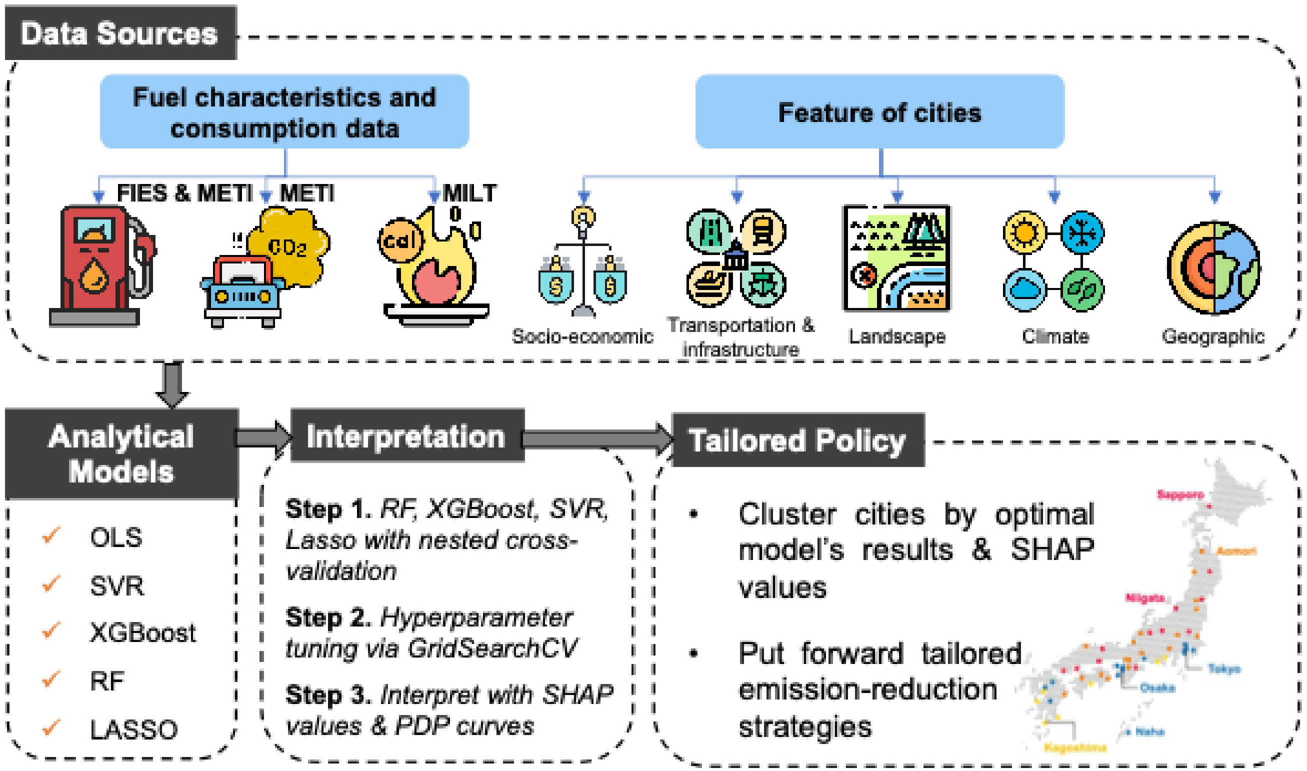
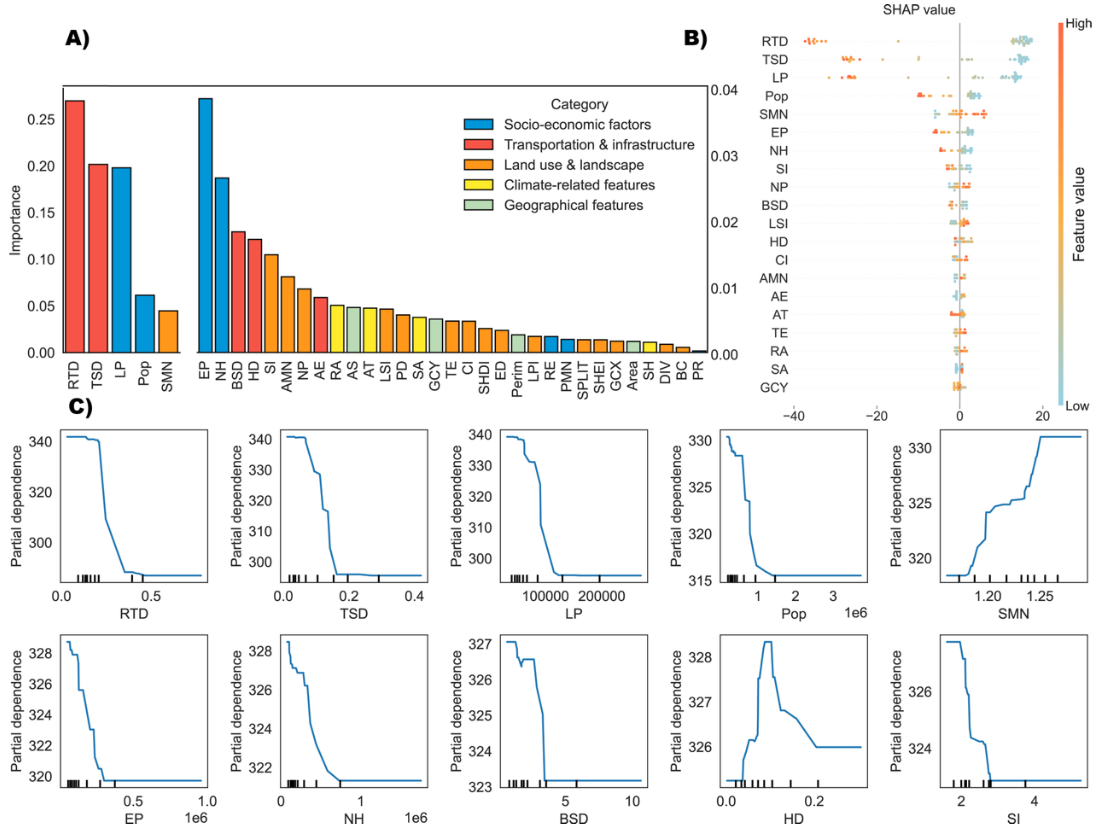
Acceptable sustainable mobility innovation

