Analysis of regional GHG reductions consistent with Japan's GHG reduction targets

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National Institute for Environmental Studies

New research project:
Analysis of Japan's decarbonization scenarios considering prefecture level measures

Period	**FY2023-FY2025**
Member	***NIES*** **Dr. Kanamori: project leader** **Dr. Hibino, Dr. Ashina, Dr, Masui: Decarbonization analysis in Japan** **Dr. Gomi: Decarbonization analysis of 47 prefectures** ***Lake Biwa environmental research institute*** **Dr. Kawase: Analysis of decarbonization and local resources in Shiga** ***Tokyo Metropolitan research institute for environmental protection*** **Dr. Katano, Dr. Okuno, Dr. Yamasaki, Dr. Koyano: Analysis of measures to decarbonize Tokyo**

Japan's reduction target

Japan's reduction target：2030　46%　2050　Carbon neutrality(CN)

■ Is it possible to realize CN in Japan by 2050?

✓ To achieve significant GHG reductions, it is necessary to promote energy conservation and electrification, introduce hydrogen and H2-based fuel and large amounts of renewable energy.

✓ Appropriate social transformation will increase the feasibility of a decarbonized society.

■ Decarbonizing the region to achieve CN Japan

✓ Declaration of net zero CO2 emissions: 46 prefectures, 1066 basic municipalities
→ Few municipalities have quantitative analysis.

✓ There are not many studies or mechanisms targeting prefectures for decarbonization.

■ Specific measures for CN and their impact

✓ Municipality-specific measures:
- Obligation to install PV in new detached houses (Tokyo)
- Transition to electric vehicles (Tokyo)

✓ Concerns about implementation of measures :
- Ecosystem impact, resource issues

What should be considered now to achieve CN

○Each region (municipalities, prefectures) has set reduction target to realize CN by 2050. Rather than each region aiming for CN, it would be more efficient to cooperate based on regional characteristics and aim to realize CN for Japan as a whole.

○Research on the relationship between decarbonization and other related local issues is also needed.

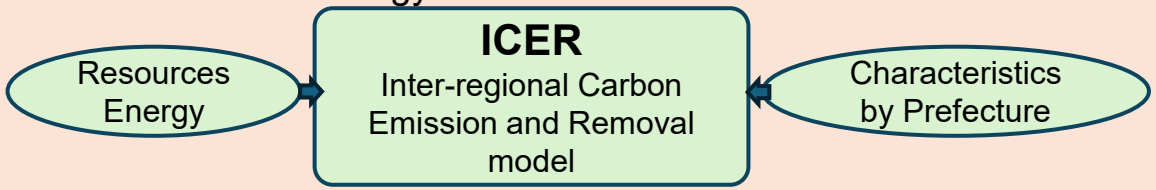
○A specific roadmap is needed according to the difficulty in spreading measures by 2050.

Analysis of Japan's decarbonization scenarios considering prefecture level measures
（FY2023～FY2025, NIES, TMRIEP, LBERI）

How should prefectures work toward decarbonization consistent with Japan's decarbonization vision?

(1) Decarbonization analysis of 47 prefectures (NIES)

Quantitative analysis of the introduction of measures consistent with Japan's decarbonization plan, based on the social and economic structure of each prefecture and the development of local resources such as renewable energy and forests.



ICER：Snapshot tool for hybrid (top-down and bottom-up) local decarbonization analysis

Barriers to adoption of measures

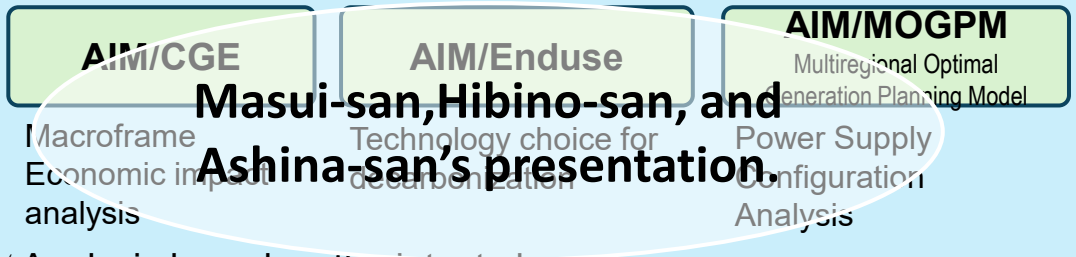
Power supply configuration, Service demand Negative emission technology

Local problem and resources, service demand

Sharing IO table by prefecture

(2) Japan's decarbonized society analysis(NIES)

Analyzing Japan's path to a decarbonization using AIM



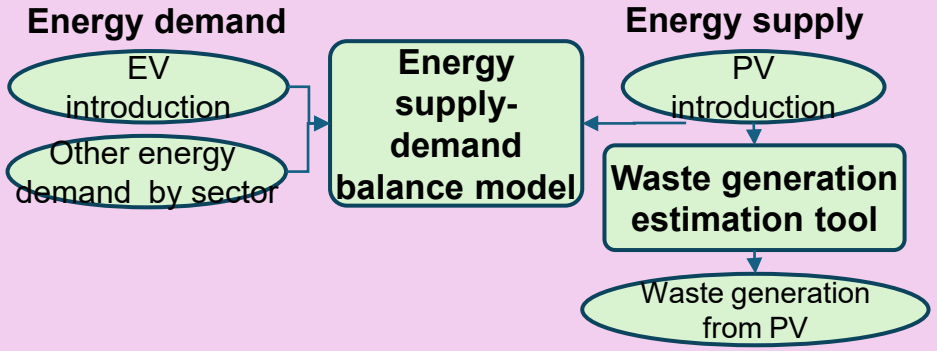
Masui-san,Hibino-san, and Ashina-san's presentation.

