optimal speed ranges.

- Increase the initial ERP charges and subsequent rate adjustment to make sure that the ERP rates remain effective in influencing motorists' behaviour.
- Set up five new gantries along the Singapore River to manage congestion in the city area more effectively by cutting down through traffic between the commercial and shopping areas of Bugis, Marina Centre, Bras Basah and Clarke Quay, and the office-based area of Shenton Way and Raffles Place.

With the above changes, ERP coverage will be more extensive and ERP charges will be higher. Motorists who choose to drive on priced roads during the ERP operational hours will generally experience smoother and faster journeys.

We will continue to lower vehicle ownership taxes such as Additional Registration Fees (ARF) and road taxes, as we rely more on usage charges.

Lower vehicle population growth rate

As the road expansion programme slows down from the current 1% per annum (p.a.) to about 0.5% p.a. over the next 15 years, it is untenable to maintain the current vehicle growth rate of 3%. We will therefore lower the vehicle population growth rate to 1.5% with effect from Quota Year 2009. This will be reviewed after three years. We will assess then whether a further reduction is necessary in light of the slowdown in road growth.

Parking policy

Besides ERP, parking policy is another lever that will restrain car usage. We will continue with the current approach where Government determines the minimum parking provision while car park operators determine the parking charges based on market demand. As we apply the prevailing parking provision standards (which have been progressively lowered since 1990) to new developments, and allow conversion of some excess parking spaces in old buildings, parking supply in the city will gradually decline over time and parking charges will rise. A Parking Guidance System (PGS) will be implemented to guide motorists to the nearest building with available parking to reduce circulating traffic looking for parking lots.

Expand road network and enhance road safety

Even as the pace of road development slows down, we will ensure that roads are built to serve new developments and support economic growth. We will build the 21-km North-South Expressway (NSE) at an estimated cost of \$7 – \$8 billion by 2020. This will provide additional capacity to serve the expected increase in travel demand along the north-south corridor. Roads serving the new employment areas in Tuas and Changi will also be upgraded.

Leverage on technology to optimise road capacity

We will continue to exploit technology to enhance the efficiency of road operations and optimise the capacity of our road network. For instance, we will expand the coverage of Junction Electronic Eyes System (J-Eyes) and the Expressway Monitoring Advisory System (EMAS) to cover more junctions and monitor traffic conditions on arterial roads respectively. The number of J-Eyes and EMAS cameras will be increased from 509 today to 1,049 by 2013.

MEETING THE DIVERSE NEEDS OF THE PEOPLE

A people-centred land transport system must provide for the diverse needs of our society and contribute to a quality, liveable environment. We will pay greater attention to the social role of transport in providing access to amenities and opportunities for our community, comprising the low-income groups, the elderly, wheelchair users, families with young children, pedestrians and cyclists, while at the same time taking care of the environment.

Ensure physical accessibility for all

To make our transport system user-friendly and accessible for all, all new and existing MRT stations will be accessible to persons with disabilities/impairments. Additional lifts will be installed at some MRT stations in towns such as Queenstown and Toa Payoh so that commuters can avoid long detours to reach the entrance with a lift. Our public bus fleet will progressively be replaced with low-floor wheelchair-accessible buses. By 2010, 40% of our public bus fleet will be wheelchair-accessible and we will work towards having all public buses to be wheelchair-accessible by 2020.

An island-wide programme costing \$60 million has been launched to ensure that our pedestrian walkways, access to RTS stations, bus and taxi shelters, and all public roads will be barrier-free by 2010. Some measures to be implemented include removing obstacles or widening walkways to provide a clear passageway for wheelchair users and using higher reflectivity materials for traffic signs to improve visibility.

Affordable public transport for lower-income Singaporeans

To ensure that public transport remains affordable to low income families, the Government will continue to provide targeted help to the needy through Government assistance such as the Workfare Income Supplement Scheme (WIS) and community help schemes such as transport vouchers.

Facilitate cycling

With its increasing popularity, cycling can be a non-motorised transport option to bring commuters to major transport nodes. To facilitate cycling, LTA will:

- Provide better bicycle parking facilities around MRT stations and bus interchanges;
- Allow foldable bicycles onto buses and trains on a trial basis;

- Close short gaps between the park connectors and transport nodes to cater to commuters who cycle to the MRT stations or bus interchanges; and
- Install appropriate road signs to alert motorists to the presence of cyclists along frequently used routes.

Promote environmental sustainability and a high quality living environment

Transport solutions can play a critical role in protecting our environment. To contribute towards cleaner air and better quality of life for Singaporeans, we will:

- Encourage energy efficiency and reduce carbon emissions by promoting the use of public transport and more energy efficient vehicles.
- Improve vehicle emission standards.
- Look into incentivising bus and taxi operators to adopt cleaner technologies and fuels such as Compressed Natural Gas (CNG).
- Adopt environmentally sustainable practices in the planning and development of transport infrastructure.

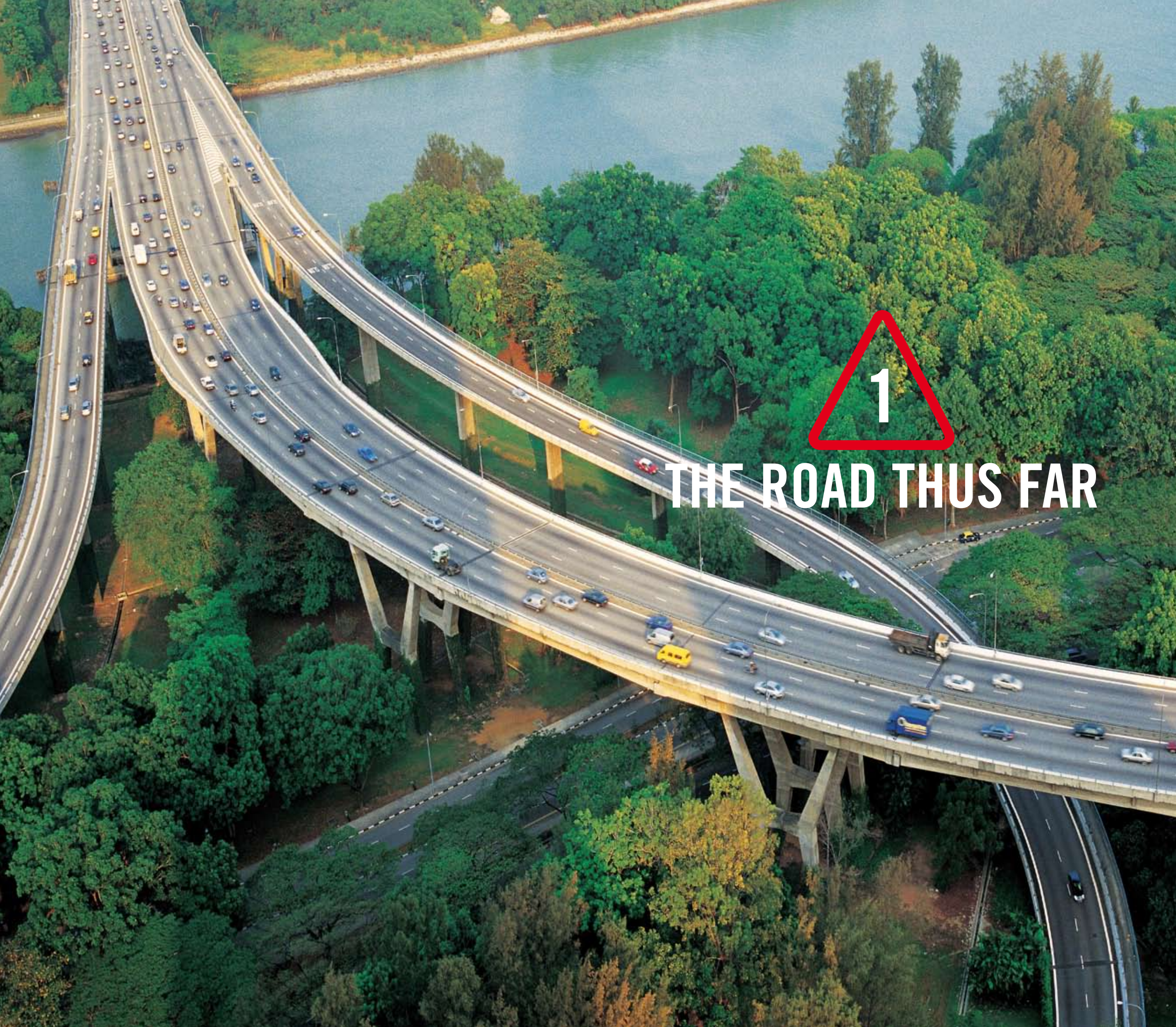
Engage the community

Land transport is a matter that affects everyone. A people-centred land transport system must be planned with the community in mind. Going forward, the community can play a bigger role in shaping and implementing land transport policy and plans. The new Land Transport Community Partnership Division in LTA will have dedicated teams assigned to each constituency to engage the community more closely on the ground. LTA will also launch a Community Partnership Programme to invite grassroots leaders to discuss and share their views on transport policies and plans.

CONCLUSION

Our ultimate aim is a land transport system developed with our people firmly in mind, planned for their needs, and one that makes it possible for all Singaporeans to enjoy an active lifestyle in a vibrant global city. The human dimension will take centre stage as we build a people-centred land transport system for all.

A list of the key initiatives of this Land Transport Masterplan is in Annex A.



THE ROAD THUS FAR

The 1996 White Paper on A World Class Land Transport System set out our vision to build a land transport system that would meet the needs and demands of a dynamic and growing city. Four key strategies were identified to realise this vision:

- Integrating transport and land use planning
- Expanding the road network and maximising its capacity
- Managing demand of road usage
- Providing quality public transport choices

The above strategies have served as a road map for our land transport developments for the past decade, in delivering a land transport system that has served Singaporeans well.

1.1 A COMPREHENSIVE NETWORK OF SMOOTH-FLOWING ROADS

Over the past 10 years, the total vehicle population has grown by almost 27% from 670,000 in end-1996 to 850,000 in end-2007. Nevertheless, we have maintained high average speeds on our roads through a combination of measures that include road expansion, harnessing technology to maximise network capacity, and managing car ownership and usage.

Between 1996 and 2000, we expanded our road network by about 229 lane-km. This exceeded the expansion plan of 225 lane-km set out in the 1996 White Paper, and at a lower cost of \$916 million compared to the budget of \$1.1 billion. From 2000 to 2007, another 510 lane-km was added to the road network, bringing our road capacity to 8,631 lane-km today, an increase of 9% from 1996.

Besides expanding the road network, we also harnessed technology to maximise network capacity, through systems such as the Green Link Determining System (GLIDE) and EMAS. While GLIDE effectively increases traffic throughput at our junctions by monitoring real-time traffic flow, EMAS ensures that incidents on expressways are cleared quickly, thereby minimizing congestion. The cost of time saving due to shorter delays on expressways has been estimated to be \$40 million per annum.

The implementation of the Vehicle Quota System (VQS) in 1990 has allowed us to manage the vehicle population growth at 3% annually. An Open Bidding System, adopted in 2001, has enabled bidders to make more informed bids for the Certificates of Entitlement (COE), thereby reducing the volatility of the COE prices.

We have progressively shifted from ownership taxes towards usage charges to manage demand on our roads. The ERP system was successfully implemented in 1998 to replace the Area Licensing Scheme (ALS) for the Central Business District (CBD) and Road Pricing Scheme for expressways. It was gradually expanded to arterial roads outside the CBD from 1999. The flexibility of ERP has allowed us to levy different ERP rates for different roads and time periods based on local congestion level. This has translated into lower cost for motorists in general.

The combination of measures has helped to ensure that our road network is efficient in facilitating travel across the island, and meets



our road users' needs and expectations. A survey¹ conducted in May 2007 showed that a significant majority (80% – 91%) of respondents were satisfied with the quality of the road infrastructure, level of road safety, operations of the traffic systems (such as traffic lights), efficiency and connectivity of the road network, as well as the provision of traffic information. However, a smaller proportion (about 55%) was satisfied with travelling speeds along roads within the CBD and expressways during the morning peak hours.

1.2 AN EFFICIENT AND SEAMLESS PUBLIC TRANSPORT SYSTEM

The White Paper envisaged that the RTS network would grow from 67km in 1995 to 160km over the long term. With the opening of new lines such as the North-East Line and Sengkang/Punggol Light Rapid Transit (LRT) system, our RTS network now stands at 138km. This has brought about a rail network density that is comparable to that in Hong Kong (Figure 1.1).

Between 1996 and 2007, the number of bus services has increased by 36%, from 239 to 325 services. This, together with the increase in capacity, allows buses to cater to the different travel needs of the commuters.

With the expansion of our RTS network and the increase in the number of bus services, the usage of mass public transport has also continued to grow. From 1996 to 2007, daily mass public transport ridership rose by 14.4% to 4.5 million.

In 2005, a new fare adjustment formula was introduced. This new formula, which takes into account macroeconomic factors such as inflation and changes in wages, better reflects the actual economic conditions faced by commuters in general while allowing operators to keep up with changes in operating costs. This helped to balance the interests of both operators and commuters. We have kept public transport fares affordable and our fares are low compared to other major cities (Figure 1.2).

A Public Transport Customer Satisfaction Survey conducted in 2007 showed that 86.5% of respondents were satisfied with bus and rail services in Singapore. About 80% of the respondents were satisfied with the overall travel time on buses and trains as well. Overall accessibility and location of the bus stops and MRT stations (85%) and the overall safety and security of our public transport system (83%) came out tops.

As for taxis, the fares were deregulated in 1998. In 2003, the taxi market was further liberalised to allow entry of new players. A new Taxi Operator License framework and a set of Quality of Service (QoS) standards were introduced to license taxi companies and ensure minimum service standards. The taxi supply has grown from 16,857 in 1996 to 24,446 taxis as at end 2007, and there are now four new players in the market. Compared to major cities like Hong Kong, London and New York, we have the highest number of taxi per million population, while taxi fares have remained relatively low (Figures 1.3 and 1.4). More innovative services such as personalised limousine taxi and taxi tourist guide services were also introduced to better cater to commuters' demands.

FIG. 1.1²
Rail network density
(km/million persons)

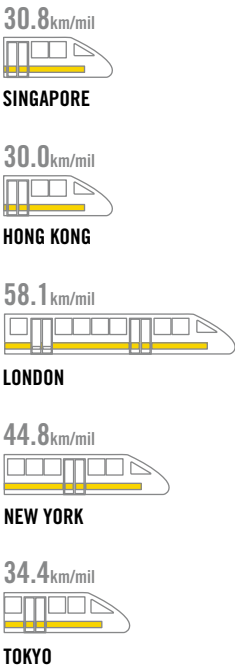


FIG. 1.2
Average MRT/bus fare
(\$/trip) for major cities*

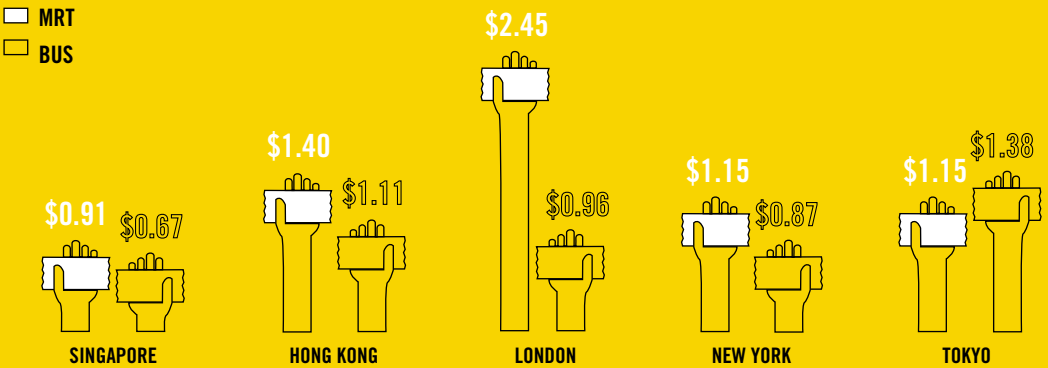


FIG. 1.3
Taxis per million persons
in major cities

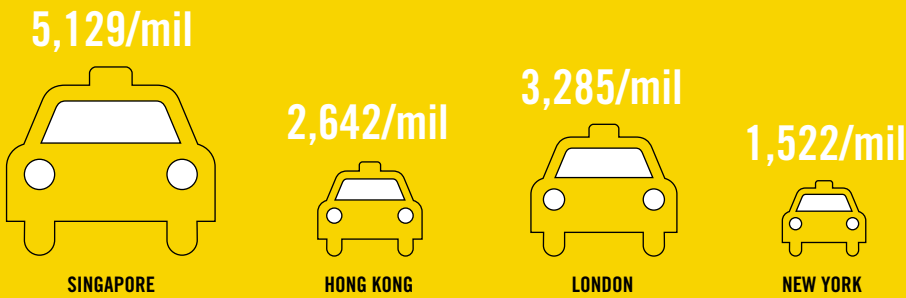
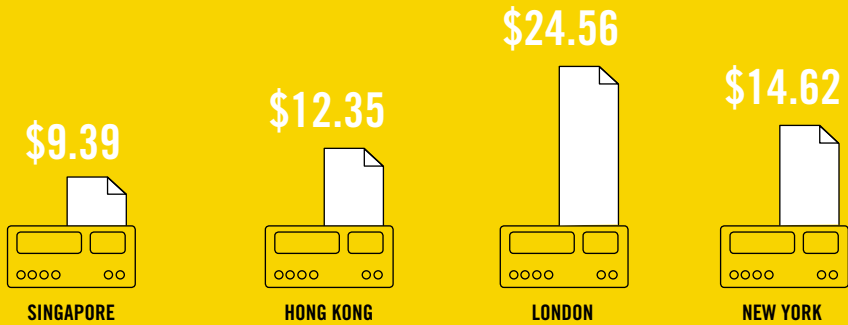


FIG. 1.4
Taxi fares in major cities
(\$/9km; during AM peak)*



* All foreign currencies are converted to Singapore dollars using Purchasing Power Parity (PPP) conversion factor 2005 (Source: World Bank 2007 World Development Indicators)

¹ Public Opinion Survey on Road and Traffic Management 2007.

² Data sources for Fig. 1.1 – 1.4: LTA; Transport Department, MTR Corporation Ltd and the Kowloon Motor Bus Co. (1933) Ltd, Hong Kong; Transport for London (TfL); MTA (Metropolitan Transportation Authority) New York City Transit, New York Metropolitan Transportation Council (NYMTC), New York City Taxi and Limousine Commission (TLC) and American Public Transportation Association (APTA); Tokyo Bureau of Transportation, Tokyo Bureau of Construction and Tokyo Metro Co. Ltd.

↑  Bus interchange

MRT  ↘

2

THE WAY FORWARD



While the 1996 White Paper has served us well over the past decade, our society and economy have evolved in the intervening years. Our population has increased significantly, and this growth is expected to be sustained for the next 10 to 15 years, placing greater demands on our land transport system. In addition, our needs and aspirations have changed as our society becomes more diverse, and expectations have risen with growing affluence. Therefore, we must improve upon our current strategies to meet the new challenges and review our land transport system to be more people-centred to meet Singaporeans' needs and aspirations.

