

## Urban Expressway Authority's Challenge for Dissemination of Electric Vehicles in Japan

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### Summary Statement

Hanshin Expressway Co. Ltd. (HEC), an urban expressway authority in the Kansai metropolitan region of Japan, has launched a car sharing project with electric vehicles (EVs). Dissemination of EVs is expected to solve tangled issues (e.g., traffic congestion, CO2 emission and finance of the highway authority); in other words, it would certainly contribute to building a sustainable urban expressway business model for HEC.



### 1. About HEC

HEC used to be called Hanshin Expressway Public Corporation (HEPC) that was established in 1962 by the local governments of the Kansai metropolitan region including Osaka, Kyoto and Kobe cities located in the western part of Japan. HEPC's mission was to sustain the metropolitan region's mobility and its economic activities by means of building a sustainable urban expressway business model. HEPC, the former organization of HEC, was privatized in 2005 in accordance with the national government policy and HEC has been established. HEC has succeeded its mission from HEPC; in other words, HEC is still responsible for catering to the public needs.

The Hanshin Expressway network extends 264.5km including 18.8km routes that are under construction. The expressway runs through the high dense metropolis. Some residential areas are adjacent to the expressway on which about 600,000 vehicles per day travel; therefore, some local communities are suffered from unpleasant noise and exhaust emission. HEC carries out



The Hanshin Expressway runs through the central business district of Osaka City.

countermeasures (e.g., noise barriers, subsidies for noise-proof windows for the individual house owners, joint-less viaducts) against the negative impacts caused by the expressway. However, air quality caused by the emission gas depends on the emission system of vehicles; therefore, air pollution and CO<sub>2</sub> and NO<sub>x</sub> emission are the most difficult issue to HEC.

In the next chapter, the authors have conducted cause-effect analysis for the current status quo of the urban expressway project and stated how HEC

has reached a decision to introduce a car sharing project of EVs.

## 2. Analysis of the Current Status Quo of the Urban Expressway

Figure 1 shows cause-effect analysis to figure out the leverage point for the countermeasure. In Japan, the society has already matured. Its economy is sluggish due to aging society with low birth rate. The phenomenon has exactly reflected reduction of the number of registered vehicles and issuance of new driver's licenses. The number of registered vehicles will decline within next decades from 61 million in 2010 to 58 million in 2050. The number of issuance of new driver's license has also kept declining since 1993. However, major cities still struggle against traffic congestion during rush hours which causes combustion inefficiency of vehicles and acceleration of CO<sub>2</sub> emission.

