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ABSTRACTS for
PARALLEL SESSION 3-3-1 on LOW-CARBON AND CARBON-FREE FUELS AND TECHNOLOGIES
and
PARALLEL SESSION 3-3-2 on SOCIOECONOMIC EFFECTS OF AN UNSUSTAINABLE ENERGY-CLIMATE SYSTEM

CHAIRPERSONS: Mikiko Kainuma and Bob van der Zwaan

Research of the Decision Model on Capacity and Operation Condition of Energy Systems of the Commercial Building and Urban District Considering Weather Condition of the City

Takeshi ISHIDA^a, Shunsuke MORI^b

^a *Systems Research & Development Institute of Japan, Tokyo, JAPAN*

^b *Department of Industrial Administration, Faculty of Science and Technology, Tokyo University of Science, Chiba, JAPAN, and Research Institute of Innovative Technology for the Earth (RITE), Kyoto, JAPAN*

Corresponding author: "Takeshi Ishida" <ishidat@blue.ocn.ne.jp>

It is said that the cogeneration system(CGS) and Heat pump system(HP) are the effective air conditioning systems for energy saving and CO₂ reduction in the commercial buildings as well as residential houses. However, the economic, energy and environmental efficiency indicators of these systems vary so much depending on the weather condition and the demand patterns of heat and electric power. In this research, we develop a model to evaluate the optimum decision on the capacity and the operating pattern of air conditioning system by nonlinear mixing integer programming in order to formulate the partial load properties of heating equipments in practical operation considering the climate conditions. The feature of this model is also applicable to assess the energy system planning of the building and urban district. The results show us that the optimum planning including the installation of equipments depends on the regional conditions and the characteristics of the energy systems.

Keywords: Commercial building, Cogeneration system, Heat Pump System, Nonlinear Mixed integer programming

Impact of Improvement and Deployment of Heat Pump Technologies on Carbon Emission from the Residential Sector in Japan

Kei YAMASHITA, Yasuyuki ENDO, Shinya ICHIOKA, Ikuo NISHIMURA

Tokyo Electric Power Company, Tokyo, JAPAN
Corresponding author: "Kei Yamashita" <yamashita.k@tepcoco.jp>

Heat pump technology is considered to be one of the most promising measures for CO₂ abatement strategy in Japan. We have developed a diffusion model of demand side technologies in residential sector in Japan, which can examine changes in total energy consumption by penetration of improving technologies and learning effects of innovative technologies, such as fuel cell and heat pump water heater. Using this model, we estimated the potential reduction in CO₂ emission from Japanese residential sector for short- to medium- term, making a parametric analysis about learning rates, technological improvement rates, etc, to find out effective measures for CO₂ reduction.

Keywords: air conditioner, heat pump water heater, diffusion model, learning effect

Analyzing the Diffusion of Dispersed Power Generation with an Energy Supply-demand Technology Mix Model for Japan

Takanobu KOSUGI

College of Policy Science, Ritsumeikan University, Kyoto, JAPAN
Corresponding author: "Takanobu Kosugi" <kosugi@sps.ritsumei.ac.jp>

The energy supply-demand technology mix model developed earlier by the authors is expanded to analyze consumers electricity prices and their impact on the diffusion of dispersed power generation systems in residential and commercial sectors in Japan up to 2030. The analysis will show the difference in dispersed power generation installations estimated between two cases: the case of a time-fluctuating electricity price according to the marginal cost of utility power generation at each month and hour, and the case of a constant electricity price regardless of month/hour, which roughly reflects the ordinary price system in Japan. The analysis will also show the condition on the discount rate of consumers energy investments for the autonomous diffusion of dispersed power generation.

Keywords: Decentralized power generation, cogeneration, energy systems model, linear programming

Strategy for Reducing CO₂ Emissions in the Residential Sector in Japan: Case Study on Energy Saving Measures in the Residential Sector in Iwate Prefecture

Shuichi ASHINA, Toshihiko NAKATA

*Management of Science and Technology (MOST), Graduate School of Engineering,
Tohoku University, Sendai, JAPAN
Corresponding author: "Toshihiko Nakata" <nakata@cc.mech.tohoku.ac.jp>*

This research shows feasible strategies for reducing CO₂ emissions in the residential sector in Japan. In this study, we have set two types of energy-saving measures as to be the strategies for reducing CO₂ emissions in the residential sector in Iwate prefecture. The measures are: (1) demand control, and (2) installation of high efficiency appliances. In order to evaluate the feasibility of the strategies, we examine the cost-effectiveness of the measures. The result shows that both demand control and installation of high efficiency appliances lead to reduce CO₂ emission in the residential sector with cost-effectiveness.

