POLICY FRAMEWORK FOR TRANSPORTATION ENERGY EMERGENCIES

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ABSTRACT

Recent exhaustion of fossil fuels and augmentation of energy demand of emerging economies intensify the possibilities of energy emergency in Korea. Since the most energy demands in transportation sector relies on petroleum related products, establishing contingency plan should be required for the intrinsic energy deficiency.
It is expected that the international oil price will ascend or fluctuate based not only on the demand of petroleum products but also on the environmental changes of the OPEC (Organization of Petroleum Exporting Countries). Thus, the appropriate and timely contingency plan is indispensable.
The purpose of this study is to classify the energy emergency, and to analyze the effectiveness of policy measures, and represents the improvement plan of related detailed readjustment plan exhibiting active and systematic contingency plans.
A provisional and long-term contingency plans are proposed for transportation energy emergency. The inter-ministerial cooperation is necessary to effectively implement the contingency plan and to improve the capability of countermeasures for energy emergency in the transportation sector.

Keywords: Energy Emergency, Contingency Plan, Policy Measures, Inter-ministerial Cooperation

INTRODUCTION

The most energy demand in transportation sector relies on petroleum related products. Due to the high reliance on petroleum products, it is necessary to establish the contingency planning to provide against energy emergencies. In fact, the international oil price increased up to US$145.49 per barrel in July 2008, and then the oil price decreased, and fluctuated depending on the production of oil from OPEC (Organization of Petroleum Exporting Countries). It is estimated that the changes of the international oil price grow serious, and

the political situation of the Middle East will be getting worse (KOTI, 2005, 2007). Thus, systematic scenario-based contingency plan should be provided in the mid- and long-term. The purpose of this study is to classify the level of energy emergencies caused by supply-demand relations in Korea, and to establish the contingency planning based on the level of emergencies. Further, this study provides the improvement plan with respect to the related laws and regulations in case of Republic of Korea, so that this study will be able to contribute in effective policy making to take precautions to keep the supply of transportation service from overwhelming economic and social chaos.

The rest of the paper is organized as follows. The following section provides literature reviews that show the contingency planning under the conditions of energy emergencies in the field of transportation. The third section describes the scenarios for responding against energy emergencies and the evaluations of each policy measures under provisional energy emergency and long-term energy emergency due to the exhaustion of energy. The following section exhibits implementation plans and evaluations for each policy measures. Finally, the concluding section briefly reviews the major policy measures to take action against the energy emergencies, and proposes potential further research.

LITERATURE REVIEW

Janarthanan and Schneider (1984) investigated contingency strategies in order to deal with the rapidly increasing demands of public transportation under the energy crisis in the United States. The purpose of the study was to establish contingency strategies of public transportation using CAD (computer-aided design) at two sub-centers of Seattle in the United States. Three emergency levels were discussed according to the utilization level of public transportation. Further, three kinds of contingency strategies were developed when the ratio of commuting trips (to work and school) are 100 percent, 75 percent, and 50 percent, respectively.

Hartgen (1983) examined the practicality of contingency strategies from federal and state governments in the United States with respect to the transportation energy emergencies. The study explored several problems appeared from oil crisis in 1973 and 1979. The volume of energy savings was measured with which mobility is continuously maintained. It was reported that most individuals have their own abilities to deal with the energy emergencies without governmental assistance.

Cho (2006) discussed the improvements of energy efficiency focusing on the contingency plan with respect to energy consumption in the field of transportation. The author provided several policy measures to increase the energy efficiency: improving driving attitude, increasing fuel efficiency of vehicles, establishing transportation demand management plan, revitalizing public transportation, providing governmental subsidies, reducing taxes, and so forth.

According to the European Commission Energy Efficiency Legislation (ECEEL, 2008), implementation planning for five divisions were explained to achieve 20 percent energy savings by 2020. Five divisions include energy efficiency for end-users, energy efficiency of buildings, environment-friendly design of products that consume energy, energy grade labelling of home electric appliances, and cogeneration. In particular, several specific implementation plans were introduced: supporting 75 percent of energy efficiency cost, introducing energy efficiency technology and "EuroWhiteCert Project", developing high efficiency building platform and standards, establishing database of electric motor efficiency, and so on.

Kang (1988) reviewed the contingency planning when the first and second oil crisis occurred during 1973-1974 and 1979-1980, respectively. At the first oil crisis, Korean government prepared energy-saving strategies in the field of transportation, and implemented consumption control policy and 10 percent energy savings policy. In the transportation field, number of trips for commercial vehicles, ships, and aircraft were decreased, and the government encouraged public officials to use train rather than using energy-intensive luxury vehicles. At the second oil crisis, oil sales in the gas station was restricted on the weekend, thus more intensive policies were implemented compared to the period of the first oil crisis. Furthermore, registration of new commercial vehicles was disapproved except for means of transportation in the metropolitan area in 1980.