✓ Analysis based on the latest plans
✓ A Roadmap to decarbonized society (2030-2050)

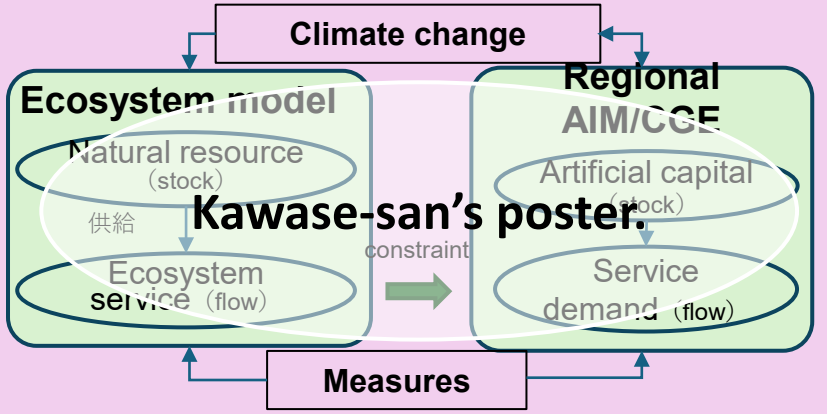
Local problem and resources

(3) Integrated analysis of local decarbonization and other issues (TMRIEP, LBERI)

(a) Analysis of electricity supply-demand balance and waste generation associated with mass introduction of PV and EVs in the Tokyo metropolitan area (Tokyo)



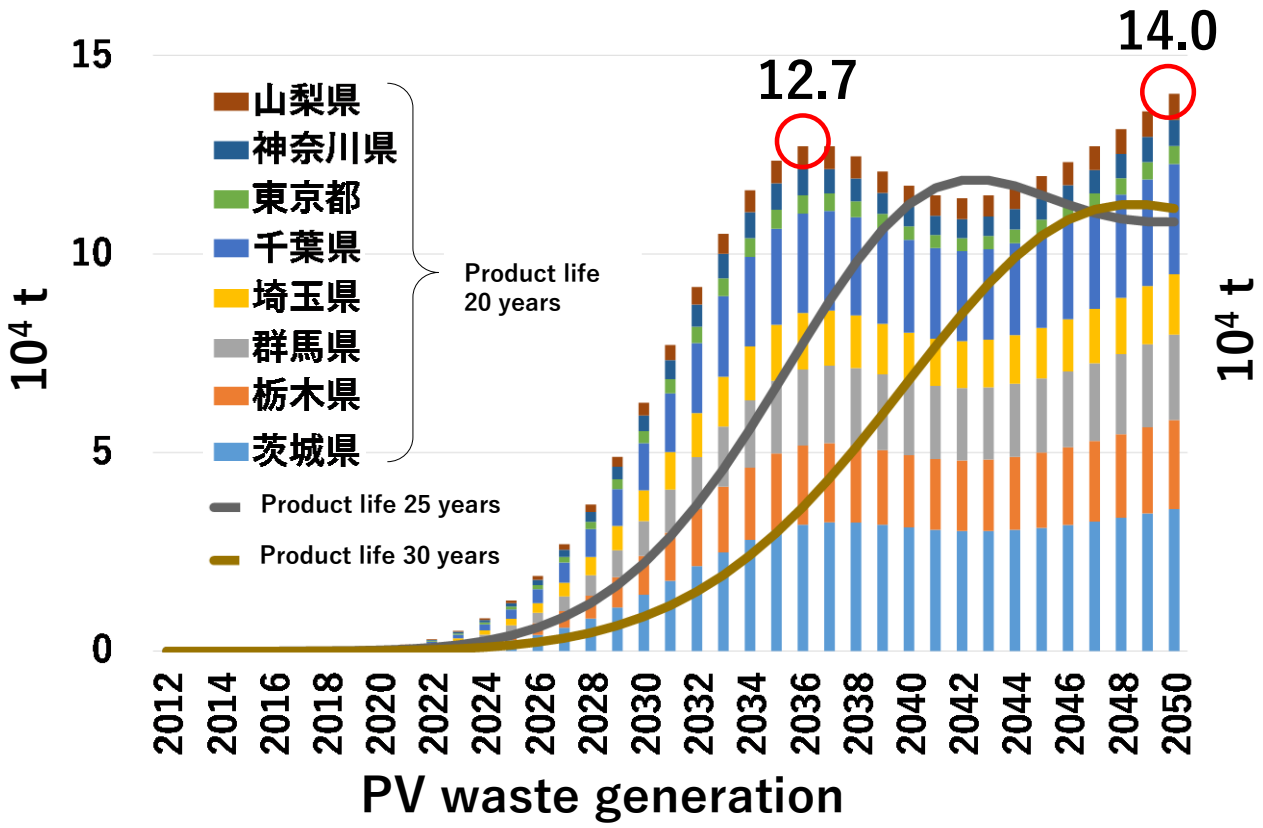
(b) Analyzing the compatibility of a natural symbiotic society and a decarbonized society with a focus on local resources in Shiga Prefecture



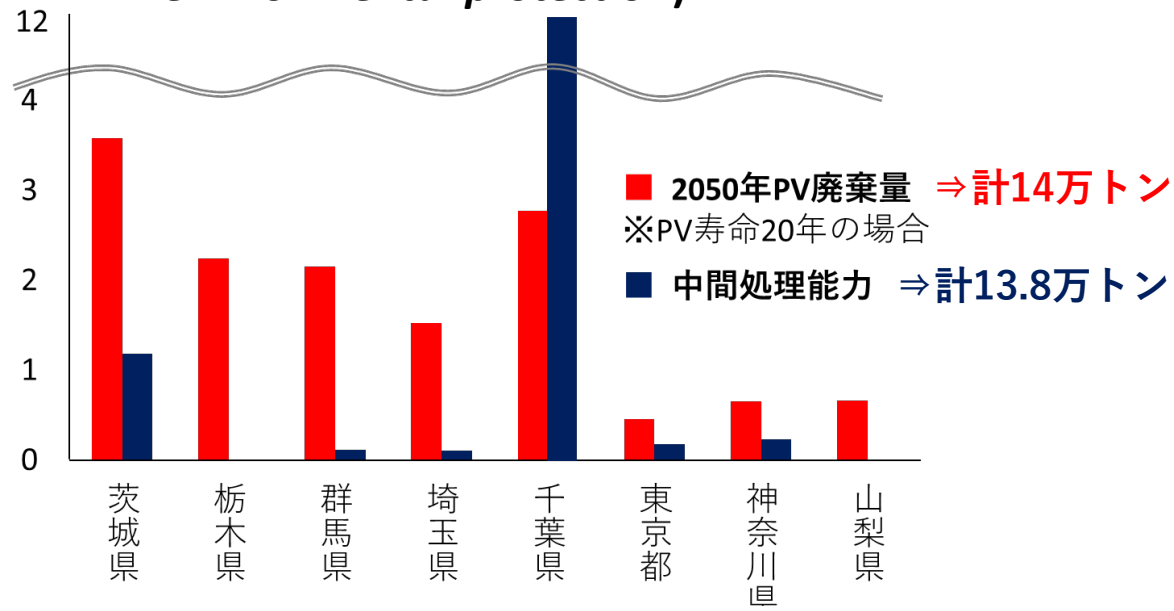
Kawase-san's poster.

