Study on Estimation for Impact of CO_2 Emission Reduction under the Policies Considered the Change of Transportation Network and Land Use -Case Study of Niigata, Japan-

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Background

- To realize Low Carbon City, we have to create strategic roadmaps relating to land use and transportation sector
- We have to deal with not only transport measures but also land use measures

However….

- Really difficult to measure which strategic roadmaps to employ efficiently
- Most studies, timing to implement each policy or countermeasure cannot be considered to develop the roadmaps dynamically
- The MARS model is one of the SD models, it cannot be considered the change of transportation network to estimate of CO_2 emission

Purpose

- Modifying the MARS model to deal with detail condition of the network, and estimation of CO_2 emission under introducing policy scenarios for realizing low carbon society

MARS and its Modification

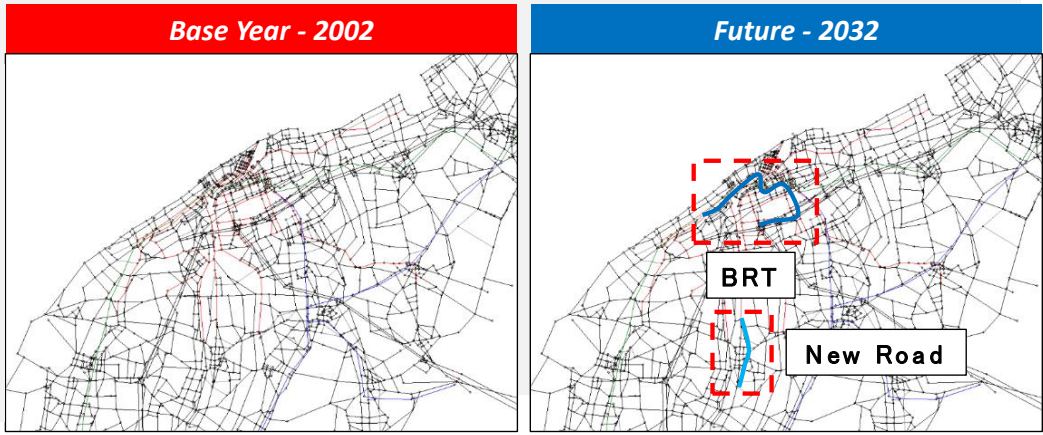
- MARS: **M**etropolitan **A**ctivity **R**elocation **S**imulator
- The model is consisted of transport and land use sub-models dynamically

$$N_j^{mv}(t) = P^{mv}(t) * \frac{a^{mv} * e^{b^{mv} * {}^{WP}Acc_j^{PC}(t) + c^{mv} * ShGr_j(t) + d^{mv} * R_j^D(t)}}{\sum_j a^{mv} * e^{b^{mv} * {}^{WP}Acc_j^{PC}(t) + c^{mv} * ShGr_j(t) + d^{mv} * R_j^D(t)}}$$