2.1 CHALLENGES AHEAD

2.1.1 Increasing travel demand and limited land

By 2020, we expect that travel demand would increase from the current 8.9 million journeys a day to about 14.3 million journeys a day based on population planning parameters, projected tourist arrivals and general increase in economic activities. With 12% of our land space already allocated to roads (compared with 15% for housing) and other competing demands to develop available land for other purposes, the scope to expand the road network would become more limited. Future roads may have to be partly or wholly built underground. However, the construction and maintenance costs of underground roads are much higher than those of surface roads. Moreover, simply building more roads will not solve our transport problems in a sustainable way because the demand for road space is insatiable. The more roads we build, the more traffic will be generated. Hence, the projected increase in travel demand must be met largely by public transport rather than by the car.

2.1.2 Declining public transport mode share

Between 1997 and 2004, the public transport mode share during the morning peak hours³ has dropped from 67% in 1997 to 63% in 2004. A higher car population has generated more car trips and this will have significant implications on the environment in terms of noise, air pollution and congestion. The challenge is to reverse this trend of declining public transport mode share and ensure that our public transport system can cater to the significant increase in daily travel demand.

2.1.3 Changing demographics and expectations

Our population, like that in many other developed cities around the world, is ageing. In addition, with rising affluence, the needs and expectations of our people have increased. The changing demographics will compel us to re-examine our current policies to better cater to the needs of the greying generation, the higher expectations of the people and those who care for their living environment, as well as the less privileged and lower income group.

2.2 A PEOPLE-CENTRED LAND TRANSPORT SYSTEM

Given these challenges, our vision is a people-centred land transport system that meets the diverse needs of an inclusive society and provides for a liveable and vibrant global city. To this end, we have identified three key strategic thrusts that will shape our land transport policies and development for the next 10 to 15 years.

2.2.1 Making public transport a choice mode

Public transport is the most efficient means of carrying large numbers of people. Given the projected increase in population and the 60% increase in daily travel demand, a high mode share in favour of public transport is crucial. This will ensure that our roads continue to be free flowing, and commuters on public and private transport, as well as goods vehicles, can reach their destinations within reasonable time.

Our target is to increase the public transport mode share during the morning peak hours from 63% today to 70% by 2020. We expect to double the number of daily public transport journeys from the current five million to almost 10 million by 2020.

To achieve this, public transport must be a mode of choice not just for existing public transport commuters, but also for those who own cars. Our public transport system must be well integrated, where bus and rail work in partnership to provide a comprehensive network with seamless connectivity, reliable and comfortable services, as well as travel times which are competitive relative to cars. At the same time, our system must be financially sustainable and fares affordable.

2.2.2 Managing road usage

As Singapore becomes increasingly built up, the constraints we face in road building have become more acute. Our limited land resources have to be shared with other competing uses such as housing, industry and recreation. Hence, road expansion will inevitably slow down in the future. Thus, we must ensure that we optimise the use of our road network.

We have been able to maintain high average speeds on our roads even though our vehicle population and the daily trips generated have increased over the years. However, rising affluence has increased the propensity to drive. Between 1997 and 2004, while our car population grew by 10%, the number of car trips increased by 23%.

To keep traffic flowing smoothly on our roads, we must adopt a holistic package of measures that includes giving priority to public transport, expanding the road network, and limiting the number of cars on our roads.

2.2.3 Meeting the diverse needs of the people

While we strive to further improve both public and private transport for the masses, a people-centred land transport system must also provide for the diverse needs of our society and contribute to a quality, liveable environment. We will pay greater attention to the social role of transport in providing access to amenities and opportunities for our community, comprising, amongst others, the low-income groups, the elderly, people with special mobility needs, wheelchair users, families with young children, pedestrians, as well as cyclists, while at the same time taking care of the environment.

We will discuss the key initiatives under each of these three strategic thrusts in the chapters that follow. See Annex A for a summary of these initiatives.

³ Between 7.30am to 9.30am.

3

CHALLENGES

- **Increasing travel demand and limited land**
- **Declining public transport mode share**
- **Changing demographics and expectations**

3

STRATEGIC THRUSTS

- **Making public transport a choice mode**
- **Managing road usage**
- **Meeting the diverse needs of the people**



3

MAKING PUBLIC TRANSPORT A CHOICE MODE



To make public transport a choice mode, the public transport system must be well integrated from the commuters' perspective, providing good coverage with seamless connectivity, high quality service in terms of reliability, comfort, convenience and competitive travel time relative to cars, and charge affordable fares.

Our target is to ensure that by 2020, at least 85% of public transport commuters complete their journey within 60 minutes from the time they set out on their journey to their destination (i.e. 'door-to-door' journey time) during the morning peak hours, up from 71% today. We will intensify our efforts to improve public transport through the following initiatives:

- LTA will take on the role of a central bus network planner by 2009. It will adopt a more commuter-centric approach in planning the bus routes to create a more integrated and service-oriented public transport network. Bus and rail services and frequencies will be improved to enhance the hub-and-spoke model so that commuters can reach the hub quickly and enjoy seamless transfers at the hub;
- A distance-based through-fare structure will be adopted by 2009 to remove fare penalty associated with transfers. Commuters will be charged a fare based on the total distance travelled in a journey, without incurring any fare penalty when they make a transfer;
- An integrated season pass will be introduced by December 2008 to allow unlimited travel on both train and basic bus services;
- Greater priority will be given to buses on the roads so that commuters can enjoy faster travel and greater reliability on buses. We aim to improve average bus speeds to 20 – 25kph by 2009, up from 16kph for feeder buses and 19kph for trunk buses today;
- RTS network will be doubled from 138km today to 278km by 2020 to enhance its coverage and connectivity. Commuters in the Central Area⁴ will be able to access an RTS station within 400m or five minutes walk on average;
- Greater contestability will be introduced in the public transport industry to encourage greater efficiency and service improvements for the benefit of commuters. The licence period for future RTS operating licences will be shortened while the basic bus service market will be opened up gradually to allow greater competition; and
- Overall journey experience will be enhanced through the provision of covered linkways and pedestrian overhead bridges; integrated transport hubs; real time public transport travel information; platform screen doors at above-ground MRT stations; and greater security measures to achieve a commuter-centric public transport system that is reliable, easy to use and safe.

Average public transport journey times will be reduced from 1.7 times of that by car today to 1.5 times by 2020 to make public transport more competitive relative to cars. Our end in mind is to have a public transport system that will be so attractive that users with choice, i.e. those who can have access to cars, will say that "my other car is a bus or train".

⁴ Central Area includes the CBD and fringe employment centres at River Valley, Rochor, Newton and Outram.



3.1 ENHANCING THE INTEGRATION OF THE PUBLIC TRANSPORT SYSTEM

Our public transport system adopts a hub-and-spoke model where buses and the LRT serve as feeders to bring people to the transfer hubs i.e. RTS stations or bus interchanges. The RTS serves the heavy demand corridors and long haul trips, and trunk buses serve areas not covered by the RTS. This model has allowed us to avoid wasteful duplication of resources by ensuring that buses provide complementary services along corridors served by the RTS. However, there is a need to improve this model to facilitate faster access to the hub and more seamless transfers.

Today, the bus routes are planned by the two bus operators i.e. SMRT Corporation Ltd (SMRT) and SBS Transit Ltd (SBST), driven primarily by commercial considerations. Of the total of more than 250 bus routes, only 35% have headways (i.e. intervals at which buses leave the bus interchange) of 10 minutes or less. Some have headways of more than 30 minutes! Commuters thus complain of long waiting time. In addition, some bus services are circuitous, further adding to travel time on buses. A fare penalty is also imposed when commuters have to make a transfer between buses, or between bus and RTS.

To achieve a people-centred public transport system, system unity is critical. From the commuters' point of view, the entire public transport system should be treated as a whole, not separate parts i.e. buses versus trains. Where transfers are needed, commuters must experience convenient and seamless transfers, with minimal or no penalty on time and fares paid. Therefore, to enhance the integration of our public transport system, LTA will take on the role of a central bus network planner just as we have done for the RTS and road network. A distance-based through-fare structure will also be adopted to remove the transfer fare penalty so that the different modes of the public transport system as far as the commuter is concerned are treated as a unified whole.

3.1.1 LTA as the central bus network planner

The LTA will take over the role of central bus network planner by 2009, with the Public Transport Council (PTC) retaining oversight. As the central bus network planner, LTA will shift the focus to place the commuter at the centre and take a holistic approach in planning the bus network, taking into consideration development in the RTS network and other transport infrastructure.

In planning the bus network, the hub-and-spoke model will be retained but improved. Having many direct bus services will compromise the overall efficiency of the public transport system. More bus services will be needed, frequencies will be lower, and the overall bus network will become more complex, not to mention the congestion along some corridors where many services converge.

LTA will adopt a more commuter-centric approach, focusing on the 'total journey' experience of the commuters. Feeder bus services will have more direct routes and ply more frequently to bring commuters quickly to the major transfer hubs. Transfers at the hub will be better co-ordinated by improving the frequency of buses and





trains so that commuters can expect seamless and quick transfers as they continue with their journeys. With the revisions to the QoS standards for basic bus services announced in July 2007, commuters can expect shorter waiting times as the headways of at least 80% of the bus services are shortened to not more than 10 minutes during peak hours on weekdays, compared to the current standard of 15 minutes.⁵

Overall, LTA will plan the bus routes to optimise network efficiency from the commuters' viewpoint. Transfers will be seamless and overall journey time will be shorter.

A transfer journey may be faster than taking a direct bus

A commuter going from Marsiling Rise to Boon Lay Interchange/ MRT Station will take about 92 minutes if he were to take a direct bus service 178. If he takes bus service 178 to Woodlands Interchange, then transfer to the MRT from Woodlands to Boon Lay, his total journey will take only about 40 minutes.

3.1.2 Integrated fares

To further improve the connectivity of the public transport system to make transfers more seamless and convenient, we will adopt a distance-based through-fare structure to remove the current fare penalty associated with bus-RTS or bus-bus transfers. This will allow commuters to pay a fare based on the total distance travelled from origin to destination, irrespective of the transfers they make, as is already the case today for journeys involving train-train transfers. This will incentivise commuters to take the most efficient route.

By December 2008, an integrated season pass will be introduced. This travel pass will allow unlimited travel on both train and basic bus services for a specified period of time. It will provide convenience and value-for-money for frequent commuters, and further facilitate a smooth journey on the public transport.

How through-fare will remove transfer penalty

Today, if a commuter makes a bus-only journey with one transfer, for example 3.0km on the 1st bus and 5.0km on the 2nd bus, he will pay a fare of \$1.31 with his ez-link card (\$0.67 for 1st bus trip + \$0.89 for 2nd bus trip – \$0.25 transfer rebate). When distance-based fare is introduced, the fare will be computed purely based on the total distance travelled. Based on today's fare level, he will pay \$1.09 for his 8.0km journey.

3.2 GREATER PRIORITY FOR BUSES ON THE ROADS

To further improve the reliability and speed of bus services, buses will be given greater priority on our roads over other vehicles. This will help to shorten bus journey time and make them a more viable competitor to cars.



⁵ The operators are given two years, up to August 2009, to comply with this new QoS.

TOP RIGHT
Fig. 3.1
Mandatory give-way at
bus bays.

BOTTOM RIGHT
Fig. 3.2
Signal priority for buses
at junctions.

Our aim is to achieve bus speeds of 20 – 25kph by 2009, up from 16kph for feeder buses and 19kph for trunk buses today. LTA will implement the following bus priority measures:

3.2.1 Bus lanes/full-day bus lanes

There are currently 120km of bus lanes and 7.6km of full-day bus lanes (FDBL) in the city. Such right of way for buses has improved bus speeds, especially with FDBL which has improved bus speeds by as much as 16%. To enhance public transport journey experience, LTA will increase the bus lanes to 150km and treble the FDBL to 23km by June 2008. Our aim is to have an extensive network of bus lanes/FDBL so that buses travel unimpeded, even under heavy traffic conditions during peak hours.

3.2.2 Give way to buses exiting from bus bays

A campaign of giving way to buses exiting from bus bays was introduced in 2005 to allow buses to exit from the bus bays with minimal delays. A trial conducted by SBST found that 9% of journey time was spent by buses trying to exit bus bays. To enhance the effectiveness of the scheme, LTA will make it mandatory by end 2008 for motorists to give way to buses through the traffic scheme as shown in Figure 3.1.

3.2.3 Signal priority for buses at junctions

Signal priority will be given for buses approaching some major junctions by extending the green-time for them to clear the junctions. Bus lanes will be extended to the junctions and traffic signals designed to give buses priority over other vehicles turning left to side roads (Figure 3.2). This will help to enhance the effectiveness of the bus lane/full-day bus lane scheme. A pilot will be carried out by end 2008 before extending the scheme to major junctions in the city.

3.2.4 Other bus priority measures

In addition, LTA will study other bus priority measures such as:

- i) Contra-flow bus lanes which allow buses to run on a dedicated lane in reverse direction to the main traffic flow. If used appropriately, such bus lanes will improve accessibility and cut down on circuitous routes, particularly along one way streets; and
- ii) Segregated bus ways where buses can enjoy uninterrupted travel along dedicated right of way. This is an improvement over bus lanes where buses are sometimes obstructed by vehicles which disregard the bus lane operation hours, or by vehicles trying to turn into side roads. Bus Rapid Transit (BRT) or tram systems, which are high quality public transport alternatives that combine the reliability and capacity of RTS with the flexibility offered by buses, can be introduced on such segregated bus ways. However, this will remove one lane permanently for other vehicles and we will need to study the overall traffic impact carefully. LTA will also study the merits of BRT and trams for implementation in Singapore.



TOP RIGHT
Fig. 3.3
Bus Rapid Transit
in Bogota, Columbia.
Photo courtesy of
Millonario (Source:
Wikimedia Commons).

BOTTOM RIGHT
Fig. 3.4
Tram in Bordeaux,
France.

BRT is a 'rapid transit-like' service that has buses running on semi or fully segregated roadways (Fig. 3.3). Key features of BRTs include:

- High quality buses for better image, comfort and service
- Stops that facilitate level boarding
- Travel information system and off board ticketing system to reduce boarding time

Trams are electrically powered 'MRT-like' trains of a smaller scale running on rail tracks fitted on roadways (Fig. 3.4). Key features of trams include:

- Stations or stops with level boarding in ensuring accessibility for all
- Environmentally friendly and aesthetically pleasing



3.3 EXPANDING THE RTS NETWORK

The RTS will remain the backbone of our public transport system given its higher capacity, greater reliability and speed. The Government has spent over \$13 billion to build up our existing 138km of rail network. Another \$20 billion has been committed (for Circle Line, Downtown Line and the Boon Lay Extension to the EWL) to expand the coverage of the RTS by more than 50% to 215km.

By 2020, we will double the RTS network from 138km today to 278km (see Figure 3.5). This will increase our RTS density from 31km per million population today to 51km per million population by 2020. This is comparable to that in cities like New York and London, and surpassing that in Hong Kong and Tokyo. Within the Central Area, commuters will be able to access an RTS station within 400m, or five minutes' walk, on average.

The Government has given in-principle approval to implement the following lines by 2020⁶ at a budget of about \$20 billion:

- TSL (27km, 18 stations) by 2018** – This will serve the additional public transport demand along the north-south corridor given the projected developments in the north and northeast regions. The line will improve accessibility along the corridor and help relieve crowding on the existing NSL;
- ERL (21km, 12 stations) by 2020** – This will provide residents of housing estates along East Coast corridor not currently served with direct RTS access to the key employment centres in CBD, Marina Bay and Changi Area.
- Tuas Extension to the EWL (14km, five stations) by 2015** – This will improve public transport and support employment growth in the Jurong Industrial Estate (JIE), especially for areas beyond the Boon Lay Extension; and
- NSL Extension (1.0km, one station) by 2015** – This will improve accessibility to new developments proposed in the Marina Bay area, such as the new cruise terminal and Gardens by the Bay.

⁶ The dates provided for the proposed lines are indicative only and the actual implementation will depend on the projected ridership, which depends on the rate of development along the corridors they serve.



RIGHT
Fig. 3.5
Map showing existing
and proposed RTS lines.



3.4 INCREASING EXISTING RTS CAPACITY AND SERVICE LEVEL

The new RTS lines will take several years to complete. In the meantime, we will improve the service levels of the existing network to meet the rising expectations of commuters. LTA will revise the Operating Performance Standards for RTS operators to prescribe minimum train headways during different time periods. For example, commuters should only have to wait for about two to three minutes during the morning peak of peak periods, and about five to six minutes during the lunch period.

Today the average maximum passenger loading on the North-South East-West line is 3.7 pax/sqm, less than the 4.0 pax/sqm and 5.0 pax/sqm on Hong Kong MTR Corporation (MTR) and London Underground respectively. Nonetheless, LTA will work with the operators to increase the frequency of the trains to provide extra capacity so that commuters will have a more comfortable ride. This will require investment in additional trains and modification to the train signalling system and infrastructure, which will take about four years to complete. When completed, it will increase capacity by 15%.



3.5 MORE CHOICES FOR PUBLIC TRANSPORT USERS

To cater to different segments of commuters and their different needs, we will continue to promote and facilitate the introduction of differentiated services to provide more choices for commuters.

3.5.1 Premium bus service scheme

The premium bus service scheme caters to commuters who are prepared to pay a higher fare for a higher level of bus service, e.g. a more direct journey with a more comfortable ride and guaranteed seats. Premium bus services can help to bridge the gap between personalised services (cars and taxis) and basic bus/rail services. A vibrant premium bus service sector will also help to attract more motorists to switch to public transport.