Local climate change measures and local issues in Tokyo and Shiga

Tokyo metropolitan area
- PV & EV waste generation
- Energy demand
- Demand & supply balance of electricity in TEPCO's service area



Fujisawa-san's research
(Tokyo Metropolitan research institute for environmental protection)



Comparison between PV waste generation and intermediate treatment capacity in 2050

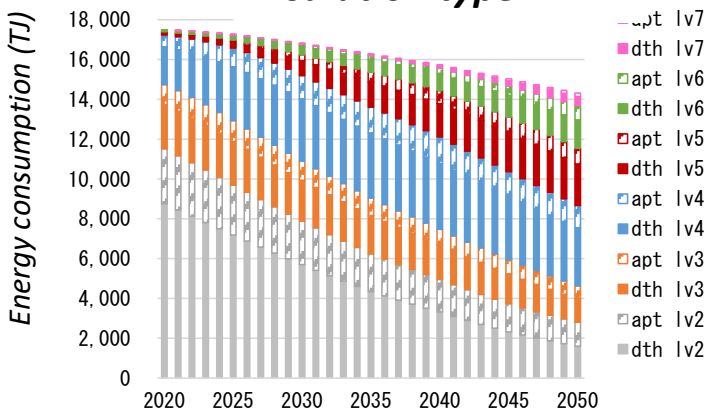
Local climate change measures and local issues in Tokyo and Shiga

Shiga prefecture
- PV waste generation
- Carbon sink by forests
- Energy consumption and CO2 emission in household sector
- Food demand
- Number of people transported for heat stroke

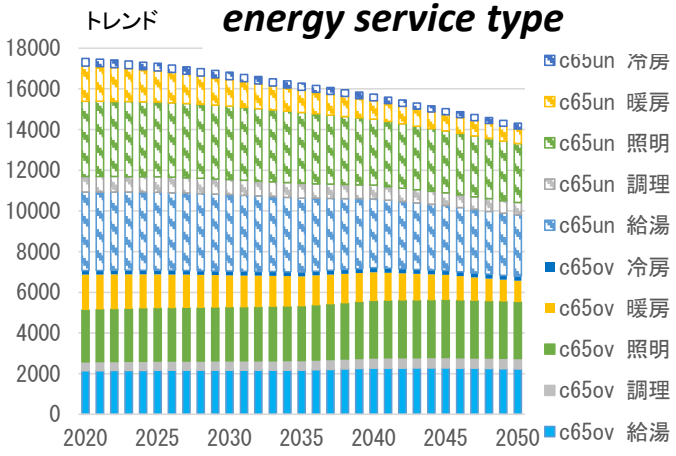
Model for estimating household energy consumption and CO2 emissions

Dr. Kawase's research (Lake Biwa environmental research institute)

Construction type × insulation type



Age of household head × energy service type



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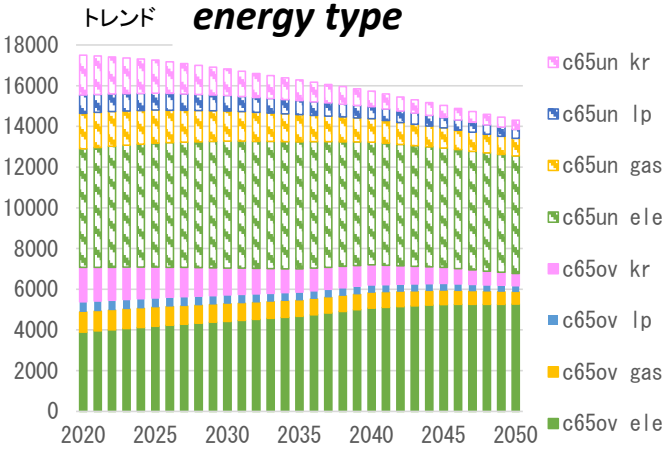

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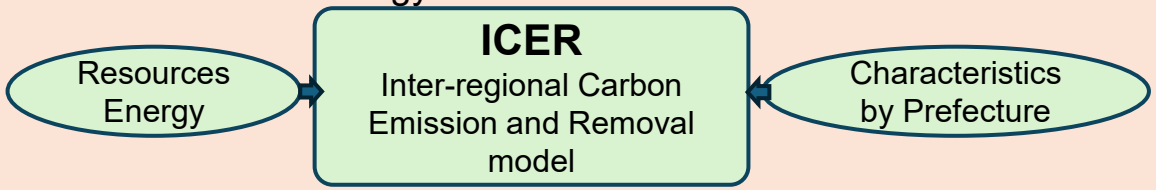

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Local problem and resources

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Analyzing Japan's path to a decarbonization using AIM

AIM/CGE	AIM/Enduse	AIM/MOGPM Multiregional Optimal Generation Planning Model
Macroframe Economic impact analysis	Technology choice for decarbonization	Power Supply Configuration Analysis

✓ Analysis based on the latest plans
✓ A Roadmap to decarbonized society (2030-2050)

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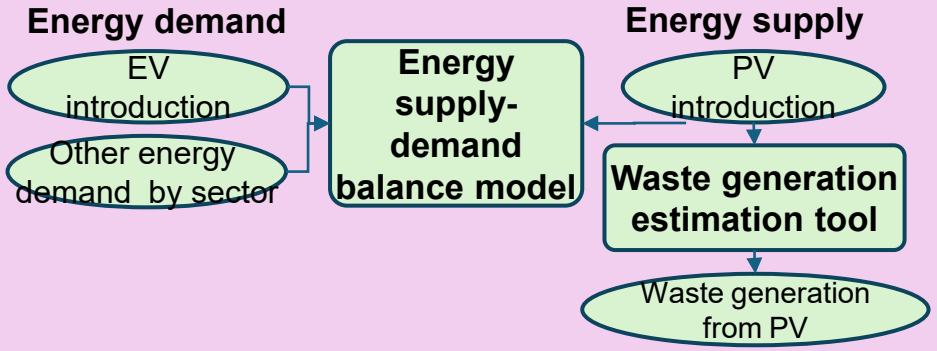

