



An Empirical Study of Regional Carbon Emission Reduction Potentials by a Smart Integration of Buildings and Mobility Energy Systems

The conversion of buildings to zero energy (ZEH/ZEB), as well as integration with electric vehicles (EVs) and solar photovoltaic (PV) cells is expected to reduce emissions in the building and transportation sectors. These actions aim to realize the goal of a zero emission society. This study analyzed the shift in energy demand to electric power through the diffusion and expansion of these technologies and the impact this shift would have on the energy supply structure, e.g. power generation expansion planning.

- A quantitative analysis was performed on potential CO₂ emission reductions, along with regional differences, through the introduction of PVs and a shift to ZEH and EV interconnection in the household sector nationwide. This analysis was established based on the results of investigations by organizations such as the Tokyo University of Science and the Ministry of the Environment. Results revealed the feasibility of these changes in detached houses along with the challenges they face in collective housing.
- The regional energy model was applied to seven areas in Utsunomiya City, with an evaluation performed based on cost minimization through the effects of energy supply and demand interconnection among residences, offices, and stores, as well as the introduction of EVs. CO₂ emissions were reduced to 35% by insulating buildings, integrating EVs, and interconnecting consumers (Figure 1, 2).
- The large-scale introduction of EVs has the potential to increase load fluctuations in the grid power system. This suggests the need for the wide-area power charging management.
- Although there is high uncertainty regarding behavioral changes amongst consumers, existing smart city reports showed a shared reduction in energy consumption of about 30% through Demand-Response (DR).

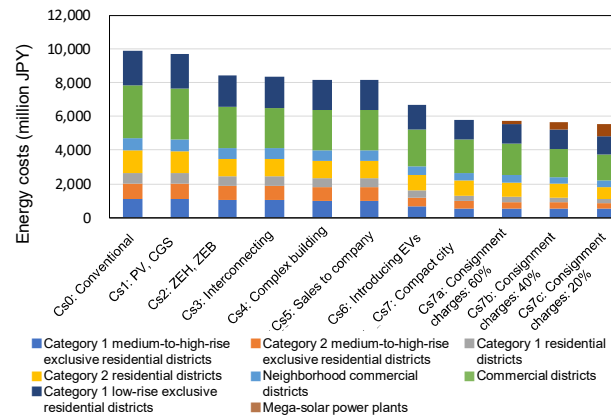


Figure 1: Comparison of annual energy costs between scenarios

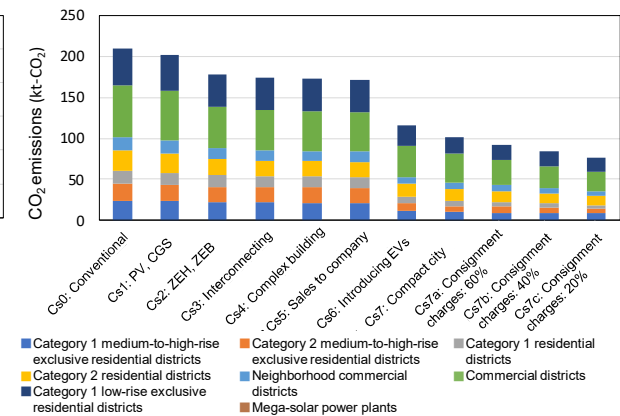


Figure 2: Comparison of changes in annual CO₂ emissions between scenarios

Proposals for Policy Development

The following policy agenda is proposed for achieving CO₂ reductions. This agenda realizes simultaneous reductions in local energy costs and CO₂ emissions by integrating energy demand among the consumer, household, and transportation sectors.

- 1) ZEB/ZEH have a large potential for emission reductions. Expansions in ZEB/ZEH introduction measures and certification of energy-creating equipment is required to promote these technologies.
- 2) EVs can replace gasoline vehicles in daily use, but the development of an efficient charging management system is essential.
- 3) Local consumer energy systems, transportation, and power supply structure models must be integrated to allow for a quantitative assessment of the potential for reductions in emissions by switching to ZEB/ZEH-M and EVs.