The International Comparative Study on Urban Energy Consumption and Environmental Quality

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1. Introduction

Today in most cities, energy consumption in transport sector dominates the major cause of air pollution problems in urban areas. The degree of problems in each city depends on the characteristics of energy consumption and travel patterns which are further influenced by economic activity level, spatial development, infrastructure supply, technology level, and legal and policies involved.

This study aims at comparing the characteristics of energy consumption in transport sector and the environmental quality in three cities those differ in the stage of development, namely, Greater London, Nagoya and Bangkok.

2. Mechanism of Transport Energy Consumption and The Environmental Problems

Figure 1 shows a simple mechanism of energy consumption in transport sector and its effects on the urban environment. The economic expansion encourages the higher car ownership and travel demand. The inappropriate spatial development such as urban sprawl and ribbon development cause the longer commuter trips. These phenomena are the major contributors in the increase of private transport. The rising in number of trips and private transport , of course, results in increase of the total trip length (vehicle-km), energy consumption and consequently emissions. On the other hand, the level of energy consumption and emitted pollution also depend on the technological innovation, characteristic of consumption, and policies and regulations concerned.

Figure 2 shows the changes in modal split. It can be seen that the share of private transport is increasing in all cities at the expense of declining share of bus transport.

Due to the rapid increase in population and economy in Bangkok, during the 1972 and 1987 the total vehicle-km in Bangkok increased more than 4 times compared with only 1.3 times in Nagoya, as shown in Figure 3. On the other hand, vehicle-km. in London between 1970 and 1980 increased around 1.2 times which is slightly higher than those in Nagoya.

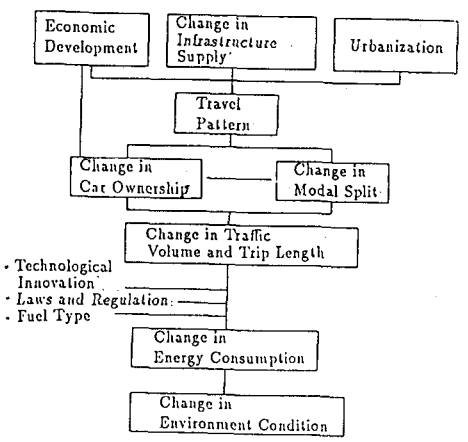

Figure 1
The Mechanism of Urban Activities and The Environmental Problem

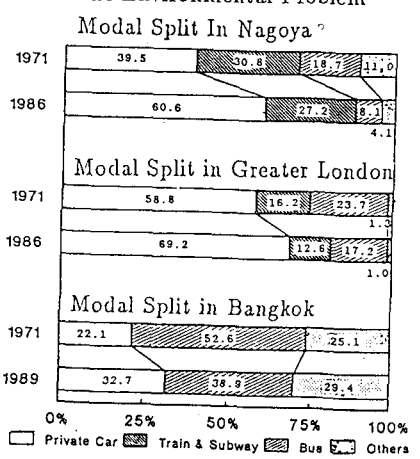

Figure 2
Changes in Modal Split

3. Road Transport Energy Consumption

Figure 4 compares the amount of road transport energy consumption and percentage share of gasoline and diesel in Greater London, Nagoya and Bangkok. Due to the smaller built up area and number of cars the energy consumption in Bangkok during the beginning of the 1970s is less than both those of Greater London and Nagoya. However, due to rapid growth during the 1970s and 1980s the consumption in Bangkok increased almost five times. Meanwhile, the trend of energy consumption in Nagoya is following the trend of its vehicle-km. In case of Greater London, the energy consumption between 1960 and 1980 increases less than twice.

Figure 4 also clearly shows that there are considerable increases in percentage of diesel consumption share in Bangkok and Nagoya while that in London has a trend to decrease. London's trends is the result of small gap between diesel and gasoline price. In Bangkok, the high percentage of diesel consumption is partly caused by intensive bus transport.

Although Nagoya consumes the least total amount of energy, it is the highest in term of energy consumption per unit area due to concentration of economic activities, as shown in Figure 5.