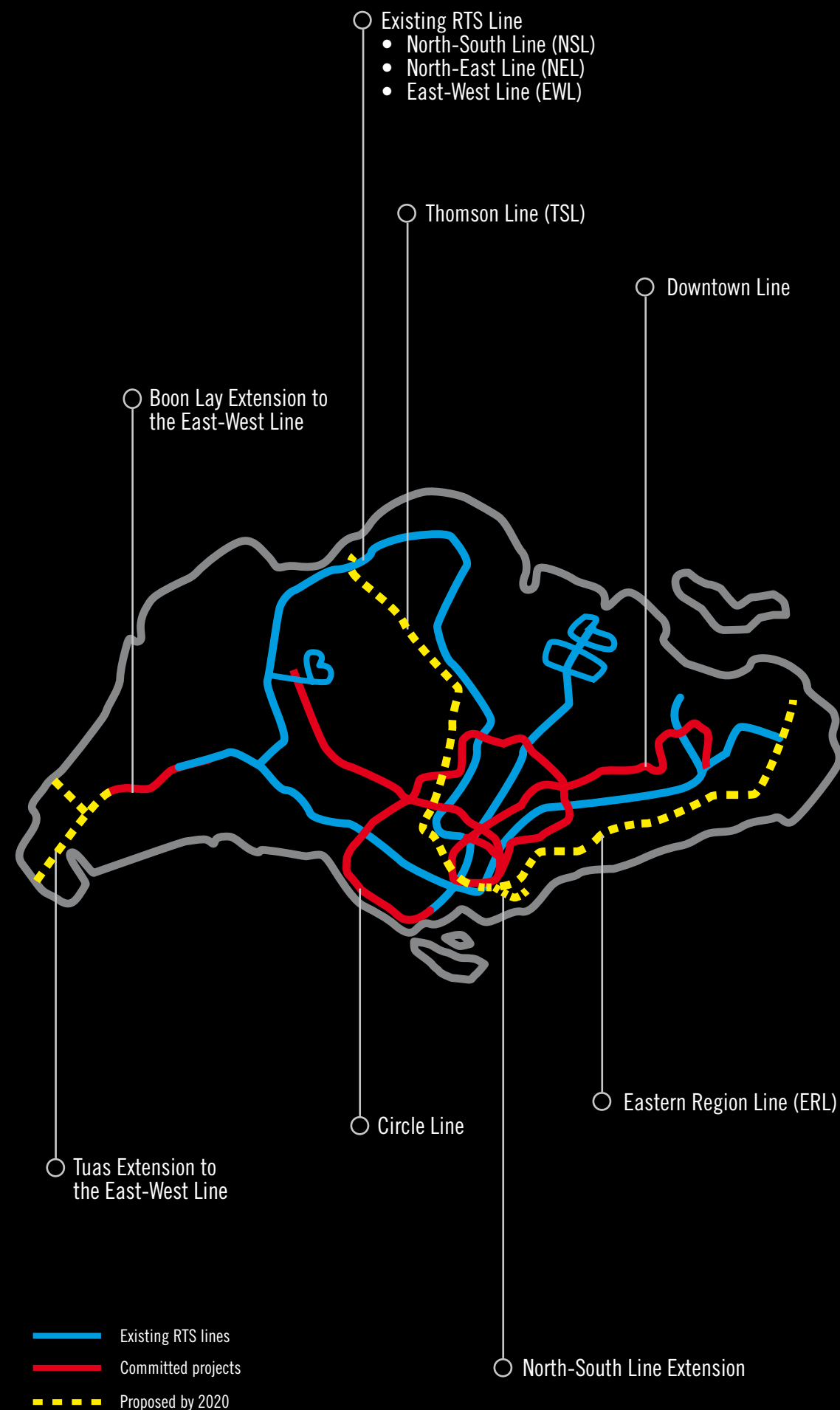
To encourage greater market participation and innovation by private bus operators, there will be minimal regulations in bus routes, fares and service frequency for such premium bus services.

3.5.2 Innovative basic bus services

LTA will continue to work with the bus operators to introduce innovative basic bus services to provide greater choice to commuters. The Fast Forward bus service is a prime example. Since its inception in 2005, Fast Forward bus services have brought travel time savings of up to 20% to commuters in the morning and evening peak hours by having fewer stops and flexible routing to avoid traffic congestion.

3.5.3 Taxi as a high end service

While mass public transport is the most efficient means of travel, taxis play a role in bridging the gap between taking mass public transport like buses or trains and driving a car. They offer the choice



for commuters who wish to have personalised door-to-door service like cars.

The taxi industry has been liberalised and government does not regulate the fares or supply of taxis. As the regulator of taxi services, LTA sets the QoS standards to maintain taxi service quality and protect commuters' interests. It also facilitates the working of the taxi industry by working closely with the taxi companies and taxi drivers' associations to improve the level of taxi service. For example, LTA provided additional taxi stands in the CBD so that there will be a taxi stand within five-minute walk from all buildings in the CBD to make it safer and easier for commuters to hail a taxi.

LTA will be refining the taxi QoS to ensure greater taxi availability during peak periods through phone booking, and reviewing the penalty framework to ensure that the standards better reflect commuter experience on the ground.

To complement the taxi companies' call booking systems, LTA will set up a common call booking telephone number for taxis by July 2008. This will make it more convenient for the public, especially the tourists, to call for a taxi as they will only need to remember one telephone number, instead of the different telephone numbers of each taxi company today.

Beyond the above initiatives, LTA will continue to engage the various stakeholders, including the taxi companies, taxi drivers' associations and the public to proactively identify and resolve issues and difficulties facing the taxi industry to ensure the provision of quality taxi services.



3.6 SHAPING THE FUTURE INDUSTRY AND FINANCING FRAMEWORK

As we improve bus services, expand the coverage and capacity of the RTS network and enhance the integration of our public transport services, we will put in place an industry and financing framework that can support our initiatives to make public transport a choice mode, while ensuring the affordability of public transport.

3.6.1 Industry and competition framework

The current public transport industry comprises two multi-modal operators: one main RTS operator which also operates a relatively small bus network, and one main bus operator which also operates a single RTS line. The intent of the multi-modal framework is to allow the operators to better integrate the bus and rail services within their respective areas of operation.

The current duopoly structure offers the benefits of peer benchmarking in terms of service standards and cost efficiency; avoidance of regulatory capture; and puts Government in a stronger negotiating position for the award of operating licences for new rail lines. To make sure that the operators continue to operate efficiently and improve service standards for the benefits of commuters, the key issue is not so much whether there are one or two operators but to have a contestable industry where the threat of competition must be real to the incumbents. At the same time, the integration of the



network should not be compromised as the seamless working of the whole network is what gives value to the commuters.

Hence, we will introduce greater contestability to the RTS industry to ensure that the operators continue to operate efficiently and improve service standards to benefit the commuters. Future RTS operating licences will have shorter duration, compared to the 30-year licences today. This will also give LTA greater flexibility to review licence conditions or appoint a new operator should the incumbent operator fail to maintain good performance.

For the bus industry, our studies and overseas examples have shown that there are limited economies of scale for bus operations above a fleet size of 500 buses. Hence, the current bus industry, which has a total of about 3,700 buses, can potentially support more than two operators. We will gradually open up the basic bus service industry for greater competition to improve the efficiency of bus operations.

We are not looking at competition in the market where the bus operators compete for the same market share. This will destroy integration and lead to wasteful duplication. Instead, we are looking at competition for the market where there is competitive tendering for the right to operate a package of bus services planned by LTA. Competitive tendering for bus services is not new. There is a clear international trend towards engaging multiple bus operators to provide bus services through competitive tendering. Such competitive pressures will drive better efficiency, service quality and innovation among the operators. LTA will study the transition carefully, taking into account the existing Bus Service Operator Licences and Bus Service Licences that have been awarded to the incumbent operators.

3.6.2 Financing framework

The expansion of our rail network will involve significant financial investment. It is therefore important to ensure that the financing framework can facilitate the expansion in a financially sustainable manner, while supporting the desired industry structure. A sound financing framework, based on the following principles, is necessary to ensure prudent use of government funds as we implement more rail lines:

- i) **Financial sustainability** – The operator is able to recover its operating costs and make provision for asset replacement from the services rendered without the need for operating subsidies from the government; and
- ii) **Affordability** – Fares remain affordable to commuters in general.

As we expand the RTS network, future lines will be more expensive to build, operate and maintain as they will be mostly underground. On the other hand, the current network is most profitable as they are serving a more built up and heavier demand corridor. Hence, to keep up the pace of rail expansion, we will refine the financing framework to allow for a network approach, instead of a line approach, to be adopted in evaluating new lines. This will potentially enable future new lines to be implemented a few years earlier, so long as the entire rail network remains viable.



For the bus industry, we will look into the need for Government to fund the provision of some common facilities such as bus depots and integrated service information or bus arrival information system. This will also help to lower the entry barriers for the provision of bus services and ensure the contestability of the market.

We will continue to look into opportunities for Public-Private-Partnerships in the funding and provision of public transport infrastructure.



3.7 ENHANCING TRAVEL EXPERIENCE AND SAFETY

Besides focusing on the provision and improvement of public transport infrastructure, a people-centred land transport system must also strive to ensure that the whole journey experience is pleasant and safe for our commuters as they take public transport for their daily travel.

3.7.1 Improving pedestrian facilities

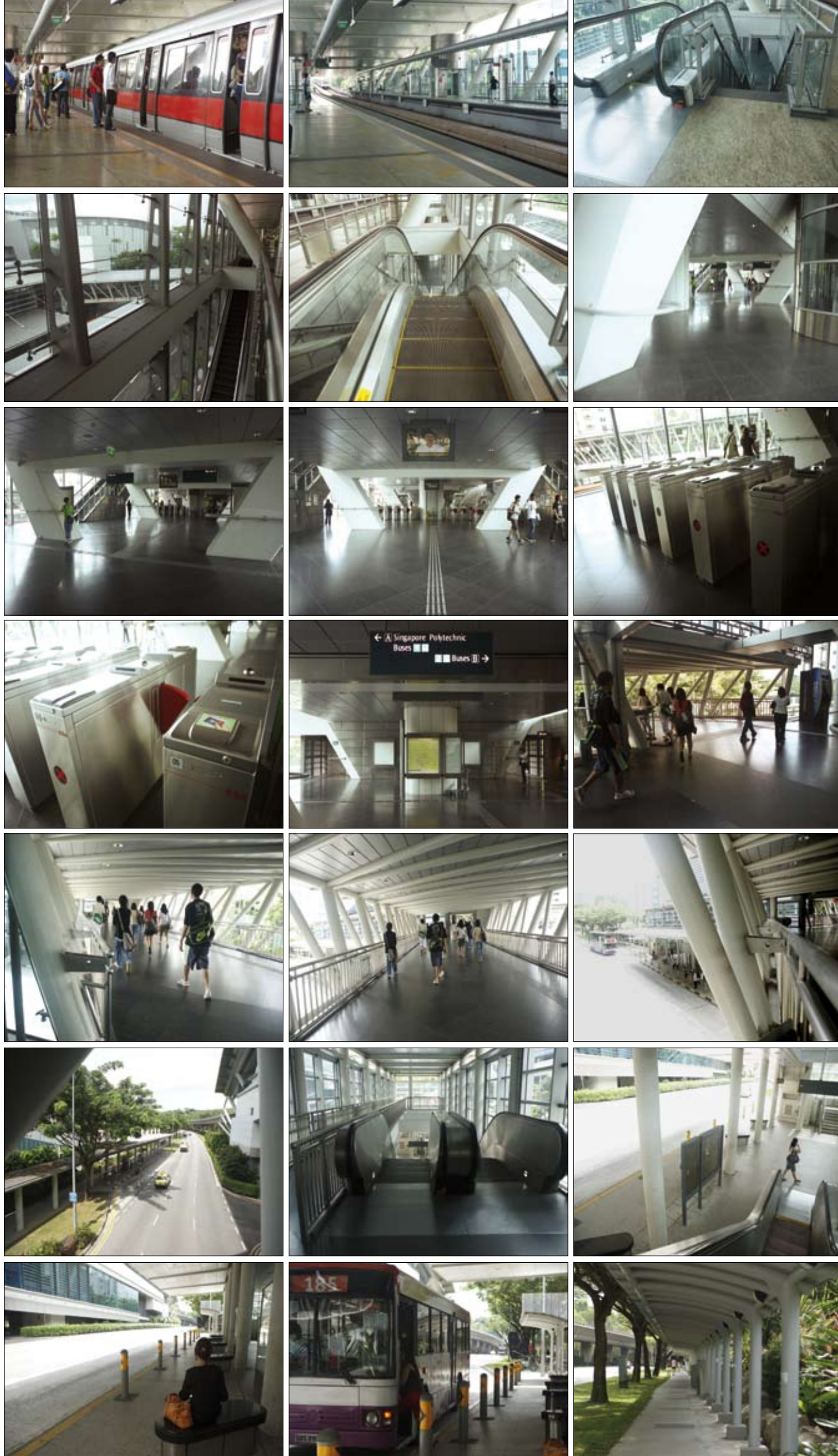
As pedestrian facilities form an integral part of our land transport system, we will continue with our efforts to provide pedestrians with a comfortable and conducive walking environment come rain or shine by providing more covered linkways and pedestrian overhead bridges and underpasses. This will also allow public transport commuters to enjoy better connectivity and accessibility to the transport nodes. Currently, about 192 pedestrian overhead bridges have been fitted with shelters. We plan to double this number so that 86% of our pedestrian overhead bridges will be sheltered by 2010. LTA will also continue to work with other agencies and private building owners to facilitate the provision of linkways, both above- and under-ground, to be connected to buildings.

3.7.2 Developing integrated transport nodes and injecting more buzz

We will embark on a programme to build more integrated public transport hubs where air-conditioned bus interchanges and RTS stations are co-located with retail and commercial activities. Such integrated transport hubs allow transfers to be done comfortably and provide added convenience as commuters can do some shopping before transferring to their connecting bus or train.

We already have three bus interchanges at Toa Payoh, Sengkang and Ang Mo Kio which are fully integrated with the RTS stations and adjoining commercial developments. Two more integrated bus interchanges at Boon Lay and Clementi are under construction and will be completed by 2009 and 2011 respectively. Over the next 10 years, we will be building another five integrated interchanges at Bedok, Jurong East, Serangoon, Joo Koon and Marina South in tandem with re-development in the respective areas, to better integrate our transport hubs with the surrounding facilities.

As we develop more integrated transport hubs, we will also look into introducing more retail spaces to inject more buzz into these transport nodes. We want to transform these places into lifestyle hubs, making them fun and exciting places and accessible meeting



points among friends and family. Besides bus interchanges, such lifestyle hubs can also be found at RTS stations such as Raffles Xchange at Raffles Place MRT station and Tanjong Pagar MRT station.

3.7.3 Providing real time travel information

As part of its initiatives to develop a commuter-centric public transport system, LTA has implemented the Real-Time Bus Arrival Information System at 30 bus stops to help commuters better manage their waiting time and make informed travel decisions. In addition, Key Bus Services Maps have also been installed at bus stops in the Orchard Road area to provide pictorial information on key bus services calling at the bus stops and the routes they ply.

From July 2008, LTA will provide integrated real-time bus arrival information via SMS on a trial basis for bus services that call at bus stops installed with display panels. This will be extended progressively to more bus stops. By March 2010, the real-time bus arrival information will be disseminated to all bus stops island-wide via various mobile platforms.

By July 2008 an integrated web-based Public Transport Journey Planner with basic map features will be developed to advise commuters, through the internet or telephone system, on possible public transport travel routes from origin to destination. In the longer term, commuters can look forward to an Integrated Multi-Modal Travel Information System (IMTI) which will provide comprehensive information on a suite of services to meet the needs of their journey from door to door.

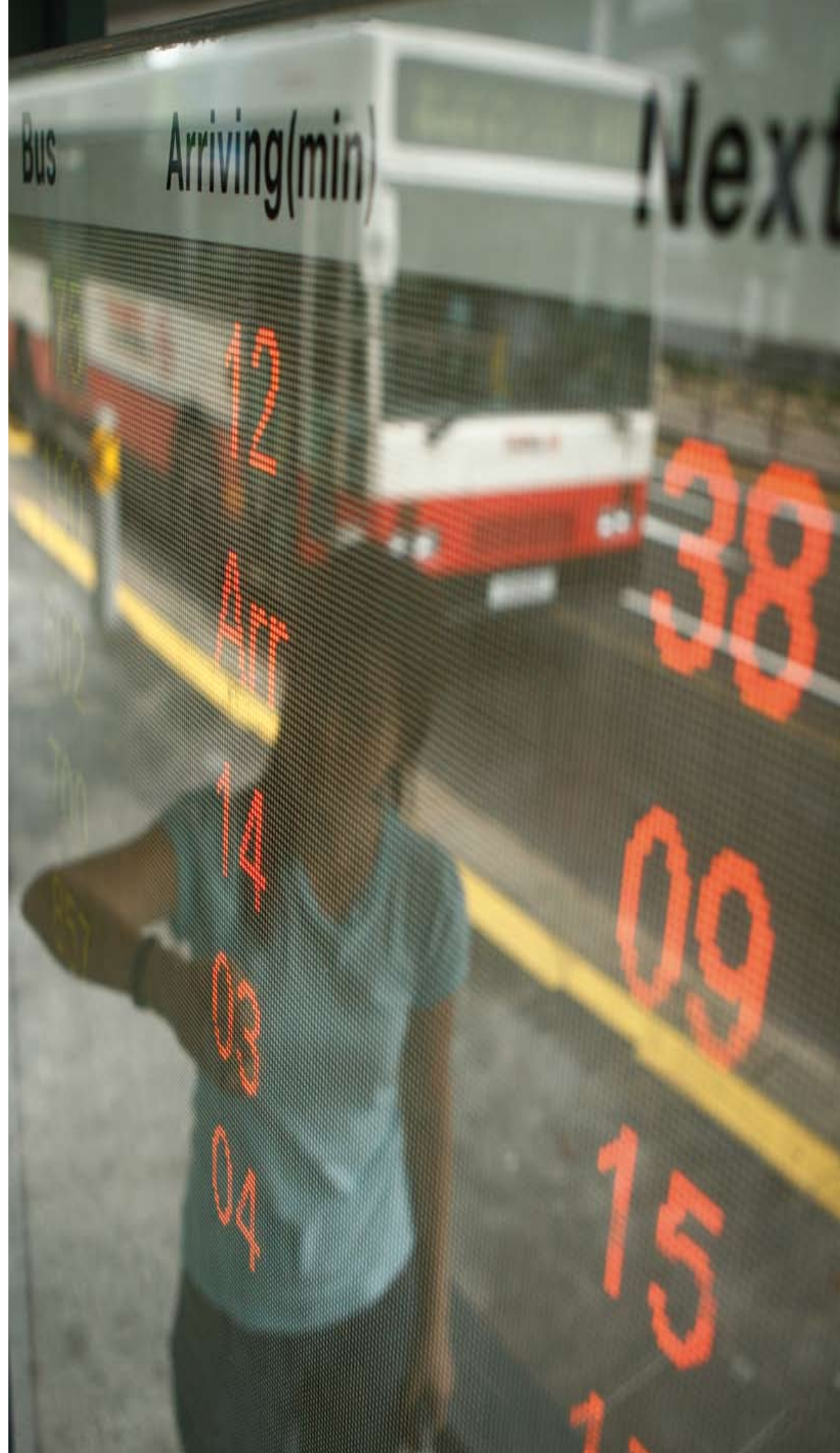
The Integrated Multi-Modal Travel Information System (IMTI) will provide commuters with comprehensive travel information on different platforms such as the mobile phone and the internet (via GPRS/ WAP/ WIFI). The two centrepieces of the IMTI are:

