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Study on Planning of Smart GRID Using Landscape Ecology

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Abstract : Smart grid is a new approach for electric power grid that uses information and communications technology to control the electric power grid. Smart grid provides real-time control of the electric power grid, controlling the direction of power flow or time of the flow. Control devices are installed on the power lines of the electric power grid to implement smart grid. The number of the control devices should be determined, in relation with the area one control device covers and the cost associated with the control devices. One approach to determine the number of the control devices is to use the data on the surplus power generated by home solar generators. In current implementations, the surplus power is sent all the way to the power plant, which may cause power loss. To reduce the power loss, the surplus power may be sent to a control device and sent to where the power is needed from the control device. Under assumption that the control devices are installed on a lattice of equal size squares, our goal is to figure out the optimal spacing between the control devices, where the power sharing area (the area covered by one control device) is kept small to avoid power loss, and at the same time the power sharing area is big enough to have no surplus power wasted. To achieve this goal, a simulation using landscape ecology method is conducted on a sample area. First an aerial photograph of the land of interest is turned into a mosaic map where each area is colored according to the ratio of the amount of power production to the amount of power consumption in the area. The amount of power consumption is estimated according to the characteristics of the buildings in the area. The power production is calculated by the sum of the area of the roofs shown in the aerial photograph and assuming that solar panels are installed on all the roofs. The mosaic map is colored in three colors, each color representing producer, consumer, and neither. We started with a mosaic map with 100 m grid size, and the grid size is grown until there is no red grid. One control device is installed on each grid, so that the grid is the area which the control device covers. As the result of this simulation we got 350 m as the optimal spacing between the control devices that makes effective use of the surplus power for the sample area.

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