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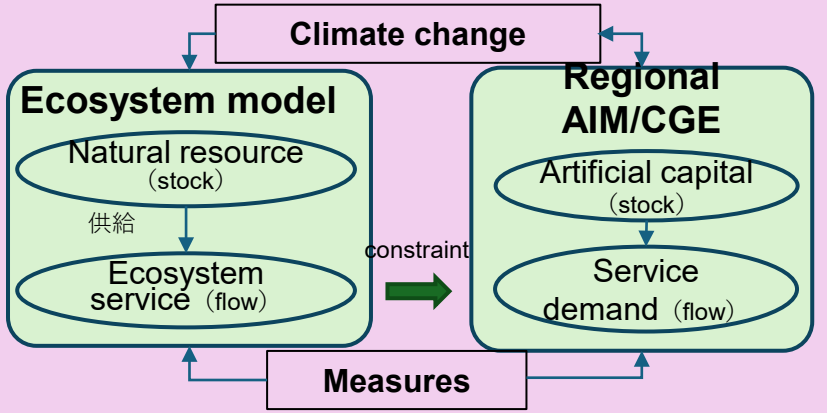
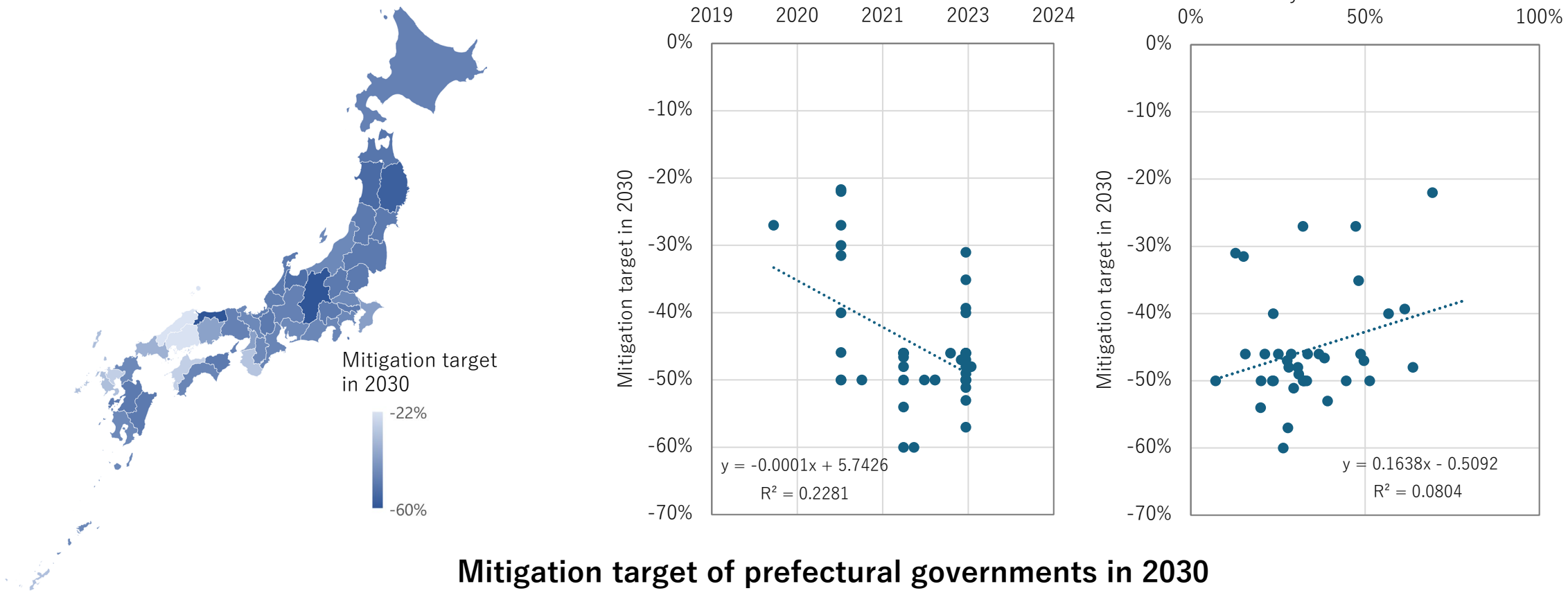


ICER* – Background of model and scenario development

*Inter-regional Carbon Emission and Removal model

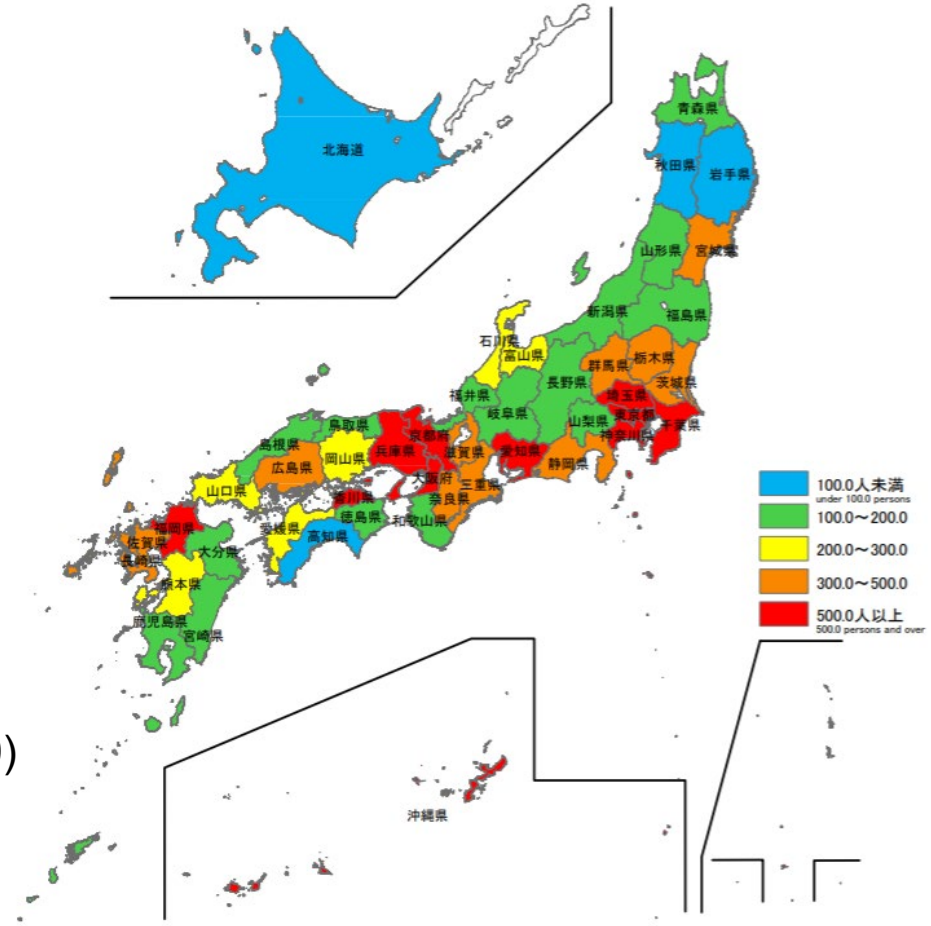
- Despite the carbon neutral declaration by many local governments, only three out of 47 prefectures have concrete plans by 2050 (Fukushima, Yamagata, Nagano).
- There is a significant difference in the 2030 mitigation targets.