Study 1: private vehicle use related emission patterns





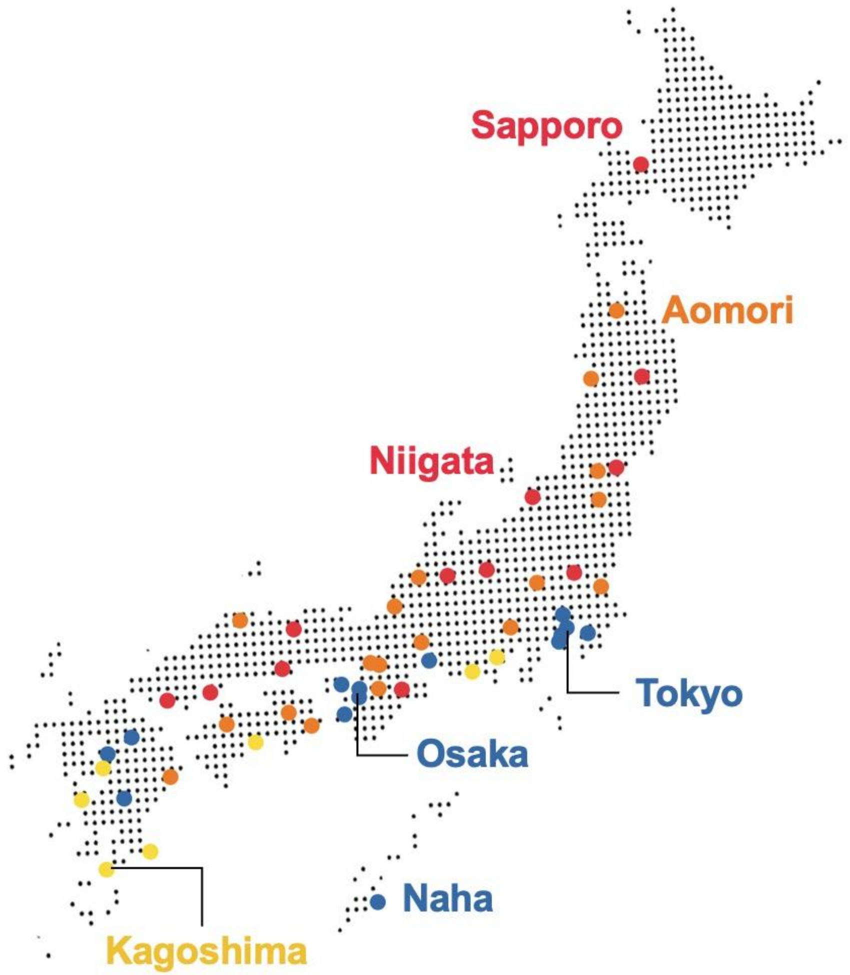
Abbr	Explanation	Abbr	Explanation	Abbr	Explanation	Abbr	Explanation
AE	Average elevation	NP	Number of Patches	HD	Highway density		
AMN	Patch Area (Mean)	PD	Patch Density	LP	Land price	SH	Sunshine hours
Area	City area	Perim	City perimeter	LPI	Largest Patch Index	SHDI	Shannon's Diversity Index
AS	Average slope	PMN	Proximity Index (Mean)	LSI	Landscape Shape Index	SHEI	Shannon's Evenness Index
AT	Average temperature	Pop	Population	NH	Number of households	EP	Elder population
BC	Boundary Complexity	PR	Patch Richness	SI	Shape coefficient	GCX	Geometric Centroid Longitude
BSD	Bus stop density	RA	Rainfall amount	SMN	Shape Index (Mean)	GCY	Geometric Centroid Latitude
CI	Compactness Index	RE	Ratio of elderly	SPLIT	Splitting Index		
DIV	Landscape Division Index	RTD	Railway track density	TE	Total Edge		
ED	Edge Density	SA	Snowfall amount	TSD	Train station density		

Study 1: private vehicle use related emission patterns

Results

Based on the emissions from private vehicle travel and the characteristics of the city, the cities are divided into five categories, and targeted suggestions for emission reduction are proposed.

City Clusters	Cities included
LTCs Low-Emission Transit-Oriented Cities	Saitama, Chiba, Tokyo, Yokohama, Nagoya, Osaka, Kobe, Wakayama, Fukuoka, Kumamoto, Naha, Kawasaki, Sakai, Kitakyushu
MESCs Moderate Emission Southern Cities	Shizuoka, Kochi, Saga, Nagasaki, Miyazaki, Kagoshima, Hamamatsu
METDCs Moderate Emission Transit-Deficient Cities	Aomori, Akita, Yamakata, Fukushima, Mito, Maebashi, Kanazawa, Fukui, Kofu, Gifu, Otsu, Kyoto, Nara, Matsue, Tokushima, Takamatsu, Matsuyama, Oita
HECTCs High-Emission Complex Terrain Cities	Sapporo, Morioka, Sendai, Utsunomiya, Niigata, Toyama, Nagano, Tsu, Tottori, Okayama, Hiroshima, Yamakuchi



Study 2: research on public transportation

Study on the Attractiveness of Stations along the Odakyu Railway Line

Background

- Urban transportation in Japan relies heavily on the railway system.
- Evaluating **station attractiveness** helps planners understand passenger demand and promote sustainable development.
- Using **point-of-interest (POI)** data, we incorporate the travel needs of passengers with different demographic characteristics into an attractiveness assessment model.
- We take the Odakyu Line in Japan as a case study, a railway corridor that connects central Tokyo with several popular destinations.

● 印は、急行停車駅で1日平均乗降人員が約65,000人以上の駅です。

LONG LABORATORY UTOKYO

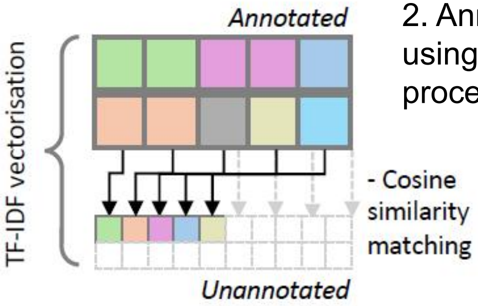
Study 2: research on public transportation

UTokyo

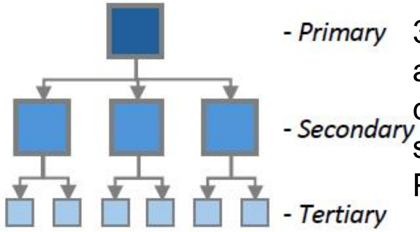
Methods

Step 1: POI data preprocessing

1. Use APIs to obtain POIs within a 1,000 m radius around each station.



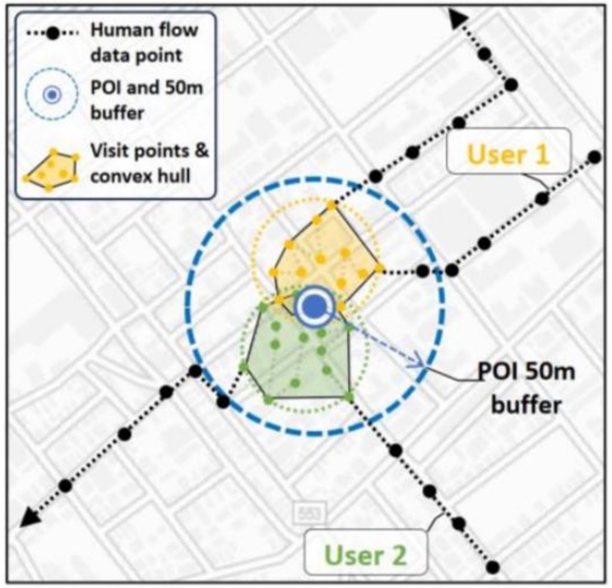
2. Annotate POIs using a text-processing model.



