

# A LARGE SCALE SOLAR BASED MICROGRID APPLICABILITY ASSESSMENT FOR THE FUTURE DISASTER RESILIENT COMMUNITY IN JAPAN

**S.SHIMADA<sup>1</sup>, W.TAKEUCHI<sup>2</sup>**

<sup>1</sup>1st year Doctoral Student, Department of Civil Engineering, The University of Tokyo, Meguro-Ku, Japan,

<sup>2</sup>Professor, Institute of Industrial Science, The University of Tokyo, Meguro-Ku, Japan,

Correspond to Mr. Shoki Shimada ([shokishimada@g.ecc.u-tokyo.ac.jp](mailto:shokishimada@g.ecc.u-tokyo.ac.jp))

**Keywords:** Solar power, renewable energy, microgrid, disaster resilience

## 1. INTRODUCTION

A microgrid (MG) is defined as “a group of interconnected energy-consuming devices and equipment and distributed energy resources within clearly defined electrical boundaries that act as a single controllable entity with respect to the utility grid” according to the Federal Emergency Management Agency [1]. The solar powered MG energy supply system for hazard resilience improvement has been discussed in recent years in Japan [2]. However, to make an efficient decision making for the future MG system installation, an assessment of the electricity supply-demand balance is necessary. Therefore, this study aims at developing a nationwide solar MG applicability potential map aiming at achieving a more disaster resilient community in the future.

## 2. METHODOLOGY

The solar PV database produced by Kim *et al* [3] is used as the data source. High-disaster risk data is first removed by using data provided from the Ministry of Land, Infrastructure, Transportation and Tourism of Japan. It is noted that the MG planning in densely populated area is quite complex [2], so those areas are not included.

The affordable population using solar power is estimated based on the typical annual energy production (kWh) per 1kW capacity, annual electricity consumption per household, and the number of people at each household.

A planned MG area must include a shelter to get a subsidy from the Japanese government. Hence, the number of residents in a 500 m buffer zone around the designated shelter places and the potential population supportable by the solar PV in that zone are compared to find the applicability of MG to mitigate the power blackout in case of a disaster. If the number of affordable people by the solar power exceeds the population around a shelter place, that place is estimated to be a candidate place for the future MG installation.

## 3. RESULT AND DISCUSSION

The result of the study is summarized in Figure 1. The candidate places for solar powered MG systems are mostly located in the prefectures along the pacific side of Japan, especially Mie, Chiba, Ibaraki, Miyagi, and Fukushima. Parts of those regions (Miyagi, Ibaraki, Chiba, and Fukushima) were severely affected by the 2011 Tohoku earthquake or are predicted to experience strong earthquakes Nankai trough earthquake (Mie), so that solar powered MG systems would further improve the disaster

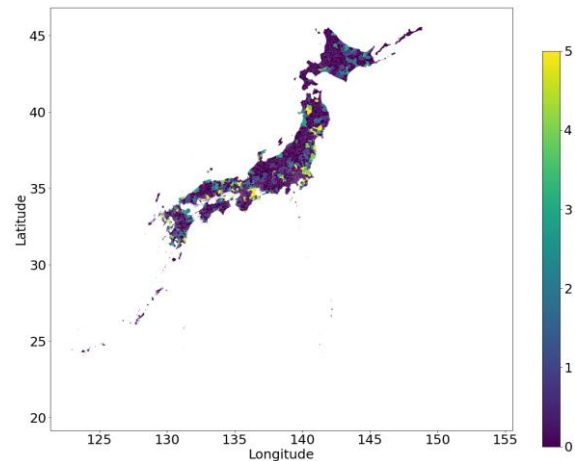


Figure. 1 The number of potential MG installation place within municipalities

resilience by providing stable electricity supply in case of a future earthquake induced power outage. However, the connectivity of a local grid to the main power supply should also be considered to assess the MG suitability more appropriately.

## 4. CONCLUSION

In this study, solar based MG applicability for aiming at the disaster resilient society is assessed. The result showed that the potential locations are mostly found along the pacific side of Japan. The electricity grid information and Tsunami hazard areas should be included to represent more realistic situation for the MG planning in the future studies.

## REFERENCES

- [1] Federal Emergency Management Agency, “Hazard Mitigation Assistance Grant Funding for MG Projects”, 2021, <https://www.fema.gov/fact-sheet/hazard-mitigation-assistance-grant-funding-mg-projects>, last accessed: 2022/09/07
- [2] Agency for Natural Resources and Energy, “An instruction for the development of regional MG”, 2021, [https://www.meti.go.jp/shingikai/energy\\_environment/energy\\_resource/pdf/015\\_s01\\_00.pdf](https://www.meti.go.jp/shingikai/energy_environment/energy_resource/pdf/015_s01_00.pdf), last accessed: 2022/09/27
- [3] Kim, Ji Yoon, et al. "Current site planning of medium to large solar power systems accelerates the loss of the remaining semi-natural and agricultural habitats." *Science of the Total Environment* 779 (2021): 146475.