Trends in Passenger Transport Energy Use in South Korea (72*36)

Jiyong Eom[1,2], Lee Schipper[1,3]

[1]Precourt Energy Efficiency Center, Stanford University
[2]Joint Global Change Research Institute, Pacific Northwest National Laboratory
[3]Global Metropolitan Studies, UC Berkeley

ABSTRACT

Having a clear understanding on transport energy use trends is crucial to identifying opportunities and challenges for efficient energy use for the transport sector. To this date, however, no detailed analysis has been conducted with regard to rapidly growing passenger transport energy use in South Korea. Using bottom-up data developed from a variety of recent sources, we described the trends of transport activity, energy use, and CO_2 emissions from South Korea's transport sector since 1986 with a particular focus on its passenger transport. By decomposing the trends in passenger transport energy use into activity, modal structure, and energy intensity, we showed that while travel activity has been the major driver of the increase in passenger transport energy use in South Korea, the increase was to some extent offset by the recent favorable structural shift toward bus travel and away from car travel. We also demonstrated that while bus travel has become less energy intensive since the Asian Financial Crisis, car travel has become increasingly energy intensive.

INTRODUCTION

- South Korea depends 97% of total energy and 100% of oil on foreign countries (EIA, 2007). The share of oil as the primary source of energy is 45% in 2008.
- The country's CO_2 emissions more than doubled since 1990, exhibiting the fastest growth in the OECD countries. Expressed in per capita terms, the OECD countries on average increased their emissions by 7% from 1990 to 2005, whereas South Korea showed an 82% increase over the same period (UNHDR, 2007).
- In 2009, the country set CO_2 reduction target at 4% below 2005 levels by 2020.
- The transport sector in South Korea consumed 37% of petroleum energy in 2007 and accounted for 20% of the economy's CO_2 emissions in 2005 (KEEI, 2007).

❖ We analyze trends of South Korea's transport sector with a particular focus on passenger transport. This study aims to answer the following questions: What has been major drivers of the changes in passenger transport energy use in South Korea? What are the challenges and opportunities for efficient energy use for passenger transport?

AGGREGATE TRENDS IN TRANSPORT ENERGY USE

Figure 1. Passenger and freight transport in South Korea

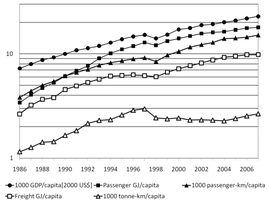
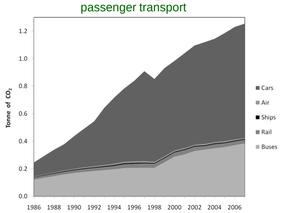


Figure 2. Per capita CO_2 emissions from passenger transport



While the freight sector remained virtually unchanged until the Asian Financial Crisis in 1997 in terms of energy intensity, the passenger sector became increasingly energy intensive. And, freight transport became more energy intensive after the Crisis, whereas passenger transport became less energy intensive (Fig.1). Passenger travel is responsible for 65% of final energy use in the entire transport sector.

As of 2007, cars accounted for 66% of total CO_2 emissions from passenger transport; buses 31%; rail 2%; and ships and air combined 1% (Fig.2). Road travel accounted for 97% of total CO_2 emissions from passenger transport and 61% of total CO_2 emissions from the entire sector.

COMPARISON OF CAR TRVEL WITH OTHER COUNTRIES

South Korea follows the motorization path of Japan—at a given GDP/capita, car ownership in South Korea is relatively close to that of Japan—but far from that of Europe or the two larger countries represented, Australia and the U.S (Fig.3). The high per capita car use of South Korea at low incomes is explained by the domination of official, company and Chauffeur-driven cars in the 1980s, which gradually yielded to usage dominated by private households (Fig.4). South Korea has among the highest fuel intensity of the countries portrayed (Fig.5). This could be a function of poor traffic as well as the significant number of larger company cars and taxes that are included. These data combined, for its car ownership and income, South Korea has relatively high per-capita fuel use for passenger cars particularly in the 2000s (Fig.6). This is mainly because the country's on road fuel intensity has been rising since 1995.