Mitigation target of prefectural governments in 2030

ICER* – Background of model and scenario development

- Each prefecture has a different climate, land-use structure, population density, and industrial structure; hence, it has different energy demand structure, RE potential, and carbon sink potential
- Achieving the same CN target independently in each prefecture is almost obviously not reasonable.
- For Japan to be carbon neutral in a reasonable way, each prefecture will be required to make different contribution (energy saving, RE supply, forest management, etc.)



Population density by prefectuares (2020)

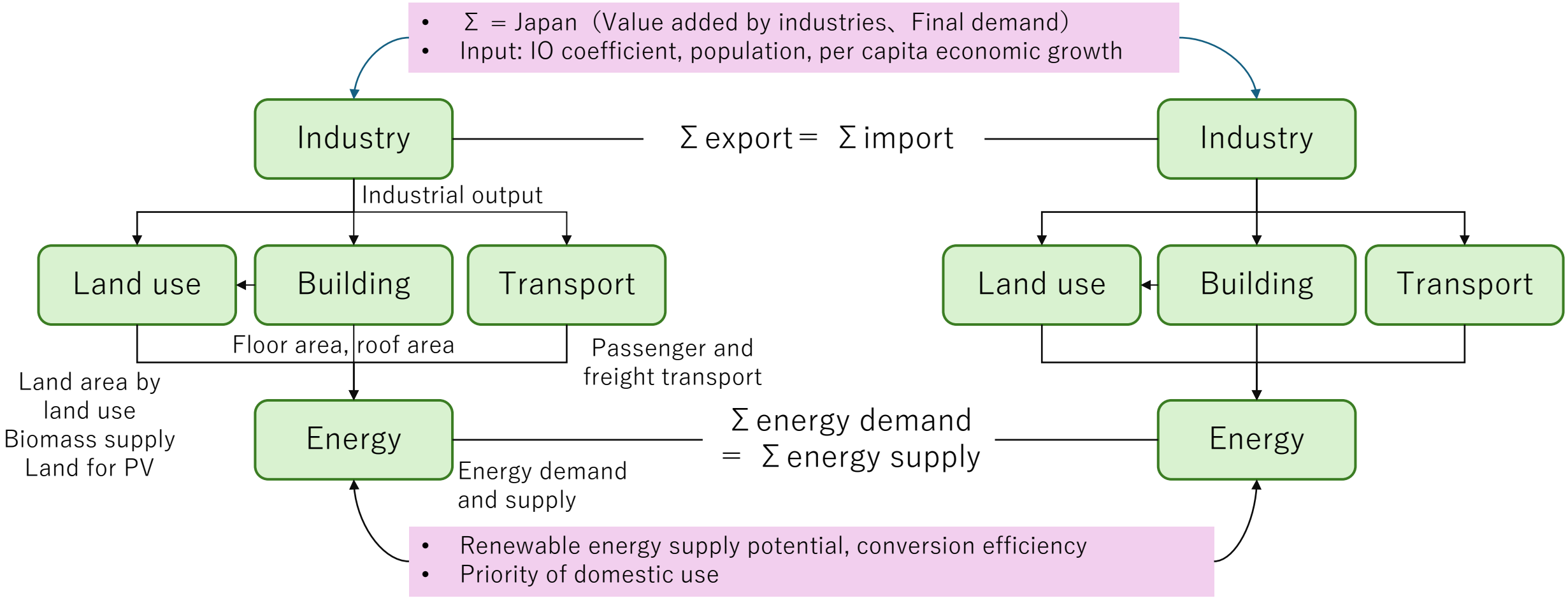
Max. Tokyo 6400 km^{-1}

Min. Hokkaido 65 km^{-1}

From: Statistics Bureau of Japan

Objective, design and structure of ICER

- ICER is to develop CN scenarios of all prefectures, which is consistent with Japan's national scenario, including socio-economic activities, energy demand, and supply, the introduction of mitigation actions, CO2 emissions, and carbon sink.
- ExSS (extended snapshot tool) is extended to the inter-regional version. Key points of development: (1) Sum of 47 prefectures equal to given Japan national scenarios (2) Inter-prefectural trade of goods and RE.



