Evaluation of Power Interchange Potential and Supply-demand Balance of Distributed Generation in Kinki

Daisuke Fukuhara,*[1] Naoki Yoshikawa, [1] Koji Amano, [1] and Koji Shimada[1]

[1] *Ritsumeikan University, Japan*
*Corresponding author: rv006078@ed.ritsumei.ac.jp

1. Introduction

In order to reduce the risk that depends on only the large-scale centralized generation, power supply by distributed generation is attracting attention. However, the stability of the supply-demand balance has become an issue because power generation amount of renewable energy and power demand have variation by district and time. When introducing a mass renewable energy, to stabilize supply-demand balance, the charge-discharge of the battery and power interchange are necessary to alleviate the variation with district and time.

There are research using Geographic Information System (GIS), to evaluate the potential of new energy [1, 2], and there are also studies of smart grid [3]. However, there is not much research to evaluate the supply and demand balance and power interchange potential using GIS.

This study evaluated the reduction of dependence on large-scale centralized power generation and the stability of system for charging-discharging power and power interchange of surplus power generated by distributed generation in Kinki region, Japan. We have estimated power generation potential and demand of power by time period in each district by using GIS. In addition, we evaluated the effect of the power interchange with supply-demand balance in consideration of variation with time or district.

2. Methods

In this study, in order to estimate the supply and demand balance of power that targets the Kinki region, from weather observations [4] and statistical data [5], we estimated the available supply of natural renewable energy and power demand by using the GIS. By using the estimation results of the supply-demand balance, this study evaluated the local area and Kinki whole power self-sufficiency rate, power supply configuration ratio, the amount of power interchange, the cumulative amount of storage, and supply and efficiency.

3. Results

As shown in Figure 1, this study revealed difference of common supply-demand balance through the year between the mountainous area and urban area, and it became clear the power storage and power interchange of efficacy for power supply exceeds the demand power in the middle and summer season. As shown in Figure 2, because the excess power by distributed generation is large, it is possible to effectively utilize the surplus electricity by the power interchange and the power storage in interim period. However, power storage and power interchange was less efficacious because power demand does not exceed supply throughout the day in the winter.

4. Conclusion

This study revealed that it can afford to supply power to the residential sector as much surplus power is generated during the day in the interim and summer period and that the more supply is required from the grid power in the early morning and evening.

This study also revealed that it can be increase more alternative power amount to the distributed generation from grid power to storage to prepare for power shortage of night and early morning from surplus power during the day or, to interchange to urban areas where electric power is insufficient from the mountains in the same time.

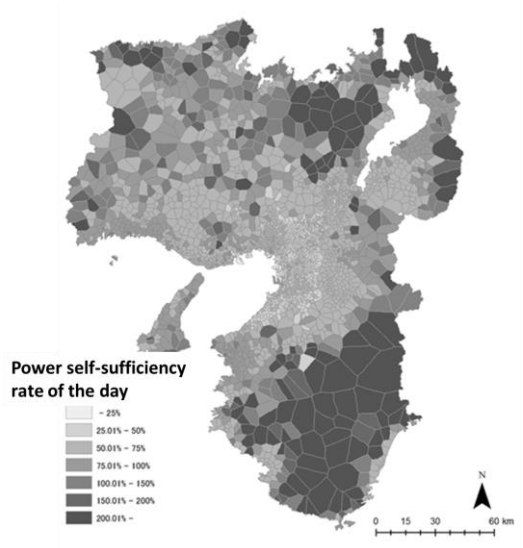

Figure 1. Power self-sufficiency rate of the day (May)

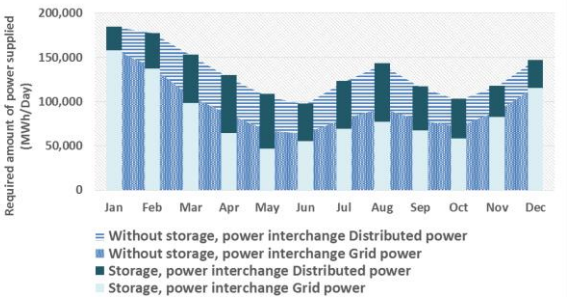

Figure 2. Evaluation of power supply efficiency

Acknowledgments

We would like to acknowledge Nippon Life Insurance Foundation for financial support.

References

[1] Olufemi A. Omitaomu, et al. *Applied Energy* 96: 292-301, August 2012
[2] Wakeyama, et al. *Journal of the Japan Institute of Energy* 88: 58-69, 2009
[3] Pertti Ja¨rventausta, et al. *Annual Reviews in Control* 34: 277-286, 2010
[4] Japan Meteorological Business Support Center, weather database AMeDAS, full set edition, 2011
[5] Statistics Bureau, Ministry of Internal Affairs and Communications. Statistics list of tables. http://www.stat.go.jp/data/guide/download/index.htm (Accessed 18.06.2014)