

EXECUTIVE SUMMARY

Background

- i. In 1994, Government set up a Working Party to examine measures to tackle traffic congestion in Hong Kong. The Working Party proposed to continue to pursue the balanced transport strategy of building new infrastructure and managing vehicle use and ownership. A package of both long term and short term measures was put forward for consideration. One of the measures considered was the subject of this Study, Electronic Road Pricing (ERP), in view of technology advancement and its effectiveness in managing road use.
- ii. Until the economic downturn in 1998, the vehicle fleet was increasing at a fast rate. Despite that, average traffic speeds in the urban areas have been maintained at about 20 km/h over the past twenty years. This has been achieved by a combination of ownership restraint measures such as First Registration Tax (FRT) and Annual Licence Fee (ALF), an efficient public transport system, road network improvements and effective traffic management schemes. Considering the high GDP per capita, these restraint measures had been successful. In Hong Kong there are less than 50 private cars vehicles per 1,000 population, compared to more than 100 in Singapore and Seoul, more than 200 in Jakarta and over 300 in Bangkok. Only about 11 per cent of daily person trips are made by private cars vehicles while 89 per cent use public transport. Nevertheless, it was considered that the adoption of the "user-pays" principle would offer a more efficient, equitable and flexible means of managing the road space particularly in congested areas during busy hours.

Study Approach

- iii. The Feasibility Study on ERP (the Study) was commissioned in March 1997, with the objective of examining the practicability of implementing an ERP system in Hong Kong and assessing the need for such a system to meet transport objectives. The Study has evaluated ERP's essential components, cost effectiveness and consequences, giving due consideration to transport planning, systems technology and public acceptance.
- iv. The Study reviewed worldwide development of road pricing, assessed future traffic conditions under a range of scenarios, considered alternatives to ERP, undertook field evaluation of the technology options, considered environmental impacts, considered legal and procedural issues, investigated system design issues, explored integration with Intelligent Transport Systems (ITS) applications and prepared an outline for public consultation.

ERP in Concept and in Practice

- v. In a congested environment, each additional trip causes all other similar trips to be delayed. This delay to other users has a cost which is referred to as the "external" cost, and is much greater than the cost of the trip to individual users. The economic theory underlying road pricing is to bring these costs into consideration and, as a result, allocates road space more efficiently. Those prepared to pay obtain a higher quality of service, and the absence of those not prepared to pay benefits all remaining road users including public transport passengers.
- vi. There are schemes being operated in the United States of America and Singapore which have proven that the concept is workable. At present, ERP is being considered in the Netherlands, United Kingdom and Japan.

Technological Options

- vii. Various technological options were assessed by the Study under a set of criteria including capital and maintenance costs, system accuracy and reliability, limitations, security against fraud, integration with existing toll systems and smart cards, anonymity, etc. Two options, namely the Dedicated Short-Range Communications (DSRC) System and the Vehicle Positioning System (VPS), were selected for field evaluation.
- viii. The DSRC system is based on an interchange of information between roadside readers and in-vehicle units (IVU) using low power microwave communication. This is similar to the operation of the existing Autotoll system at various toll facilities in Hong Kong.
- ix. The VPS effects charges by an IVU based on the location of the vehicle using the satellite-based Global Positioning System (GPS). No roadside equipment is required at charge points but violation enforcement stations are required at strategic locations. A wireless data communication network is provided between the vehicles and the control centre for transaction data transmissions, database updating and enforcement verification.
- xi. DSRC technology is more mature and available for implementation in the near future. However, it requires roadside equipment at every charging point. This makes DSRC less flexible and adaptable to changes in charging zones due to dynamic traffic conditions. It also presents installation difficulties because of the existing underground utilities making it progressively more expensive with the introduction of each change. In addition, DSRC can only communicate with the vehicle when it is directly under the charging station. This limits its adaptability to ITS and Transport Information System needs.
- xii. VPS technology, on the other hand, offers greater flexibility and adaptability. It provides vehicle location information and wide area communications to the driver. It may also better fit future ITS and Transport Information System needs. Although the present cost of VPS is higher than DSRC, the projected cost of VPS is dropping at a rate faster than that of DSRC. Hence, taking into account various aspects such as adaptability, flexibility and better integration with ITS, VPS technology offers the best-balanced choice for ERP in the longer term.