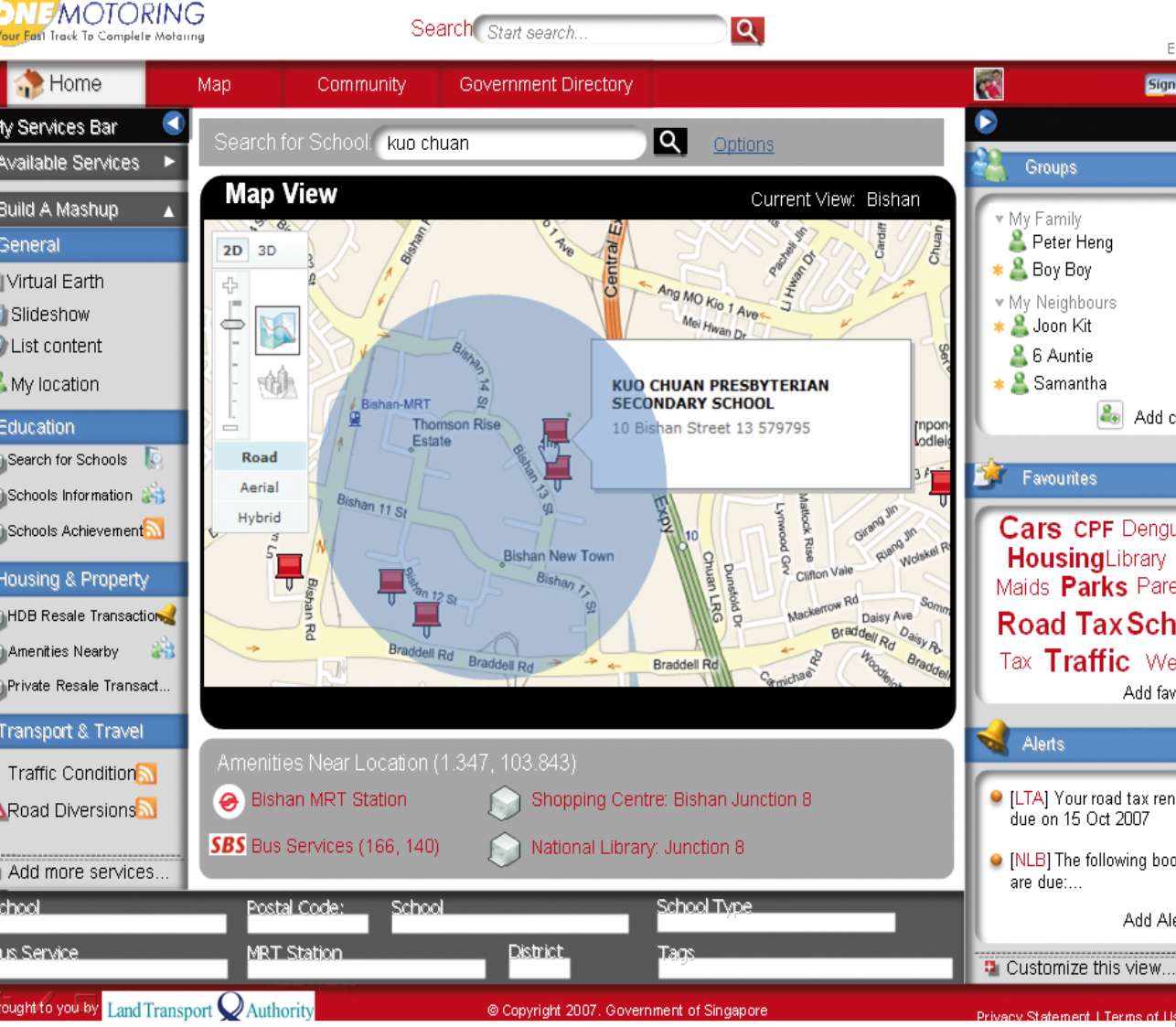
i) **An Integrated Island-wide Public Transport Map**

The electronic interactive map (Fig. 3.6), allows commuters to easily access real time public transport vehicle locations and information on bus arrivals, either by service number or by specific bus stop. Other information available on the interactive map may include service routes and the bus stops, RTS stations and major landmarks along the service route.

ii) **A Public Transport Travel Advisor**

The Public Transport Travel Advisor is an advanced version of the Public Transport Journey Planner. It will feature a multi-modal door-to-door journey planner, including walking routes between origins/destinations and nearby public transport interchanges and stations. Commuters can use the enhanced search options to search for travel routes by shortest travel distance, shortest travel time or cheapest fares, etc. There will also be notification of service disruptions or route changes and information on alternative travel routes. Commuters can use this information to plan their preferred alternative routes as necessary.





3.7.4 Improving commuters' safety

Safety and security are two key determinants of commuters' experience. The former is on the minds of all Singaporeans with the rise in the number of track intrusions at elevated MRT stations. Track intrusions, whether intentional or accidental, also delay train services and cause undue inconvenience to commuters, who may have to transfer to buses to complete their journeys. To reduce such incidents, LTA will be installing Platform Screen Doors at above-ground MRT stations. This will start with three stations i.e. Yishun, Jurong East and Pasir Ris in 2009, with a target to fit all above-ground stations with the Platform Screen Doors by 2012. Half-height screen doors, as shown in Figure 3.7, will be used as they meet our objectives of making our system safer, while still allowing good air circulation at the stations for the comfort of the commuters, thus avoiding extra energy cost for air-conditioning.

With the fundamental transformation of the global security climate, there is an urgent need to ensure the security of our public transport system. A series of security measures have been implemented to protect our transport system. These include installing closed circuit television (CCTV) cameras and having security officers at RTS stations and bus interchanges. We will continue to work closely with various security agencies and public transport operators to further secure our public transport system against terrorist threats.

TOP LEFT
Fig. 3.6
An Integrated Island-wide Public Transport Map (artist impression only).

BOTTOM LEFT
Fig. 3.7
Proposed platform screen doors.





4

MANAGING ROAD USAGE

To keep traffic flowing smoothly on our roads, we must adopt a holistic package of measures that includes promoting public transport, road expansion as well as managing demand for road use by controlling vehicle growth and restraining usage. Through the VQS, we will continue to control vehicle population growth to reduce pressure on road space. We will also strengthen the effectiveness of ERP as a key tool to manage travel demand. These measures will ensure that Singapore remains a liveable city.

To better manage the use of our limited road space, we will:

- Enhance the effectiveness of ERP.
 - Refine the method of measuring traffic speeds for triggering ERP rate changes by using the 85th percentile speed measurement method. This will ensure that 85% of motorists will be assured of smooth travel on ERP-priced roads, as opposed to using average or mean speed today where a significant proportion of motorists may, for some routes, experience speeds below the optimal speed ranges.
 - Revise the ERP rate structure to ensure that ERP rates remain effective in influencing motorists' behaviour.
 - Introduce the Singapore River Line, i.e. five new gantries along the Singapore River, to more effectively manage congestion within the city area in the evening.
 - Upgrade the ERP technology in the longer term for greater effectiveness.
- Lower vehicle ownership taxes to strike a better balance between ownership and usage costs as we rely more on ERP to manage road usage.
- Lower the vehicle growth rate to 1.5% p.a. with effect from Quota Year 2009. This rate will be reviewed after three years.
- Expand road capacity to meet travel demand arising from economic and population growth. We will build the 21-km North-South Expressway (NSE) at an estimated cost of \$7 – \$8 billion by 2020.
- Leverage on technology to optimise the use of our limited road space. We will expand the coverage of J-Eyes and the EMAS to cover more junctions and monitor traffic conditions on arterial roads respectively by 2013.
- Enhance road safety in collaboration with other agencies such as the Traffic Police Department and the National Safety Council of Singapore (NSCS).



4.1 ENHANCING THE EFFECTIVENESS OF ERP

ERP works by requiring motorists to take into account the costs of congestion caused by their driving to others and encourage them to consider alternatives. It places the decision whether to drive or take public transport in their hands. Through regular reviews and rate adjustments, we have been able to keep traffic on the priced roads relatively smooth-flowing. Without ERP and if road usage is free, our major roads will be overused and become congested over time.

The ERP scheme has remained essentially unchanged since its introduction in 1998. However, the traffic conditions on our roads today are very different from what they were 10 years ago. Growing affluence has led to a greater propensity to drive which in turn has caused a significant increase in traffic volumes. The scale and intensity of traffic congestion today is therefore very much different from what it was a decade ago. With more cars on the road, congestion is now more prevalent, particularly during the peak periods. To ensure that ERP remains effective in addressing current and future traffic conditions and motorists continue to have a smooth journey on our roads, we need to continually review the scheme, taking into consideration the growth in the vehicle population and changes in driving patterns.

Why we need ERP

Traffic congestion is costly to the individual and society. It results in the loss of productive hours, environmental pollution, wasted fuel and adverse health effects, and if left unchecked, will undermine our quality of life and the overall efficiency of the economy.

To keep our roads smooth-flowing, LTA will continue with a holistic and integrated approach using all the tools available, including building more roads, regulating vehicle growth, implementing traffic engineering solutions and promoting the use of public transport. In addition to the various measures, we also need to manage traffic demand through ERP.

Wouldn't it be sufficient to build more roads?

The building of more roads is by itself not a sustainable approach in addressing traffic congestion, particularly in land-scarce Singapore, where 12% of our land is already taken up by roads. Even if land is not a constraint, the addition of a lane to an already congested road will only bring about a temporary improvement in traffic flow.

This is because the initial improvement in traffic conditions will encourage more motorists to use the road. Drivers who previously used alternative roads may now find this road more attractive. Those who previously chose to travel at other times may switch to travel during the peak periods and some public transport users may now choose to drive. Congestion soon returns. This is the phenomenon of 'latent' or 'induced' demand. The peak hour traffic that we see on any road does not represent the full traffic demand because congestion causes many potential trips to be cancelled or re-scheduled, or be diverted to public transport or to less congested routes or destinations.

This problem of induced demand is what happened on the Central Expressway (CTE) and the East Coast Parkway (ECP). LTA widened the northbound CTE by one lane between Pan Island Expressway (PIE) and Ang Mo Kio Avenue 1 in 2002 to improve traffic speed, but within six months, congestion had built up again. Similarly, one lane was added to the eastbound ECP in February 2007 between Marina South and Fort Road and within two months the same traffic condition returned.

Ultimately, the reason why building more roads alone is insufficient in itself is because it does not address the underlying problem that if road usage is not priced, our popular roads will be overused, resulting in congestion.

Why we need ERP (cont'd)

Will it be enough to provide better public transport?

One argument commonly put forward is that a better public transport system will solve the problems of traffic congestion. A good public transport system will help but by itself will not ensure that the roads remain smooth-flowing. Just as in the case of simply building more roads, building a new rail line will help to relieve congestion on the affected roads initially but is not a lasting solution. This is because once congestion is alleviated, driving on these roads becomes more attractive and in time, when more drivers use these roads, congestion returns.

Tackling congestion effectively

This is why, in addition to the various measures that we pursue, such as road building and a better public transport system, we also need ERP or congestion charging. Of all the different measures to deal with congestion, ERP is the only one that deals directly with the problem by requiring individuals to take into account the costs of congestion caused by their driving to others.

LTA will make the following changes which will take effect progressively from July 2008 to ensure that ERP remains effective in managing congestion:

- Refining the method of measuring traffic speed for triggering ERP rate changes;
- Revising the initial ERP rates and rate increment/decrement; and
- Introducing the Singapore River Line to manage congestion in the city area.

4.1.1 Refining the traffic speed measurement method

Currently, ERP rates are reviewed on a quarterly basis to ensure that traffic speeds remain within the optimal speed ranges of 45kph to 65kph and 20kph to 30kph for expressways and arterial roads respectively. The optimal speed ranges serve to optimise the capacity of the road network and ensure smooth-flowing traffic.

The current optimal speed ranges were determined based on technical studies conducted some 10 years ago. Over time, driving characteristics and behaviour have changed. Speed limits on our roads have also been increased. Recent studies show that these developments have led to changes in the speed flow characteristics of our roads, with more frequent start-stop conditions being experienced since there are more cases of minor disturbances in the traffic flow causing traffic speeds to deteriorate rapidly. As a result, some motorists experienced being caught in congestion despite paying ERP charges.

There is thus a need to create a buffer to ensure that traffic does not deteriorate to start-stop conditions so rapidly. To address this problem, LTA will refine the method of measuring traffic speeds for triggering ERP rate adjustment. It will use the '85th percentile speed' of an individual road or a basket of roads (for a cordon)



to determine if ERP rate changes are necessary. The 85th percentile speed measurement method is an international traffic engineering practice for assessing traffic conditions. This means that at least 85% of motorists on ERP-priced roads will be assured of smooth travel, moving within the optimal speed ranges. It is also a more representative method for measuring actual traffic conditions, compared to the current practice of using average or mean speeds. The nature of using averages is such that lower speed readings can be evened out by higher speed readings, resulting in a significant proportion of motorists experiencing slow traffic on some routes, even though the average speed measured may be within the optimal speed ranges.

4.1.2 Revising the ERP rate structure

Traffic volumes have increased substantially in the last few years. This has resulted in the need to make more frequent rate changes on our ERP-priced roads and expressways, from nine times in 2006 to 25 times in 2007, based on the same number of gantries. Instead of resorting to so many small adjustments, it would be more effective to make larger rate increments.

Therefore, for ERP charges to remain effective in influencing motorists' behaviour, LTA will raise the incremental ERP charge from \$0.50 to \$1.00. In addition, the ERP base charge, which is the starting charge for a new ERP gantry point, will be increased from the current \$1.00 to \$2.00. These changes will improve the effectiveness of the ERP system, so that each time ERP rates are adjusted, motorists who still choose to drive on these roads would see a visible improvement in traffic flows.

Table 4.1: Revised ERP rate structure

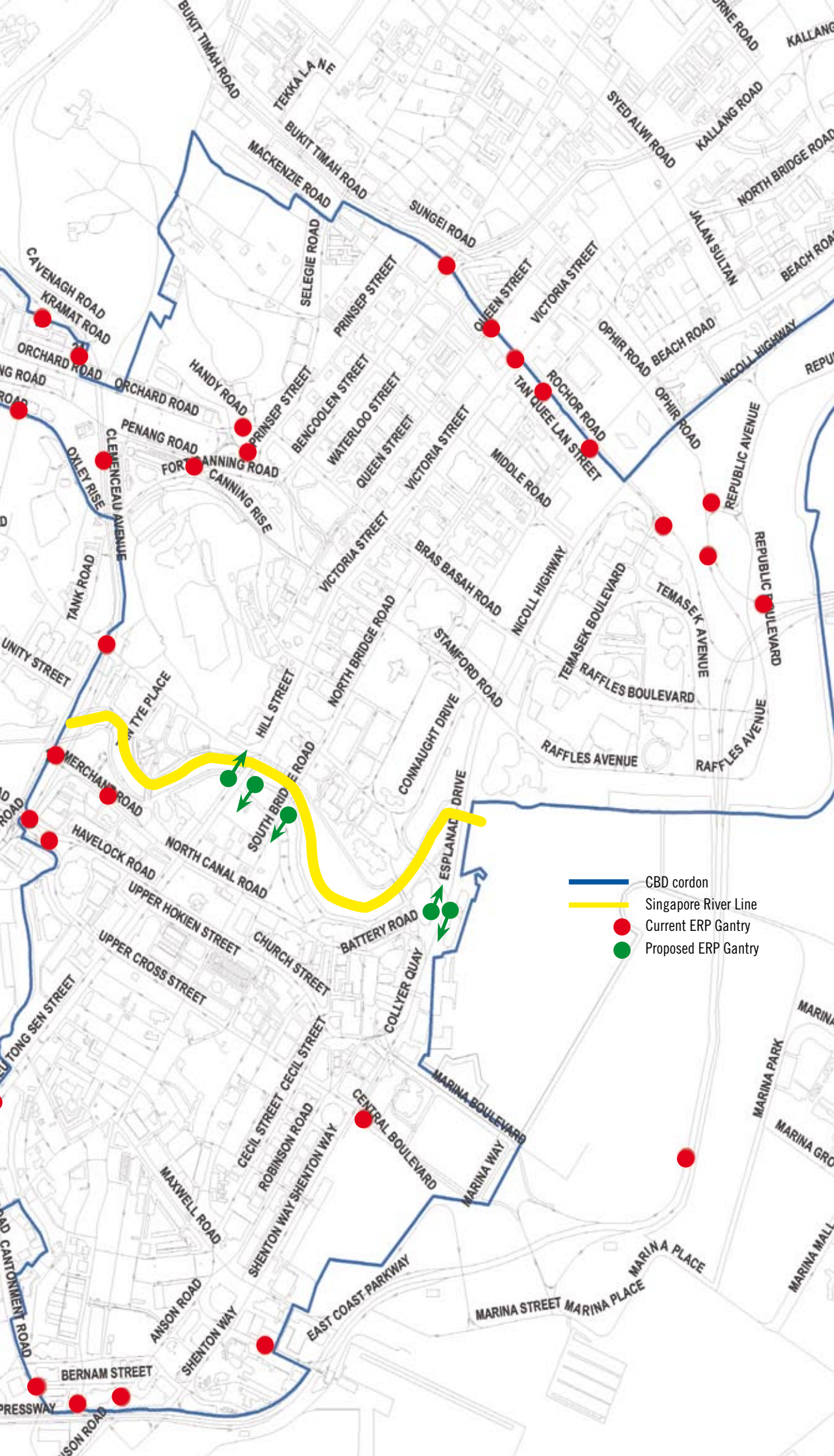
	Current (S\$)	Revised (S\$)
Base or initial rate per Passenger Car Unit (PCU)	1.00	2.00
Rate adjustment per PCU (Increase/reduction in rates when traffic speeds warrant it)	0.50	1.00

4.1.3 Managing congestion in the city area

In the last few years, traffic in the city area has been building up, leading to falling speeds on major roads within the city. For example, five years ago, a motorist could travel at a speed of 25kph in the evening from Bugis to Chinatown. Today, the speeds have fallen by almost 30% to 18kph.

To manage the rising congestion in the city area, LTA will set up five new gantries within the CBD. The gantries will run roughly along the Singapore River from Clemenceau Avenue to Fullerton Road, forming a 'line' which separates the commercial and shopping areas of Bugis, Marina Centre, Bras Basah and Clarke Quay, from the office-based area of Shenton Way and Raffles Place.





LEFT
Fig. 4.1
Map showing proposed
ERP gantries along the
Singapore River.

This Singapore River Line (see Figure 4.1) will be implemented in July 2008 during the evening peak period during weekdays and on Saturdays. It will reduce the through traffic, which currently makes up about 38% of the traffic, in these very busy zones. The concept is similar to the Orchard cordon where ERP was implemented to reduce through traffic, which would otherwise use roads inside the Orchard cordon to get to other areas. Our traffic surveys show that this has reduced through traffic on Orchard Road by 20%.

4.2 REDUCING VEHICLE OWNERSHIP TAXES

Usage charges such as ERP encourage motorists to consider whether and when to drive, whereas ownership costs are sunk costs and may in fact result in motorists driving more rather than less. Hence, as we expand the ERP system, we will continue to shift the focus of our demand management strategies from ownership taxes to usage charges.

The ARF for cars has been reduced over the years – from 150% of the Open Market Value (OMV) of the car prior to the implementation of ERP in 1998 to 110% of OMV today. The road tax for all vehicles has likewise been reduced. For instance, the road tax for a 1,600cc car has been reduced from \$1,440 prior to 1998 to \$874 today, while that for a pick-up truck no more than 3.5 metric tonnes has been halved from \$1,000 to \$500 today.

Moving ahead, we will continue to lower vehicle ownership costs and rely more on usage charges. Since March 2008, the ARF for cars has been further reduced to 100% of OMV.⁷ The road tax for all vehicles will also be reduced by 15% from July 2008.

4.3 LOWERING VEHICLE POPULATION GROWTH RATE

Since the introduction of VQS in 1990, our vehicle population growth rate has been set at 3% p.a.

In 1990, a 3% growth amounted to 16,000 additional vehicles a year. Today, with a vehicle population of about 850,000, a 3% quota amounts to 25,000 additional vehicles every year. At the current growth rate, the vehicle population will increase by 40% from today's level to about 1.2 million by 2020. It is important that we continue to control the vehicle population and keep its growth in tandem with the increase in road space because once a car is bought, its owner will tend to use it as much as possible.