3. Construct a three-level classification system for POIs.

Step 2: Linking POIs with passenger demand

1. Group the population by age and household attributes.
2. For age-based groups, use people-flow data to identify the preferences of specific groups for different POI categories.



3. For household-attribute groups, manually annotate the preferences of specific groups for different POI categories.

Step 3: Attractiveness evaluation based on a gravity model

1. Decompose station attractiveness g_{ij} into two components: the intrinsic characteristics of station $i(v_i$ (and passengers' demand for POIs around station $j(W_j$.(In addition, following the gravity model, attractiveness is assumed to be a function of distance d.

$$g_{ij} = k_{ij} v_i^{\alpha} w_j^{\beta} d_{ij}^{\gamma}$$

2. Log-linearize the above expression as the baseline model, and use the evaluation scores of POIs around each station as a proxy for station attractiveness g_{ij} .Estimate the coefficients of the factors:

$$\ln g_{ij} = \ln k_{ij} + \alpha \ln v_i + \beta \ln w_j + \gamma \ln d_{ij} + \varepsilon_{ij}$$

3. Extend the baseline model by incorporating the heterogeneous demand of different groups h and the temporal accessibility of POIs.

$$g_{ijh} = k_{ijh} v_i^{\alpha} w_{jh}^{\beta'} d_{ijh}^{\gamma'}$$

Study 2: research on public transportation

Results

- There is no simple proportional relationship between a station's average daily ridership (i.e., its size) and its overall attractiveness.
- Adjacent stations tend to form clusters of attractiveness, where POIs around neighboring stations are more likely to be jointly shared by passengers.
- We identify the ten most attractive stations along the Odakyu Line based on a composite index of accessibility and diversity, and evaluate station attractiveness from two perspectives: age-specific groups and broader demographic segments.

