

## **Development of Integrated Assessment Approach for Designing and Assessing the Socio-economic Impact on Regional Circular and Ecological Sphere utilizing Regional Resources**

Principal Investigator: Shuichi ASHINA, Keisuke MATSUHASHI, Toshihiko NAKATA, Hiroki TANIKAWA

Institution: National Institute for Environmental Studies, Tsukuba City, Ibaraki, JAPAN

Tel: +81-29-850-2227

E-mail: ashina.shuichi@nies.go.jp

Cooperated by: Tohoku University, Nagoya University

[Abstract]

**Key Words:** Local decarbonization, Municipalities, Local resources, Renewable energies, Local production for local consumption, Inter-regional cooperation, Analytical models, Geographical Information System

This project aimed to develop a methodology for designing transition scenarios toward local decarbonization, a key concept of the Regional Circular and Ecological Sphere, utilizing regional resources, such as renewable energies, forest resources and building stocks, while considering population decline and other future socio-economic changes in local areas in Japan. For this purpose, we developed a series of analytical models to evaluate impacts of local decarbonization actions on carbon dioxide reductions and to design inter-regional network structure for enhancing use of local energy resources among municipalities by using Geographical Information System.

The project maintained databases of population distribution, energy demand and supply, renewable energies and building stocks from past to present by municipalities and/or 1km-mesh resolution to provide basic information for the analytical processes in the project. The database also used to analyze historical changes and its driving forces in the municipalities; we identified impacts of age effect, period effect and cohort effect on changing population distribution by applying APC analysis, and investigated explanatory variables for transition to dead stock in building stocks of a municipality.

The models were applied to municipalities to gain insight into how to transition to decarbonized society by utilizing local resources. Taking actions proposed in a national decarbonization scenario will lead more than 90% of municipalities to reduce their CO<sub>2</sub> emissions by 90% in 2050; Demand side actions, such as energy efficiency and fuel shift, will contribute around 50% of CO<sub>2</sub> reductions, and installation of renewable energies and decarbonization of grid electricity will reduce another half of CO<sub>2</sub> emissions in 2050. In addition, local production for local consumption of forest resources will suppress use of new materials and increase in carbon stocks in the municipality. We found that suitable cooperation network differs between western and eastern Japan; all the network connects to Tokyo metropolitan area in western Japan, on the other hand, eastern Japan formulates cluster-like network which renewable rich zone as a core node. Such inter-regional cooperation network will enhance use of renewable resources and may gain additional incomes and jobs in energy export areas such as Hokkaido and Tohoku. Based on such results, cluster analysis was used to classify types of cooperation network and we found five cooperation types as biomass-core type, solar+battery type, resource production type, resource use type, and transferring zone.

[References]

- 1) L. GAO, Y. HIRUTA, S. ASHINA: *Renewable Energy*, 162, 818-830 (2020) (IF:8.634), Promoting renewable energy through willingness to pay for transition to a low carbon society in Japan.
- 2) Y. HIRUTA, N.N. ISHIZAKI, S. ASHINA, K. TAKAHASHI: *Data in Brief*, 108047 (2022), Hourly future climate scenario datasets for impact assessment of climate change considering simultaneous interactions among multiple meteorological factors.
- 3) N. NAGANO, R. DELAGE, T. NAKATA: *Energies*, 14(10), 2823-2848 (2021) (IF: 3.252), Optimal Design

and Analysis of Sector-Coupled Energy System in Northeast Japan.

- 4) R. DELAGE, T. MATSUOKA, T. NAKATA: *Energies*, 14(8), 2168-2179 (2021) (IF: 3.252), Spatial–Temporal Estimation and Analysis of Japan Onshore and Offshore Wind Energy Potential.
- 5) W. WUYTS, R. SEDLITZKY, M. MORITA, H. TANIKAWA: *Sustainability*, 2, 13 (2020) (IF: 3.889), Understanding and managing vacant house in support of a material stock type society-The case of Kitakyushu, Japan.
- 6) H. TANIKAWA, T. FISHMAN, S. HASHIMOTO, I. DAIGO, M. OGUCHI, A. MIATTO, S. TAKAGI, N. YAMASHITA, H. SCHANDL: *Journal of Cleaner Production*, 285 (2020) (IF: 11.072), A framework of indicators for associating material stocks and flows to service provisioning: Application for Japan 1990-2015.