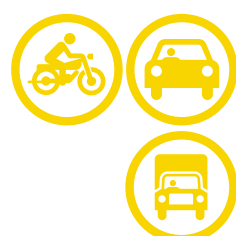
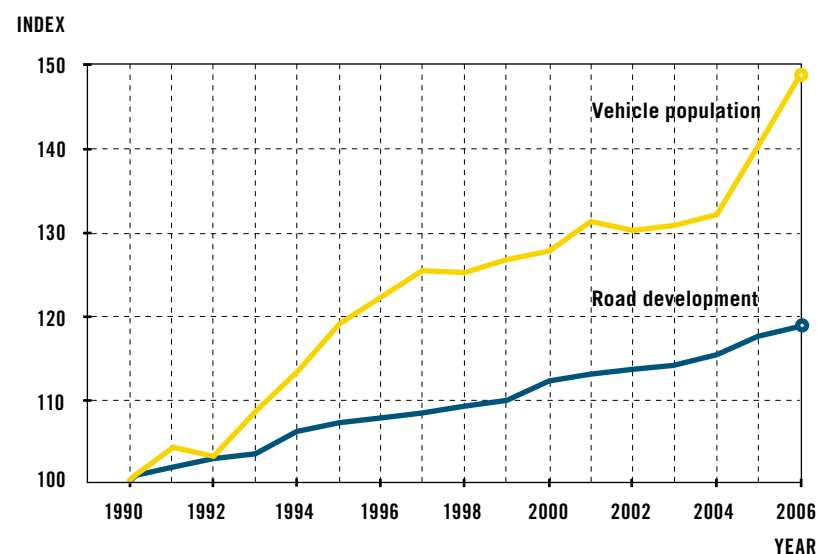
Over the past 15 years, the rate of total vehicle population growth has outstripped road development, as shown in Figure 4.2. Our road growth has been only 1% p.a. in the last 15 years and this rate will be halved to about 0.5% p.a. over the next 15 years. Clearly, it is not tenable to maintain the annual vehicle growth rate at the current rate of 3% p.a.

The vehicle growth rate will therefore be lowered to 1.5% p.a. with effect from Quota Year 2009 i.e. May 2009. This rate will be reviewed after three years. We will then assess whether a further reduction is necessary in light of the slowdown in road growth.



⁷ This reduction is also applicable to taxis and goods-cum-passenger vehicles (GPV) which pay the same ARF rate as cars.

FIG. 4.2
Vehicle growth and road development



4.4 PARKING POLICY

Many cities in the world such as London, Hong Kong, Tokyo and New York rely on parking policies as a tool to manage the demand for road use, in the form of parking surcharges or restrictions on the supply of parking spaces. Such policies aim to move people out of their cars and onto public transport.

In Singapore, we rely on ERP to manage road usage. As for parking, we have adopted the approach where Government determines the minimum parking provision while parking charges are market-driven, left to individual building owners or car park operators to determine. The current approach ensures adequate car park provision and allows the market to optimise the use of parking spaces through pricing. It has worked well and we will continue with the approach.

The car parking standards were lowered in 1990 and further tightened in 2002. A range-based car parking standard (RCPS) was introduced in December 2005 to allow developers more flexibility to reduce parking provision. As many of the buildings in the CBD were developed when our car parking standards were more generous, the existing supply of parking spaces in the CBD is significantly higher than the current standards for car parking provision.⁸ Parking charges, especially season parking rates, in the city are low relative to cities like Hong Kong, London and Tokyo, as seen in Table 4.2.

Table 4.2: Comparison of season parking charges and parking provisions in CBD

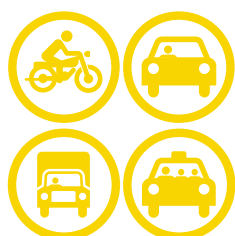
	Singapore	Hong Kong	London	Tokyo
Season parking in CBD (S\$) (average per month) ⁹	160 – 200	720 – 850	>400	420
Parking spaces per 1,000 jobs in CBD ¹⁰	165	23	85	40

⁸ Today, there are 49,000 parking spaces in the CBD. If we apply the prevailing parking standards, there should only be 29,000 parking spaces based on current Gross Floor Area (GFA) of the buildings.

⁹ Data source: LTA; Hong Kong Transport Department; London Borough Authorities; Tokyo Tourism Information. Foreign currencies are converted to Singapore dollars using PPP conversion factor 2005 (Source: World Bank 2007 World Development Indicators).

¹⁰ Union Internationale des Transports Publics (UITP) (International Association of Public Transport) Mobility in Cities database.





4.5 ERP II – THE NEXT GENERATION ERP

In the longer term, the LTA will look into how to upgrade the ERP technology to put in place a more effective system of congestion management. As congestion becomes more extensive, it is not practical to erect physical gantries everywhere to contain congestion. ERP charges at discrete gantry points could also lead to undesirable consequences e.g. congestion spills over to nearby minor roads in residential areas, thus leading to localised congestion. The next generation of ERP system (ERP II) can help to overcome such problems by making distance-based congestion charging possible. This is also fairer as congestion charges are computed based on the actual length of congested roads used by the motorists.

LTA has been studying suitable technologies that could be adopted for ERP II. One of the key technologies being considered is the use of the United States' Global Positioning System (GPS), a fully operational Global Navigation Satellite System (GNSS), to facilitate the identification of the location of a vehicle. GPS-based technology will allow us to adopt a more flexible and efficient method to manage congestion, as well as provide opportunities to develop a more intelligent information dissemination and navigation system for drivers.

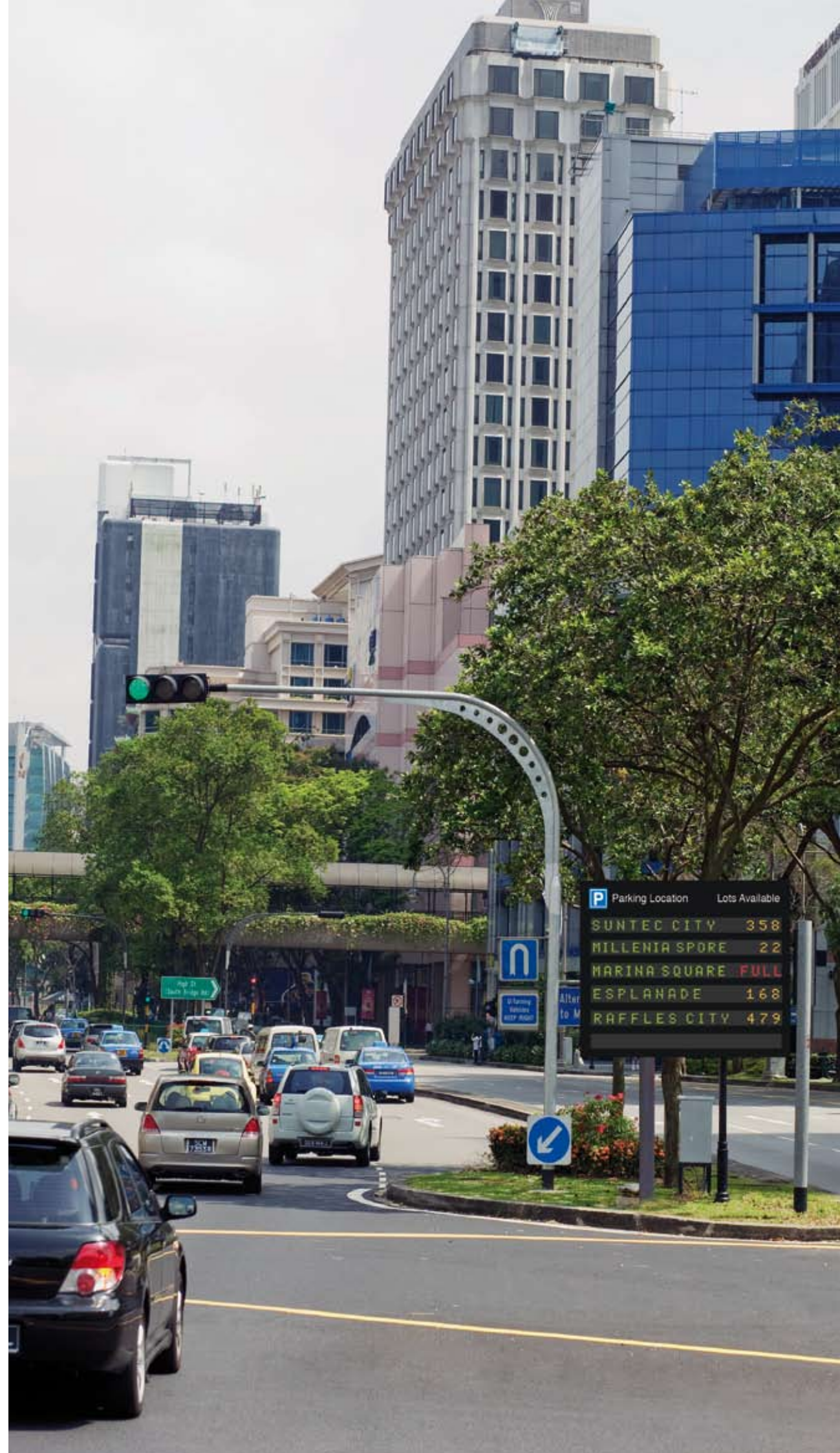
The development and testing of a new ERP system that can meet our requirements and local conditions is still some years away as the technology is still evolving.



4.6 ROAD DEVELOPMENTS TO SUPPORT GROWTH AND IMPROVE ACCESSIBILITY

Over the next 15 years, the LTA will continue to build new road infrastructure to cater to the travel demands of new employment and residential centres. The expansion of the road network will help to improve connectivity and serve new development areas such as Marina Bay, Tuas and Changi Industrial Areas.

By 2013, we will have completed the 5-km Marina Coastal Expressway (MCE) which provides high speed access to the Marina Bay area. The Government has also decided to construct the 21-km North-South Expressway (NSE) at an estimated cost of \$7 – \$8 billion by 2020 (see Figure 4.3). It will provide additional capacity to serve the increase in travel demand expected along the north-south corridor. We will also make improvements to major roads leading out from the central to the east and west regions. These include upgrading works to expand capacity on roads that will serve the anticipated increase in traffic going to JIE and the Changi Cargo Area, extension to existing roads to improve accessibility and carrying capacity of certain road corridors such as Jalan Boon Lay.



RIGHT
Fig. 4.3
Map showing proposed
Marina Coastal
Expressway, North-
South Expressway
and Kallang-Paya
Lebar Expressway
(Phase 2 opens in
September 2008).

Where there are physical constraints limiting the scope for road widening and the traffic flow shows a tidal pattern, i.e. heavy traffic in one direction during the morning peak hours and in the opposite direction in the evening, LTA will consider implementing the 'reversible flow' scheme. This allows traffic lanes from the direction with less traffic to be reversed for use in the peak direction, thereby optimising the capacity of existing roads. LTA will study the feasibility of introducing the 'reversible-flow' scheme along suitable stretches of expressways where it meets the criteria.

Another development that LTA is looking at is the Singapore Underground Road System (SURS). This comprises two concentric rings of underground tunnel each of about 15km in length. It encircles the city centre where most of the commercial activities are concentrated, and directly serves the Marina Bay area. Based on expected developments in the Central Area, SURS will likely be needed in the longer term, beyond 2020. LTA will monitor the development of the Central Area and review SURS' implementation accordingly.



4.7 ENSURING ROAD SAFETY

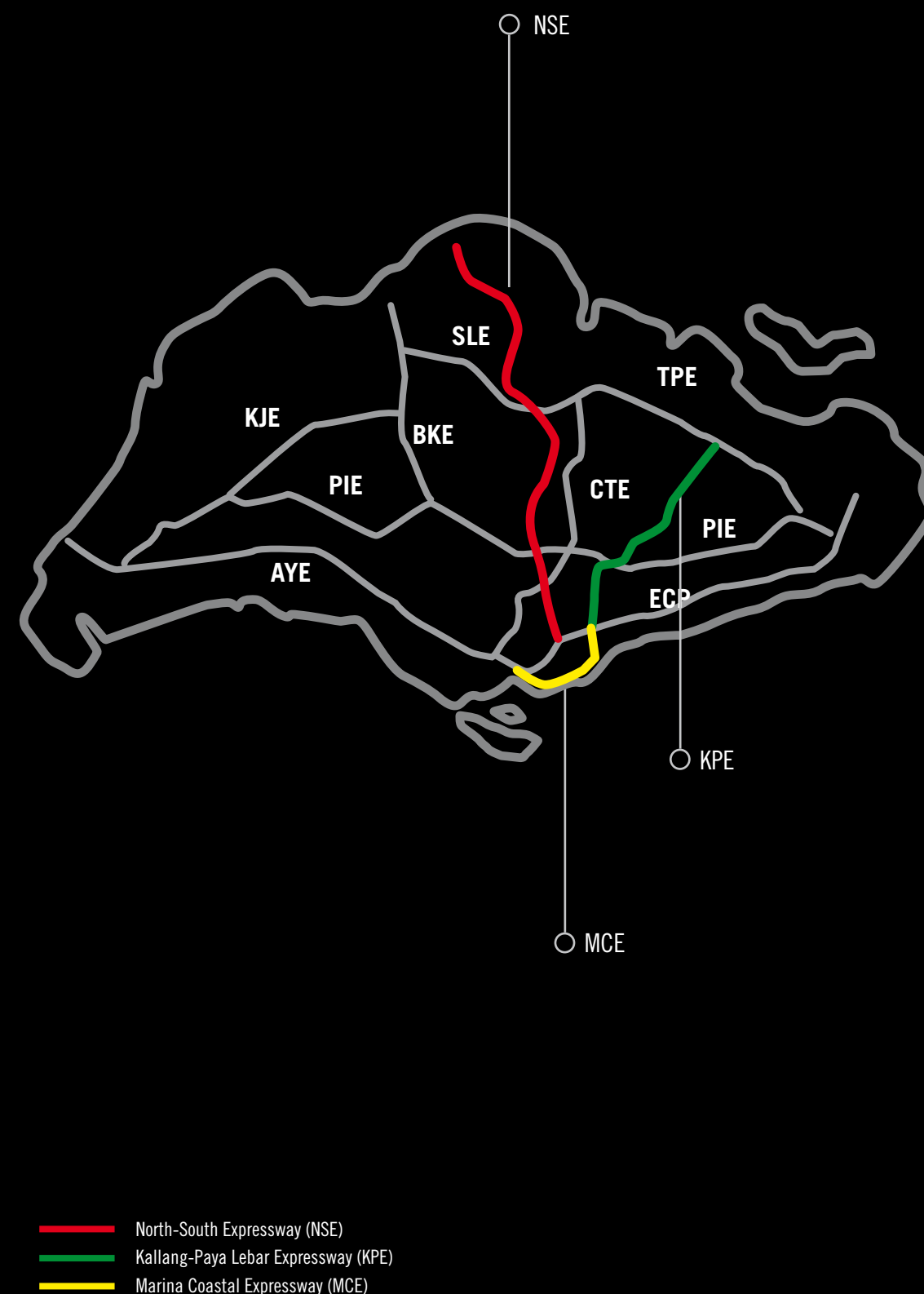
As the developer and manager of almost all roads in Singapore, LTA places great emphasis on providing a safe environment for all road users. Moreover, incidents and accidents on our roads often result in congestion and delays for road users. Therefore, we will continue to enhance road safety in collaboration with other agencies such as the Traffic Police Department and the NSCS.

Over the years, LTA has implemented a series of initiatives to enhance road safety. The Enhanced School Zone was introduced in May 2004 to improve traffic safety around schools. A Black Spot programme was implemented to target areas with high incidence of road accidents. Road infrastructure has been improved to enhance safety. For example, crash cushions installed at high-risk locations have helped to reduce the seriousness of accidents, and concrete bollards at selected bus stops give waiting commuters protection from runaway vehicles.

LTA will continue to enhance the safety of pedestrians with the installation of new safety devices. Intelligent road studs at pedestrian crossings that light up automatically to warn motorists to give way to pedestrians crossing at signalised junctions have been tried and will be introduced at more locations where necessary. LTA will also look into the use of personal electronic device for elderly pedestrians. These devices are used at signalised pedestrian crossings, which when detected, will give the elderly more time to cross the roads.

LTA will embark on new traffic calming measures to alert motorists to lower their speeds to suit the environment. These will make it safer for themselves and pedestrians. In the pipeline are various traffic calming initiatives such as 'Your Speed Sign', 'Advance Road Markings' and 'Traffic Calming Markings' (see Figure 4.4).

Motorcyclists are a group of road users who are especially vulnerable on the roads, accounting for more than half the number of road



TOP RIGHT
Fig. 4.4a
'Your Speed' sign.

CENTRE RIGHT
Fig. 4.4b
Advance road markings.

BOTTOM RIGHT
Fig. 4.4c
Traffic calming markings.

fatalities for the past few years. While education and enforcement will continue to be undertaken to enhance road safety, engineering measures will also be intensified. Road surfaces at accident-prone sites will be treated with high skid-resistant material to give better control for all road users, particularly motorcyclists. In addition, roadside structures and devices such as vehicular impact guard-rails and signages will be made more forgiving in the event of motorcyclists hitting them. Motorcyclists are also more prone to accidents when it rains. LTA has already provided 32 rain shelters for motorcyclists along expressways. Another 38 rain shelters will be built by the end of 2009.

A 'Your Speed Sign' displays real-time speeds of motorists if they exceed the speed limit along a particular stretch of road (Figure 4.4a). Overseas experience with such vehicle-activated speed display signs have been shown to be effective in reducing vehicle speeds.

For pedestrians, 'Advance Road Markings' (Figure 4.4b) will be introduced before zebra crossings where necessary. The markings will provide early warning to motorists on their approach to zebra crossings to give way to pedestrians.

Narrowing the road using visual effects has been shown to be an effective traffic calming tool to slow vehicles down. The UK practice of using 'Dragon Teeth' road markings (Figure 4.4c) will be tried out in Singapore.

4.8 LEVERAGING ON TECHNOLOGY – INTELLIGENT TRANSPORT SYSTEM MASTERPLAN

4.8.1 Managing traffic flow

The adoption of Intelligent Transport System (ITS) technologies such as GLIDE¹¹, EMAS¹², J-Eyes¹³ and the i-transport platform for integrating these various systems to manage traffic flow has helped to improve the operational efficiency of our road network. Looking ahead, LTA will continue to rely on technology to make the best use of our available road space. LTA has developed an Intelligent Transport System (ITS) Masterplan to guide the implementation of innovative traffic management solutions, not only to optimise our limited road capacity, but also to benefit road users. For instance, J-Eyes and EMAS will be expanded to cover more junctions and monitor traffic conditions on arterial roads respectively. We currently have 509 J-Eyes and EMAS cameras and we aim to double to 1,049 cameras on expressways, major arterial roads and junctions by 2013.

4.8.2 Providing more traffic information

Timely dissemination of traffic information is key to motorists taking the best route to their destinations. Currently, traffic information is disseminated through limited channels such as the variable message signs on expressways, radio and the LTA website. Route navigation and guidance devices with dynamic updates of real-time



¹¹ GLIDE intelligent traffic light system increases the carrying capacity of traffic light junctions by monitoring traffic flow in real time and optimising the duration of red and green signals for each direction of traffic.

¹² EMAS performs live-video traffic surveillance, incident detection and traffic advisory functions. It allows for prompt activation of vehicle recovery crews and other agencies (Traffic Police, Singapore Civil Defence Force, etc) to quickly attend to incidents. EMAS also informs motorists of prevailing traffic conditions through strategically located electronic signboards and radio broadcasting).