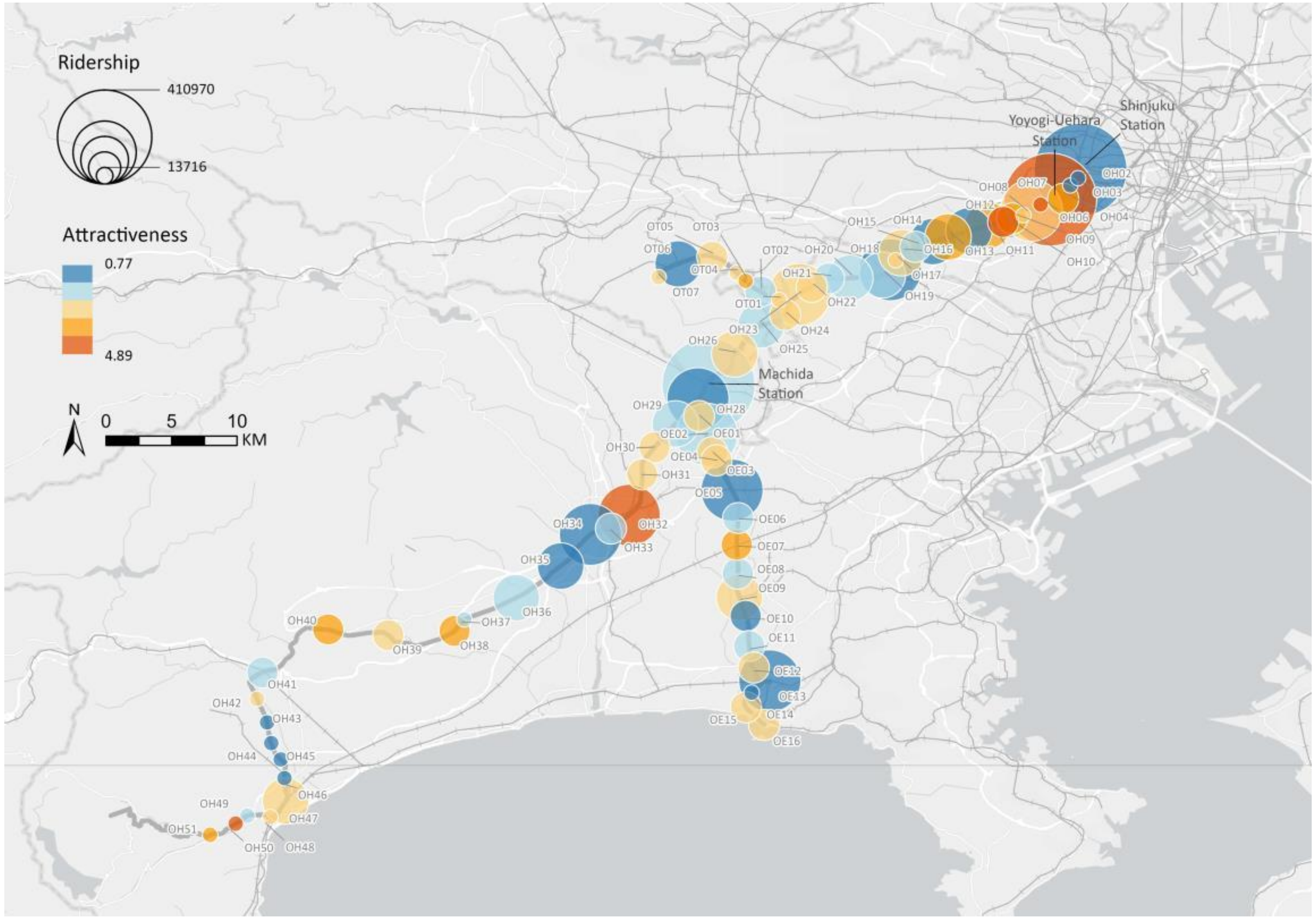


Figure: The Attraction and Scale of 74 Stations on the Odakyu Railway

Study 2: research on public transportation

Results

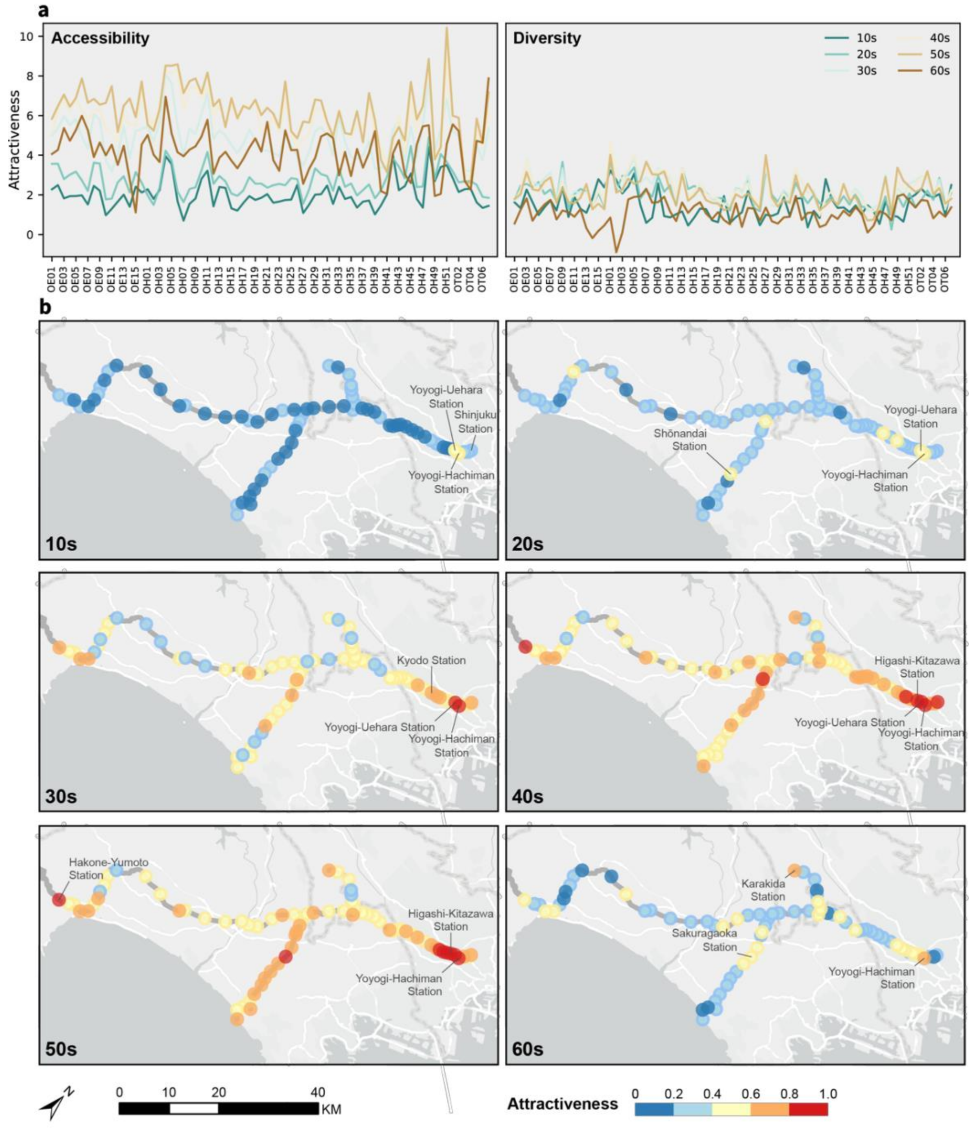


Figure: Attractiveness Evaluation Based on Age Groups

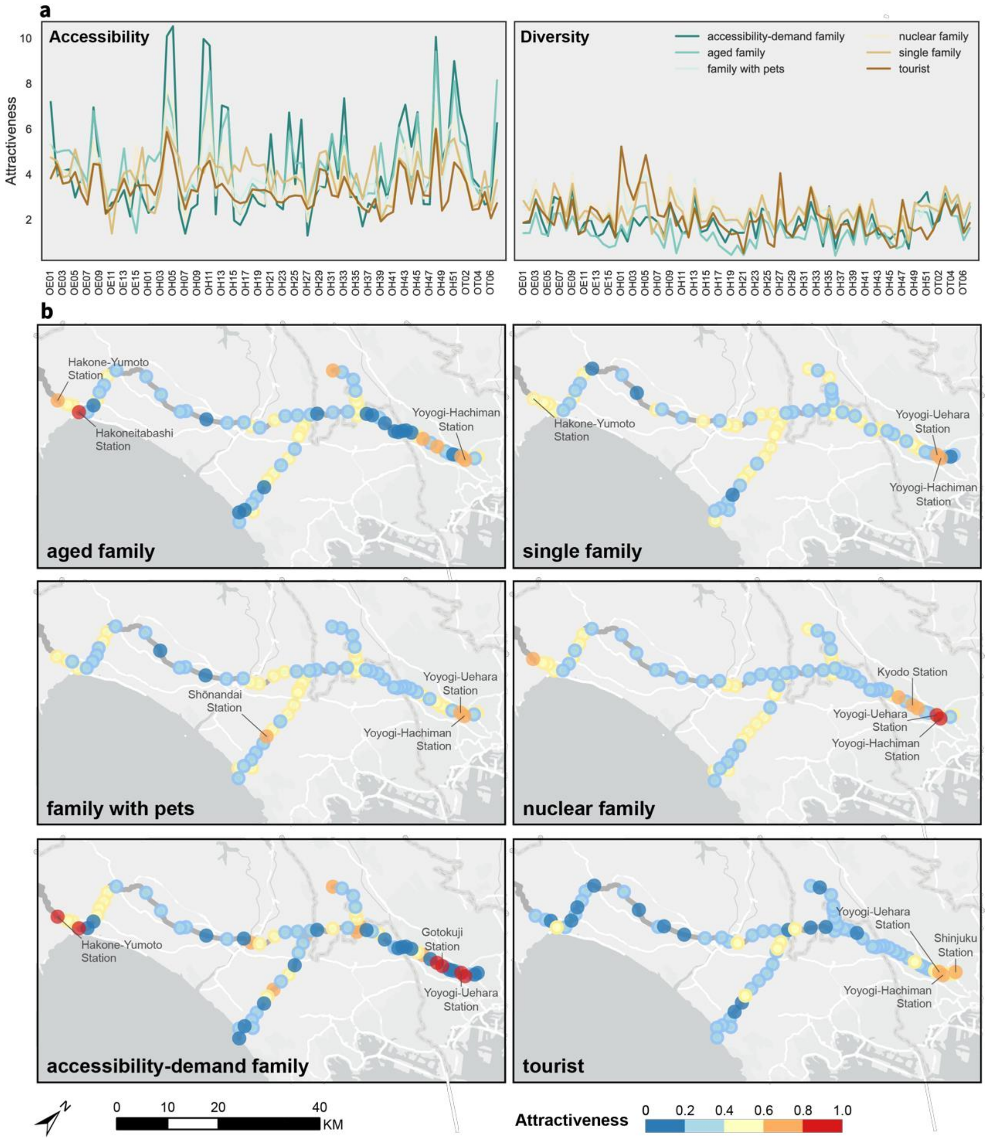
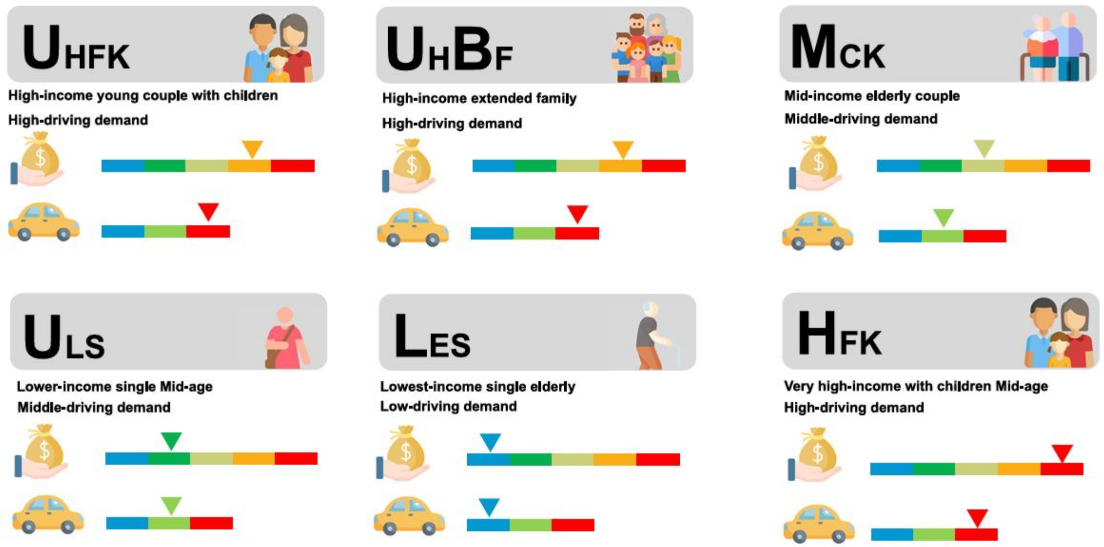


