[Sustainable Energy Demand and Supply System]

Collaborative Research Center for Energy Engineering

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Sustainable Energy Demand and Supply System

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Our research goal is exploring what kind of energy system has low environmental impact (in terms of carbon dioxide emissions or energy consumption) and how we can realize the system. The goal is simple, but we should consider wide-ranging constraints of the economy, the amount of resources, the international competition and political problems, the human preference, the uncertainty over the future, the rigidity of existing systems, etc. Interdisciplinary research is needed in order to properly assess those factors, not only engineering, but economics, social sciences. The following three topics of recent research in our laboratory.

Autonomic Cooperative

Energy Management System We assumed the system for balancing supply and demand where centralized energy management treating a whole power system and decentralized energy management treating one building operate cooperatively.

Demand Measurement Survey



Fig. Constitution of measurement system

Integration of Transport Sector and Power Sector

We propose the use of batteries in the Battery Switch Station as a countermeasure for surplus electricity from PV plants and evaluated the economic value of the proposed system. Assumption

We assumed that 53 million kW of PV is introduced in the nationwide power system and considered following cases.

Pumped case: pumped storage systems are used for surplus electricity from PVs.
Battery case: station's batteries are used for surplus electricity from PVs.

Result

Difference in total cost between *Pumped* case and *Battery* case resulted in 792 billion yen. By dividing 792 billion yen by the battery capacity, we calculated an economic value per battery capacity. It can be interpreted as an annual lease fee for the station's battery.



Battery capacity (91GWh)





In the transport sector, Electric vehicle (EV) is being seen as an environmentally friendly vehicle, but in terms of the short electric drive range, installation of rapid charging infrastructures is necessary to meet EV users' convenience. EV charging demand with consideration for rapid charging is different from that in case of charging in only home. In this research, we calculated EV charging demand in a day using road traffic simulator where rapid charging infrastructures are installed. In addition, we also evaluate the effect of reduction of peak output in photovoltaic (PV) system by EV charging demand in rapid charging infrastructures.



Fig. EV Road traffic simulator

Institute of Industrial Science



Fig. Autonomic Cooperative Energy Management System Including Renewable Energy Resources and Sophisticated Butteries

In this study, we propose an analysis method to figure out the electricity consumption structure in a house using the branch current data at one minute interval in the residential distribution board.

We started energy measurement survey in 50 households living in apartment buildings to verify the effectiveness of the proposed method in November 2009.







Fig. EV charging demand in a day with consideration for rapid charging