¹³ J-Eyes is a system of surveillance cameras at signalised junctions to spot and rectify causes of traffic congestion.

traffic conditions on the roads are currently being developed by the industry. The implementation of ERP II with GPS-based technology will bring about potential spin-off developments which will help to enhance information dissemination for motorists, and this will in turn improve the overall efficiency of our road network. All these will allow motorists to better plan their journeys by deciding when, how and where they want to travel. It will help to spread traffic demand over different modes, time and space and help relieve congestion on heavily used routes.

The GPS-based technology used in ERP II could also play a role in providing dynamic fleet management for commercial fleet operators such as logistics or taxi companies. This could eventually lead to travel time savings and service improvements for businesses and commuters alike. The technology could also be employed to improve the operation and efficiency of emergency services by giving priority to emergency vehicles on the road when the situation arises.

Separately, LTA will also look into the use of radio to broadcast traffic information in a timelier manner to motorists and to host public education programmes on transport issues by third quarter 2008, thereby providing an additional avenue for LTA to engage the public more proactively. It will also look into the feasibility of setting up a dedicated radio channel for the above purpose.

4.8.3 Improving road safety

Another potential application of technology is the development and adoption of in-vehicle systems such as Adaptive Cruise Control, Crash Avoidance System and Intelligent Speed Adaptive Systems that could help drivers avoid dangerous situations and reduce accidents on our roads, thus enhancing safety for all road users. Where needed, roadside infrastructure will be provided to facilitate the deployment of such systems.

4.8.4 Facilitating electronic payments

For motorists who wish to do away with the need to carry and top up stored-value cards, the ERP payment system will be further enhanced to allow alternative payment modes, such as credit card payment which will be implemented by mid 2008. The existing In-vehicle Units (IUs) used for ERP will also be upgraded to allow motorists to use contactless smartcards, such as the ez-link cards, in addition to the current NETS Cashcards. This will be implemented by end 2008.





5

**MEETING THE DIVERSE
NEEDS OF THE PEOPLE**

Our transport system plays a key role in enabling every Singaporean to access the expanding opportunities of our vibrant city. With an extensive and efficient transport network, Singaporeans will enjoy convenient travel to their workplaces, schools and the myriad of leisure and entertainment options in our city. Transport is a basic need and we will ensure that everyone – the young, the old, the disabled, and the needy – has access to it. Therefore, moving ahead, we will reposition the land transport system to be more people-centred to meet the many diverse needs and aspirations of our people.

The community as a whole can help to balance various transport demands at the local level, in contributing to transport policies and plans and in facilitating the implementation of transport solutions. As a maturing society, we will foster mutual accommodation and graciousness among the public transport commuters, motorists, cyclists and pedestrians who share our road space.

Our transport policies will also give greater emphasis to environmental sustainability and preserving a high quality living environment. By doing so, we will enhance the quality of life not only for Singaporeans today, but also for future generations.

Our aim is to ensure that our transport system is accessible to all and there is greater ownership of transport issues at the community level. To achieve a sustainable and socially inclusive transport system, we will:

- Ensure physical accessibility for all, including the elderly and the less mobile.
 - New RTS lines will be designed to be more accessible, according to the standard in the latest requirements of the Code of Accessibility in Built Environment.¹⁴
 - All existing RTS stations have been retrofitted with lifts in at least one entrance at the end of 2006. Additional lifts and ramps will be built at some stations by end 2011 to further enhance accessibility to these stations.
 - Public bus fleet will progressively be replaced with low-floor wheelchair-accessible buses. By 2010, 40% of our buses will be wheelchair-accessible and 100% by 2020.
 - Pedestrian walkways, access to MRT stations, taxi and bus shelters, and all public roads will be barrier-free by 2010, that is, they will be accessible to persons with disabilities, e.g. the wheelchair-bound or visually impaired and elderly persons.
- Ensure that lower-income Singaporeans have access to public transport, by providing targeted help to the needy through Government assistance such as the WIS and community help via the ‘many helping hands’ approach.
- Facilitate cycling.
 - Provide more and better bicycle parking facilities around MRT stations and bus interchanges from 2009.
 - Allow foldable bicycles to be brought onto trains and buses on a trial basis from March 2008.
 - Leverage on National Parks Board’s (NParks) nation-wide network of Park Connectors to provide cyclists with

¹⁴ The Code of Accessibility in Built Environment was launched on 12 October 2007 and would be enforced on 1 April 2008. This new Code is to replace the old Code on “Barrier-Free Accessibility in Buildings”. It sets out the fundamental design and construction requirements and guidelines for making the whole ‘Built Environment’, which includes both buildings as well as the external spaces (e.g. walkways, courtyards), accessible to persons with physical or sensory disabilities or impairments.

enhanced connectivity to transport nodes such as bus interchanges and MRT stations.

- Promote environmental sustainability and ensure a high quality living environment.
 - Encourage energy efficiency and reduce carbon emissions by promoting the use of public transport and more energy efficient vehicles.
 - Improve vehicle emission standards to promote a clean and healthy environment. Since 1 October 2006, all new diesel vehicles must comply with the Euro IV emission standard.
 - Look into incentivising bus and taxi operators to consider cleaner technologies and fuels, such as using CNG, to improve air quality.
 - Adopt environmentally sustainable practices in LTA’s planning and development of transport infrastructure.
- Engage and involve the community in shaping and implementing land transport policy and plans.
 - A new division in LTA will spearhead greater community engagement on transport matters. It will have dedicated teams assigned to each constituency to engage the community more closely on the ground. LTA will also launch a community outreach programme to engage transport stakeholders and the community.

5.1 ENHANCING PHYSICAL ACCESSIBILITY



As our population ages, we must ensure that our transport system caters to the needs of elderly as well as less mobile Singaporeans, so that they remain active and engaged in society. Removing physical barriers will also enhance the user-friendliness of our transport system to other users, including families with young children.

LTA adopts international best practice in improving the accessibility of our public transport network, roads and commuter facilities. To ensure that our barrier-free initiatives are sustainable and well tailored to the needs of users, LTA works closely with relevant organisations such as the Handicaps Welfare Association and the Singapore Association for the Visually Handicapped to identify the barrier-free road facilities required.

5.1.1 MRT system

New rail lines will comply with the Code of Accessibility in Built Environment. Existing MRT stations have at least one station entrance fitted with a lift and a barrier-free route, as well as tactile guidance systems and wheelchair-accessible toilets. The upgrading programme was completed in 2006 at a cost of \$81.5 million. To further improve accessibility, LTA will install additional lifts at selected MRT stations, such as those in the HDB towns of Queenstown and Toa Payoh, at a cost of \$70 million where the station entrances are far apart or separated by a major road.

As part of SMRT’s train upgrade project to be completed by end 2008, trains on the North-South and East-West Lines will be provided with a designated recess area for wheelchair users. These are already present on the North-East Line trains.

RIGHT
Enhancing the accessibility of our land transport system for all.

TOP RIGHT (L – R)
Fig. 5.1a
Lift at MRT stations.

Fig. 5.1b
Tactile guidance system at MRT stations.

CENTRE RIGHT (L – R)
Fig. 5.1c
Wheelchair-accessible buses. Photo courtesy of SBS Transit Ltd.

Fig. 5.1d
Ramps at bus interchanges.

BOTTOM RIGHT (L – R)
Fig. 5.1e
Ramps at bus stops.

Fig. 5.1f
Smoothed road kerbs with tactile guides.

5.1.2 Wheelchair-accessible public buses

The LTA has mandated that all new public buses from June 2006 must be wheelchair-accessible. The Government is supporting this initiative by subsidising the cost of the ramps amounting to \$21 million for the entire fleet. By 2010, 40% of our public bus fleet will comprise low-floor wheelchair-accessible buses which will bring convenience to the less mobile as well as the wheelchair-bound. We will work towards having all public buses to be wheelchair-accessible by 2020.

5.1.3 Pedestrian and road facilities

Since December 2006, the LTA has embarked on a programme to implement barrier-free routes within a 400m radius of all MRT and LRT stations. This is part of an ongoing island-wide programme to enhance the accessibility of road facilities for all pedestrians, including the less mobile. This island-wide programme will cost \$60 million in all and will be completed in 2010.

Measures to be implemented include:

- Pedestrian walkways – Ensuring a minimum of 1.0m to 1.5m clearance on walkways by removing obstacles or by widening the path, to provide a clear passageway for wheelchair users.
- Pedestrian crossings
 - Removing the slight drop (25mm) from the footpath to the road and providing tactiles to indicate the edge of the road for the visually impaired
 - Thickening road crossing lines to guide the visually impaired to walk within the designated crossing
 - Installing vibrating push button (with audio alert) at traffic signal posts to help the visually impaired
 - Providing at-grade i.e. road-level crossings where traffic conditions permit
- Traffic signs – Using higher reflectivity materials for traffic signs and street name signs to improve visibility.
- Interchanges – Providing more ramps connecting bus interchanges and train stations.



5.2 ENSURING ACCESS TO PUBLIC TRANSPORT FOR THE LOW-INCOME GROUPS

Public transport must remain accessible to all Singaporeans, particularly for low-income families. However, our approach cannot be to keep public transport fares artificially low. Otherwise, it would not be possible to keep up with operating cost increases or to fund investments such as new buses and train upgrades, leading to a deterioration of public transport services.

We keep public transport fares affordable to the general public by ensuring that public transport operations are run as efficiently as possible, and through the fare regulation of the PTC. The fare



adjustment mechanism administered by the PTC protects the public by capping the allowable fare increase instead of letting the public transport operators (PTOs) charge what the market can bear, and by requiring the PTOs to share productivity gains with commuters. The PTC also tracks the proportion of income that an average commuting household¹⁵ spends on public transport to ensure fare affordability by the majority of commuters.

However, we recognise that low-income households may need additional help to cope with rising transport costs. To help low-income families cope with increases in public transport fares as well as tackle their larger cost of living concerns, the Government has provided assistance to such households through various schemes such as the Progress Package, New Singapore Shares, Economic Restructuring Shares, CPF Top-Ups, rebates on utilities, rentals, service and conservancy charges. Low income workers will also receive more help under the WIS. Help from community schemes is also available, for example, public transport vouchers provided by the PTOs.

Under the ‘many helping hands’ approach, the Government, together with the community, will continue to provide targeted help to low-income families to enable them to have access to public transport and job opportunities.



5.3 FACILITATING CYCLING

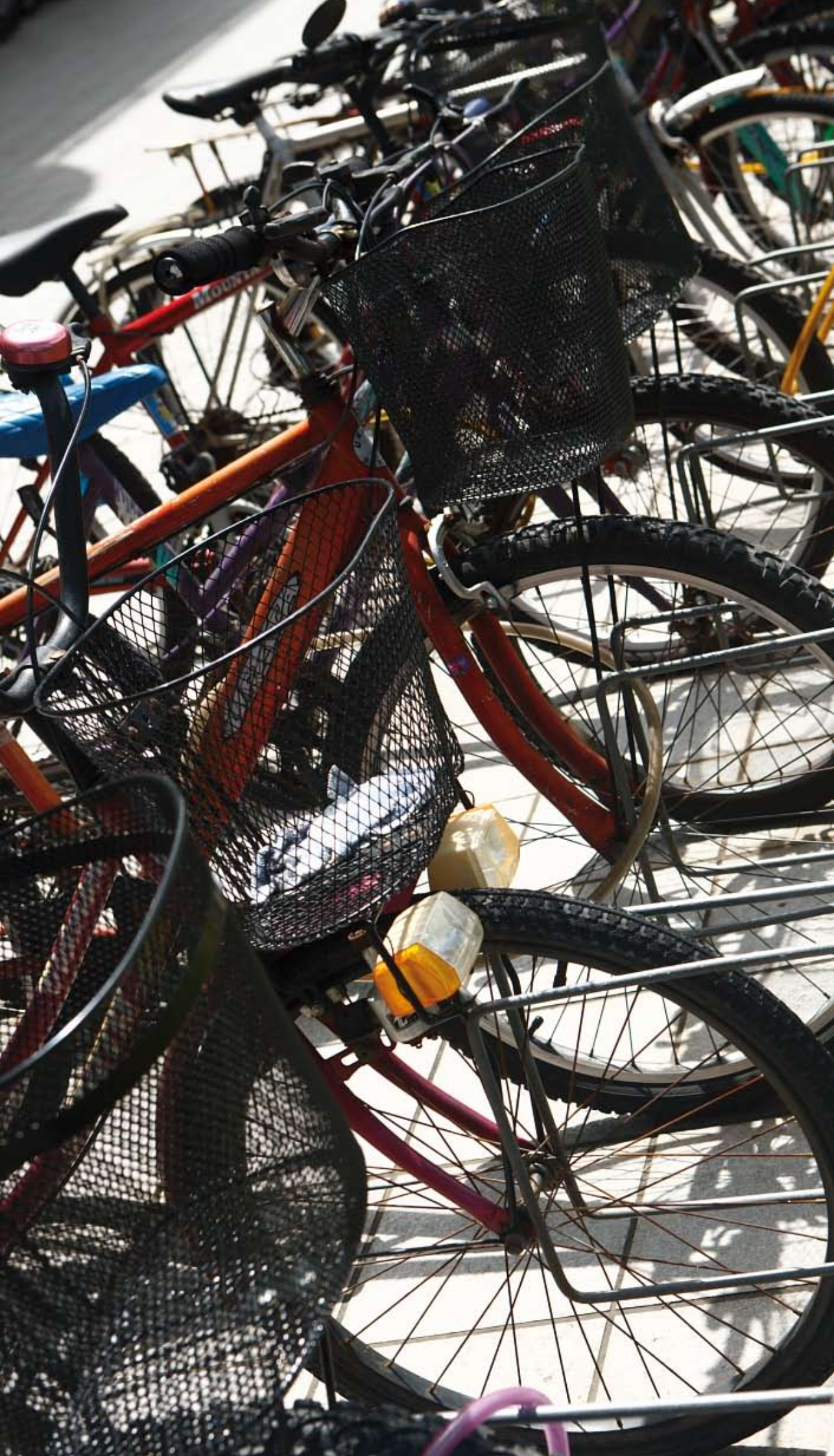
Cycling has become increasingly popular in Singapore in recent years. Besides being a healthy recreational activity, cycling is also a non-motorised transport option that can link commuters to major transport nodes such as RTS stations and bus interchanges. Recognising this, LTA is working with relevant agencies to study how best to cater to the growing cycling population in Singapore, bearing in mind the many competing uses for our limited land.

For a start, LTA will provide more and better bicycle parking facilities around MRT stations and bus interchanges in the housing estates. A six-month trial will be conducted from March 2008 to allow cyclists to carry their foldable bicycles onto our buses and trains, subject to certain conditions to ensure the safety and comfort of other commuters.

Our limited land does not allow us to provide a comprehensive network of dedicated cycling tracks island-wide. Instead, LTA will leverage upon NParks’ nation-wide Park Connectors Network to bring cyclists to transport nodes. Where there are short gaps between the park connectors and transport nodes, LTA will work with the relevant agencies to close these gaps.

In mid-2007, Traffic Police and LTA embarked on a trial to allow cycling on pedestrian footways in Tampines. The outcome of the trial and the feedback gathered will also help us to determine the best approach to provide facilities for both cyclists and pedestrians.

In facilitating cycling, safety is always a priority. Following a pilot in Changi, LTA will implement appropriate signs to alert motorists of the presence of cyclists along frequently used recreational cycling routes such as those in the West Coast and Thomson areas from March 2008. LTA will also continue to work with other agencies and



¹⁵ Based on surveys, this corresponds to the 2nd quintile (which is the 21st to 40th percentile) household income group.



the cycling community to promote safety awareness and implement measures to ensure the safety of cyclists and pedestrians.

LTA will look into providing more and better bicycle parking facilities at and around MRT stations and bus interchanges.

The initiative will be progressively implemented. Priority will be given to towns which have high demand for such parking facilities. Prior to full implementation, LTA is considering a one-year pilot at selected MRT stations/bus interchanges in Pasir Ris, Tampines and Yishun. For example, Tampines Bus Interchange is going to be upgraded and, by end 2009, 150 new bicycle racks will be provided taking into account the current demand.

5.4 PROMOTING ENVIRONMENTAL SUSTAINABILITY



Land transport is central to our quest for a high quality and sustainable living environment, given its wide-ranging impact on air quality, energy consumption, noise pollution and our urban landscape.

Emission from the combustion of fuels in motor vehicles is a significant source of air pollution. Vehicular emissions contribute to ambient concentrations of air pollutants such as sulphur dioxide, carbon monoxide and particulates. Vehicles also emit carbon dioxide (CO₂) from the combustion of fossil fuels such as petrol, diesel and natural gas. As shown in Figure 5.3, the transport sector is a major contributor of CO₂ in our environment, accounting for 19% of Singapore's CO₂ emissions in 2005.

Figure 5.3 Key CO₂ contributors in 2005 (kilo tonnes)

	Electricity Generation	Industry	Transport	Buildings	Consumers/ Household	Others
Primary Consumption (combust fuel)	19,315 (48%)	13,465 (33%)	7,056 (17%)	325 (1%)	216 (1%)	–
Secondary Consumption (use electricity)	–	8,328 (21%)	930 (2%)	5,910 (15%)	3,415 (8%)	732 (2%)
Overall	–	21,793 (54%)	7,986 (19%)	6,235 (16%)	3,631 (9%)	732 (2%)
Total CO ₂ = 40,377 kilo tonnes						

Source: National Environment Agency

A greater push toward improving energy efficiency and reducing emissions in land transport would contribute significantly towards cleaner air and better quality of life for Singaporeans.

5.4.1 Promoting public transport is key

In this regard, our key transport strategies of promoting public transport and restraining the use of cars are critical in protecting our environment. Public transport is by far the most energy efficient means of transporting passengers. A single-deck bus can transport about 80 passengers at any one time, whereas the average occupancy of our cars is only about 1.5 persons per car. By promoting the use of public transport we will also improve energy efficiency and reduce greenhouse gas emissions.

Besides promoting public transport, we will also raise emission standards and encourage the use of cleaner fuels.

5.4.2 Improving emission standards

Since 1 October 2006, all new diesel vehicles are required to comply with the Euro IV emission standard. By this alone, all taxis will be of Euro IV standard by 2014, while all public buses will only be so in 2023. LTA will work with the bus operators to accelerate the conversion of their buses to Euro IV standard by 2020. LTA will also look beyond Euro IV diesel buses/taxis, and incentivise operators to consider even cleaner technologies and fuel sources, such as using CNG, to further improve air quality.