SCENARIOS FOR ENERGY EMERGENCY

Scenarios for Provisional Energy Emergency

We set up two levels of the provisional energy emergency as the following. The emergency level 1 is defined at which the following situation is estimated:

- If OPEC or major petroleum exporting countries plan to reduce oil production
- If the national emergency (rebellion, disturbance, or coup) occurs in the petroleum exporting countries, or the imbalance of energy supply occurs due to the declination of oil supply or suspension of oil
- If the Dubai international oil price exceeds US $150 per barrel, and provisional supply-demand imbalance occurs
- If this situation is estimated to be back to normal within three months

The emergency level 2 is defined at which the following situation is expected:

- If the level of emergency is more serious than that of emergency level 1 (e.g. natural disaster, earthquake, terror for oil refinery)
- If the supply-demand of energy cannot be controlled using oil price policy, and energy distribution system is required (severe emergency is estimated)
- If the Dubai international oil price increases up to US $200 per barrel
- If this situation is estimated to be continued about six months to one year, and back to normal after a year

Potential policy measures in case of the emergency level 1 can be summarized as follows:

- Increase Congestion Fees
- Grant Incentives for Those Who Use Public Transportation or Bicycles
- Decrease the Speed Limit on the Highways
- Closure of Parking Space on the Roadway

And potential policy measures in case of the emergency level 2 can be displayed as follows:

- Compulsory Carpooling
- Implement Energy Distribution System
- Implement Oil Supply Cap per Capita
- Facilitate Demand-flexible Chartered Bus
- Reconsideration of Air Flight Routes
- Increase the Ratio of Telecommuting

Scenario for Long-term Energy Emergency

The long-term energy emergency can be defined if the situation of energy emergency is getting worse, so that possibility of normalization from the emergency would be low (e.g. in case that fossil fuels are exhausted). Potential policy measures in case of long-term energy emergency can be summarized as follows:

- Extend the Congestion Pricing
- Increase Alternative-Fuel and Electric Vehicles
- Maximize the Utilization of Subway or Railway
- Extend the Supply of Two- and Three-wheel Bicycles

EVALUATION OF POLICY MEASURES FOR ENERGY EMERGENCIES

To evaluate the policy measures for energy emergencies, the following five standards of evaluation can be considered: Measuring social acceptance, Possibility of energy savings, Possibility of decreasing transportation demands, Availability of administrative maintenance, and Availability of Legislation.

Measuring Social Acceptance

Measuring social acceptance of policy measures is different according to the intensity of implementation. In general measuring social acceptance is relatively low with respect to the policy measures in case of the provisional energy emergency, for example, implement energy distribution system, implement oil supply cap per capita, closure of parking space on the roadway.

In particular, for the energy distribution system the consensus between provider and consumer should be composed. However, if the level of emergency is serious, it is difficult for consumers to receive even minimum amount of energy. Closure of parking space on the roadway can be ineffective according to the regional characteristics, and illegal parking might be increased where off-street parking facility is limited. Further, traffic congestion can be serious around the area in which the roadway parking space is closed.

On the other hand, social acceptance of the policy measures including compulsory carpooling, increase congestion fees, grant incentives for those who use public transportation or bicycles, facilitate demand-flexible chartered bus, reconsideration of air flight routes, decrease the speed limit on the highways, and increase the ratio of telecommuting is, in fact, relatively high. It is estimated that decrease the speed limit on the highways can fall into confusion in the beginning of the implementation. However, social acceptance becomes higher after the system will be settled down. Furthermore, social acceptance of potential policy measures in case of long-term energy emergency is relatively high (e.g. extend the congestion pricing, maximize the utilization of subway or railway, extend the supply of bicycles)

Possibility of Energy Savings

Energy savings is one of the important policy measures, and should be implemented with high priority. In general, possibility of energy savings is relatively high especially for policy measures in case of provisional energy emergency (e.g. compulsory carpooling, increase congestion fees, grant incentives for bicycle users, decrease the speed limit on the highways, closure of parking space on the roadway). The above policy measures are likely to suppress the demand of passenger vehicles, and some of them are likely to switch the demand of passenger vehicles into that of public transportation. However, if the operation of public transportation is also limited due to lack of energy, the confusion is unavoidable. Further, policy measures for long-term energy emergencies are likely to be effective in energy savings.