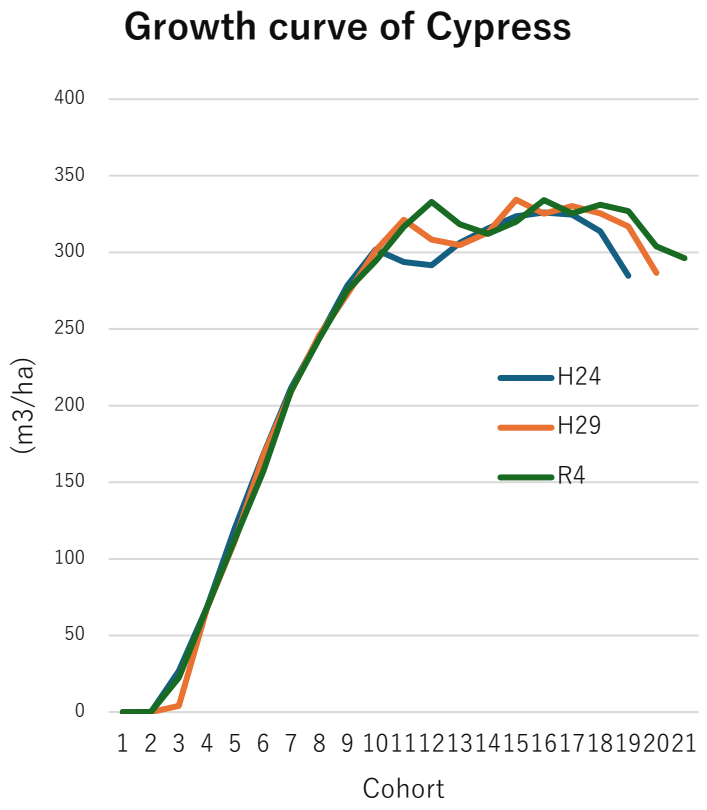
Progress

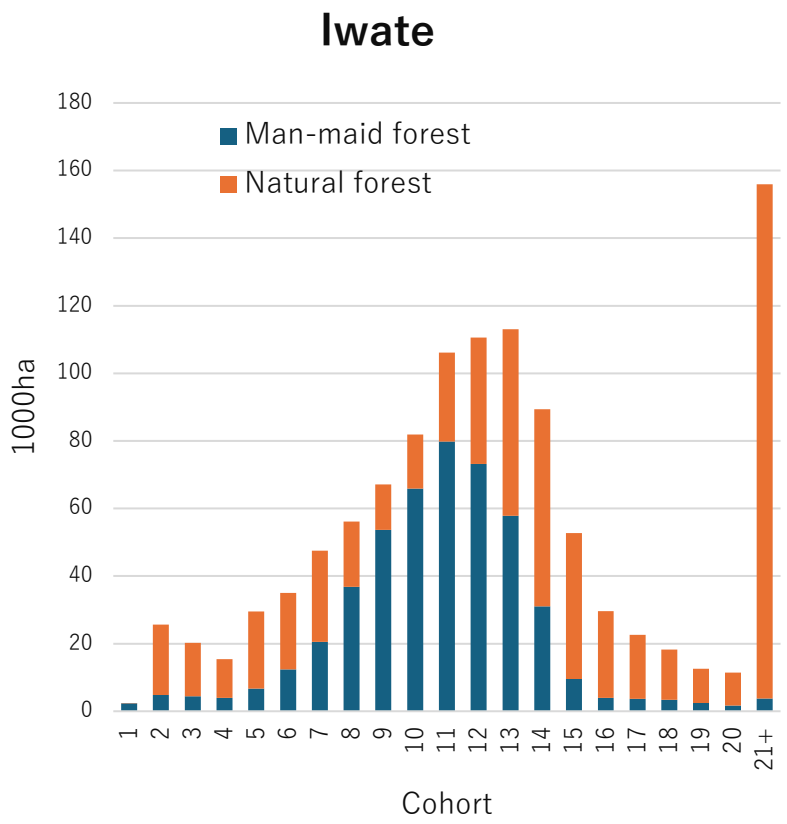
- Carbon sink by forest by prefectures
- RE potential* vs energy demand in 2050 CN scenario

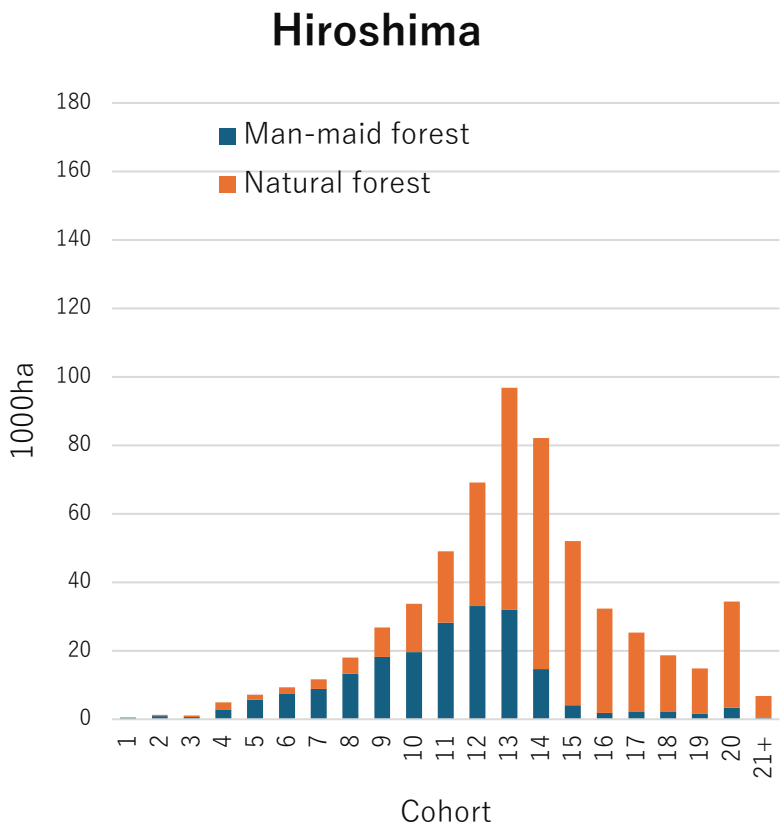
  *PV, on-shore wind, geothermal, and small hydro

Carbon sink by forest

- Carbon sink by forest by prefectures were projected using tree cohort data and growth curve.
- The cohort structures are significantly different by prefectures.