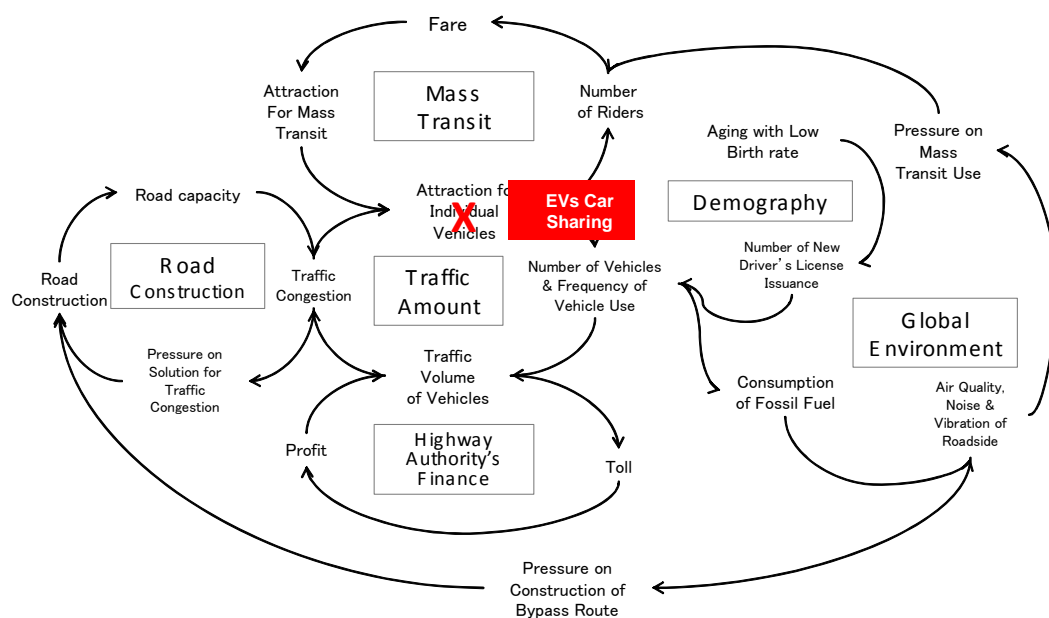


Figure 1: Analysis of the Current Status Quo of the Urban Expressway

Traffic congestion is caused by the following primary reasons; concentration of economic activities into major cities, difficulty of highway network expansion due to high density<sup>1</sup>, and attraction of individual car ownership.

HEC tackles such a seemingly contradictory challenge as a solution for traffic congestion with keeping its expressway business robust to achieve the mission, “Building a sustainable urban expressway business model”. As a result of the analysis (Figure 1), the EV car sharing project is thought out as a countermeasure to achieve the aforementioned mission.

It would certainly be difficult for individual car owners to make a drastic change in their mobility mode since an individual car ownership mode is much more flexible rather than the mass transit mode. This means an intermediate mode, a car sharing mode, is essential to switch their mobility mode (Figure 2). At the same time, the EV car sharing mode allows HEC to keep some amount of the traffic volume with no impact of CO2 and NOx emission. It is expected that the EV car sharing project encourages individual car owners to give up their car ownership and switch their lifestyle from an individual car use to the transit-oriented lifestyle with a car sharing.

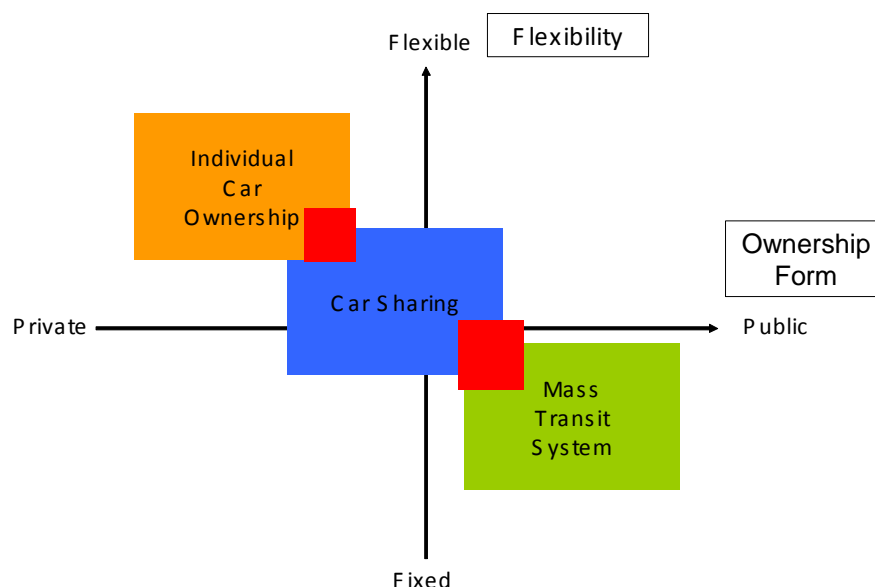
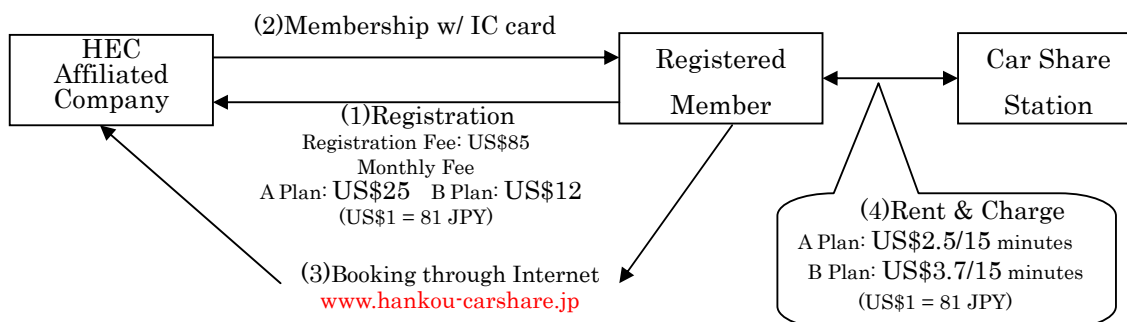


Figure 2: Positioning Map for the Transportation Modes

<sup>1</sup> Population of the Kansai Metropolitan Region: 17 million  
Population Density of Osaka City: 12 thousand/sq. km

### 3. Outline of the EV Car-sharing Project

This chapter describes the outline of the EV car sharing project scheme. The HEC's car sharing project has introduced a membership system. The following flow chart shows the business structure.



