Design targets for self-sustaining energy systems for post-disaster residential continuity

(Research period: FY 2020–2021)

HABARA Hiromi (Ph.D. in Engineering), Chief researcher, Building Environment Division, Housing Department

MIKI Yasuhiro (Ph.D. in Engineering), Head, YAMAGUCHI Hideki (Ph.D. in Engineering), Chief researcher, Equipment Standards Division, Building Department

Keywords: Solar power generation, storage battery, designtarget, housing, power outage, continuity of residence

1. Background and objectives

One of the ways to enable people to continue living in their homes when a power outage continues after a disaster is to use a system that combines solar power generation and storage batteries (hereinafter referred to as a "self-sustaining energy system"). The use of self-sustaining energy systems can be expected to contribute to both the enhancement of energy conservation measures and the avoidance and mitigation of disaster risks and is expected to grow in importance in the future.

In order to ensure the effectiveness of the self-sustaining energy system, it is important for building owners and architects to determine whether the system has adequate performance against disasters and changes in conditions. In terms of post-disaster residential continuity, however, there is no design target for a self-sustaining energy system in housing design, meaning that no indicator is available for use as a basis for judging the adequacy of performance. Thus, this urgent issue needs to be addressed.

Therefore, a study on the design targets for self-sustaining energy systems for post-disaster residential continuity was started in FY 2020. This study tries to identify the use of power necessary for the continuation of residence after a disaster, quantify the requirements for the design of a self-sustaining energy system in a house, and organize these results into a design target of a self-sustaining energy system for the continuation of residence after a disaster. In FY 2020, the study examined the use of power necessary to continue living in a house in the event of a power outage.

2. Examination of the use of power necessary to continue living in a house in the event of a power outage (FY 2020)

The use of power required to continue living in a house during a power outage was expected to change with the time elapsed since the start of the outage. A questionnaire survey was conducted of households that had experienced power outages in past disasters. In the survey, the time elapsed from the start of a power outage was divided into five periods: immediately after the start of the power outage (about half a day), one day later, more than one day to three days later, more than three days to one week later, and more than one week later. The survey then asked about the priority of daily activities and the necessity of various equipment and devices during each period (table). Based on the survey results, the verification of whether there was any change overtime and the organization of priorities are conducted regarding the use of the power necessary to continue residency.

Table: Outline of the survey

Subject of the survey	2018 Hokkaido Eastern Iburi earthquake 2018 Typhoon Trami (#24) 2019 Typhoon Faxai (#15)
Number of household that responded	600 households
Survey method	Online survey
Items of the survey	○ Basic information: - Type of housing building, year of construction, etc. - Facilities and equipment owned and their types ○ Condition of damage: - Condition of damage to the housing building - Length of period without lifeline ○ Condition of power outage: - Activities of daily living that were found to be inconvenient - Whether each type of facility and equipment was used - Status of the use of alternative power source ○ Demand to power uses during power outage: - Priority of daily living activities - Necessity of each type of facility and equipment

3. Future prospects

In FY 2021, assuming the use of electricity necessary to continue living at home based on the results of the above survey, a simulation-based parametric study will be conducted to calculate the amount of electricity

needed to continue living at home after a disaster and the amount of electricity that can be supplied by the self-sustaining energy system.