Keywords: Energy-saving, Demand control, Economic impacts, Household expenditure

Economic Impacts of Energy Saving Investment to Reduce CO₂ Emission in Japan

Toshihiko MASUI^a, Tatsuya HANAOKA^a, Mikiko KAINUMA^a, Saeko HIKITA^b

^a *Social and Environmental Systems Division, National Institute for
Environmental Studies (NIES), Ibaraki, JAPAN*

^b *Department of Social Engineering, Tokyo Institute of Technology Tokyo, JAPAN
Corresponding author: "Toshihiko MASUI" <masui@nies.go.jp>*

AIM/Enduse model, which is the bottom-up model consisting of energy consumption technologies, can select the least cost advanced technology sets to meet the energy service demand. In order to make active use of these results, the global dynamic optimization model with endogenous technological change has been developed. The results of AIM/Enduse Japan, the relationship between additional energy saving investment and energy efficiency improvement in Japan, reflects the formulation of endogenous energy efficiency change in Japan. By using this dynamic model, the optimal mitigation strategies considering the energy saving investment and their economic impacts under the CO₂ emission constraint can be examined.

Keywords: CO₂ emissions, Endogenous technological change, Energy saving investment, Integrated assessment models

Development of a Dynamic Energy-economic Assessment Model with Multi-regions and Multi-sectors for the Evaluation of the Carbon Emission Reduction Policy

Takashi HOMMA^a, Shunsuke MORI^{a,b}, Keigo AKIMOTO^a, Toshimasa TOMODA^a

^a *Research Institute of Innovative Technology for the Earth (RITE), Kyoto, JAPAN*

^b *Department of Industrial Administration, Faculty of Science and Technology,
Tokyo University of Science, Chiba, JAPAN*

Corresponding author: "Takashi Homma" <takasih@joy.hi-ho.ne.jp>

In order to enable analysis on both industrial structures and energy systems changes up to the middle of this century, we developed a global optimization model DEARS (Dynamic Energy-economic Assessment model with multi-Regions and multi-Sectors) by integrating a top-down economic model and a bottom-up energy technologies assessment model. The model consists of 18 non-energy sectors and 12 kinds of energy technologies, dividing the world into 18 regions. The simulation studies under various kinds of the carbon reduction policies are also described. The obtained computational results reveal the global and regional impacts on industrial structure, energy technologies and energy systems.

Keywords: climate change mitigation, global warming, industrial structure change, economic model, energy model

Input-output Analysis on Inter-industrial Waste Recycling System in Japan

Takuya HARA^a, Yoshikuni YOSHIDA^a, Ryuji MATSUHASHI^a, Hirokazu SHIMA^b

^a *University of Tokyo, Tokyo, JAPAN*

^b *Matsuhashi Laboratory, Tokyo, JAPAN*

Corresponding author: "Takuya Hara" <hara@globalenv.t.u-tokyo.ac.jp>

In this study we investigate environmental effects of inter-industrial recycling system, such as energy consumption, CO₂ emission and waste reduction. We develop extended input-output table, which is physical and monetary hybrid input-output table, and some industry featured in the study are divided into more detailed major processes. We analyze the direct and indirect environmental effect of the system by using the input-output table.

Environmental Policy Analysis in Iran: Application of Energy Input-Output Table

Davood MANZOOR

Imam Sadegh University, Tehran, IRAN

Corresponding author: "Davood Manzoor" <manzoor@isu.ac.ir>

Energy is a primary recourse used directly and indirectly in the production of all goods and services in the economy. Energy production and use results to carbon dioxide emissions which cause greenhouse effect and climate change problem. Trade-offs among energy security, environmental protection, and economic growth is a major concern for energy policy making. The main aim of this paper is to discuss the use of input-output analysis to model energy-environment-economy interactions in Iran. In an input-output approach, the economic structure is defined in terms of sectors which provide a modelling framework for policy analysis. In its recent applications, input-output model has been extended to reflect the link between the level of economic activity, the corresponding energy requirements and its impact on the environment. This approach can provide a systematic tool to evaluate the impacts of environmental policies. This paper applies input-output technique to analyze the energy-economy-environment interactions in Iran, taking into account the energy intensities and carbon dioxide emissions caused by energy use. The paper presents a description of the appropriate modifications to the basic input-output model as regards the environmental impacts of energy use, followed by an outline of the data used. Finally, some results on energy requirements and carbon dioxide emissions in Iran are reported.

Keywords: Energy Policy; Input-Output Analysis; Iran