Figure: Attraction Evaluation Based on Population Types

Study 3: analysis of the penetration rate of new energy vehicles

By combining information on Japanese household purchases of new energy vehicles (NEVs), travel demand, and household characteristics, we analyze the heterogeneity in NEV adoption.

- The penetration of NEVs in Japan remains very low, accounting for only 1.4% of households in our survey sample.
- Under current policy conditions, households that purchase NEVs are typically affluent car-owning households. At the same time, they tend to have longer travel distances, higher travel frequency, and larger travel-related carbon footprints.



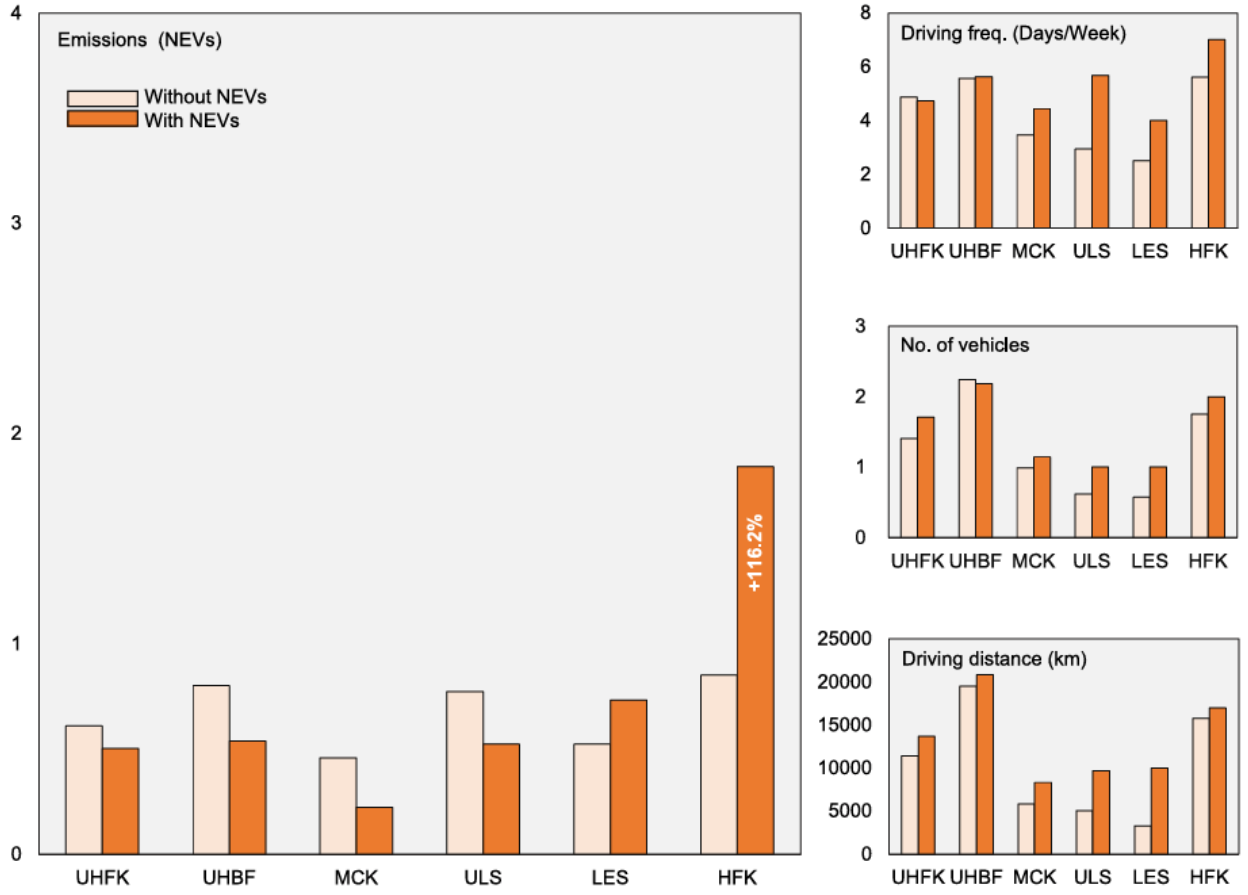


Figure. Differences in car use-related emissions between NEV adopters and non-adopters across household groups.

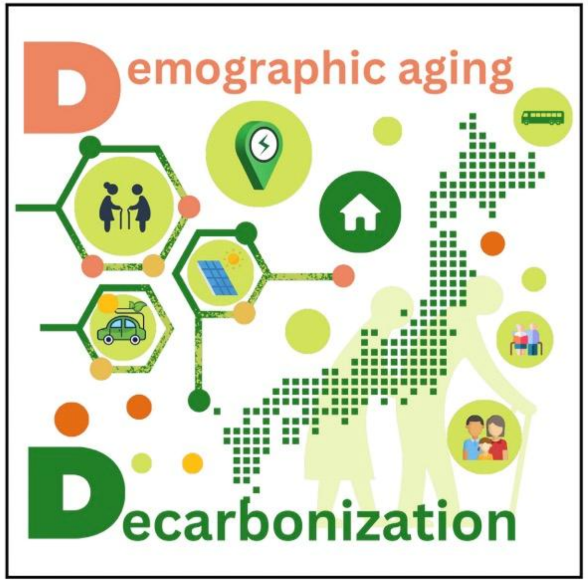
Study 3: analysis of the penetration rate of new energy vehicles

Cell Reports Sustainability

Article

Demographic transitions hinder climate change mitigation for Japan's shrinking and aging households

Graphical abstract



Authors

Yin Long, Yoshikuni Yoshida, Liqiao Huang, Peipei Chen, Yi Wu, Alexandros Gasparatos

Correspondence

longyinutokyo@gmail.com (Y.L.), ucbq929@ucl.ac.uk (Y.W.), gasparatos.alex@gmail.com (A.G.)