Euro IV Emission Standards

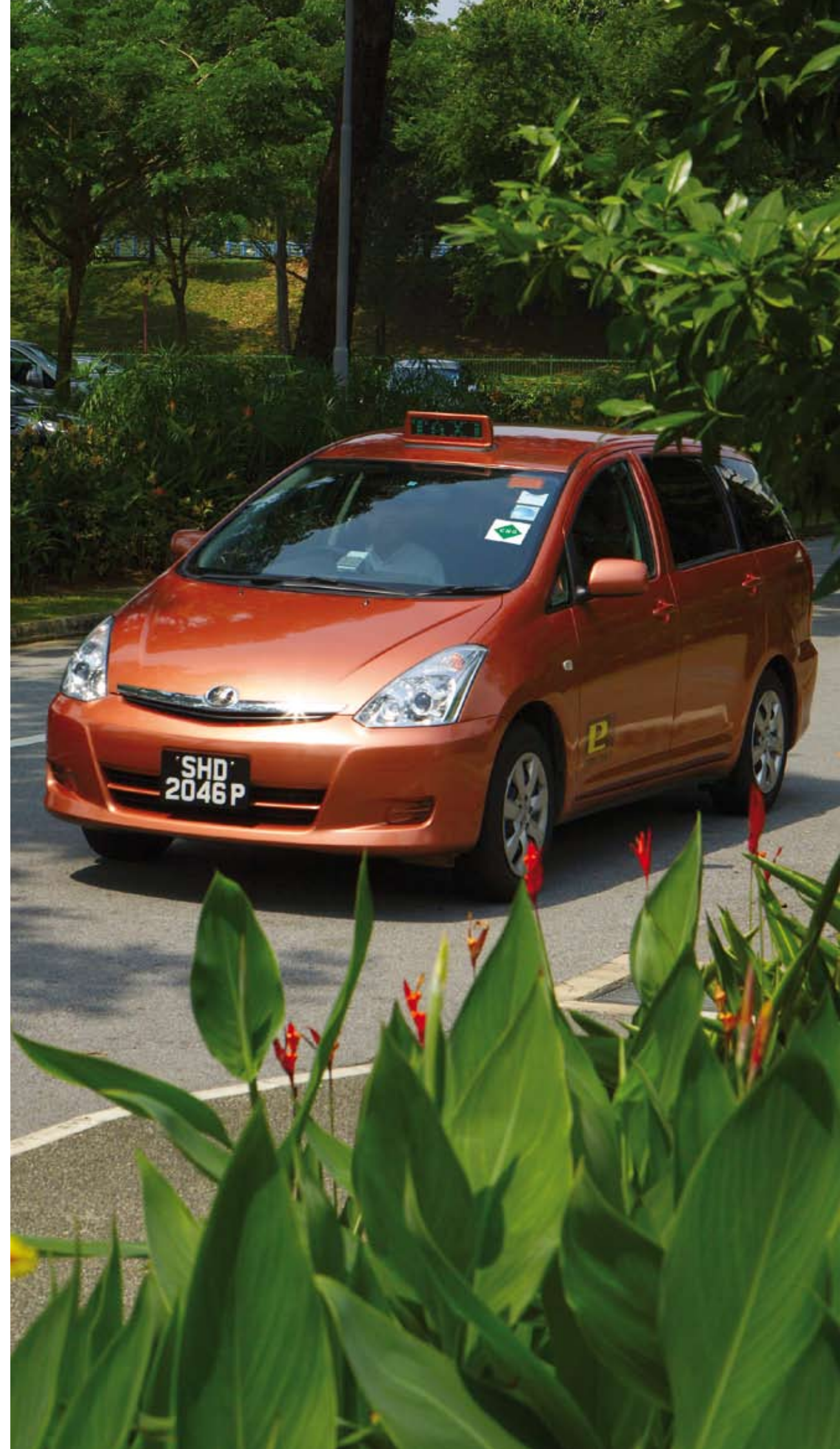
The ambient air in Singapore meets the standards of the United States Environment Protection Agency (USEPA) and World Health Organisation (WHO), except for particulate matters smaller than $2.5\mu\text{m}$ in size i.e. PM_{2.5}. The ambient concentration of PM_{2.5} in Singapore in 2005 was 21 $\mu\text{g}/\text{m}^3$, almost 50% higher than the 15 $\mu\text{g}/\text{m}^3$ standard set by USEPA. High levels of PM_{2.5} is associated with health conditions such as acute bronchitis, aggravated asthma and respiratory diseases.

In Singapore, diesel-driven vehicles contribute to about 50% of PM_{2.5} in the ambient air. Of the remaining 50%, industries contribute about 30% and the remaining 20% come from background sources.

The adoption of the Euro IV emission standards for diesel-driven vehicles is one of the efforts to bring down the PM_{2.5} level in Singapore. Euro IV diesel-driven vehicles emit 70% less PM_{2.5} compared to Euro II diesel vehicles.

5.4.3 Cleaner and more energy efficient vehicles

We will continue to promote the use of cleaner and/or more energy efficient vehicles, such as hybrid and CNG vehicles through the Green Vehicle Rebate (GVR) scheme. There were a total of 1,543 'green vehicles' as at December 2007, compared to a mere seven vehicles at the start of the scheme in 2001. This is a positive trend.



LTA will review the current GVR scheme in consultation with Ministry of the Environment and Water Resources (MEWR)/National Environment Agency (NEA) to ensure that the incentives remain relevant even as technology evolves over time. We target to achieve a 7% improvement in the energy consumption per capita for the land transport sector by 2020, as part of the National Energy Efficiency Programme.

Green Vehicle Rebates

Green Vehicle Rebates (GVR) were introduced for hybrid and electric cars in January 2001 and extended to natural gas vehicles in October 2001. The rebates narrow the price differential with conventional gasoline-powered cars, and help to encourage more motorists and transport operators to consider buying green vehicles instead of conventional ones.

When first introduced, the rebates were equivalent to 20% of the OMV of the green cars, to be used to offset the fees and taxes payable at registration. An annual road tax rebate of 20% for electric cars or natural-gas driven cars or 10% for hybrid cars was also given. To further promote the use of green vehicles in Singapore, the GVR was increased from 20% to 40% of OMV of the vehicles with effect from 1 January 2006¹⁶ and will be valid until December 2009.

5.4.4 Environmentally sustainable practices in developing land transport infrastructure

LTA will firmly entrench environmentally sustainable practices in the planning and development of transport infrastructure.

The design and alignment of road and rail infrastructures are planned to minimise adverse impact on environmentally sensitive areas and to preserve the natural environment wherever possible. Construction methods are chosen to minimise environmental impact and noise, and where possible, sustainable building materials and methods are used. Effort is also made to reduce wastage at all stages of construction.

In support of environmental sustainability, LTA will be collaborating with NEA, SPRING and industry players to recycle municipal, road and building waste material for use in road resurfacing works and road pavement construction. LTA envisages that waste materials currently being disposed of at the Pulau Semakau landfill could be processed into recycled construction material to be used in the aggregate layer of a typical road pavement. If successful, this measure will potentially extend the lifespan of the landfill by another 25 years.

We will also look into ways to improve energy efficiency throughout the life cycle of our infrastructure such as bus and rail depots and explore the use of renewable energy such as solar energy.

To reduce traffic noise, LTA employs noise abatement measures such as planting trees to act as a buffer and selecting trains based on strict criteria to limit noise emission levels. LTA will continue to conduct research and develop new measures to minimise traffic noise.

5.5 ENGAGING THE COMMUNITY



Our land transport system must ultimately be planned and built to improve Singaporeans' access to opportunities and amenities, and improve our quality of life. Land transport is a matter that affects everyone. Hence, LTA has always welcomed suggestions and feedback from transport stakeholders and members of the public. We want to better understand their concerns and priorities, and see through the eyes of the commuting public.

Moreover, LTA cannot build a people-centred land transport system single-handedly. Transport stakeholders such as public transport companies, bus and taxi drivers, public transport commuters, motorists, pedestrians and cyclists all play an integral role in contributing to an effective transport system for today and the future.

For these reasons, LTA has over the years actively engaged all levels of stakeholders through community events, publications, exhibitions, site visits and road shows to keep them updated of developments and to seek feedback.

The community can play a larger role in helping to shape and implement land transport plans and initiatives. This land transport review itself has benefited from the inputs of a broad spectrum of stakeholders and public. At the local level, respected community leaders can help to balance various demands and forge a consensus on the choices and trade-offs that are needed for effective transport solutions.

To support such community efforts and to encourage more ownership of transport issues at the local level, LTA has set up a new division to give it priority. Dedicated teams from the new 'Land Transport Community Partnership Division' will be assigned to each Group Representative Constituency and Single-Member Constituency to handle not only the day-to-day road and traffic management functions more effectively, but to also engage the community more closely on the ground. LTA will also launch its Community Outreach Programme where grassroots leaders are invited to discuss and share land transport policies and plans.

LTA will also step up efforts to communicate with, and reach out to, the wider public through various forums. To reach out to the young people, LTA will continue to engage the schools and tap on the internet and other new media.

With greater knowledge, understanding and participation, there will be greater ownership by all of our land transport system. This then is the core of a people-centred land transport system.

¹⁶ With higher rebates on the taxes payable at registration, the road tax rebates for all green vehicles were removed.



6

CONCLUSION

As we embark on the new initiatives and work towards a more people-centred land transport system, we must continue to recognise that land transport is more than just getting from one point to another; it also makes possible an active lifestyle in a vibrant global city. With limited land supply and the need to serve a larger and more diverse population, and to protect our environment, the need to make public transport system a choice mode is imperative.

By 2020, Singaporeans will enjoy an integrated, efficient and user-friendly public transport system. A vastly expanded rail network will enhance accessibility and provide fast and reliable connections for Singaporeans to travel from their homes to offices or places of leisure and entertainment. The bus network will complement rail to ensure quick and seamless connections, and there will be a gamut of different options such as premium buses to meet different needs. Buses will travel unimpeded on bus lanes along major arterial roads, enjoy right of way to exit bus bays and priority at major junctions, helping to keep commuting time within 60 minutes for most passengers. Commuters can access travel information readily at bus stops and MRT stations, online or by phone to find out when their bus or MRT will be arriving, or determine the shortest route to take. Those who prefer a more personalised door-to-door service will only need to remember one number to call a taxi, or find a taxi stand within five minutes' walk in the CBD.

Given the constraints on road expansion, road usage management will remain a priority, with ERP as a key tool for us to optimise the capacity of our roads. The enhanced ERP system will ensure that traffic remains smooth-flowing most of the time, while we continue to lower ownership costs by reducing vehicle taxes. The use of ITS will provide motorists with a wealth of real time traffic information to better plan their routes, including parking guidance systems that will advise them on where parking is available.

Our initiatives to increase accessibility will bring about a more socially inclusive land transport system that can better accommodate the special needs of the elderly, families with infants in prams and those with mobility difficulties. By 2010, pedestrian walkways, access to transport nodes and all our roads will be barrier-free. In time to come, cycling can potentially be an alternative feeder to our public transport network as we provide more and better bicycle parking facilities at MRT stations and bus interchanges in the housing estates, and embark on trials to allow foldable bicycles onto our buses and trains.

To minimise the impact of transport on the environment, we strive to reduce emissions through more stringent emission standards and the promotion of the GVR scheme, while recycling waste materials for use in road construction work.

Our goal is a land transport system that places people at the centre. To achieve this, we will plan it with the commuters and the community in mind. We will expand our efforts to engage the community to ensure that we hear and address their needs, and incorporate ideas and suggestions where possible. The end result is an increased understanding of the choices we make together and the trade-offs we must balance, to build a land transport system for all of us.



ANNEX A: SUMMARY OF INITIATIVES

By 2020, we will have an integrated, efficient and user-friendly public transport system that enables every Singaporean, including those with special needs, to take part in the life of the city. With a vastly expanded rail system and a bus network that works in close partnership with rail, commuters will have fast and reliable connections that bring them where they want to go seamlessly. To keep our roads free flowing, we will lower our vehicle growth rate and enhance ERP. At the same time, we will continue to engage our community on how best to meet their different needs and aspirations. We will therefore develop a more people-centred land transport system that will allow Singaporeans to enjoy a quality urban environment now and into the future. The key initiatives are summarised below.

SUMMARY OF INITIATIVES	REF. SECTION
MAKING PUBLIC TRANSPORT A CHOICE MODE	
BUS AND RAIL SERVICES	
LTA to be central bus network planner by 2009	3.1.1
Implement fully integrated distance-based through-fares by 2009	3.1.2
Introduce an integrated season pass by December 2008 to allow unlimited travel on both train and basic bus services	3.1.2
Greater bus priority on the roads <ul style="list-style-type: none">Extend bus lanes from 120km to 150km and full day bus lanes from 7.6km to 23km by June 2008Make it mandatory for motorists to give way to buses existing bus bays by end 2008Implement signal priority for buses at junctions starting with a pilot by end 2008	3.2
Gradually open up basic bus service market to allow competition for the market	3.6.1
Encourage premium and innovative basic bus services	3.5.1 & 3.5.2
Consider Government funding for provision of common facilities for bus services	3.6.2
Double RTS network from 138km to 278km by 2020. Implement the following new lines: <ul style="list-style-type: none">North-South Line Extension by 2015¹⁷Tuas Extension by 2015Thomson Line by 2018Eastern Region Line by 2020	3.3
Enhance capacity on existing RTS by increasing train frequency <ul style="list-style-type: none">Revise Operating Performance Standards to prescribe minimum train headwaysInvest in additional trains and modification to signalling system and infrastructure to allow trains on NSEW line to operate at higher frequency	3.4
Introduce greater contestability in RTS industry by shortening licence period for future RTS operating licences	3.6.1
Review rail financing framework to support the expansion of the rail network	3.6.2

¹⁷ The dates provided for the proposed lines are indicative only and the actual implementation will depend on their projected ridership, which depends on the rate of development along the corridors they serve.

SUMMARY OF INITIATIVES	REF. SECTION
Install Platform Screen Doors at above-ground MRT stations by 2012	3.7.4
PUBLIC TRANSPORT TRAVEL INFORMATION	
Implement integrated Public Transport Journey Planner with basic map features by July 2008	3.7.3
Provide integrated real-time bus arrival information at bus stops via SMS and various mobile platforms progressively from July 2008	3.7.3
Implement Integrated Multi-Modal Travel Information System	3.7.3
INTEGRATION BETWEEN TRANSPORT NODES AND DEVELOPMENTS	
Double the number of covered pedestrian overhead bridges (POBs) from 192 today to 384 by end 2010 i.e. 86% of current POBs	3.7.1
Build more air-conditioned bus interchanges integrated with RTS stations and retail/commercial activities: <ul style="list-style-type: none"> Boon Lay Bus Interchange by 2009 Clementi Bus Interchange by 2011 Develop another five integrated interchanges at Serangoon, Bedok, Jurong East, Marina South and Joo Koon over next 10 years in tandem with re-development 	3.7.2
TAXI SERVICES	
Refine taxi QoS to ensure greater taxi availability during peak periods through phone booking	3.5.3
Set up a common call booking telephone service for taxis by July 2008	3.5.3
MANAGING ROAD USAGE	
ENHANCING EFFECTIVENESS OF ERP & PARKING POLICY	
Use 85th percentile speed measurement method to determine if ERP rate changes are necessary from July 2008	4.1.1
Implement revised ERP rate structure from July 2008	4.1.2
Introduce new gantries along the Singapore River to more effectively manage congestion within the city area from July 2008	4.1.3
Study relevant technology for ERP II	4.5
Allow supply of parking spaces to reduce over time with the application of new parking standards, while leaving the market to optimise the use of parking spaces through pricing	4.4
REVIEWING OWNERSHIP MEASURES	
Reduce vehicle ownership costs	4.2
Reduce vehicle population growth rate to 1.5% per annum from Quota Year 2009 for three years	4.3

SUMMARY OF INITIATIVES	REF. SECTION
EXPANDING ROAD NETWORK AND IMPROVING ROAD SAFETY	
Implement Marina Coastal Expressway by 2013	4.6
Implement North-South Expressway by 2020	4.6
Study implementation of Singapore Underground Road System	4.6
Study feasibility of reversible flow scheme on suitable stretches of expressways that show tidal traffic flow	4.6
Enhance pedestrian safety with installation of new safety devices e.g. intelligent road studs at pedestrian crossings and personal electronic device for elderly pedestrians	4.7
Increase motorist and pedestrian safety with new traffic calming measures e.g. Your Speed Sign, Advance Road Markings and Traffic Calming Markings	4.7
Provide more rain shelters for motorcyclists along expressways, from 32 today to 70 by end 2009	4.7
LEVERAGING ON TECHNOLOGY	
Expand J-Eyes and EMAS from 509 cameras today to 1,049 cameras by 2013	4.8.1
Introduce Parking Guidance System from March 2008	4.4
Introduce more timely broadcast of traffic news & host education programmes on radio channels. Study feasibility of setting up traffic radio channel	4.8.2
Allow payment of ERP charges by credit cards by mid 2008	4.8.4
Allow use of contactless smartcards in ERP IUs by end 2008	4.8.4
MEETING THE DIVERSE NEEDS OF THE PEOPLE	
EXPANDING BARRIER-FREE ACCESSIBILITY	
All existing and new MRT stations will have at least one barrier free access for persons with disabilities or impairments. Additional lifts will be installed at selected MRT stations by end 2011 so that these stations will have at least two barrier free access routes	5.1.1
40% of public bus fleet will be wheelchair-accessible by 2010. We will work towards having all public buses to be wheelchair-accessible by 2020	5.1.2
Implement \$60 million programme to ensure pedestrian walkways, access to MRT stations, taxi and bus shelters and all public roads will be barrier free by 2010	5.1.3
ASSISTING LOW-INCOME GROUPS	
Targeted help for the needy through Government assistance such as Workfare Income Supplement Scheme (WIS) and community help, including public transport vouchers	5.2

SUMMARY OF INITIATIVES	REF. SECTION
FACILITATING CYCLING	
Provide more and better bicycle parking facilities at MRT stations and bus interchanges from 2009	5.3
Allow foldable bicycles on trains and buses on a trial basis from March 2008	5.3
Implement safety signs along commonly used cycling routes such as Thomson and West Coast from March 2008	5.3
SUPPORTING ENVIRONMENTAL OBJECTIVES	
Achieve 7% improvement in energy consumption per capita for the land transport sector by 2020	5.4.3
Adopt Euro IV standards for all diesel vehicles and work with taxi and bus operators to consider cleaner technologies or fuels e.g. CNG	5.4.2
Promote the use of cleaner and more energy efficient vehicles, and review Green Vehicle Rebate (GVR) scheme regularly to ensure its relevance	5.4.3
Use recycled waste materials for road resurfacing works and road pavement construction	5.4.4
Adopt environmentally sustainable practices in design and construction of road and rail infrastructure to minimise noise and impact on environment	5.4.4
Study impact of traffic noise and mitigating measures	5.4.4
ENGAGING THE COMMUNITY	
Launch Community Outreach Programme in March 2008 to better engage the community on land transport policies and plans	5.5

ANNEX B: KEY FINDINGS OF THE SINGAPORE PUBLIC TRANSPORT INDUSTRY STRUCTURE REVIEW*

* submitted by Booz Allen Hamilton (BAH) Australia Ltd

1.0 TERMS OF REFERENCE OF PUBLIC TRANSPORT INDUSTRY STRUCTURE REVIEW

The Ministry of Transport (MOT) and the LTA have the mandate to provide a world class transport system for Singapore. The vision is to provide:

“A system that meets the needs and demands of a dynamic and growing city with a population that will increasingly expect high standards in service and infrastructure.”

This Review has been established to develop recommendations in relation to the regulatory and institutional arrangements required to support the Government’s vision. The Review’s Terms of Reference are, in summary,:

- a) Does the current structure and regulatory processes accord with best practice elsewhere?
- b) What measures of effectiveness and quality could be adopted here?
- c) How can we further incentivise the attainment of higher operational efficiency?
- d) What measures should the service providers adopt to better meet commuters’ needs and changes in the operating environment?
- e) What are the possible new measures or programs that provide a greater choice of differentiated and innovative services?
- f) Evaluate whether the key policy assumptions are still valid today and how far do they go towards providing commuters with more choice and an integrated and efficient system?
- g) Recommend changes that strengthen the current structure, and advise whether more competition should be introduced.

