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Energy Procedia 61 (2014) 313 – 317

Energy Procedia

The 6th International Conference on Applied Energy – ICAE2014

Low-carbon transport sectoral development and policy in Hong Kong and Singapore

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Abstract

The transport sector remains one of the main sources of carbon emissions in most countries and road transport accounted for more than 16.5% of global carbon emissions in 2011. The urgent need to develop sustainable low-carbon urban transport systems particularly in Asia will face the challenge of increasing motorization following population growth and economic development in the coming decades to 2050. This paper makes a comparison of the transport sector development and policy in Hong Kong and Singapore. Their relative performance will be determined qualitatively and quantitatively to understand the impacts of transportation policies over the past decades. Policy lessons to develop a sustainable transport system drawn from the experience of Hong Kong and Singapore will be put forth to conclude.

Peer-review under responsibility of the Organizing Committee of ICAE2014

Keywords: Road transport, Low-carbon development; Hong Kong; Singapore; LMDI.

1. Introduction

Road transport alone accounted for more than 16.5% of global carbon emissions in 2011. Rapid motorization in developing cities worldwide, particularly in Asia, is set to further increase transport energy demands and carbon emissions in the coming decades. Given this unsustainable situation, it is important to extract policy lessons from the cities with best-performing urban land transport sectors. This paper focuses on the low-carbon transport developments in Hong Kong and Singapore. Both are developed Asian cities that have similar characteristics (see Table 1), and have developed a transport sector that consumes significantly less energy than developed cities in the OECD and the EU.

Comparative research is valuable for transport studies because well-designed comparative case studies can combine the strengths of individual case studies and cross-sectional statistical analyses while simultaneously avoiding their weaknesses [1]. This paper applies qualitative and quantitative analyses to evaluate the relative performance of transport sectors in two cities. The qualitative analysis establishes the drivers and costs of urban land transportation un-sustainability, and then uncovers the similarities and differences in the two cities' transportation planning. Quantitatively this paper applies decomposition analysis to derive the effects of driving forces to the historical changes of energy use in road transport, and cross-compare their energy efficiency performances between Hong Kong and Singapore. This will

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Peer-review under responsibility of the Organizing Committee of ICAE2014
doi:10.1016/j.egypro.2014.11.1114

demonstrate the impact of their transportation policies and also indicate how they may make further improvements.

Table 1. General statistics for Hong Kong and Singapore, 2011

	Area (km^2)	Population (millions)	Density ($pop./km^2$)	GDP (billion USD)
Hong Kong	1,104	7.1	6,500	248.6
Singapore	710	5.3	7,700	239.7

2. Qualitative analysis of the transport sector

Based on our survey of the transport studies on the externalities and causes linked to unsustainable urban land transport sectors, we summarize the most common of these drivers and impacts. The central issues identified are grouped into four categories: (a) traffic congestion; (b) inefficiency urban land use; (c) automobile dependency; and (d) inefficient and highly polluting vehicles. There are several interactions and overlaps in the social costs imposed and many commonalities in across the different transportation problems. Fig. 1 illustrates the relations from the drivers to the problems and to the social costs systematically.