In brief

In their study, Long et al. analyze Japanese household energy consumption and emissions. The research finds people's age, household size, and income to be associated with emissions and the adoption of green technologies such as photovoltaics and new energy vehicles. It shows that demographic transitions associated with household aging and shrinking can have significant ramifications on climate change mitigation efforts in the household sector.

Highlights

- Multiple household characteristics affect energy use and emissions
- Differentiated climate change mitigation technology adoption rates among groups

Determine factors of adoption

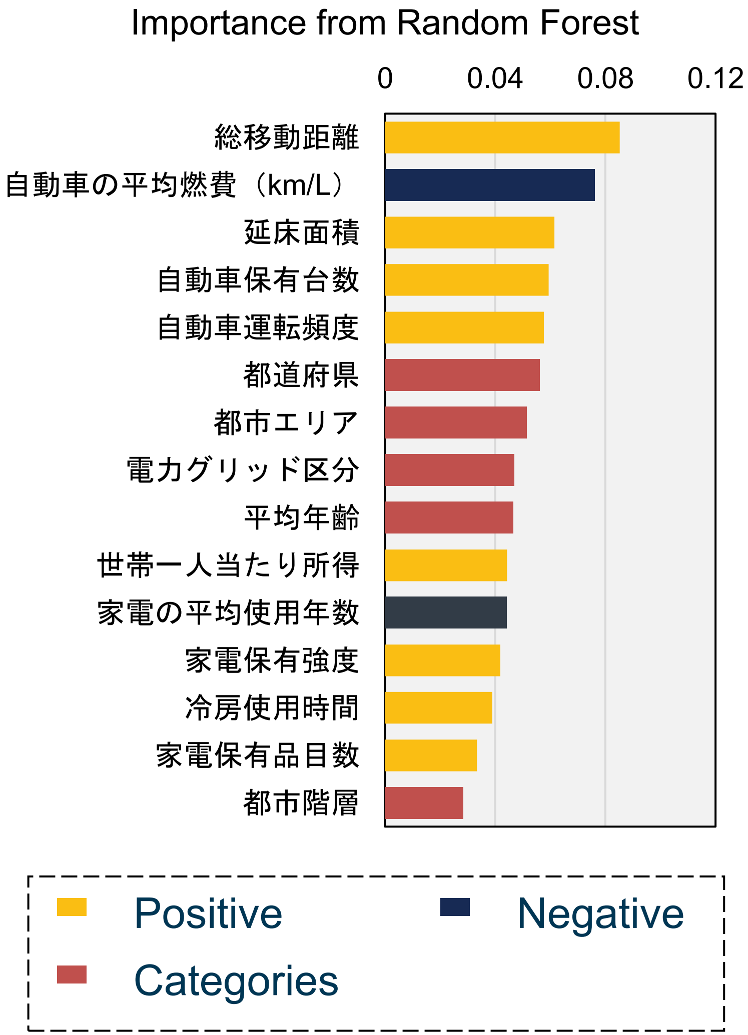
Mobility-related factors rank highest (behavior-driven)

- Longer annual driving distance, higher driving frequency, and a larger number of owned cars ⇒ higher likelihood of EV adoption

Housing and location's effects

- Areas with larger floor space, a higher share of detached houses, and small / medium-sized cities ⇒ more parking space and higher feasibility of home charging

Choke points: / Key bottlenecks: There is a tendency to suppress the adoption of such cars because of the parking space, cost, difficulty of charging, and high substitutes for public transportation in metropolitan areas.



Study 4: Road-specific EV charging insufficiency analysis

Results

- Charging infrastructure within the non-urban areas lags behind central urban clusters
- Rapid chargers account for only 23.05% of the total, which is less than half of the proportion of slow chargers.

