F1-16

Feasibility Study of EV Project in Samui Island

Kosuke Akiyama[1], ○Atsushi Fukuda[2], Yasuki Shirakawa[3], Yossapong Laoonual[4], Rachen Chumuean[4], Tuenjai Fukuda[5]

Abstract: Koh Samui, which is famous as a resort site in Thailand, was selected as one of the model cities of "Low Carbon Model Town" project implemented by APEC. According this project, the Ministry of Natural Resources and Environment also planned the Samui Smart Resort concept. Although the use of EV is the key in these concept, it is difficult to introduce because EV is not produced in Thailand, and it is expensive when importing it. So, it is necessary to consider whether introduction of EV becomes feasible, if what extent of assistance. Therefore, in this research, we grasped the existing situation of vehicle usage for sightseeing on Koh Samui and estimated the amount of CO2 emission reduction when introducing EV. Based on these results, we aim to confirm the profitability as a project by comparing the current vehicle operation expenses with the EV introduction cost when receiving assistance, and to consider the possibility of EV introduction.

1. Introduction

The aim of this research is to estimate the amount of CO2 emission reduction when commercial vehicles used for sightseeing in Koh Samui will be replaced by EV. Also, the feasibility of this project was examined by comparing the current vehicle operation costs with the EV operating cost with financial assistance from Joint Crediting Mechanism (JCM) and subsidy from Thai government.

2. Litreture Review

Kashima et al.[1] proposed the introduction of EV which can make maximum use of natural energy in Yakushima. They grasped the travel behavior of the islanders by conducting questionnaires and showed that EV is sufficiently substitutable for the current use of automobiles. They also estimated CO2 emission reduction by using a simple estimation method. Baptista et al. [2] examined the introduction of EV in San Miguel Island, Portugal. As the result, it was clarified that replacement of EV can stabilize additional power demand and smart grid management. Although these studies show effects such as reduction of CO2 emissions, profitability is not necessarily analyzed.

3. Methodolgy

3.1 Interview Survey

We conducted an interview survey on 34 companies including rental car operators, airport related contractors and hotel companies on Koh Samui from 20th to 22nd August. Question items consisted of questions to ask business operators to grasp the intention of introducing EV under various conditions in order to grasp the acceptability of EV introduction by business operators.

3.2 Estimation of CO2 Emission Roduction

In this research, we refered the MRV (measureble, reportable and verifiable) methodology which was developed for bilateral credit system (JCM) applying in Vientiane to estimate CO2 emission reduction by introducing EV.

Specifically, the reference emission amount is calculated by the equation (1) and the project emission amount is calculated by the equation (2). Finally, as shown in Equation (3), the CO2 emission reduction is calculated as the difference between the reference emissions and project emissions.

$$RE_y = \Sigma_i (SFC_i \times NCV_{RF,i} \times EF_{RF,i} \times DD_{i,y} \times N_{RF,i,y}) \quad (1)$$

$$PE_y = (SFC_{PJ,i,y} \times \frac{EF_{elect,y}}{1-TDL_y} \times DD_{i,y} \times N_{PJ,i,y}) \quad (2)$$

$$ER_y = RE_y - PE_y \quad (3)$$

ER_y:the amount of CO2 emission reduction, RE_y:CO2 emissions in reference scienrio, PE_y:CO2 emissions in project scienario, SFC_i:Fuel consumtion by reference vehivle type i, $NCV_{RF,i}$:Net heating value of fuel consumed by reference vehicle type i, $EF_{RF,i}$:CO2 emission factor of fuel consumed by reference vehicle type i, $DD_{i,y}$:Average mileage in year y of project vehicle type i, $N_{RF,i,y}$:Reference vehicle number of vehicle type i in year y, $SEC_{PJ,i,y}$:Electricity cost of project vehicle type i in year y, $EF_{elect,y}$:CO2 emission factor of electric power used by project vehicles, TDL_y:Average power transmission and

1, 5: CST, Nihon-U, 2: Yokohama City, 3: Climate Consulting Co.Ltd, 4: King Mongkut University Thonburi

distribution loss in power supply , $N_{PJ,i,y}$:Number of projected vehicles type i in year y