Dynamically Estimation

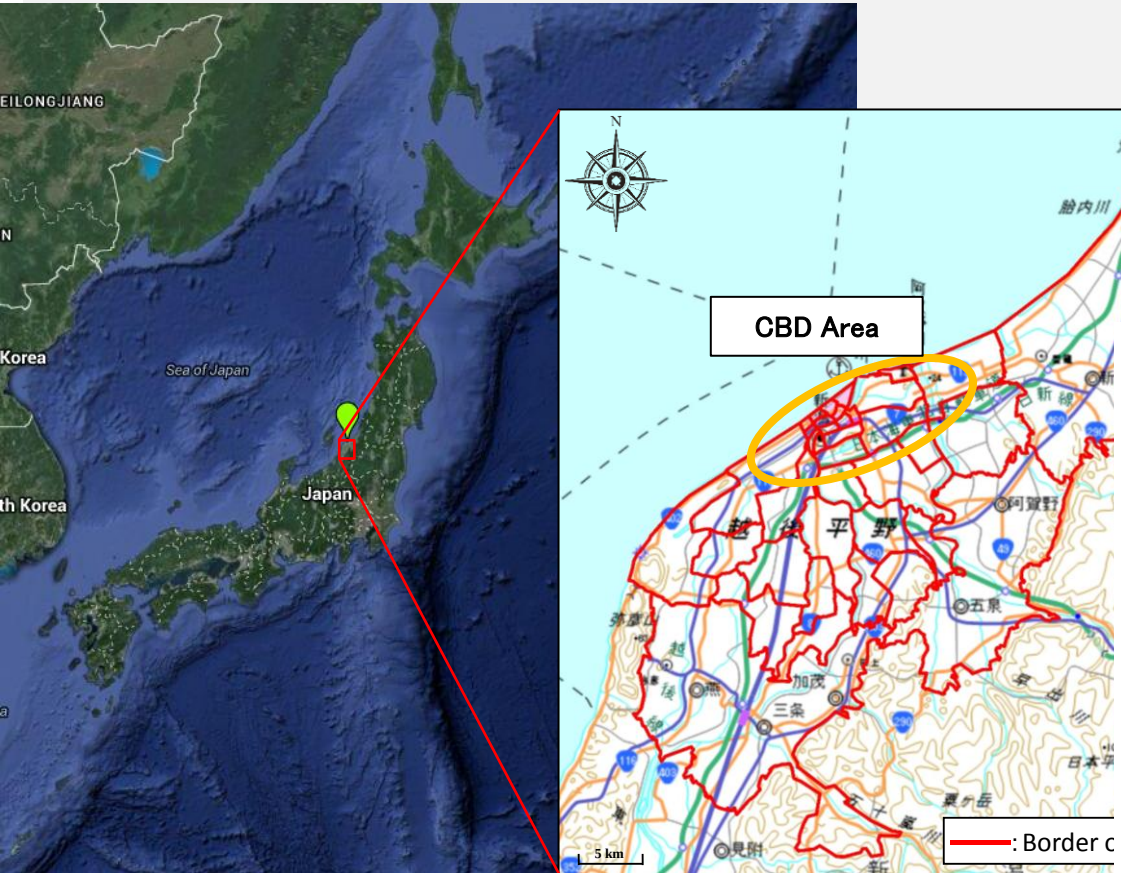
$N_j^{mv}(t)$: No. of residents moving from zone j in the year t, $P^{mv}(t)$: Potential of moving residents in the year t, ${}^{WP}Acc_j^{PC}(t)$: Accessibility of working places by car from zone j in the year t, $ShGr_j(t)$: Share of green land in zone j in the year t, $R_j^D(t)$: Monthly rent or mortgage for a domicile in zone j in the year t

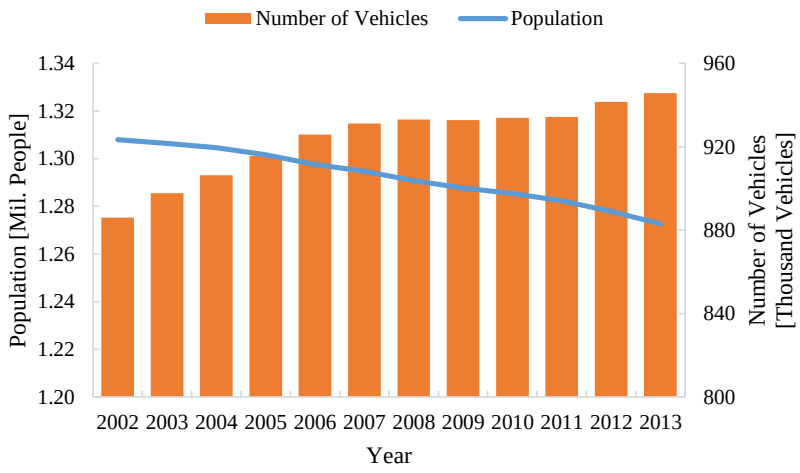
- In this study, to modify the MARS model can be considered with real transportation network
- The improved MARS model can be considered with the widening of road and the new construction of BRT for dealing with travel behavior on the real transportation network



Case Study

- Case Study : Niigata Urban Area (Consist of Niigata, Shibata, Agano, Gosen, Sanjyo, Tsubame, Tainai, Seiro)
- Reason for selecting: The number of population is still decreasing, but the number of vehicles are gradually increasing and residential area was spread to suburbs





Relationship with Population and Car Ownership

Setting Policy Scenarios

- Setting policies
  1) Change of the Transportation Network every 10 years
  2) Improvement of the headway for rail
     ex. Changed from 15 min. to 7.5 min. [peak hour]
  3) Introducing Urban Consolidation (UC) policy
     ⇒Population is aggregated to CBD area from suburbs (3 %/year)
     ⇒Timing of the introducing policy (year: 2002, 2012, 2022)
- Setting scenarios
  ⇒4 scenarios were set to consider with some policies

Scenarios	1) Network	2) Headway	3) UC (Year)
BAU Scenario	○	—	—
Scenario A	○	○	○ (2002)
Scenario B	○	○	○ (2012)
Scenario C	○	○	○ (2022)

CO_2 Emissions Estimation

- The equations used to estimate CO_2 emissions is as follows (Matsuhashi et al., 2004)
- Car and Motorcycle

$$E_j = N_j \times V_j \times e_j$$

j: Mode of transportation, E_j: CO_2 emission, N_j: Number of vehicles/motorcycles, V_j: Vehicle kilometer travels, e_j: CO_2 emission factor