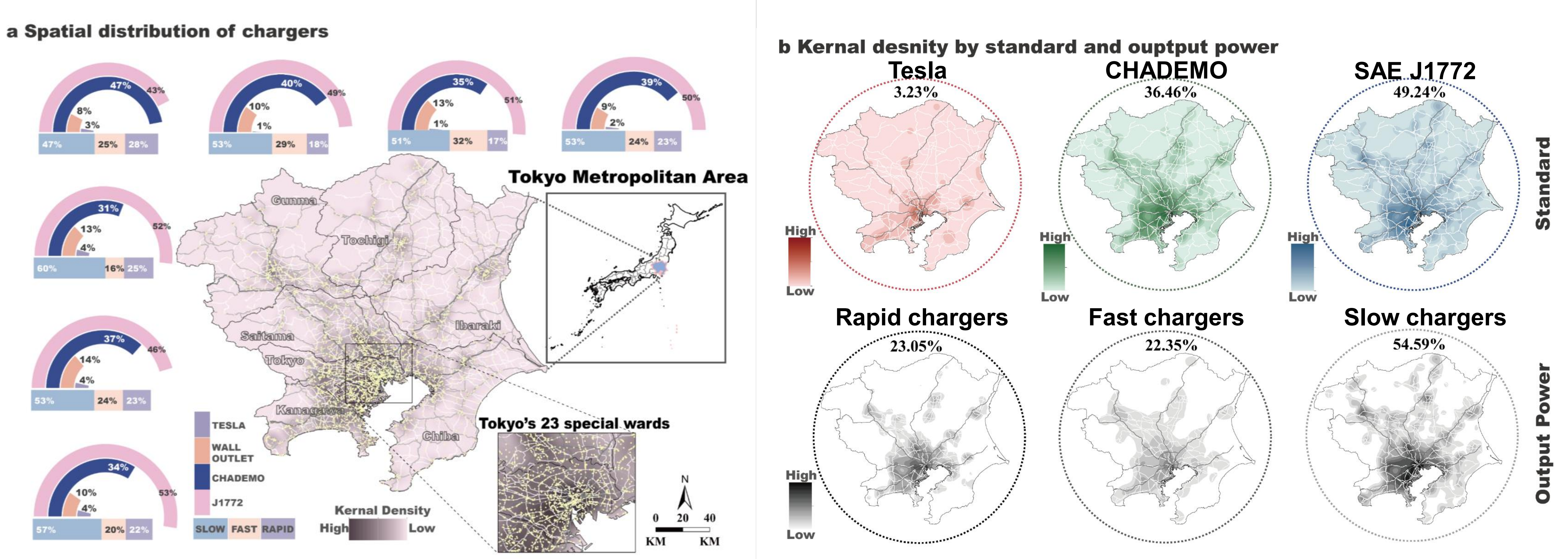
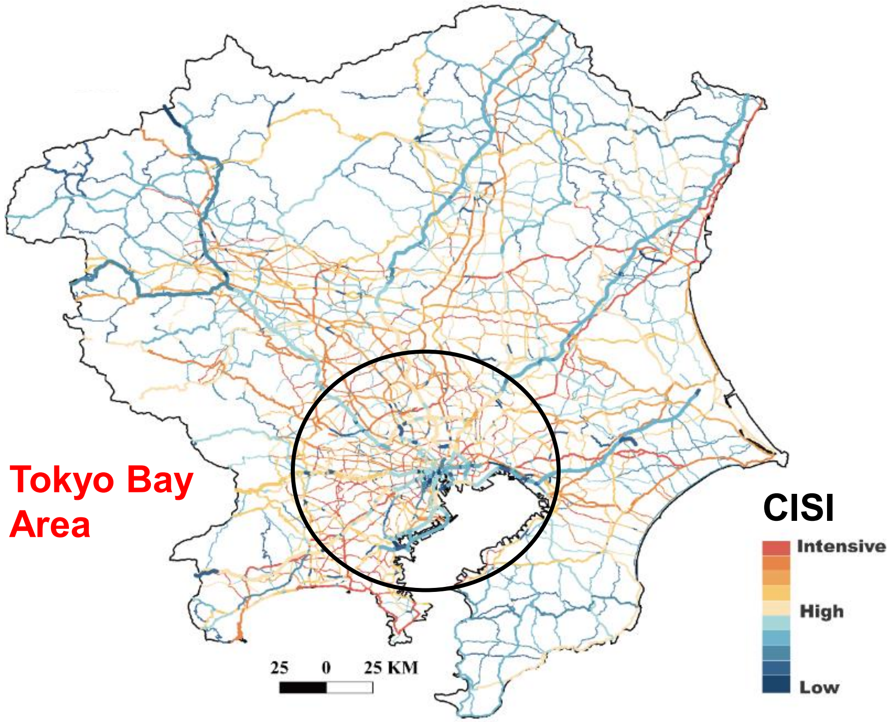
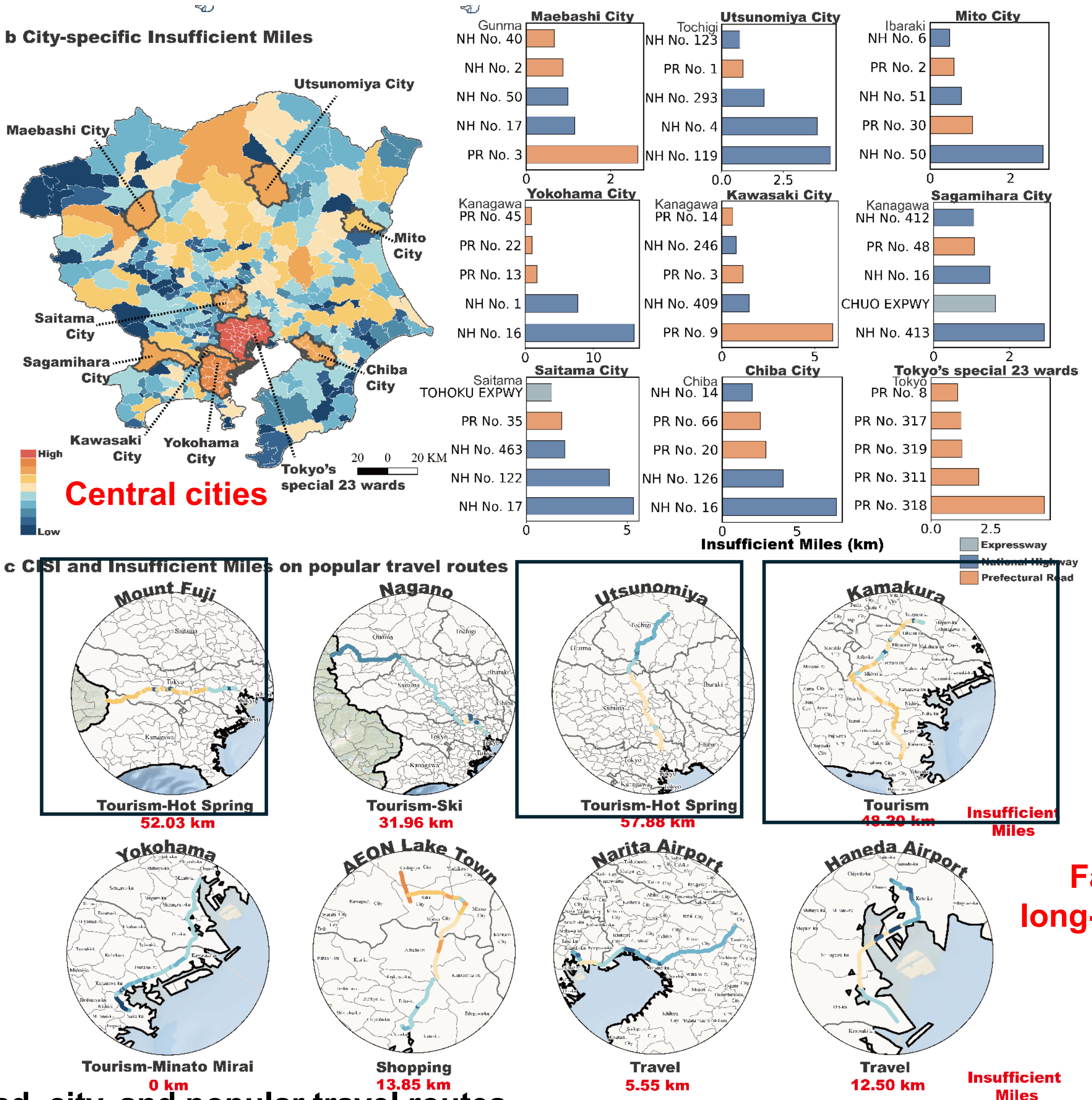


Figure. Spatial distribution of EV chargers and their kernel density by types

Study 4: Road-specific EV charging insufficiency analysis

Results





Famous and long-distance trips

Insufficient miles

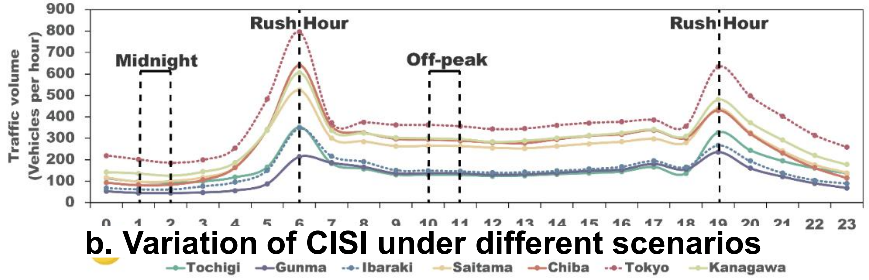
- The miles of road where the charging insufficiency index exceeds the average value

