AN ANALYSIS ON THE PV AND BATTERY INSTALLATION CONNECTING THE COMMERCIAL AND RESIDENTIAL SECTORS

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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). The discussions on the GHGs reduction measures to achieve this target are still wandering. However, in the long-run, Japan must intensify her GHGs reduction measures basically, because she already committed 50% (or 80%) reduction of GHGs in 2050 in the past several Summits etc. In addition, the rule of Paris Agreement has been finally adopted in COP24 which was held at Katowice in Poland on December 2018.

The GHGs emissions of Japan in 2016 recorded to the 3.6% up from the 1990 level (the base level in Kyoto Protocol) [1], though the first commitment period of Kyoto Protocol finished in 2012. 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 the long-run, especially, the continuous increases in GHGs emission in the commercial and residential sectors were largely influenced to the whole GHGs increases in Japan.

In recent years, the progress of ICT (information and communication technologies) such as cloud computing and bidirectional communication system is very marvellous. The battery system of electricity such as NAS battery and redox flow battery is also being made a great progress. Therefore, in this study, we would like to analyse the PV (Photovoltaic cell) and battery installation connecting the commercial and residential sectors under various conditions. We also would like to discuss the present problems and future subjects of this activity.

Methods

In this study, we made economics simulations on the installation of PV and battery connecting the commercial and residential (household) sectors. The average electricity demand pattern in the commercial and residential sectors was estimated based on the METI survey report [2], EDMC survey data [3] and Cogeneration Comprehensive Manual [4]. We also surveyed present situations on PV and battery on the basis of NEDO and METI reports [5, 6]. The average daily pattern of solar power output was also estimated using NEDO Sunshine Database [7].

The economics is judged from the simple payback period which is calculated by dividing the total investment (deducting cost covered by the subsidy) of necessary equipment by the annual net profit (the reduction of purchased electricity and the revenue of PV electricity sold by using FIT). In the simulation, first, the starting point where purchased electricity from the power company outside could be made absolutely zero (a kind of extreme case) is determined. This starting point is the PV maximum (Case (vi): PV capacity 44,000 kW and battery capacity 20,000 kWh).

We also make the following several simulations : Case (i): PV capacity zero and battery capacity zero, Case (ii) PV capacity zero and battery capacity 20,000 kWh, Case (iii): PV capacity 8,000 kW and battery capacity zero, Case (iv): PV capacity 8,000 kW and battery capacity 20,000 kWh, and Case (v): PV capacity 44,000 kW and battery capacity zero. In Case (iv), the electricity purchased from the power company outside is well balanced with the surplus PV electricity sold to the power company outside. Therefore, this case is positioned as “net zero” but not “absolutely zero.”

Results

Figure 1 shows the electricity demand and supply balances in sectors, PV and battery. The base case is PV zero and battery zero. In this case, all electricity demand in residential and commercial sectors is supplied by the purchased electricity from the power company outside. In the following three cases: (ii): PV zero and battery 20,000 kWh, (iii): PV 8,000 kW and battery zero, (v): PV 44,000 kW and battery zero, the purchased electricity from the power company outside still remains to a certain extent, as compared with “net zero” (iv) and “absolutely zero” (vi) cases.

Figure 2 shows the components of net profits and the payback period of total investment. The payback period is less than 10 years as for the following two cases: Cases (iii): PV 8,000 kW and battery zero and (v): PV 44,000 kWh and battery zero because of no battery and the payback period is 11.2 years in Case (vi) (“absolutely zero”) because of the preferable FIT purchased price for PV. The payback period of total investment remains still high owing to the expensive battery cost in the Case (ii) PV zero and battery 20,000 kWh and Case (iv) “net zero”.

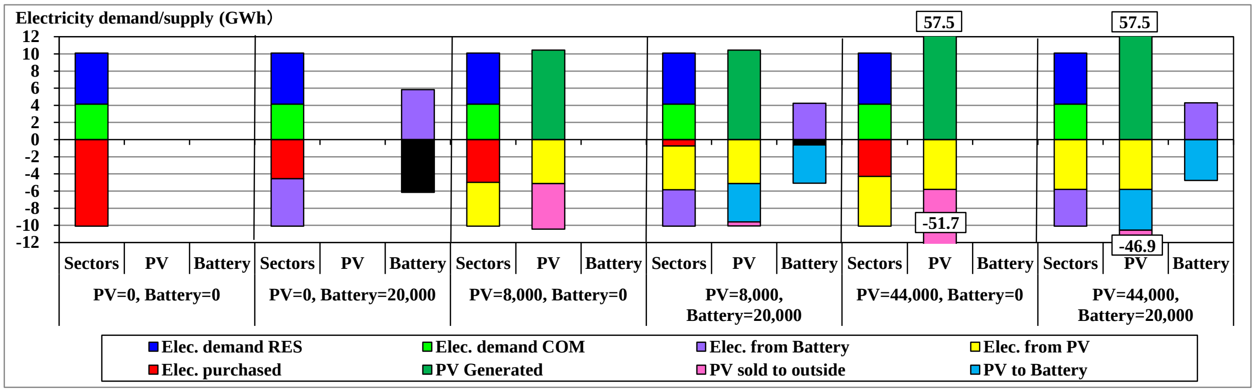

Fig. 1 Electricity demand and supply balances in sectors, PV and battery

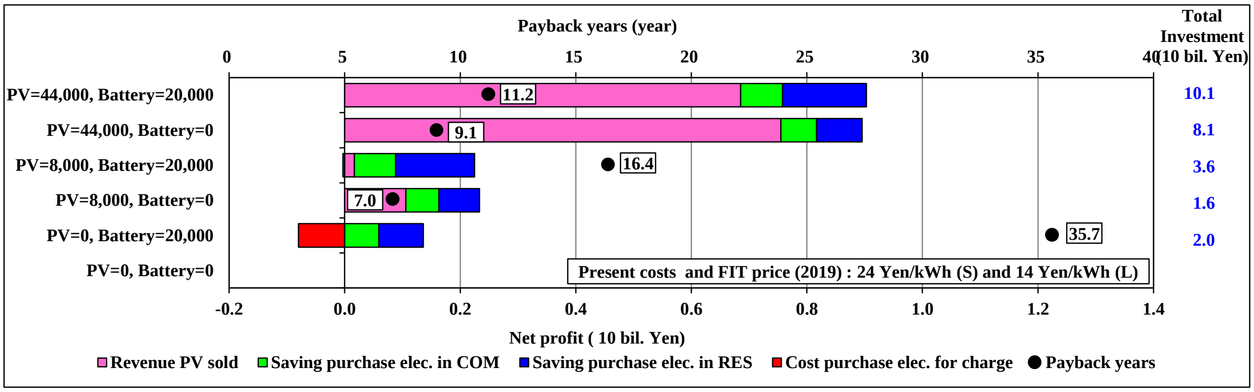

Fig. 2 Components of net profits and payback period of total investment under the present cost conditions

Conclusions

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 desirable and sustainable FIT system, particularly to solar, more carefully.

For the installation of PV and battery connecting the commercial and residential sectors, the cost reduction 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 from now on.

The “absolutely zero” purchased electricity at any time is often pursued as an achievable target. But the realization of this target is not reasonable. Instead of this strict target, the balancing between the purchased electricity and the sold PV electricity (“net zero”) would be pursued.

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