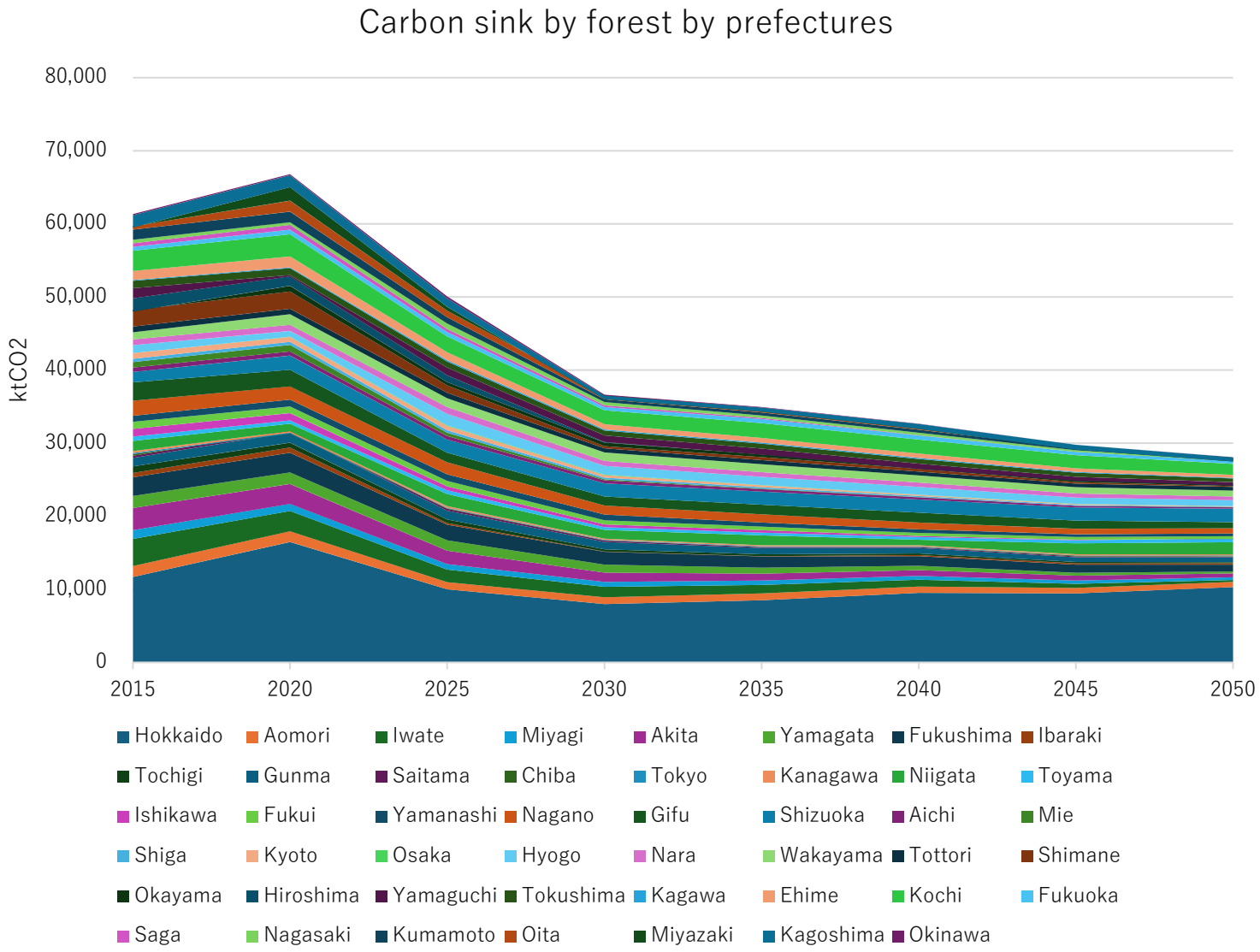






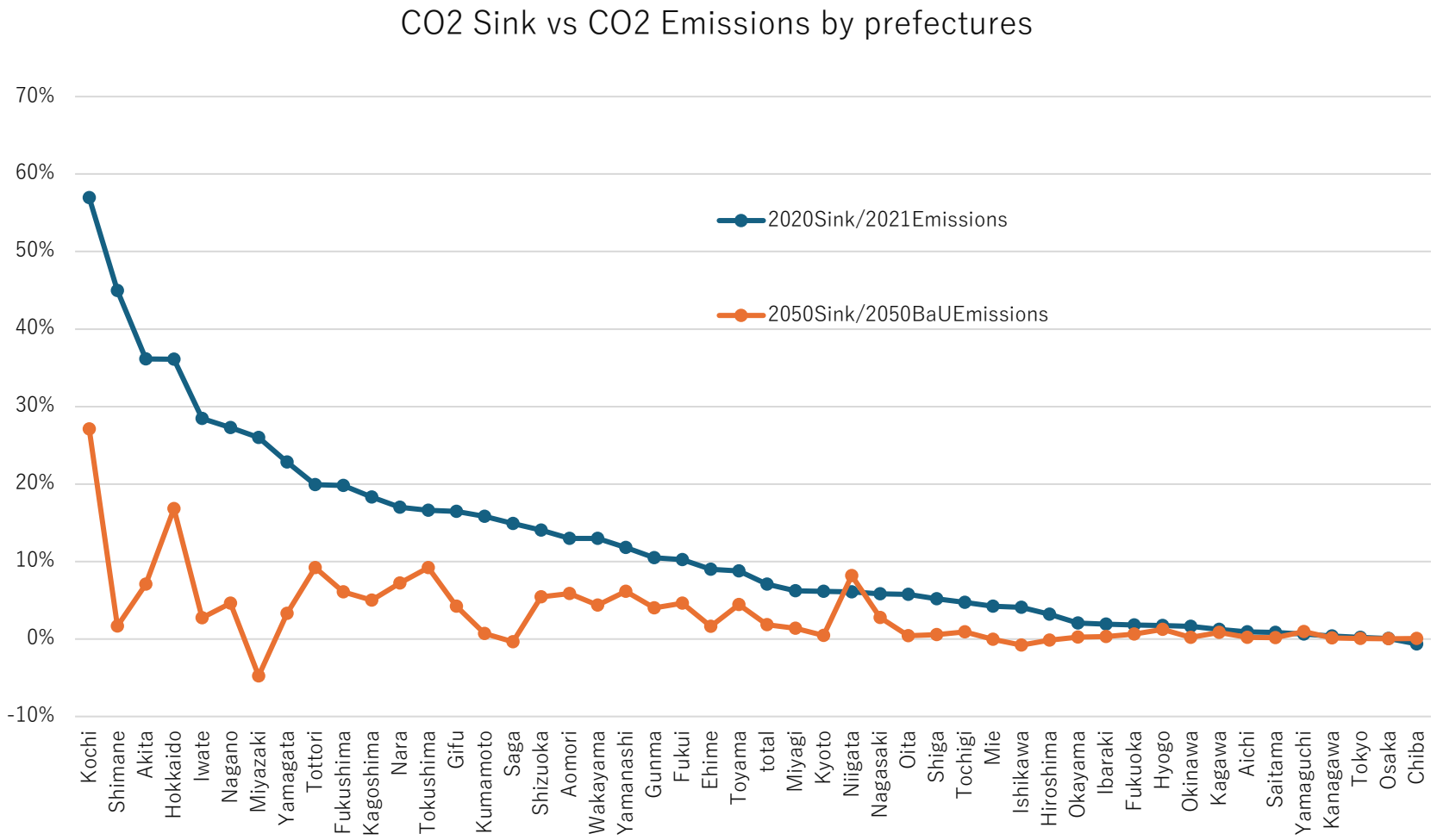
Carbon sink by forest

- Area of young cohort (<5) trees are relatively small in most prefectures.
- As a result, net carbon sink will be decreasing in the future in most prefectures