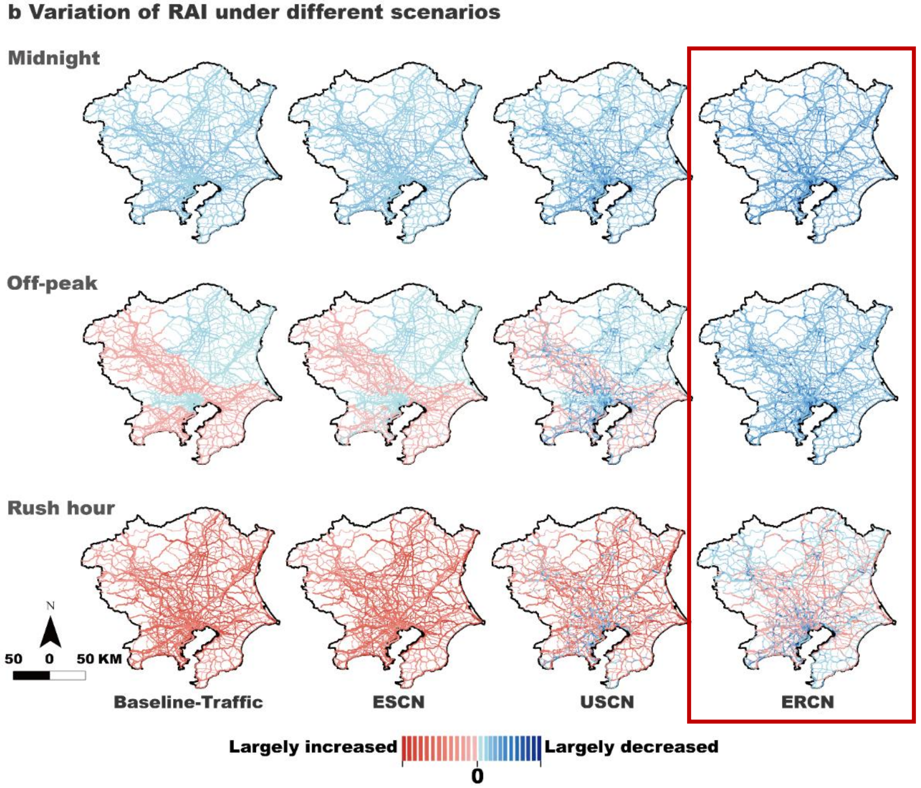
Figure. Charging insufficiency of road, city, and popular travel routes

Study 4: Road-specific EV charging insufficiency analysis

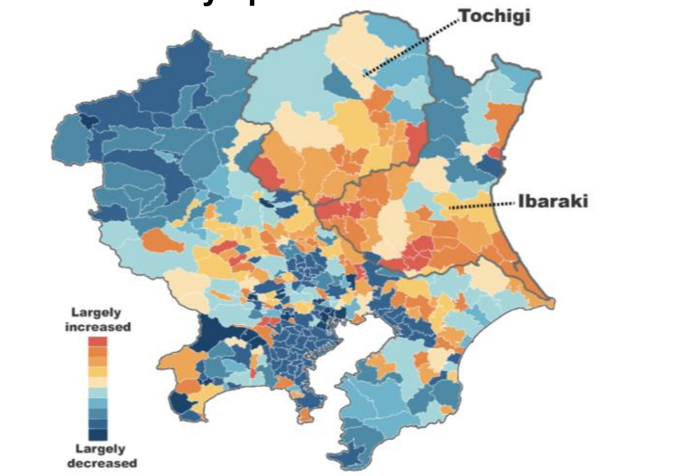
Results

Traffic volume scenarios

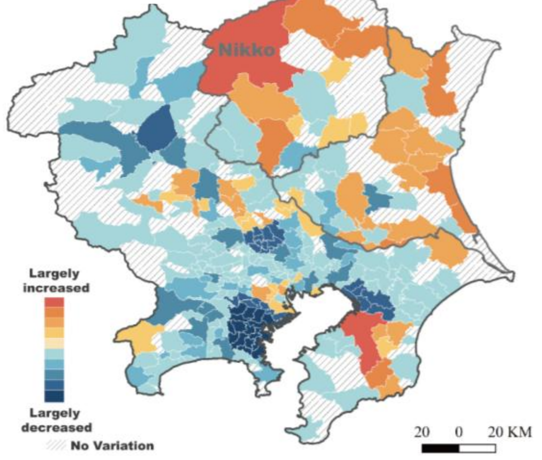




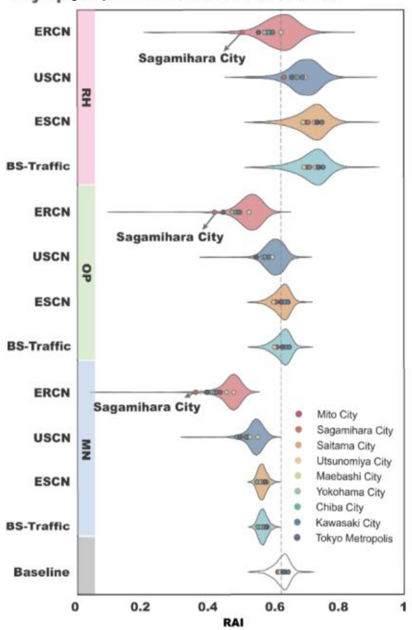
Variation of city-specific CISI under RH-ERCN

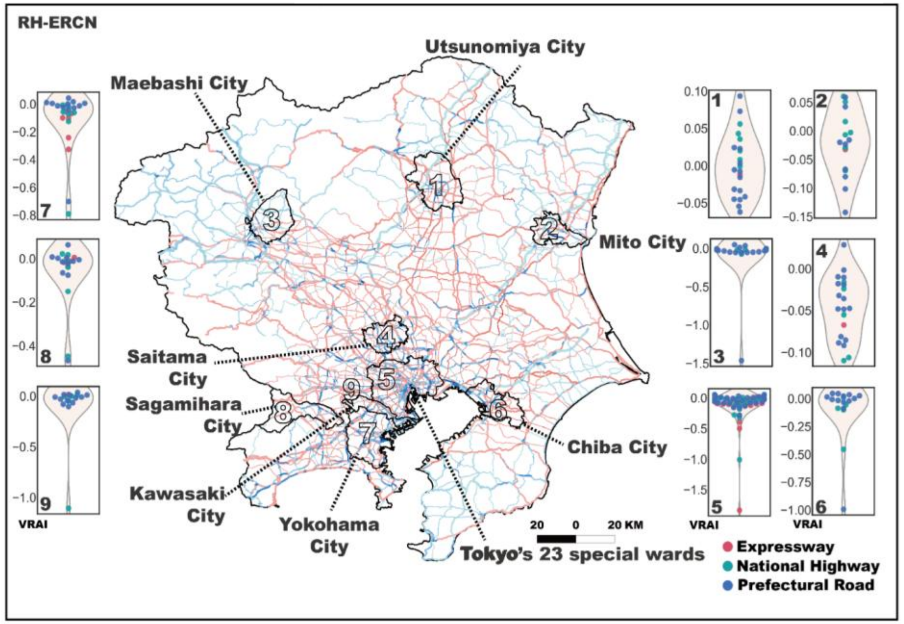


Variation of city-specific Insufficient Miles under RH-ERCN



City-specific CISI in different scenarios





Expanding high-output chargers