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Introduction

Background

According to the **Paris Agreement**, the Japanese government decided to reduce CO2 emission from energy use in 2030 by 25.0% compared to that in 2013 [1].

The Japanese government obliged prefectural government to formulated the **action plans of global warming countermeasure** according to the Act on Promotion of Global Warming Countermeasures .

The action plans include :

- **greenhouse gas emission reduction targets**
- Prefectural governments decided methods of setting targets **independently** [2].

Object

In this study, we investigated and compared the current CO2 emission reduction targets for each prefecture in Japan, clarified the problems, and proposed new methods of setting targets and target values for prefectures.

Method

Survey of Action plans in each prefecture

We reviewed public records of the action plans of global warming countermeasure in 47 prefectures in Japan to collect detailed information about methods of setting targets, base year, target year, CO2 emission in 2013, and targets of CO2 emission in 2030.

Table 1. Survey overview.

Research object	All 47 prefectures in Japan
Research period	2019/8 ~ 2019/12
Research reference	The action plans of global warming countermeasure
Research items	<ul style="list-style-type: none"> • Method of setting CO2 emission reduction targets • Base year and target year • CO2 emission in the past • CO2 emission reduction targets

Result

Current CO2 emission reduction targets

Methods of setting targets, base year and target year differ depending on prefectures. 33 prefectures set targets based on the Paris Agreement, while **14 prefectures have not yet revised**.

Table 2. Current methods of setting targets of CO2 emissions.

Method of setting target		Number of prefectures
Method that accumulates the reduction effects of countermeasures	From base year	4
	From target year	24
Method that divides the national target proportionally	Total target	8
	Sectoral target	5
Method that counts back from the long-term target		2
Others		4

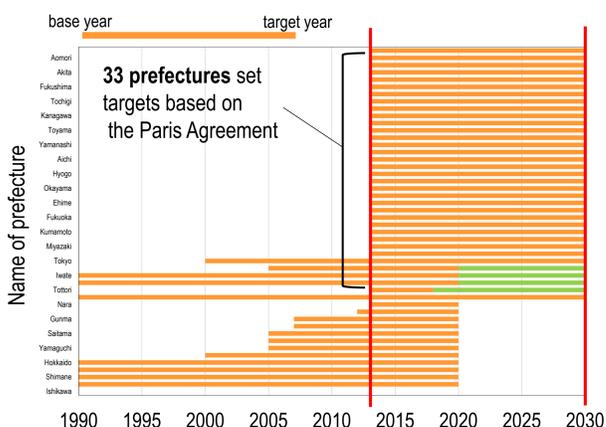


Figure 1. Base year and target year in action plans of prefectures.

Analysis

Comparison of target values

We compared the target reduction rates of CO2 emissions from energy use in each prefecture, considering population and GDP in each prefecture.

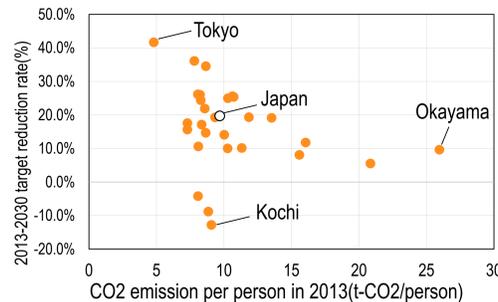


Figure 2. the CO2 emission per person (t-CO₂ / person) of each prefecture in 2013 and the target reduction rate per person in 2030 compared to 2013.

CO2 emission per person

The maximum : 25.96 t-CO₂ / person in **Okayama**

The minimum : 4.80 t-CO₂ / person in **Tokyo**

In prefectures where population is expected to decline, there is a possibility that **the target reduction rate per person may come out negative**.

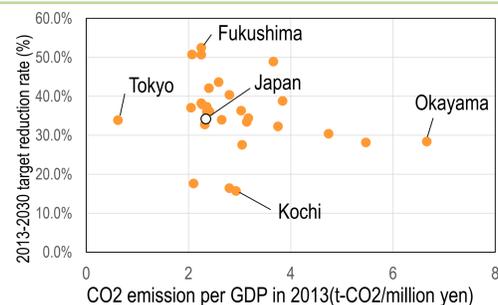


Figure 3. the CO2 emission per GDP (t-CO₂/million yen) of each prefecture in 2013 and the target reduction rate per GDP in 2030 compared to 2013.

