Development of Demand Side Power Control Methodologies for Realization of Zero Carbon Cities

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Research Outline

Motivation

Energy management in cities is becoming increasingly important in order to become carbon neutral by 2050. In particular, the power consumption of electric power devices such as commercial air conditioners and heat pump water heaters is large and important to manage and control. In our laboratory, we are developing a method that contributes to the realization of a zero-carbon city by integrating and controlling distributed energy resources such as photovoltaic power generation and storage batteries with electric power devices dispersed throughout the city, thereby maintaining virtually zero carbon emissions in the city.

Visualization of Spatial Distribution of DR Potential Using Remote Sensing

In recent years, Demand Response (DR), which controls the power consumption of demand side facilities for load leveling of electricity demand, has been attracting attention. In order to realize a zero-carbon city, DR can also be used to deal with local load fluctuations that occur within a city, in which case the geographical distribution of the consumer facilities that perform DR becomes important.

In actual cities, demand side facilities such as VRF type air-conditioners are thought to exist in large quantities over a wide area, but it is still not well known how they are distributed and how much DR potential there is at each location.

Therefore, we are studying a method to visualize the spatial distribution of DR potentials in urban areas by detecting demand side facilities from satellite imageries, as shown in Fig. 1 and Fig. 2.

Development of Demand Side Power Control Methods for Distribution Network System

As more and more renewable energy sources such as solar power, large storage batteries, and electric vehicles are introduced to realize a zero-carbon city, ensuring voltage stability at the end of the power distribution system becomes an issue.

Some demand side facilities can control not only active power but also reactive power. Therefore, they can contribute to voltage stabilization as distributed phase rectifiers.

We are studying a method to realize a robust power distribution system against local load fluctuations by controlling both active and reactive power of a group of demand side facilities.

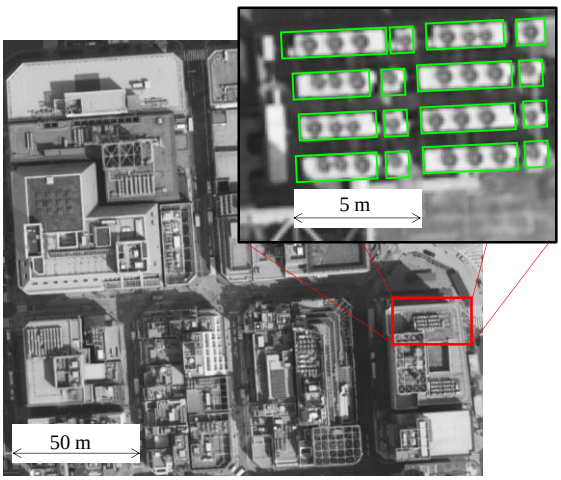

Fig. 1. Detection of VRF type air-conditioners from a satellite imagery

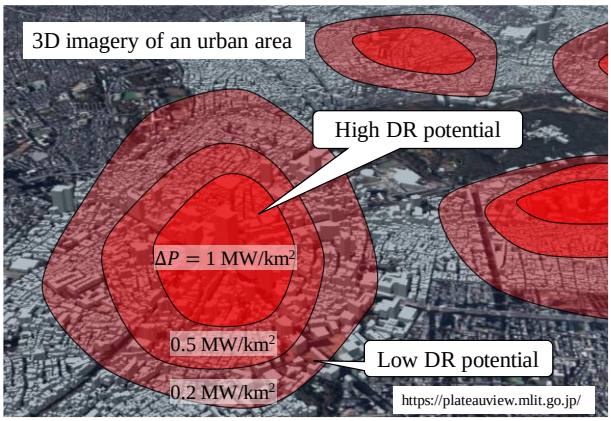

Fig. 2. Visualization of spatial distribution of DR potentials