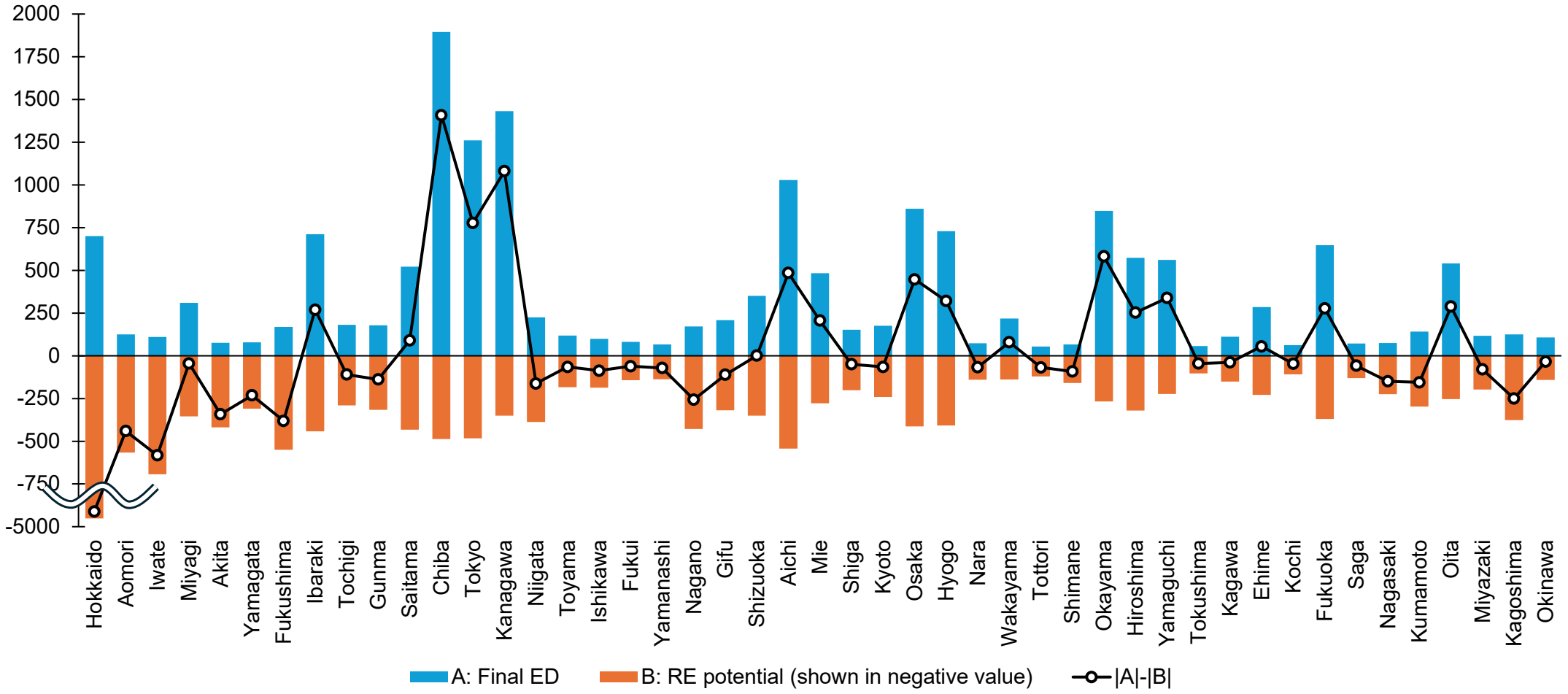
Carbon sink vs Emissions

- In 22 prefectures, the sink is more than 10% of the CO2 emissions currently.
- In 2050 BaU, sink of only two prefectures exceeds 10%
- It is less than 0.5% in 16 prefectures.



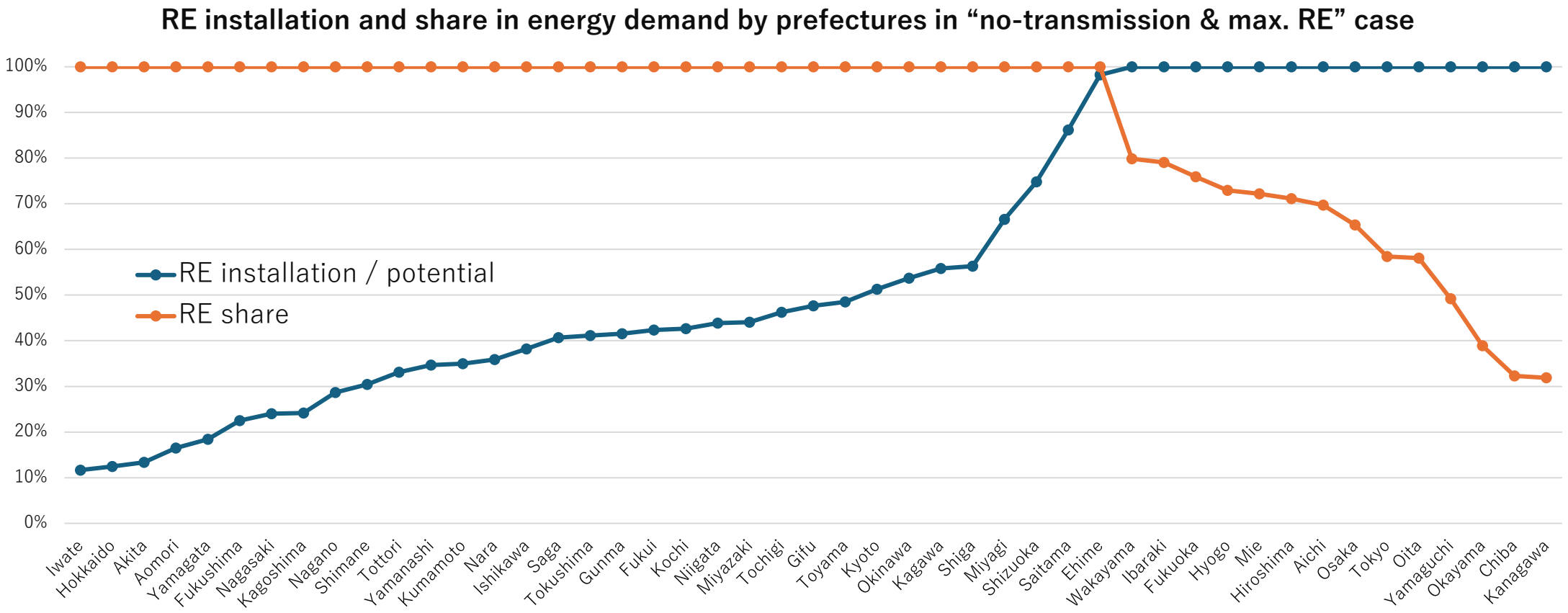
Current energy demand vs RE potential

- Total RE potential is slightly exceeding total demand. By prefectures, it varies from 24% (Kanagawa) to 627% (Iwate)



Energy demand in 2050CN vs RE potential

- Without inter-prefectural transmission of RE, 33 prefectures can fulfill their own demand.
- It covers 30.8% of total energy demand in Japan in 2050 CN



Next step

- Scope and detail of energy and carbon systems
  - Consideration of off-shore wind
  - Differentiate power and fuels, including green H2/CH4/NH3
  - Contribution of forestry to emission reductions by biomass fuel and product stock

- Scenarios
  ① Achieving CN targets independently in each prefecture
  ② Introducing an equal level of mitigation actions in all prefectures to achieve the national CN target
  - Projection of intermediate targets in 2035 and 2040.

- Provide information to prefectural governments for goal-setting, action, and co-operation among regions.