AN ANALYSIS ON THE ECONOMICS OF SMART COMMUNITY CONNECTING COMMERCIAL AND RESIDENTIAL SECTORS AND THEIR FUTURE SUBJECTS

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Overview

Recently Japanese Government has detemined the new target of GHGs reduction to achieve 26% reduction from the emission level in 2013 up to 2030. Because of the East Japan great earthquake and Fukushima nuclear accident, the discussions on the reduction target were wandered so largely and finally converged into the present conclusion. However, Japan must intensify her GHGs reduction measures basically in the long-run, because she already agreed 50% (or 80%) reduction of GHGs in 2050 in the past Summits etc.

The first commitment period of Kyoto Protocol finished in 2012. The GHGs emissions in Japan has increased to the large extent from the 1990 level (the base level in Kyoto Protocol). Especially speaking, the continuous increases in GHGs emission in the commercial and residential sector were largely influenced to the whole increases.

In recent years, the progress of information and communication technologies is so remarkable and the large progress is also made in the storage system of electricity. Therefore, in this study, we would like to analyze the economics of smart community connecting the commercial and residential sector using photovoltaic cell and electricity storage system under various conditions. We also would like to discuss the future subjects of smart community.

Methods

In this study, we made economics simulations on the introduction of smart facilities such as photovoltaic cell and electricity storage system as important functions of smart community. First of all, the average electricity demand pattern in a house and an office building was estimated by month based on the METI survey report [1], EDMC survey data [2] and Cogeneration Comprehensive Manual [3]. We also surveyed present situations on photovoltaic cell, and electricity storage system [4, 5].

The number of house holds in the residential sector was assumed to be 15,000 and the total floor area in the commercial sector was also assumed to be 300,000 m^2. The capacity of electricity storage system was changed from 0 kWh to 240,000 kWh every 40,000 kWh in the simulation. The capacity of photovoltaic (PV) cell for each house in the residential sector was assumed at 4 kW and the number of houses where the photovoltaic (PV) cell was installed was changed from 0 to 15,000 by every 2,500. The capacity of photovoltaic cell in the commecial sector was also changed from 0 to 50 MW by every 10MW. In addition, the various differences of electricity charge between daytime and night were assumed.

The economics of the introduction of smart facilities is judged from the simple payback years which is calculated by dividing the net initial cost (excluding cost covered by the subsidy) of necessary equipments by the annual profit brought by the reduction of purchased electricity.

Results

Figure 1 shows the estimated results on changes in economics of smart community using photovoltaic cell and electricity storage system under various conditions. The increase on the capacity of electricity storage system is quite important to reduce purchased electricity by using photovoltaic cell effectively in the smart community. Based on these results in this study, the purchased electricity could be largely reduced if the size of electricity storage system becomes larger.

However, under the present cost conditions such as the photovoltaic system cost 350,000 Yen/kW for houshold and 300,000 Yen/kW for Megasolar, and the electricity storage cost 150,000 Yen/kWh, the economics of smart community become worse rapidly, judging from the payback years, as shown in Fig. 1. It is considered that the infiltration of smart communities would be quite difficult in the present stage, because the cost burden of introducing smart facilities, especially the electricity storage system is too large.

As the capacity of photovoltaic (PV) cell in the residential sector increases, the economics of smart community becomes worse at first, then levels off and finally becomes better, judging from the payback years shown in Fig.1. As the capacity of electricity storage system becomes larger, the PV electricity sold on the basis of FIT system is reduced more, also shown in Fig. 1, but the economics of smart community becomes worse.

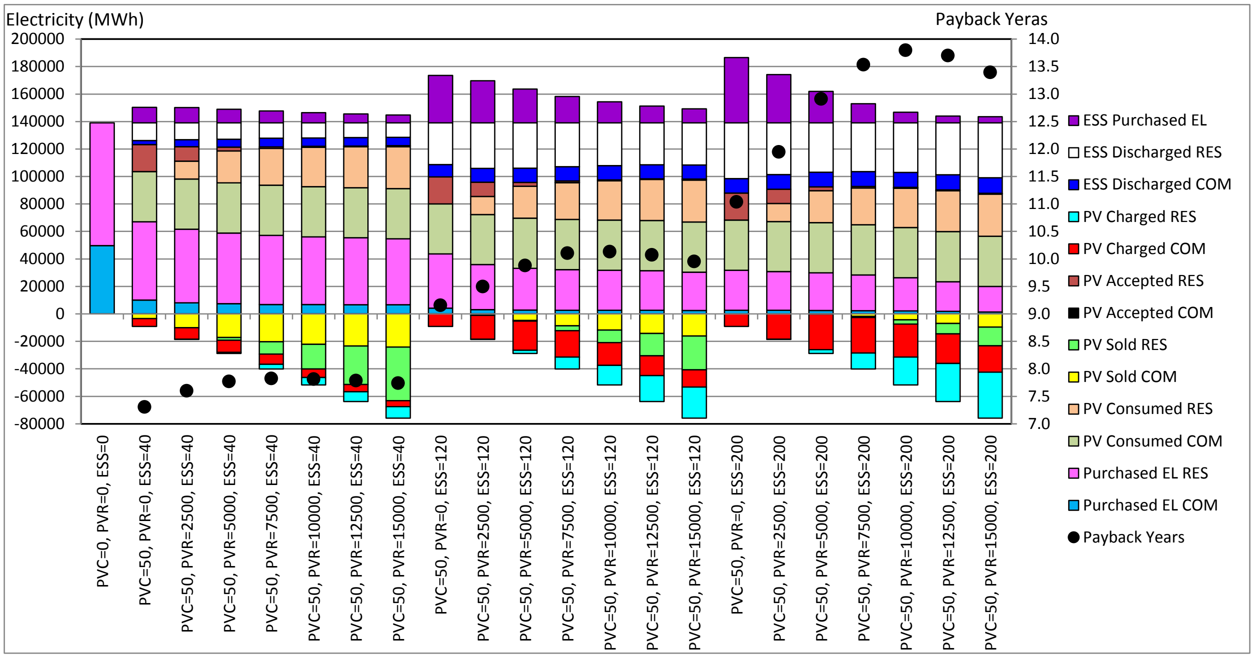

Fig. 1 Changes in electricity supply-demand in the smart commnity and changes in economics

Conclusions

The electricity storage system has the largest problem of economics in smart community functions. Under the present cost situations on the electricity storage system, total economics of smart community become worse, as the size of electricity storage system becomes larger.

For the expansion of smart communities, the cost reduction of smart facilities are important as a future subject. Of these, the cost reduction of the electricity storage system would play a key role particularly from the viewpoint of technology. Recently, Tesla company announced the quite low cost of 50,000 Yen/kWh as for the electricity storage sysytem.

It is quite essential to strengthen peoples' incentives to the introduction of smart house from the viewpoints of policy. It is also required to check FIT system more carefully. The smart community would be expected to influence to peoples' life style in the future largely.

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