Field Evaluation

- x. Field trials were conducted at both off-street and on-street test sites for a period of two months in late 1998 under a range of conditions to determine the robustness and reliability of the systems. The results proved that both DSRC and VPS technologies could be adopted for an ERP system in Hong Kong. While both technologies achieved a high degree of accuracy for its charging function, the enforcement accuracy of both systems could be further enhanced by a vehicle-specific coding system.
- xiii. Measures that could improve the functioning of the transport system may be categorised into supply management and demand management. Supply management are measures that increase the supply of road or rail capacity, add or improve public transport services. Demand management are measures that limit the number or usage of vehicles using the road network. There are two alternative approaches to managing traffic demand. The first one is ownership restraint by regulation and fiscal measures such as quota systems, parking policies, FRT and ALF. The second alternative measure is usage management that imposes restraints on the use of vehicles such as an "odd-even" number

plate system, restrictions on access or charging for usage. However, as the causes of traffic congestion differ from district to district, there is no simple solution that can be applied universally.

- xiv. ERP and the alternative traffic management measures are not mutually exclusive. ERP can reinforce the effects of both ownership and usage restraints. It also provides the financial incentive for motorists to switch to public transport. The diversion and mode switch make more efficient use of the existing road network by reducing the number of vehicles on the roadway thereby delaying or eliminating the need to build more infrastructure.

Need for ERP

- xv. The existing policy is that growth in the private vehicle fleet should not significantly exceed 3% per year. If the growth of the private vehicle fleet size is not greater than 3% per year, the traffic conditions will be similar to those experienced over the past two decades. As a result, additional restraint measures on the main east-west corridor on Hong Kong Island may not be warranted on traffic management grounds before 2006, although some localised traffic congestion may occur at the busy hours. Whether ERP will be required after 2006 depends on public acceptability of the forecast traffic conditions in terms of traffic speeds, control on the growth of the vehicle fleet, improvements to transport infrastructure and public transport services. The need for ERP will also diminish after 2010, as the completion of Central-Wan Chai Bypass will relieve the traffic congestion along the main east-west corridor. For Kowloon, additional restraint measures will not be required at least until 2011, the planning horizon of the current study.
- xvi. It is worth noting that the projected traffic speed on the main corridors on Hong Kong Island in 2006 and 2011 are higher than those

of present day Tokyo, central London and New York. Tokyo and London are currently considering road user charging systems to help alleviate traffic congestion during peak periods.

Possible ERP System for Hong Kong

- xvii. The Study has looked into a possible ERP system for Hong Kong covering the following aspects.
- xviii. Charging Method - A cordon-based charging scheme is preferred in comparison with distance-based, time-based and congestion-based for its simplicity in both operation and enforcement, and technology readiness. Directional charging, i.e. charging on entering in the morning and exiting in the afternoon, is preferred to bi-directional charge whereby charging will be imposed on both directions during the busy hours.
- xix. Charging Zone - It should only cover areas that are perceived to be the most congested and well served by public transport to provide opportunities for road users to change mode of travel. A single zone encompassing Central, Wan Chai and Causeway Bay is preferred to multiple charging zones which will add complexity to the scheme.
- xx. Charging Period - Charging periods are considered in terms of their overall economic benefits according to traffic volume at different times of the day. The analysis showed that peak hours charges should apply from 8:00 am to 9:00 am and from 5:30 pm to 7:00 pm and a slightly lower charge for the inter-peak hours. To reduce the problem of "bunching", shoulder periods at lower charge rates for 30 minutes before the morning and after the evening peaks are proposed. No charge is envisaged for the overnight period from 7:30 pm to 7:30 am or on Sundays and Public Holidays.

- xxi. **Charging Rate** - The required level of charge is determined by the target traffic speed to be achieved. Based on the historical average traffic speed, a target speed of 20 km/h was adopted for the model tests. Charges under the test target speed range from \$8 to \$31 depending on the period of the day and the traffic demand growth scenarios.
- xxii. **Exemption** - ERP provides the flexibility to differentiate charges by vehicle type and to exempt a particular vehicle type from charge. However, exemptions other than for emergency vehicles must be thought through carefully because all trips contribute to congestion. Any exemption to be granted has to be evaluated against the basic principles of equity, efficiency and public acceptability.

Impact of Possible ERP Scheme

- xxiii. It was estimated that 40% of car trips in the morning peak may be diverted to public transport and 10% may change time of travel. The remaining 50% may stay-and-pay the road user charges but will benefit from higher travel speeds and less congestion.
- xxiv. While the ERP may bring about some improvement in the air quality in the charging zone, the environmental conditions of other areas show some deterioration due to the overall redistribution of traffic in reaction to the ERP charging zone.

Complementary Measures

- xxv. ERP will divert car and taxi trips to public transport, producing a small percentage increase in overall demand for public transport. Complementary measures such as providing park and ride facilities, improving public transport interchanges, providing feeder services and improving public transport information system should be considered.

