

1. Introduction

In Japan, electricity demand is expected to decline as the aging society and depopulation. In low demand areas such as mountainous villages, the financial burden on power distribution businesses will increase because facility maintenance costs cannot be recovered from wheeling charges. Converting low demand areas to off-grid has the potentiality to reduce the burden as it can be operated without excessively long distribution lines between the village and high-density populated areas (Fig. 1). We evaluated the economic efficiency of the converting. Also, we selected a mountain village, where contract power is 9.7 kW and distribution line is 4.9 km (Fig. 2). In the selected area, electricity was supplied to only three households through a long distribution line.

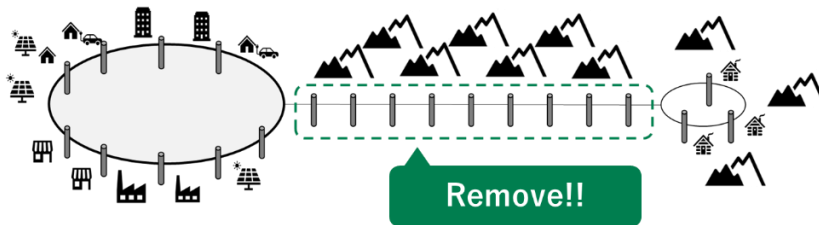


Fig. 1 Image of going off-grid



Fig. 2 Selected area

2. Simulation conditions

The economic efficiency was evaluated by comparing the costs of the existing system and the off-grid. The existing system costs includes the maintenance, replacement and inspection of the aging distribution system leading to the selected area. The cost of the off-grid system includes the installation and maintenance of PV and BESS and the removal of the existing distribution lines leading to the selected area. The details are shown in Table 1. We checked the cash flow of both costs with the discounted cash flow method (DCF), because we can confirm the cash flow for each system for each year.

Table 1 Cost for each system

Existing system	Off-Grid
<ul style="list-style-type: none"> - Facility repair cost - Monitoring & inspection costs - Facility site cost - Logging cost - Logging patrol cost etc. 	<ul style="list-style-type: none"> - Removal cost of existing facilities - PV installation costs - BESS installation costs - Control system installation cost - Facility repair cost - Monitoring and inspection expenses etc.

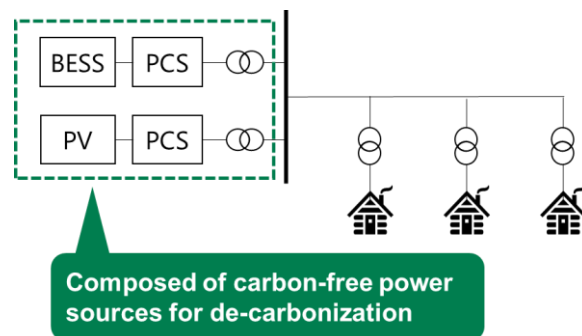


Fig. 3 Off-grid Model

3. Results

The off-grid can be more economical because the existing system includes a high cost for replacement in the 20th year due to aging. In low-demand areas with long distribution line lengths, we found that converting to off-grid was economical. As PV and BESS become even less expensive in the future, we expect that the economics of converting to off-grid will increase. We plan to review for any missing conditions and conduct evaluations in other regions.

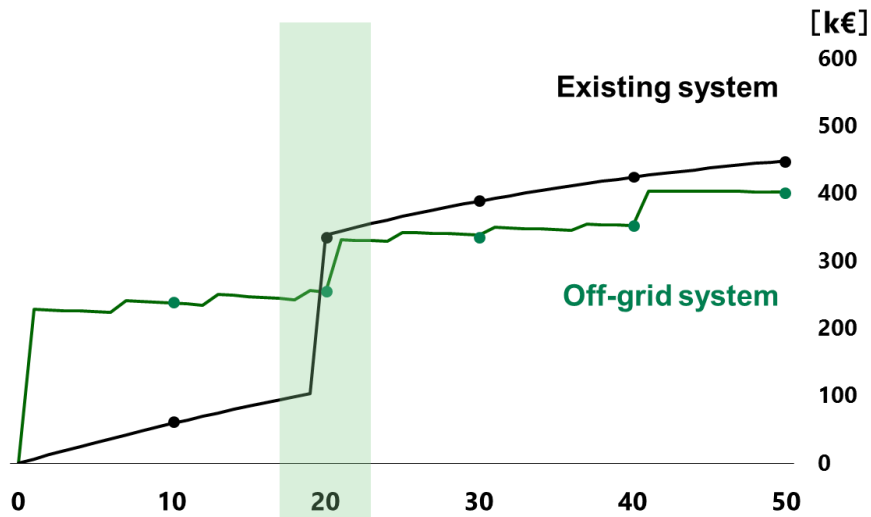


Fig. 4 Economic evaluation