Possibility of Decreasing Transportation Demands

Possibility of decreasing transportation demands is closely related to energy savings, and the most policy measures are likely to decrease the demand of passenger vehicles. Some policy measures including compulsory carpooling, increase congestion fees, closure of parking space on the roadway, reconsideration of air flight routes are relatively effective in decreasing transportation demands. However, other policy measures including decrease the speed limit on the highways, implement energy distribution system, and implement oil supply cap per capita are likely to be ineffective although there is effectiveness in a certain extent.

Availability of Administrative Maintenance

In general, availability of administrative maintenance is hardly to be achieved since the policy makers and energy consumers might have different opinions. The role of administrative maintenance is important because the policy measures for provisional energy emergency are likely to suppress the transportation demands. In particular, for compulsory carpooling we need to find the effective way of enforcement, and to provide distinct standards for imposing penalty. Policy measures for long-term energy emergency are likely to be effective in availability of administrative maintenance (e.g. extend the congestion pricing, increase alternative-fuel and electric vehicles, maximize the utilization of subway or railway) since the social acceptance of the policy measures is relatively positive.

Availability of Legislation

Legislation is required to efficiently implement the policy measures. Also, we need to consider the confliction with the higher level of laws, and effectiveness of legislation. In general, the availability of legislation is relatively low for policy measures in case of provisional energy emergency (e.g. grant incentives for public transportation users, decrease the speed limit on the highways, closure of parking space on the roadway, implement energy distribution system, implement oil supply cap per capita). Policy measures for long-term energy emergency are likely to be required enough time to implement, so that the availability of legislation is also relatively low. However, we need to establish the circumstances for overcoming energy emergencies.

Table 1 – Evaluation of Policy Measures for Provisional Energy Emergency

Policy Measures	Evaluation Standards	Degree of Achievement	Special Feature
Compulsory Carpooling	Measuring Social Acceptance	△	
	Possibility of Energy Savings	○	
	Possibility of Decreasing Transportation Demands	○	
	Availability of Administrative Maintenance	△	If it does not carry legal binding force, the enforcement is unlikely to be continuous.
	Availability of Legislation	○	
Increase Congestion Fees	Measuring Social Acceptance	△	It varies depending on the congestion fees increase.
	Possibility of Energy Savings	△	
	Possibility of Decreasing Transportation Demands	○	
	Availability of Administrative	△	It is hard to decide on the size of congestion fees increase.

	Maintenance		
	Availability of Legislation	○	
Grant Incentives for Public Transportation or Bicycle Users	Measuring Social Acceptance	○	
	Possibility of Energy Savings	○	
	Possibility of Decreasing Transportation Demands	○	
	Availability of Administrative Maintenance	×	It is hard to set up the standards of incentives, and to identify whether they in fact utilize the public transportation or bicycle or not.
	Availability of Legislation	×	
Decrease the Speed Limit on the Highways	Measuring Social Acceptance	△	
	Possibility of Energy Savings	△	There can be a negative effect if the decrease of speed limit is relatively substantial.
	Possibility of Decreasing Transportation Demands	△	
	Availability of Administrative Maintenance	△	It is estimated that there can be a confusion at the beginning of the policy measure.
	Availability of Legislation	×	
Closure of Parking Space on the Roadway	Measuring Social Acceptance	△	It varies depending on the geographical characteristics.
	Possibility of Energy Savings	△	
	Possibility of Decreasing Transportation Demands	△	
	Availability of Administrative Maintenance	×	Administrative procedure is complicated, and it is hard to select the target parking space.
	Availability of Legislation	×	
Implement Energy Distribution System	Measuring Social Acceptance	×	Consumers may have resistance since the energy may be distributed uniformly.
	Possibility of Energy Savings	○	
	Possibility of Decreasing Transportation Demands	○	
	Availability of Administrative Maintenance	×	If there is no legal binding force, continuous enforcement will be difficult.
	Availability of Legislation	×	
Implement Oil Supply Cap per Capita	Measuring Social Acceptance	×	Since oil supply hardly applies differential rates according to the classes of consumers, resistance can be expected.
	Possibility of Energy Savings	○	