3.3 Method of examining profitability

In this study, 50% subsidy system for JCM project was applied to EV introduction cost. The EV charging facility was supposed to be developed by Ministry of Natural Resources and Environment, Thailand. Therefore, the expenses are the sum of half of the vehicle price and the electricity bill, and from this value, the amount excluding the income obtained from the credit obtained by the CO2 emission reduction amount is posted. Compare this value with the purchase cost of the vehicle currently used and the total fuel cost. From the result of the questionnaire, we also grasp how much the price difference is intentional and decide whether or not it can be installed. Furthermore, we decided to replace Son Tau with Nissan LEAF and van with Nissan e-NV 200. Moreover, trial calculation was made assuming that the material year of the vehicle is 5 years.

4. Estimated result of CO2 emission reduction amount

The results of estimating the amount of CO2 emission reduction for each of the four routes based on the number of departures of Songtheo and van for 8 days and the result of aggregating the average mileage for each vehicle is shown in Table 1. The estimated annual total CO2 emission reduction amount was 3,000 t-CO2 / year.

Table 1. CO2 Emission Reduction by Route

Origin	Replacement plan			CO2 emission		
	Vehicle Type	Fuel	No. of vehicles	Reference	Project	Reduction
Cheung-Mon	Truck->LEAF	D->E	266	1570	307	1263
Nar-Thon	Truck->LEAF	D->E	316	1866	365	1501
Chavieang	Van->e-NV200	G->E	16	147	50	97
Nar-Thon	Van->e-NV200	G->E	24	215	76	139

D:Diesel, G:Gasolin, E:Electrocity

5. Examination of profitability[3]

Table 2 shows the credit income obtained from various expenses related to EV introduction and CO2 emission reduction amount, and Table 3 shows the introduction expenses of the present vehicle. Here, the price of the vehicle was calculated as the selling price (including tax) in Japan, and the income from the credit was calculated as 1,000 yen / t CO 2 per CO 2 reduction amount. Replacing Son Tau with LEAF resulted in a reduction of 1.7 million yen per unit over five years and a cost reduction of 2.7 million yen per unit when replacing the van with e-NV 200. However, the number of passengers in Son Tau is about 20 people, but LEAF can only get five people, so we studied the case of replacing Son Tayu with two or more LEAF. As a result, it turned out that in the case of three or more machines it will be in the red.

Table 2. Costs and Revens of EV operation

Installation cost for EV	Vehicle Type	Cost and Revenue
Vehicle purchase cost (Exclude subsidies)	LEAF	1.6 million yen
	e-NV200	2.4 million yen
Electricity usage fee	LEAF	90,000 yen/5 years
	e-NV200	360,000 yen/5 years
Revenue from Credit obtained by CO2 emission reduction	LEAF	23,000 yen/ 5 years
	e-NV200	29,000 yen/5 years

Table 3. Cost and Revens of Exiting Vechicle

Operation cost for existing car	Vehicle Type	Cost and Revenue
Vehicle purchase cost (Exclude subsidies)	Songtaew	2.65 million yen
	Van	3.84 million yen
Fuel cost	Songtaew	0.8 million yen/5 years
	Van	1.59 million yen/5 years

6. Conclusion

We estimated the CO2 emission reduction amount when replacing the vehicle used for sightseeing in Koh Samui with EV. We also examined the profitability of using JCM project assistance. As a result, it was revealed that profitability was sufficient if subsidies were available, and that it could be introduced.

7. Acknowledgment

This study was conducted as part of ATRANS research project. We express our gratitude here.

8. References

[1] S. Kashima, M. Tanishita and N. Abe: “Study on Possibility to Introduce EV in Yaku Islan”, Bulletin of College of Engineering, Chuo Universiy No. 40, pp.21-34, 1997 (in Japanese).

[2] P. Baptista, et al.: “Impact of the Introduction of Electric Based Vehicles in Sao Miguel Island”, MIT, Cambridge, 2009.

[3] MISSAN HP：http://www.nissan.co.jp/, 2016.