AN ECONOMICAL ANALYSIS ON THE INSTALLATION OF PHOTOVOLTAIC CELL (PV) AND BATTERY IN THE RESIDENTIAL SECTOR

Yoshiki Ogawa, Professor, Toyo University, Phone +81 3 3945 4736, E-mail: y-ogawa@toyo.jp

Overview

Japanese Government has determined the new target of GHGs reduction to achieve 26% reduction from the emission level in 2013 up to 2030 as Japanese INDC (Intended Nationally Determined Contributions). We have not been able to fix the concreate reduction measures to achieve this target yet. However, in the long-run, Japan must intensify her reduction measures basically, because she already committed 50% (or 80%) reduction of GHGs in 2050 through the past several Summits. In addition, the Paris Agreement will move to the execution stage from 2020 after COP24.

The GHGs emissions of Japan in 2017 recorded to the 8.2% down from the 2013 level [1]. Because of the East Japan great earthquake and Fukushima nuclear accident in 2011, the thermal power generations was increased sharply instead of nuclear power generations. In addition, the continuous increases in GHGs emission in the residential sector have been significantly contributed to the whole GHGs increases in Japan through the long period.

In recent years, the developments of ICT (information and communication technologies) such as cloud computing and bidirectional communication system are quite remarkable. The battery system such as lithium ion battery, NAS battery and redox flow battery has also been made a great progress. Therefore, in this study, we would like to analyse the installation of PV (Photovoltaic cell) and battery in the residential sector under various conditions. We also would like to discuss the present problems and future subjects of this reduction measure.

Methods

In this study, we made economics simulations on the installation of PV and battery connecting the commercial and residential sectors. The average electricity demand pattern in the commercial and household sectors and the average daily pattern of solar power output were adopted from the previous study [2]. We also made a cost survey on PV and battery on the basis of various domestic and overseas reports [3, 4].

The following simulations: (i) PV capacity zero and battery capacity zero, (ii) PV capacity 8,000 kW and battery capacity zero, (iii) PV capacity 44,000 kW and battery capacity zero, (iv) PV capacity zero and battery capacity 20,000 kWh, (v) PV capacity 8,000 kW and battery capacity 20,000 kWh ("net zero" case) and (vi) PV capacity 44,000 kW and battery capacity 20,000 kWh ("absolutely zero" case) were made. The economics was judged from the simple payback years obtained by dividing the total investment of necessary equipment by the annual net profit.

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Results

Figure 1 shows the components of net profit and the payback years to total investment. The results in the upper figure are obtained by the present costs of PV and battery and the present FIT purchased price for PV. The payback years to total investment is less than 10 years as for the following three cases (ii), (iii) and (vi) because of no battery or the preferable FIT price. The payback years to total investment remains still high owing to the expensive battery cost in the cases (iv) and (v).

The results in the middle figure are obtained by the present costs of PV and battery and the lowest FIT purchased price of 7 Yen/kWh which is competitive at the power generation cost level. The payback years to total investment in the above-mentioned three cases (ii), (iii) and (vi) change to higher than or around 10 years because of the lowering of preferable FIT price.

The results in the bottom figure are estimated by the expected lowest costs of PV and battery in the near future and the FIT purchased price of 7 Yen/kWh. The payback years to total investment in all of the cases (ii) – (vi) change to lower than 10 years because of the lowering of PV and battery cost.

