The future energy grid: Demand Side Management and Distributed Energy Resources.

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The rapid industrial growth that occurred during the twentieth century was marked by the incremental occurrence of significant side effects on the atmospheric environment such as acid rain, depletion of the stratospheric ozone and global warming. However, international efforts to achieve sustainable societies are increasing as the consequences of climate change are starting to be felt. International commitments to the Kyoto protocol, the United Nations Framework Convention on Climate Change (UNFCCC) and later the Copenhagen Accord and the Paris agreement have resulted in significant commitment by various countries to reduce greenhouse gas emissions.

Despite this global action plan towards achieving sustainable societies, greenhouse gas emissions grew more rapidly between 2000 and 2010 than in the previous decade. The main contributor to this was the energy supply sector, which in 2010 accounted for approximately 35% of the total anthropogenic greenhouse gas emissions.

As the 21st century progresses, the electricity sector is seeking to take advantage of novel approaches to meet the growing energy demand and abide by the required environmental targets. To achieve these goals, the concept “smart grid” emerged, and utilizes new technologies that can potentially establish an open electricity market, increase the adoption of renewable energy sources and finally decrease or control the demand for electricity. Currently, the electric power industries of many developed countries are discussing the possibility of promoting energy demand management, as it is considered a cost effective and reliable solution that can help ease the operation of the electrical system. The concept of demand side management incorporates activities that alternate the demand profile of the end-users to match electricity supply, improves energy efficiency, decreases overall energy consumption and aims at efficiently integrating higher shares of renewable energy resources. Additionally, demand side management can also be employed to facilitate the integration of distributed generation, a promising approach to relieve the existing power system from today’s stress on transmission and distribution networks, reduce greenhouse gas emissions and improve the efficiency and reliability of the electric power system.

The proposed research aims to study the energy consumption and generation patterns of a sustainable neighborhood in Japan, which has earned a LEED ND platinum rating. More specifically, this research will evaluate the current and future behaviors and intents of the residential and commercial energy consumers of Kashiwa-no-ha area. Further, this project will conduct a questionnaire survey to acquire qualitative and quantitative data related to the preferences of the energy consumers and their intent to adopt new energy habits such as energy production and energy conservation. The main methodology utilized to understand household intents will be a refined model of the theory of planned behavior.

Additionally, this research will discuss the potential of a project that integrates distributed energy resources and implements demand side management in order to reach a new level of grid efficiency and to achieve higher level of energy independence on a small community. The results subsequent to the examination of data will yield useful insights and recommendations for future policy changes.