- Rail and Bus

$$E_j = \sum \left(P_j \times e_j \right)$$

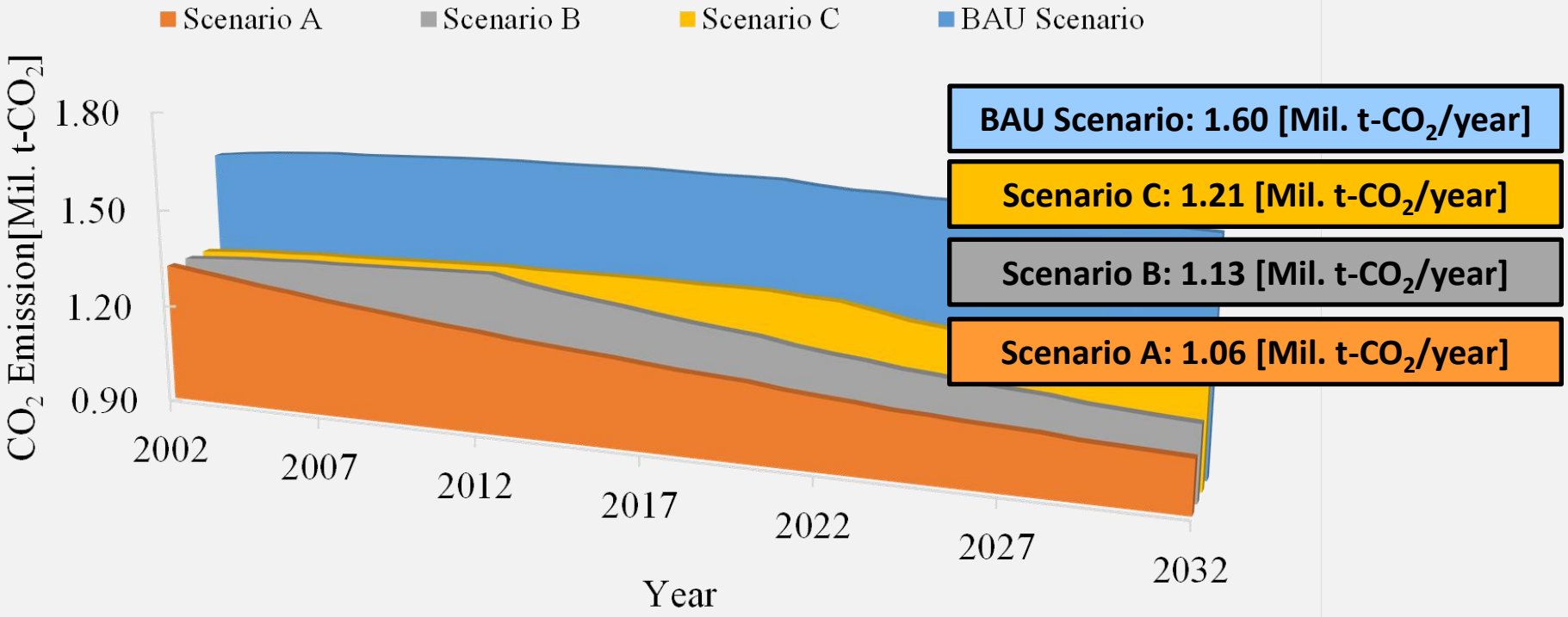
P_j: Passenger kilometer

- The CO_2 emissions factor (the Ministry of the Environment, Japan)

Mode	Car	Motorcycle	Bus	Rail
CO_2 Emission Factor [kg-CO_2per capita・km]	0.175	0.104	0.053	0.019

CO_2 Emissions Estimation

- The results of CO_2 emissions after implementing each policy scenario
- The estimated CO_2 emissions of each scenarios in 2032



- Scenario of max. reduction: ***Scenario A***

⇒Included as Network Chang, TOD Policy from 2002, and Headway Change

Conclusion

- When 5 scenarios had set, CO_2 emissions was estimated from 2002 to 2032
- For the results, Scenario E of introduction of urban consolidation policy with improvement of headway for rail could reduce max. 30.5% of CO_2 emission compared with base line

- The results of CO_2 emissions reduction, the introduction urban consolidation policy with improvement of headway time could evaluate for high impacts to realize low carbon society
- In further studies: necessary to estimate CO_2 emissions reduction when the transport network is changing in order to evaluate the impacts of introducing policies where commercial land, and work places are consolidated.

Thank you for your attention

Have any questions?