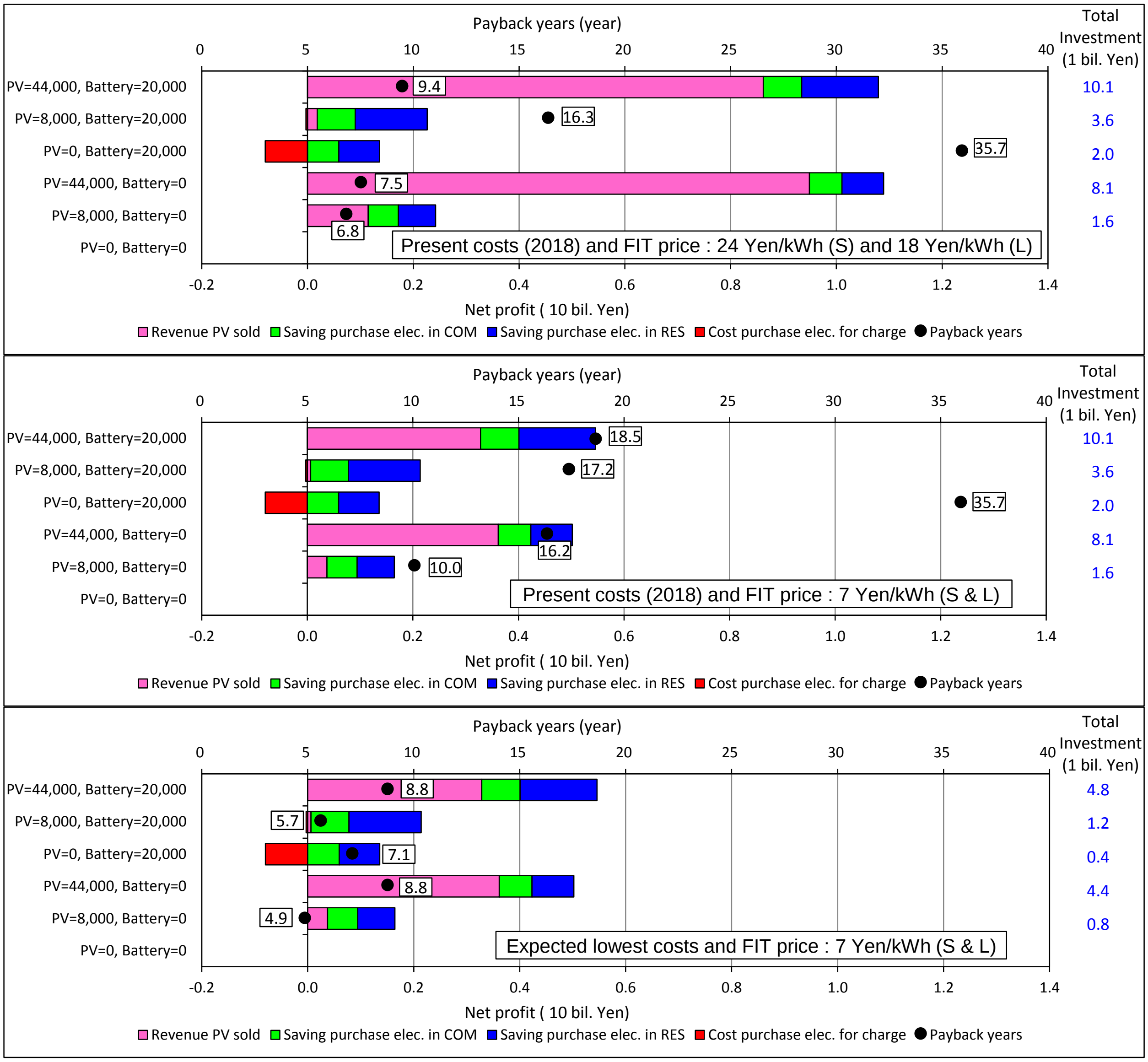

Fig. 1 Case Comparison on Components of net profits and payback years to total investment

Conclusions

First, the special environment brought by the much preferable purchased price of PV electricity by FIT makes quite large distortion to the decision making of investments for the installation of PV and battery. We need to reconsider more reasonable and sustainable FIT system, particularly to PV, more carefully.

Second, for the installation of PV and battery connecting the commercial and household sectors, the cost reduction of PV and battery will be quite essential. Of these, especially, the cost reduction of various batteries would play a crucial role. Thus, technology innovation of battery will be desired earnestly.

Third, the "absolutely zero" purchased electricity at any time is often pursued as an achievable target. But the realization of this target is difficult. Instead of this strict target, the balancing between the small purchased electricity and the small sold PV electricity ("net zero") would be pursued.

References

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