	Possibility of Decreasing Transportation Demands	○	
	Availability of Administrative Maintenance	×	If there is no legal binding force, continuous enforcement will be difficult.
	Availability of Legislation	×	
Facilitate Demand-flexible Chartered Bus	Measuring Social Acceptance	△	Since the number of chartered buses is only about 33,000, utilization is limited.
	Possibility of Energy Savings	△	
	Possibility of Decreasing Transportation Demands	○	
	Availability of Administrative Maintenance	△	It is hard to build demand-flexible utilization of chartered buses.
	Availability of Legislation	○	
Reconsideration of Air Flight Routes	Measuring Social Acceptance	△	
	Possibility of Energy Savings	○	
	Possibility of Decreasing Transportation Demands	○	
	Availability of Administrative Maintenance	×	The process can be complicated if we reconsider the current routes.
	Availability of Legislation	×	
Increase the Ratio of Telecommuting	Measuring Social Acceptance	△	
	Possibility of Energy Savings	△	
	Possibility of Decreasing Transportation Demands	△	Although working trips can be decreased, other transportation demand is likely to increase.
	Availability of Administrative Maintenance	△	Classifying industries should precede the implementation of telecommuting.
	Availability of Legislation	△	

Note: Symbols ○, △, and × indicate the degree of achievement of each policy measure for transportation energy emergencies.

○: High, △: Medium, ×: Low

Table 2 – Evaluation of Policy Measures for Long-Term Energy Emergency

Policy Measures	Evaluation Standards	Degree of Achievement	Special Feature
Extend the Congestion	Measuring Social Acceptance	△	

Pricing	Possibility of Energy Savings	○	
	Possibility of Decreasing Transportation Demands	○	
	Availability of Administrative Maintenance	△	It is hard to select the target region.
	Availability of Legislation	△	
Increase Alternative-Fuel and Electric Vehicles	Measuring Social Acceptance	○	If the price of alternative-fuel vehicles is adjusted to a realistic level, the social acceptance is likely to increase.
	Possibility of Energy Savings	○	
	Possibility of Decreasing Transportation Demands	×	In fact, the effectiveness may be minimal since the means of transportation is transferred to the other means of transportation.
	Availability of Administrative Maintenance	△	
	Availability of Legislation	△	
Maximize the Utilization of Subway or Railway	Measuring Social Acceptance	○	
	Possibility of Energy Savings	○	
	Possibility of Decreasing Transportation Demands	○	
	Availability of Administrative Maintenance	△	Administrative procedure can be complicated since integrated fare system might be implemented.
	Availability of Legislation	△	
Extend the Supply of Two- and Three-wheel Bicycles	Measuring Social Acceptance	○	Necessary bicycle infrastructure is required.
	Possibility of Energy Savings	○	
	Possibility of Decreasing Transportation Demands	△	
	Availability of Administrative Maintenance	△	Campaign should be implemented to get effective result.
	Availability of Legislation	△	

Note: Symbols ○, △, and × indicate the degree of achievement of each policy measure for transportation energy emergencies.

○: High, △: Medium, ×: Low

CONCLUSIONS

This study investigates scenario-based policy measures for transportation energy emergencies, and evaluate each policy measures using five evaluation standards that include measuring social acceptance, possibility of energy savings, possibility of decreasing transportation demands, availability of administrative maintenance, and availability of legislation. Some policy measures can be applied for provisional energy emergencies, and other policy measures are useful to be applied for long-term energy emergencies in case of Republic of Korea. A provisional and long-term contingency plans are proposed for transportation energy emergency.

Social acceptance of the policy measures including compulsory carpooling, increase congestion fees, grant incentives for those who use public transportation or bicycles, facilitate demand-flexible chartered bus, reconsideration of air flight routes, decrease the speed limit on the highways, and increase the ratio of telecommuting is, in fact, relatively high. In general, possibility of energy savings is relatively high especially for policy measures in case of provisional energy emergency (e.g. compulsory carpooling, increase congestion fees, grant incentives for bicycle users, decrease the speed limit on the highways, closure of parking space on the roadway).

Some policy measures including compulsory carpooling, increase congestion fees, closure of parking space on the roadway, reconsideration of air flight routes are relatively effective in decreasing transportation demands. However, other policy measures including decrease the speed limit on the highways, implement energy distribution system, and implement oil supply cap per capita are likely to be ineffective although there is effectiveness in a certain extent. Policy measures for long-term energy emergency are likely to be effective in availability of administrative maintenance (e.g. extend the congestion pricing, increase alternative-fuel and electric vehicles, maximize the utilization of subway or railway) since the social acceptance of the policy measures is relatively positive. Legislation is required to efficiently implement the policy measures. Also, we need to consider the confliction with the higher level of laws, and effectiveness of legislation. In general, the availability of legislation is relatively low for policy measures in case of provisional energy emergency (e.g. grant incentives for public transportation users, decrease the speed limit on the highways, closure of parking space on the roadway, implement energy distribution system, implement oil supply cap per capita). The inter-ministerial cooperation is necessary to effectively implement the contingency plan and to improve the capability of countermeasures for energy emergency in the transportation sector. Potential further research would be detailed improvement plan for related laws and regulations to implement these policy measures.

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