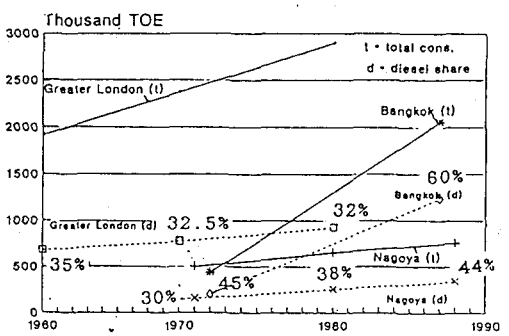

Figure 4
Changes in Road Transport Energy Consumption

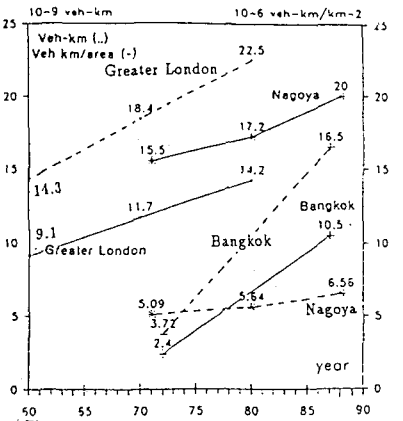

Figure 3
Changes in Vehicle-km and Vehicle-km/area

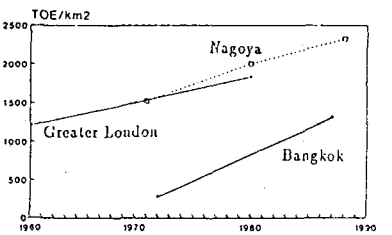

Figure 5
Changes in Road Transport
Energy Consumption Density

4. Road Transport Energy Consumption and Environmental Quality

Figure 6 shows the roadside air quality in all three cities. Though transport energy consumption per area in Nagoya is the highest, roadside air quality is the best. This happens because Nagoya is equipped with the better road infrastructure supply which avoid traffic congestions. Moreover, due to the technological development of engine, high share of new cars and strict emission standard, the level of emission per unit consumption is comparatively low. However, as the considerable increase in diesel consumption, the concentration of NO_2 will become dominant in urban air pollution problem in the near future.

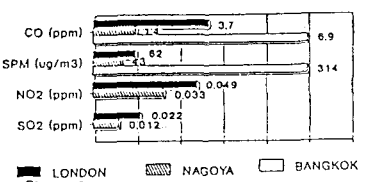

Figure 6
Comparison of Roadside Pollutants
(Central Area, 1987)

For Bangkok, the concentration of CO and SPM are very high. The figure is a result of high energy consumption, both gasoline and diesel, along the road due to serious traffic congestion and high percentage share of diesel. The traffic volume on major roads in the central area within the three cities can be seen from Figure 7.

Greater London consumes the highest amount of road transport energy but the concentration of energy along the road is expected between Bangkok and Nagoya as the sectional traffic volumes are between these two cities. Then, the roadside air quality is also between Nagoya and Bangkok.

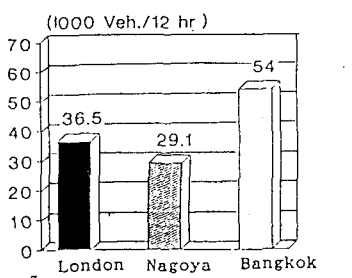

Figure 7
Average Traffic Volume on Major
Roads in Central Area

5. Conclusion

The impact of transport energy use to the environmental problems within each city is different mainly due to the gap in infrastructure supplies. The analysis of the growth of the total trip length due to the rapid increase in population and economy , associated energy use and air pollution in Bangkok demonstrates an evolution towards non sustainable futures since the present infrastructures could not cope with the growth. In Nagoya and London due to the high level of infrastructure supplies the effects of the problems can be reduced, but the rise in the ownership and use of private transports which are higher than the reduction in emissions need special attentions. Therefore the effective control measures for inappropriate spatial developments have to be adopted from now on.