Figure 3. Per capita car ownership

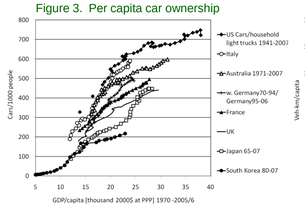


Figure 4. Per capita car use

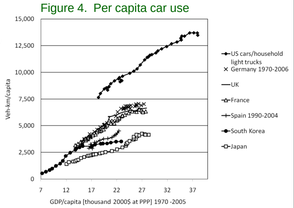


Figure 5. On road fuel intensity of cars and CO_2 emissions (gasoline equiv.)

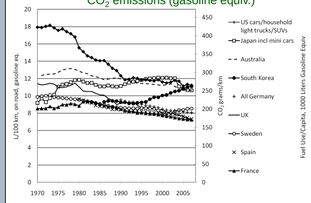
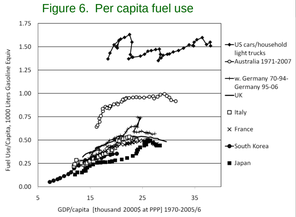
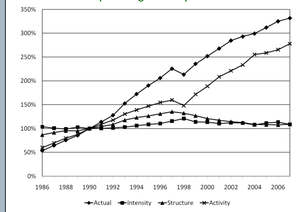


Figure 6. Per capita fuel use



PASSENGER TRANSPORT ENERGY USE IN SOUTH KOREA

Figure 7. Decomposition of energy use trends of passenger transport



Before the Asian Financial Crisis, the rising activity, structure, and intensity effects all contributed to the overall increase in actual energy consumption. After the Crisis, while the steadily rising activity effect was in part offset by both the declining structural effect and the nearly stagnant intensity effect, the net effects still resulted in the overall increase in actual energy consumption (Fig.7).

Transitions in the Structure of Passenger Transport

Figure 8. Passenger activity by mode

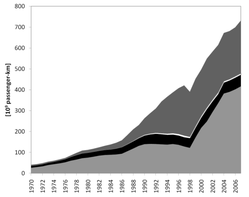
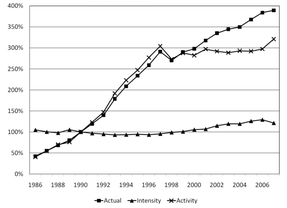


Figure 9. Decomposition of energy use trends of car travel



In 2007, buses accounted for 57% of total passenger-km traveled; cars 34%; rail 8%; and air and ships combined 1%. The shares of car and bus travel evolved largely in a substitutive manner. The steady increase in the share of car travel before the Financial Crisis was coupled with the steady decrease in the share of bus travel; and the decrease in the share of car travel after the Crisis was coupled with the sharp increase in the share of bus travel (Fig.8). Car and bus travel have been the most attractive modes of travel and the other modes—rail, air, and ship travel—have not been much regarded as substitutes for car and bus travel to South Korea passengers. Cars are still consuming a majority of passenger transport energy: in 2007, car travel accounted for 67% of passenger transport energy; bus travel 30%, rail travel 2%, and ship and air travel combined 1%.

Before the Crisis, the activity effect propelled car energy use to keep increasing despite the existence of the minor counterbalancing intensity effect. After the Crisis, however, while the increasing activity effect started to moderate, the intensity effect started upward, contributing to an increase in its energy use (Fig.9): although South Koreans started to decrease their relative use of cars in total passenger travel, car energy use became more intensified.