### 4. Challenging Issues for the Dissemination of EVs

In Japan, the total amount of the electric generation is about 1,100 billion kwh per year and about 24% of electricity is generated by the nuclear power station. The myth that nuclear power stations are safe has collapsed since the disastrous event of the Fukushima nuclear power station. The Fukushima nuclear power station was struck by *Tsunami* triggered by the great earthquake that occurred in the northern-east region of Japan on March 11, 2011.

The advent of EVs has been highly expected to exhaust no CO<sub>2</sub> and NO<sub>x</sub> emission; however, dissemination of EVs causes much more electric consumption. In Japan, we have a difficult time to disseminate EVs due to the fact that 49 nuclear power stations are not working among 54 stations as of January 14th. Remaining 5 stations are planned to stop for inspection. This means EVs do not help to suppress CO<sub>2</sub> emission if thermal power stations are substituted for nuclear power stations (Table 1).

Here are the estimations of the amount of CO<sub>2</sub> emission:

Type of Vehicle	Amount of CO <sub>2</sub> Emission	Remarks
Toyota Prius Hybrid	65g-CO <sub>2</sub> /km	—
Mitsubishi i-MiEV	38.9g-CO <sub>2</sub> /km	Electricity Consumption: 0.125kwh/km CO <sub>2</sub> emission on the electric generation: $0.125 \times 0.311 \text{ t/kwh}^* = 0.0389 = 38.9\text{g-CO}_2/\text{km}$ *Basic Unit of Electric Generation issued by Ministry of Environment of Japan

Table 1: Comparison of CO<sub>2</sub> Emission of the Type of Vehicles

## 5. Key Success Factors of the EV car sharing projects

There are five key success factors for EV car-sharing projects;

- Transit Oriented Development

It is of crucial importance to select a place to provide car-sharing services. Car sharing is regarded as an intermediate transportation mode between an individual car ownership and a mass transit system. Those who choose a car sharing mode have a tendency to live in a transit oriented city and rely on a mass transit system in their daily life; therefore, car sharing services should be provided with transit oriented development.

- Increase in the Number of Rapid Battery Charges for EVs

According to the specification of i-MiEV produced by Mitsubishi Motors Corporation, the cruising distance is limited to about 100km under air-conditioned practical situation. It takes 30 minutes for the rapid battery charger to fill the i-MiEV's battery up to full charge. So, it is essential to



HEC's EV model car with the rapid battery charger at the Nakajima Parking Area along the Hanshin Expressway

install rapid battery chargers in some common places to disseminate EVs. Potential places are gas stations and parking areas of shopping malls and highway service areas. It is expected that government bodies subsidize not only purchase cost of EVs but also installation expenses of rapid battery chargers.

- Reasonable Membership Fee and Charge System

As was noted previously, the EV car sharing project is aimed at switching a lifestyle from an individual car ownership to the mass transit-oriented mode with a car sharing. So, car sharing services should be provided at a reasonable membership and rented fees of which the total amount is competed enough with the total cost of the individual car ownership.

- Management of the Number of Registered Members and Shared Vehicles

It is also important to keep balance between the number of registered members and shared vehicles to keep availability of shared vehicles. The management leads to retain the number of registered members and keeps the project/business attractive.

- Development of the Regenerable Power Systems

EVs do not help to suppress CO<sub>2</sub> emission if thermal power stations generate electricity for the EVs. So, the pressing issue is development of regenerable power systems to utilize green energies (e.g., solar, wind, geothermal, and biomass energies).

#### Afterword

I would like to express my sincere appreciation to the international community who has given a heartfelt aid and encouraging words since the disastrous event occurred in the northern-east region of Japan on March 11th, 2011. I strongly believe that Japan would certainly revive itself by inventing sustainable electric generation systems originated from green energies that contribute to the dissemination of EVs with no CO<sub>2</sub> emission.

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