2.0 ASSESSMENT OF SINGAPORE’S PUBLIC TRANSPORT SYSTEM

The Review has found that there are many positive features of Singapore’s public transport system. These include:

- High market share;
- Low fares, low operating costs and full operating cost recovery;
- High productivity and efficiency; and
- Expanding and modern RTS.

High market share

Singapore’s public transport modal share is relatively high compared with other cities reviewed. However, the 4.9 million daily trips on public transport (bus, RTS and taxi) have remained relatively unchanged over the seven years between 1997 and 2004. With growth in car usage, there has been a decline in morning peak modal share from 67% to 63%.

Low fares, low operating costs and full operating cost recovery

The Government’s commitment to full operating cost recovery and the regulation of fare adjustments by the PTC creates an environment of strict financial discipline for the operators. Among the major developed cities examined, only Hong Kong and Singapore fully recover public transport operating costs through the farebox, while most European cities have operating cost recovery ratios in the order of 40% to 60%. Table 1 summarises key statistics of major cities throughout the world.

Table 1: Performances of PT operations by cities

Performance of PT operations by cities				
City	Standard-ised ⁽ⁱ⁾ fare revenue per trip (euro cents)	Standard-ised operat-ing cost per passenger-km (euro cents)	Farebox ratio ⁽ⁱⁱ⁾ (%)	Market share of whole day journeys by PT (%)
Singapore	36.7	4.4	126.0	45.7
Hong Kong	78.7	7.1	157.0	73.9
Prague	12.9	9.0	30.5	54.2
Budapest	20.0	11.0	72.5	55.9
Vienna	31.6	14.4	48.5	46.6
Helsinki	36.7	9.4	53.0	34.6
Marseilles	44.9	36.1	54.0	17.2
Paris	47.5	15.0	45.5	27.5
Madrid	59.9	12.3	51.5	30.2
Berlin	59.9	32.4	42.5	33.2
Copenhagen	70.2	13.1	68.0	15.0
London	89.6	18.3	81.0	26.8
Manchester	112.4	26.3	96.0	11.8

(i) Standardised fare and cost includes discount fares and operating expenditure
(ii) Revenue divided by operating costs as a percentage
Source: UITP Mobility in Cities Database 2001

High productivity and efficiency

The RTS and bus systems perform well in comparison with other cities in aspects such as system utilisation, fares and financial performance. Tables 2 and 3 summarise the relative performance of the Singapore operators against some key metrics.

Table 2: Summary of key bus performance comparisons

Functional area	Indicator	Operator ranking	
		Bus (out of 11)	
		SMRT buses	SBST
System utilisation	• Passenger km: Revenue vehicle km	1	3
	• Passenger boardings: Stations	1	2
Fares	• Fare: Passenger boarding	2	1
	• Fare: Passenger km	1	3
	• Affordability Index	2	1
Financial performance	• Op costs: Passenger boarding	2	1
	• Op costs: Passenger km	1	2
	• Farebox Recovery Ratio	2	2
Productivity	• Staff: Bus	N/A	2
	• Vehicle km: Staff	N/A	1

Source: LTA PTO International Benchmarking Appraisal 2006
Benchmarked cities: Hong Kong, Sydney, Dublin, London, Barcelona, New York, Chicago, Stockholm, Vancouver, Montreal

Table 3: Summary of key RTS performance comparisons

Functional area	Indicator	Operator ranking SMRT trains (out of 10)
System utilisation	• Passenger km: Revenue vehicle km	2
	• Passenger boardings: Stations	4
Fares	• Fare: Passenger boarding	2
	• Fare: Passenger km	1
	• Affordability Index	1
Financial performance	• Operating costs: Passenger boarding	1
	• Operating costs: Passenger km	1
	• Farebox Recovery Ratio	2

Source: LTA PTO International Benchmarking Appraisal 2006
Benchmarked cities: Hong Kong, Beijing, Shanghai, Taipei, London, Tyne & Wear, Barcelona, New York, Chicago

Expanding and modern RTS

There has been a high level of investment in the RTS network since the 1996 White Paper and some priority measures for buses on the roads. However, there has only been limited development of ‘integrated’ facilities such as interchanges. Table 4 summarises key public transport network developments in Singapore over the last decade.

Table 4: Public transport network developments

MRT development	
Original lines	
East-West Line (19km)	First section opened 1987
North-South Line (38km)	Completed 1990
Proposed in 1996	
Woodlands Line (16km)	Opened 1996
North-East Line (20km)	Opened 2003
Other Developments	
Changi Airport Extension (6.4 km)	Opened 2002
Boon Lay Extension (4.0km)	due 2009

MRT development	
Circle Line (33km)	due from 2010
Downtown Line Stage 1 (4.3km)	due 2013
Downtown Line Stage 2 (16.6km)	due 2015
Downtown Line Stage 3 (19.1km)	due 2018

LRT development	
Bukit Panjang (8.0km)	Opened 1999
Sengkang (10.7km)	Opened 2003 (East Loop) Opened 2005 (West Loop)
Punggol (10.3km)	Opened 2005 (East Loop)

Other developments	
First priority bus lanes (Currently 120km of bus lanes)	Opened 1974
Full day bus lane	Extended to 8.0km in total in 2007
Air-conditioned Bus Interchanges (BI)	
Toa Payoh	Opened in 2002
Sengkang	Opened in 2003
Ang Mo Kio	Opened in 2007

Our assessment is that more action is required to further improve what is already a very good system. With the public transport mode share falling, without a strategy to improve bus services or to achieve higher RTS ridership, the Government is unlikely to realise its public transport goals. Table 5 provides a brief summary of our assessment of Singapore’s public transport industry when compared with the goals outlined in the 1996 White Paper.

Table 5: Assessment of Singapore’s public transport system against MOT and LTA’s goals

Goal	Assessment
To contribute to the Government objectives of increasing public transport mode share	<ul style="list-style-type: none">Public transport mode share is currently failingCar ownership is increasing notwithstanding ownership control and ERPHigh risk that new RTS lines will shift demand from buses rather than grow overall public transport market share
To meet the needs of an increasing and more diverse population, with higher expectations for service quality	<ul style="list-style-type: none">RTS appears to be meeting this requirement better than busesOverall quality of bus services requires improvement
To be accessible, easy to use, convenient, seamless (integrated), speedy, comfortable, safe and affordable	<ul style="list-style-type: none">Bus and RTS development is not conducted in a consistent and coordinated mannerLack of development at the points of interchange and in the provision of information
To continue to develop an integrated, seamless system in which each public transport mode will be deployed for the situations in which it is most appropriate (effective and efficient)	<ul style="list-style-type: none">There is an absence of integrated planningIt will be a challenge for bus services to improve service standards without affecting its commercial viability
To provide good value for money	<ul style="list-style-type: none">The services appear to be cost effective and low cost

3.0 CHALLENGES AHEAD

In examining the current trends, we believe that the next 10 to 15 years will present a number of challenges:

- The public transport system is losing market share to the motor car and unless significant changes are made, this trend is expected to continue. The investment in RTS is delivering a high quality rail service, but the effect has largely been to transfer patronage from bus to rail rather than growing the overall public transport market share
- The existing bus services, while adequate, fall short of the ‘world class’ standards set for RTS. Furthermore, there has been limited attention to the integration of bus and rail services (e.g. interchanges, travel information) that would be characteristic of a ‘world class’ integrated system.
- Future RTS lines are expected to be less financially attractive on a stand alone basis, whereas older lines are expected to remain profitable. Further RTS expansion is very expensive and focuses public transport investment in the central region and heavy demand corridors.
- In the case of buses, the bus network will be affected by the expansion of the RTS network. The secondary role played by buses, compared to RTS, is likely to result in further patronage loss from the buses to RTS. To remain viable, bus service rationalization would likely be necessary, especially in face of increasing cost pressures (e.g. fuel, bus replacement).
- Faced with a declining bus service the Government is unlikely to realise its public transport market share target. Therefore significant effort is required to boost the performance of the bus network to reverse this downward trend.

4.0 INTERNATIONAL EXPERIENCE

In reviewing Singapore’s public transport system, we studied relevant international experience and examined some of the key factors in detail as follows:

Cost recovery

Singapore, Hong Kong and Tokyo are notable as they achieved full operating cost recovery¹ from their metro systems unlike all the other cities. In subsidised systems, the government contributes some 40% to 60% of operating costs; and it would appear (but not tested) that subsidies tend to grow over time as governments are often reluctant to increase fares in line with increasing costs or to fully fund new service initiatives.

Competition

For bus services, many cities around the world (such as those in Europe, Australia and Hong Kong) are increasingly using competition to minimise costs and/or improve service quality. In bus systems, competition (both ‘in the market’ and ‘for the market’) is recognised to be the most valuable driver of cost efficiency.

Most cities have at least two or more major bus operators competing within their markets. There are no significant economies of scale in bus

fleets larger than 300 – 500 buses and competition ‘for the market’ is intensified where there are multiple bus operators. Measures to ensure easy bus market entry and exit² are necessary to maximise competition.

For the rail industry, our international review found that competition in rail is also emerging as an effective driver of service improvements. Rail competition ‘for the market’³ has been used to drive performance improvements but the results have been more mixed. In most cities, the railways and metros continue to be operated by public agencies with little or no effective competition. Peer competition through the benchmarking of the rail systems is used in many of these places as an alternative to competitive tendering.

Network planning and development

Bus services in Europe and elsewhere are planned by a central government authority and either operated by public or private operators under contracts, with operators having little discretion to vary services.⁴ However, these cities also tend to be heavily subsidised with fare levels dictated by political process and cost recoveries from fare revenue ranging between 40% and 60%.

Integration

The integration of modes and services is most advanced in European cities. The typical European public transport model has a highly integrated, multi-modal network, little duplication of modes and a zone-based fare system with no fare penalty for interchange. Many of these cities have achieved similar or better public transport market shares than Singapore, despite having higher car ownership and lower population density.

Our observations suggest that Singapore’s current ‘multi-modal’ industry structure has not delivered ‘world class’ integration of modes. Table 6 compares Singapore’s current performance across a range of system elements important in achieving an integrated network.

Table 6: Assessment of Singapore’s network integration

System element	Best practice	Singapore
Network	Coordinated planning to ensure best use of available resources and an equitable trade-off between economic and social objectives	Responsibility for planning of network is shared by LTA, PTC and bus operators
Fare	No penalties for interchange between modes or services	Transfer penalties partially offset by fare rebates
Interchanges	High quality, strategically located to minimise impact of transfer	High quality rail/rail at all key nodes but only at three bus/rail locations
Information	Extensive network information provided consistently throughout	Information is provided on a modal/operator basis
Branding	System branding to emphasise integration	Mix of brands (e.g. SBST, SMRT, TransitLink, ez-link)

² For example, bus depots leased to operators for the duration of the contract, market in used buses, transferability of staff between operators.

³ For example, the UK established competitive rail franchises and these have now been established in a few other, selected locations. These contracts often are one of two types: (1) Short term (<10 years) operating franchises; and (2) Long term (>20 years) Build, Own, Operate and Transfer (BOOT) or variation schemes.

⁴ These characteristics are enshrined in a draft regulation which will serve as a model for all EU cities.

¹ Singapore recovers all RTS and bus operating costs through system revenue (including fares, property and advertising). However, significant subsidies are provided by Government to fund RTS system development.

This international experience forms the basis of our recommendations. The key lessons we believe are important to further improve Singapore's public transport system, in order of importance, are as follows:

- **Role of Government** – Network integration is best achieved through the active intervention of Government
- **Network integration guidelines** – Network integration must find a balance between user needs (i.e. demand for travel) and network resources (i.e. cost to satisfy)
- **Procurement model** – Short-term contracts (<10 years) allow for increased competition and the regular review and redefinition of system requirements
- **Industry structure** – In many cities, multiple operators and competition promotes efficiency and service quality
- **Funding** – Full cost recovery is only achieved in a few developed countries and should be retained to promote financial discipline
- **Investment criteria** – Singapore's current assessment methodologies may be understating the benefits of system improvements

5.0 RECOMMENDATIONS

In our view, the most important reform is expanding LTA's mandate to take on a more active role in the planning and development of the bus network. This will allow this sector of the transport system to be placed on an equal footing with RTS and road development. This will need to be complemented by the review of network development guidelines to ensure the right balance is struck between overall network efficiency, community expectations and the Government's transport goals. In order to give effect to a more centralised approach to service development, new procurement models are also needed.

With the above reforms, there is no necessity to maintain a policy of having multi-modal operators to encourage greater integration between modes. There remains a case, however, in maintaining multiple operators within each of the bus and rail sectors to ensure a competitive industry. A multi-operator environment is consistent with a greater role for Government in planning, specifying and procuring services.

Modification of the existing funding mechanisms would provide greater flexibility to implement new service initiatives but any change would add complexity and risk the introduction of operating subsidies. Should a more flexible funding mechanism be adopted, then some revision to the current investment criteria will be necessary.

The following sections provide in greater detail our observations and recommendations.

Role of Government

Network planning and development is currently split between the Government and the operators. LTA plans and develops road and rail infrastructure, and bus stops and interchanges. For rail operators,

their roles are limited to schedule development. For bus operators, their role extends to network planning (within defined areas) and schedule/service development, while the PTC has an oversight role of the bus network. However, this system does not ensure the total network is actively developed for the best outcomes.

It is recommended that the government take a lead role in bus network planning and development. This enables the Government to pursue its strategies of full network coverage and inter-modal integration. The Government's role should be increased to include:

- Integration of rail and bus services;
- Allocation of resources to meet unsatisfied demand; and
- Supporting network development through infrastructure investment in areas such as interchanges, travel information and bus priority.

Operators would retain control of service design according to stipulated standards and contribute to overall network planning. The operators would also continue to address local network planning issues such as responding to changes in road network or land use.

Network integration

The current focus of strategic network planning is to maximise RTS utilisation, limiting buses to that of a 'feeder' mode. Under existing guidelines, 'competing' bus services are 'rationalised' after balancing between resource optimisation and the potential impact on commuters. Overall, this policy is likely to coincide with interests of the combined RTS/bus operator, but differs from interests of competing bus operators and some passenger groups.

It is recommended that the existing guidelines should be reviewed to adopt a principle of overall network optimisation. The network design should seek to maximise the overall economic performance of the network (including consideration of both operator and user costs and benefits) while continuing to respect the need to maintain cost recovery.

Procurement of public transport services should allow for greater competition

There has been minimal competition for the current operating licences for bus and rail services. Efficiency has been promoted by control of fares within defined caps and peer competition. The current model has produced a low cost operation; however, this has been aided by significant Government investment in a modern RTS, and lower bus quality standards than found in other cities.

It is recommended that Singapore move towards a procurement model that allows greater competition between operators for the rights to service particular markets. All new contracts/licences (bus or RTS) should be for no more than 10 years, consistent with European practice, and be competitively tendered. They should also include 'best practice' provisions such as 'excess' profit sharing and clear allocation of risks or risk sharing arrangements. Existing RTS licences should be retained until expiry and existing bus licences should be transitioned from their current form to a new model which

reflects the Government's greater role in network development and other proposed industry reforms.

These changes would ensure consistency with the strategy of increasing competition with multiple operators and consistency with the greater role of Government in determining network and service quality. Government would procure bus and RTS services through a competitive process designed to maximise service quality while maintaining commercial viability. Changing the terms and conditions of the contracts to allow competition more frequently would enhance incentives for efficiency.

Industry structure

SMRT and SBST are the incumbent multi-modal operators providing rail and bus services, overseen by PTC (bus) and LTA (rail). This model was intended to facilitate modal integration through common ownership of the complementary modes.

However, this multi-modal operator model is not the best way to achieve a high standard of network integration in view of the limitations⁵ associated with defining appropriate operator areas. More importantly, neither operator has a mandate to plan an optimised network. Given the nature of the current structure, SMRT's interests lie in maximising the usage of the MRT, while SBST's interests lie in increasing the use of the trunk bus services. This structure suggests one of competitive tension rather than a model of integration.

Our recommendation is that integration will be more effectively realised through greater involvement in network development by the relevant central agencies (i.e. LTA). The existing multi-modal policy of promoting integration through common ownership is not necessary in the context of a greater role of Government in network planning and development.

Number of public transport operators

Based on international practices and competition principles, it is recommended that multiple rail and bus operators be retained. A multi-operator environment is consistent with a greater role for Government in planning, specifying and purchasing services. It also ensures Government can negotiate competitive agreements for all new lines and bus routes, and international experience shows this will encourage efficiency and innovation.

Funding

Under the current arrangements, all operating costs are recovered from system revenue (including passenger fares, property leases and advertising). In addition, system revenue funds all capital assets for bus services, such as bus fleets and bus fleet management systems. The Government, through the LTA, funds the infrastructure development of the RTS system and the first set of operating assets.

It is recommended that the principle of full recovery of operating costs should be retained, allowing government funds to support asset and system improvement. Maintaining operating cost

recovery from revenue imposes a specific performance target on both Government and the operators, which sets a strong financial discipline.

However, a mechanism to allow re-distribution of system revenue across the network should be considered. It is also proposed that the PTC be allowed to approve a fare surcharge to raise funds to support non-commercial transport initiatives. Allocation of revenue in addition to any direct fare (or other) revenue provides greater flexibility and a tool to prioritise the allocation of resources. The economic benefits of a subsidy to ensure delivery of specific initiatives may be positive and may have significant social benefits.

Investment criteria

The Government currently applies both economic and financial criteria to any new initiative. The LTA evaluates projects using discounted cash flow analysis which is a technique commonly used by transport agencies worldwide. This seeks to determine the net economic worth of projects using selection criteria such as net present value (NPV), benefit cost ratio (BCR) and internal rate of return (IRR).

The current assessment methodologies viz. Cost-Benefit Analysis (CBA) for transport projects should be refined to include the residual value of capital investments and the valuation of user benefits and externalities should be reviewed.

6.0 CONCLUSION

The intended effect of these recommended reforms will be to:

- Place bus on a more equal footing with RTS, in terms of gaining government support in planning and development, including providing access to new funding for infrastructure works;
- Give LTA a mandate and the mechanisms to fully integrate the public transport modes;
- Provide a new funding mechanism that allows the early implementation of system improvements, whilst still maintaining a commitment to full cost recovery;
- Define the relationship between the public transport operators and the Government as one clearly based on coordinated, centralised planning principles; and
- Promote competition within the industry to drive continuous improvement in service delivery.

It is recognised that these improvements alone are not a panacea to the declining public transport mode share. A complete solution must also include managing the use of cars and ensuring all land use development is transit oriented. However, these considerations go beyond the scope of this study.

Critical to the success of these reforms will be LTA's commitment to envision and implement a much improved and integrated public transport system. The reforms presented here provide the 'tools' to implement the required improvements: what is 'built' with these tools will determine the ultimate outcome.

⁵ Some of the key limitations include:

- Only the North-East (Punggol/Sengkang) and the North-West (Woodlands/Bukit Panjang) are integrated areas;
- The majority of SMRT stations rely on SBST bus services as feeder modes; and
- The model does not address bus/bus integration issues across bus licence areas.