Transitions in the Energy Intensity of Passenger Transport

Figure 10. Energy intensity of travel by mode

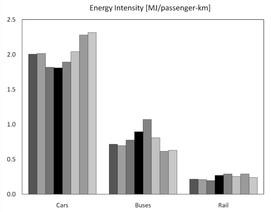
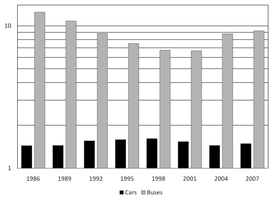


Figure 11. Load factors of car and bus travel



Energy intensity of car travel fell a little in the 1990s and then started to rebound in the early 2000s. Meanwhile, energy intensity of bus travel exhibited exactly the opposite: A steady increase in the 1990s, followed by a decline in the 2000s (Fig.10). This contrasting trends in energy intensity of car and bus travel may be explained by changes in their load factors. An average car was used by increasingly more passengers, followed by increasingly less passengers, whereas an average bus was used by increasingly less passengers, followed by increasingly more passengers (Fig.11). However, that load factor is neither an exogenously given nor a single determinant of energy intensity.

Figure 13. Domestic sales of passenger cars produced by South Korean automakers

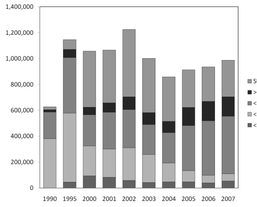
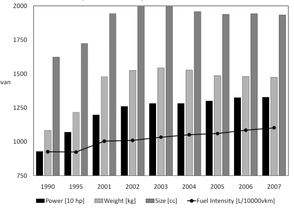


Figure 14. Fuel intensity and sales-weighted characteristics of domestic cars produced by automakers



There has been deterioration in overall technical efficiency of cars on the road in the 2000s due to (i) distortionary taxation imposed on the automobile market that favored larger cars and SUVs and (ii) a steep increase in the market penetration of automatic transmission, which leads to a sizeable drop in fuel economy (Fig.13). Average passenger cars sold in Korea became heavier, larger, and more powerful by the early 2000s, followed by a moderate lessening of the trend (Fig.14).

An important regulatory policy that may have contributed to the decline in energy intensity of bus travel was the public transport reform in Korea. In 2004, the city of Seoul reformed its public transport system with the introduction of the central-lane BRT, as well as the integrated fare system. The reform may have promoted operational efficiency of Seoul urban buses: the nationwide fuel economy of urban buses increased from 2.57 km/L in 2004 to 2.85 km/L in 2007. Along with the reform is government push for the highway BRT. Since the early 2000s, the government has been expanding the geographical and time coverage of the highway BRT: the fuel economy of intercity buses increased from 3.32 km/L in 2001 to 3.73 km/L in 2007.

DISCUSSION

While in South Korea the activity effect has been the major driver of passenger energy use, roles played by the structural changes of travel modes and their energy intensity changes cannot be ignored: Without the favorable shift to less energy intensive car travel and the decrease in the energy intensity of bus travel, its passenger energy situation would have been even worse. Thus, if the government is to economize its travel energy use while sustaining its economic growth, it is well advised to take even more aggressive and orchestrated steps to promote energy efficiency of popular travel modes (i.e., car and bus travel) and to encourage a shift toward less energy intensive modes (i.e., bus and rail travel).

Longer-term solutions for car energy use would require more fundamental and aggressive regulatory measures. Recently, the government has adopted a flexible standard that requires automakers to comply either the average fuel economy of 17 km/L (40mpg) or the CO_2 emission standard of 140g/km by 2012 with a penalty clause. Another necessary condition for establishing more energy-efficient passenger travel is to promote public transport such as bus travel. The government may also make rail travel a close and efficient complement to bus travel and ultimately make rail and bus travel as a whole an attractive substitute for car travel.

DATA SOURCES FOR THE ANALYSIS

- Korea Energy Consumption Survey, Korea Energy Economics Institute, 1986, 1989, 1992, 1995, 1998, 2001, 2004, 2007
- Automobile Industry Annual, Korea Automobile Manufacturers Association, various years
- Statistical Yearbooks, Ministry of Land, Transport, and Marine Affairs, 2001-2007
- National statistics and authoritative national analyses used in Schipper (2008) and Schipper & Fulton (2009)

TEMPLATE DESIGN © 2008
www.PosterPresentations.com