CO2 emission per GDP

The maximum : 6.66 t-CO₂ / million yen in **Okayama**

The minimum : 4.80 t-CO₂ / million yen in **Tokyo**

Current Problems

- The method of setting targets in each prefecture is not uniform.
- There is a difference in the burden of the target reduction rate of CO2 emissions per person and GDP in each prefecture.
- It is difficult to evaluate whether targets are appropriate to be archived by 2030.

Proposal <Unified methods>

Proposal of unified methods of setting targets

By unifying methods of setting targets adopted by each prefecture, consistency between target values of prefectures and the target value of Japan is ensured. We propose unified 4 ways to set target values. We evaluate ways from 3 viewpoints.

Table 3. Proposal of new unified methods.

Method of setting target	Consistency with the national target	Reflect the industrial structure	Consistency with the national countermeasures
1) Set CO2 emissions per person as target values for all sectors based on population	Yes	No	No
2) Set CO2 emissions per GDP as target values for all sectors based on GDP	Yes	No	No
3) Set the volume of activity for each sector and set target values for each sector respectively	Yes	Yes	No
4) Set the volume of activity for each sector and accumulate effects of countermeasures	Yes	Yes	Yes

- Plan 1 uses **population** and Plan 2 uses **GDP** as the activity volume for calculating target values.
→ Not fully reflect the characteristics of local governments.
- Plan 3 sets the volume of activity for each sector and set target values for each sector respectively
- Plan 4 aims to ensure consistency with national countermeasures to reduce CO2 emissions based on Plan 3.

Proposal <Calculation target values>

An example of calculation target values

We calculated CO2 emissions target values by methods in Table 3. For example, Figure 4 shows new target values proposed by Plan 4.

Future CO2 emissions from energy source

$$= \text{activity volume} \times \text{energy consumption intensity} \times \text{carbon intensity}$$

Table 4 shows the activity volume for each sector to calculate

Table 4. Activity volume in each sector.

Name of sector	Activity volume	
Industrial Sector	GDP	
Manufacturing Industry	Manufactured goods shipment	
Construction and Mining Industry	Number of employees	
Agricultural Forestry Industries and Fishers	Number of employees	
Commercial and Other Sectors	Number of employees	
Residential Sector	Population	
	Household	
Transportation Sector	Population	
	Car	Number of owned cars
	Railway	Population
	Ship	Arriving ship tonnage

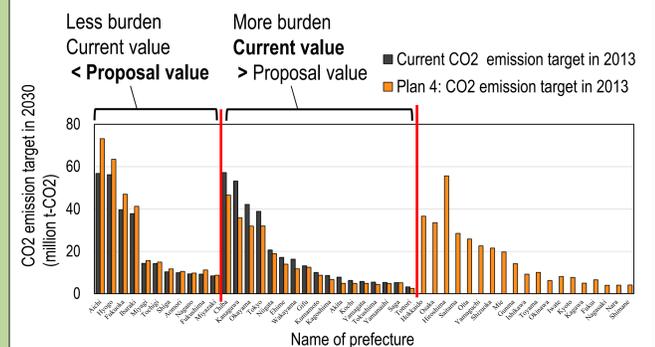


Figure 4. Current and Plan 4 CO2 emission target in 2030.

Target reduction rate in 2030 compared to 2013 (Plan 4)

The maximum : 56.3% in **Nagasaki**

The minimum : -7.1% in **Hiroshima**

Conclusion

In this study, we investigated the action plan of global warming countermeasures in Japanese prefectures and clarified the problems. At the time of the survey, methods of setting target, target year and base year were not unified by prefecture. Therefore, we proposed multiple unified methods for the future, calculated new target values and compared them.

Reference

- [1] Ministry of the Environment 2015 *Submission of Japan's Intended National Determined Contribution* Online: <https://www.mofa.go.jp/mofaj/files/000090897.pdf>
- [2] Ministry of the Environment 2017 *Manual for formulating the action plans of local governments (area measures)* Online: https://www.env.go.jp/policy/local_keikaku/data/manual_main.pdf
- [3] Statistics Bureau of Japan 2019 *Chapter 2 Population by gender, prefecture and gender ratio of population* Population estimation in 2018
- [4] Cabinet Office 2016 *Prefectural Economic Calculation (2006-2016)* 11 prefectural GDP
- [5] Statistics Bureau of Japan 2019 *Labour Force Survey 1 Results*(Basic Tabulation)
- [6] Ministry of Economy, Trade and Industry 2018 *Industrial statistics survey 2018 definite report* Industry statistics

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