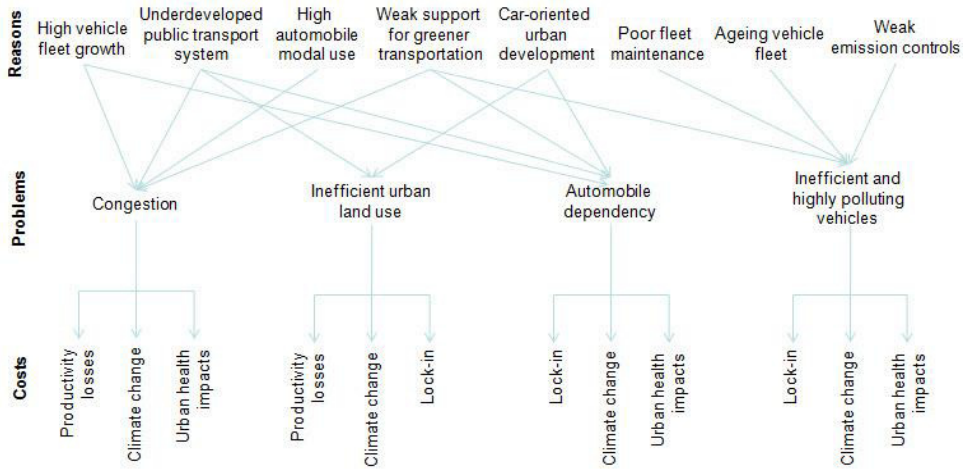

Fig. 1. Causal linkages in urban land transport sector problems

Using the above analytic categories, we identified common policy measures behind Hong Kong and Singapore's low-carbon urban land transportation sector. Traffic congestion and automobile dependency have been mitigated in Hong Kong and Singapore through the use of a comprehensive suite of supply and demand oriented transport sector policies (see Table 2). On the supply side, both cities have invested in developing a well-developed public rapid transit system anchored by a comprehensive urban passenger rail network. This availability of an affordable and efficient public transport system has helped to reduce the incentive to own a car. On the demand side, road network development has been constrained in favor of private vehicle ownership restraint and usage management policies. Collectively, these policies have systematically addressed the problem of traffic congestion by simultaneously improving the attractiveness and capacity of the public transportation system while discouraging private vehicle ownership and usage. This enabled their exceptionally low car ownership ratios relative to economic development. They also have comparable public transport ridership rates to cities with older and more extensively developed public transport systems such as London, New York and Tokyo [2].

Table 2. Key policies for traffic congestion and automobile dependency in Hong Kong and Singapore

		Hong Kong	Singapore
Supply	Public rapid transit	1979: MTR 1988: MTR light rail 1995: Bus-only lane (BOL) system Public transit system integration	1987: Mass Rapid Transit (MRT) 1999: Light Rail Transit (LRT) 1974: Bus-lane scheme Public transit system integration
Demand	Ownership restraint	1961: First Registration Tax (FRT) Annual License Fee (ALF)	1972: Additional Registration Fee (ARF) 1990: Vehicle Quota System (VQS) 1990: Certificates of Entitlement (COE)
	Usage management	1983-1985: ERP trial Fuel tax Road tunnel tolls Parking controls	1975: Area Licensing Scheme (ALS) 1998: Electronic Road Pricing (ERP) 1994: Off Peak Car scheme Park & Ride Scheme
	Road network development	Increasing road network capacity Traffic monitoring	Increasing road network capacity Traffic monitoring

Both cities implemented urban planning for "New Towns" integrating land use and transportation planning, creating a system of high density satellite towns linked by a transportation network to the central city. This reduced private car growth by improving the attractiveness of public transit within the New Towns [3]. As such, the public transport modal shares in Hong Kong and Singapore are 80% and 44% respectively. They have also enacted policies explicitly for sustainable transportation in the past decade. The shared transport planning characteristics in both cities are: (a) consistent, forward-looking, integrated transport vision; (b) long-term commitment to public transit oriented development; (c) hierarchical public transport system with defined roles for each transport element; (d) pragmatic implementation of private vehicle ownership and usage demand schemes; (e) economically sound financing arrangements for transport infrastructure development. Transportation planning in both cities was not explicitly geared for sustainability per se but rather towards addressing specific transport sector problems but still created sustainable outcomes such as high fleet fuel efficiency and low levels of car ownership as a result [4, 5].

3. Quantitative analysis of the transport sector

Decomposition analysis is applied to derive the effects of driving forces to the historical changes of energy use in passenger transport in Hong Kong and Singapore. Passenger transport includes cars, taxis, buses and motorcycles. The identity can be written as:

$$\Delta E_{tot} = \Delta E_{POP} + \Delta E_{VO} + \Delta E_{VS} + \Delta E_{VEI} \quad (1)$$

where ΔE_{tot} is the total change of energy use, ΔE_{POP} is the population effect, ΔE_{VO} is the vehicle ownership effect, ΔE_{VS} is the vehicle structure effect, and ΔE_{VEI} is the vehicle energy intensity effect. The four effects can be derived using the LMDI method discussed in decomposition analysis literature [6, 7].