Implementation Strategy

- xxvi. ERP offers a more precise tool to tackle traffic congestion in specific areas. Singapore experience indicates that a revenue neutral scheme would increase public acceptance. However, it should be noted that Singapore maintained a quota on the vehicle fleet. The implementation strategy may, for instance, include a reduction in FRT/ALF and use of the ERP revenue towards a traffic management and information centre and ITS applications to provide real-time information about existing traffic conditions to road users and suggest modes of travel for public transport.

Implementation Programme

- xxvii. Singapore took about six years to implement the ERP system. Given that the DSRC technology has since become more mature, the lead time for the installation of a DSRC system in Hong Kong is expected to take about five years. The lead-time for VPS would likely be longer because there is no off-the-shelf product available in the market and the installation of the in-vehicle units may be more complicated. An estimated six years lead time would be required.

ERP & ITS Integration

- xxviii. The Study identified potential areas that both DSRC and VPS technologies could be employed with other ITS applications in Hong Kong, most of which were demonstrated during the Field Evaluation. If ERP was not required to be implemented in the near future, the ERP technology could still be employed in fleet management, taxi dispatch, non-stop tolling, traveller information and integration with other ITS applications. These applications would have a positive economic benefit and provide for greater operational efficiencies that would benefit motorists and

public transport alike. The overall effect of integrating ERP with ITS is synergy. Together, ERP and ITS would provide a more robust, effective and cost efficient transport system than either could deliver separately.

Benefits of ERP

- xxix. The *transport operation benefits* relate to reduced vehicular traffic, particularly during congested periods, reduced travel times, increased public transport use and higher car and taxi occupancy.
- xxx. The *economic benefits* derive from reduced traffic delays accrued to all road users and to the community at large. The estimated net economic benefit resulting from journey time savings and lower vehicle operating cost is about \$2 billion/year. On the other hand, the estimated cost for the proposed ERP scheme is \$1 billion (including the cost of in-vehicle units for existing vehicles) with an annual recurrent cost of \$200 million. ERP is forecast to generate annual gross revenue of \$0.4 to 1.3 billion. If it is decided to adopt a revenue neutral scheme, this revenue can be ploughed back for transport infrastructure investment.
- xxxi. The *environmental benefits* involve reduced vehicle emissions and reduced exposure to traffic noise inside the charging zone. However, the environmental conditions of other areas may witness some deterioration due to the overall redistribution of traffic. ERP therefore can assist in the overall improvement to the environment, but is not the sole solution to the complex issue of air quality and noise abatement. If ERP is to be used to meet environmental objectives, further studies will need to be conducted to define the parameters, benchmarks and related implementation details.

Public Consultation

- xxxii. Implementation of ERP will not be possible without a general public consensus on the objectives and principles of the proposal. A well-planned and executed public consultation programme to demonstrate how ERP works and to allow public input into the development of system objectives can promote awareness of the ERP system as a measure to relieve traffic congestion and develop understanding in the community for its possible introduction. The public should be consulted specifically on the acceptable traffic condition in terms of traffic speeds, size of the charging zone, the charging level, the type of vehicles which may be charged and the use of the ERP revenue.

Findings and Recommendations

xxxiii. Major findings of the Study

- Both DSRC and VPS technologies can be adopted for a possible ERP system in Hong Kong.
- DSRC is more mature and ready for implementation in the near future with a lead time of about 5 years.
- VPS offers the best-balanced choice in the longer term because of its adaptability, flexibility and better integration with ITS and the lead time is about 6 years.
- ERP technology could be integrated with or employed in other ITS applications such as fleet management, multi-lane tolling and traveller information.
- ERP could generate transport operation, economic and environmental benefits.
- ERP and other alternative traffic management measures are not mutually exclusive.

- ERP could be used to support the funding of new transport initiatives and an integrated transport policy.
- While ERP can be so designed to achieve environmental objectives, a separate study will be required to define the parameters, benchmarks and implementation details.

xxxiv. Key recommendations of the Study

- Drastic restraint measures are not warranted on traffic management grounds before 2006 if the growth of the private vehicle fleet is no more than 3% per year.
- Closely monitor the GDP growth, vehicle fleet size and infrastructure programme.
- Actively monitor the development of ERP technologies and ERP projects in Singapore, USA, UK, the Netherlands and Japan.
- Initiate a public consultation programme to promote public understanding of the traffic congestion problem and how a possible ERP system will work in Hong Kong.

xxxv. Specific issues for public consultation:

- Whether ERP is needed after 2006 in consideration of acceptable traffic speeds, vehicle fleet size and expansion and improvement of transport infrastructures and public transport services?
- If needed, whether ERP should be implemented as a revenue neutral scheme.
- If needed, what should be the charging method, charging zone, charging period, charging rate and exemptions.