Decomposition results for Hong Kong (1994-2011) and Singapore (2000-2012) are shown in Fig. 2. For Hong Kong and Singapore, their energy uses in passenger transport generally increase during the periods. However, the contributors to the changes in passenger transport energy use in two cities are not the same. For example, population change in Singapore accounts for most of the increase of passenger transport energy use, especially after year 2005; in contrast, vehicle ownership change is the largest contributor to the increase of passenger transport energy use for Hong Kong, especially in the latest period 2007-2011. The vehicle structure changes in Hong Kong help to reduce passenger transport energy use, while those in Singapore contribute little to the changes in passenger transport energy use in Singapore. The vehicle energy intensity changes in both Hong Kong and Singapore help to reduce passenger transport energy use in 2007-2011.

By comparing the different contributors to the changes of passenger transport energy use, some further improvements can be suggested to both cities. For example, Singapore can make the best improvements by reducing the impact of vehicle structure while Hong Kong can make improvements by reducing

vehicle ownership and improving vehicle energy intensity. Those effects along the time line discussed above can be further linked with the policies or characters discussed in Section 2.

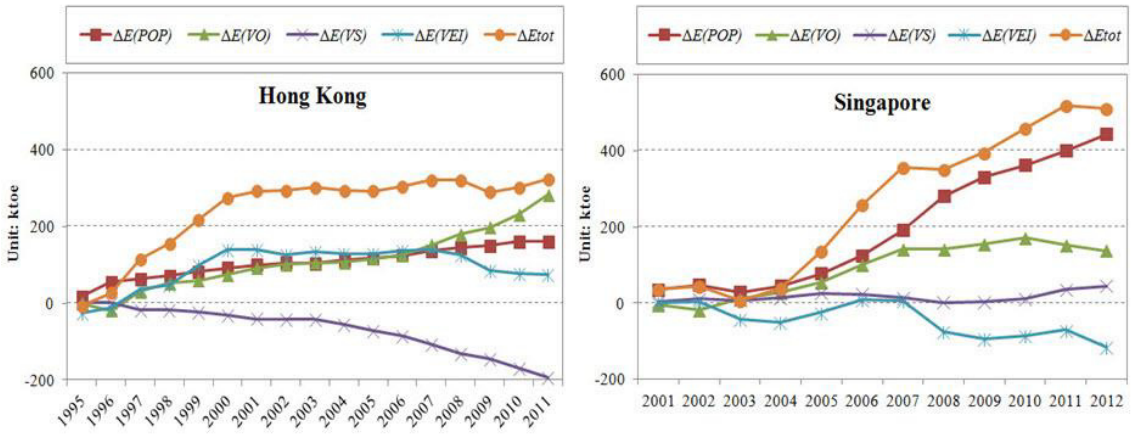

Fig. 2. Time-series decomposition results of passenger transport energy use

4. Concluding remarks

The growing energy use and externalities imposed by transport provides the impetus for concerted policy action. This paper has discussed the causal linkages between the drivers, problems and costs of the urban land transport sector and has shown how Hong Kong and Singapore have implemented policies to develop a lower-carbon and more efficient sector. These policies can serve as a model for the transport policy in other developing cities. The results of index decomposition analysis have also indicated potential areas for transport policy interventions to make further improvements in each city. The Hong Kong and Singapore experience has demonstrated the need for urban policymakers to view private car ownership as a target for regulation for successful transport sector management especially due to the lock-in costs of transport sector problems. Their experience also highlighted how policies targeted towards particular transport problems can have substantial positive effects on other transport problems due to overlapping causal drivers. Environmental benefits thus derived in tandem with economic benefits.

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Biography

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