

# Study on Evaluation of Social Systems for Climate Change Mitigation in terms of Japan's National and Regional Scales with Quantitative and Qualitative Picture

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**ABSTRACT:** This paper discusses the structuration of policies and emission data for climate change mitigation with both national and regional scales in Japan. Many political researches of the environmental issues and modeling researches of greenhouse gas emission are already done separately, however there are the difficulties to manage the roadmap for low carbon society. This study focuses on the relation between how the policies have been going on and how to make, from the emission data, the reduction targets of emission and policies for future scenario.

From the historical review of the mitigation policies, it can be said that the most of these in local cities are operated by central government with the reactive manner. On the other hand, few local cities are positive to take the innovative mitigation in the proactive manner; however the feasibility and effectiveness of roadmap for mitigated reduction target are not always related to the activeness for that target.

From the reviews of the available emission data and the mitigation policies it can be pointed out the questions to join the qualitative policies and quantitative emission reduction to manage a roadmap for future vision of low carbon society as the structural issues. The question is that, although it is needed to discuss individually the roadmap for low carbon society in local areas, emission data of current status are not calculated with small scale in most of situations. These phenomena can't lead the systems of cities to innovative changes. One of these reasons is that the boundaries of local area for calculation of emissions are not always clear.

It is also emphasized that it is important to be considered the composite nature about a wide range of issues so that low carbon society or emission target is only one aspect of the society.

**KEYWORDS:** Roadmap, Future Vision, Low Carbon Society (11pt, align left, less than 3 keywords)

## INTRODUCTION

The amount of greenhouse gas emission in the world is rising while mitigation is negotiated at United Nation of Framework on Climate Change Conference (abbreviated as UNFCCC) from 1995. Japan became the world's fifth-largest volume of greenhouse gas emission from 2005 replaced by India that became the world's fourth-largest one. The numbers of emission reduction for developed

countries are assessed in Kyoto Protocol which was adopted in 1997 at UNFCCC. The commitment period of Kyoto Protocol is from 2008 to 2012, therefore the main negotiation agenda has shifted from around 2005 to future framework for beyond 2012. Although these negotiations have difficulties as usual, the Copenhagen Accord as political agreement of future framework was taken note in 2009. Just before that in 2009, Japan with Liberal Democratic Party clarified the internal reduction

\* Viewpoint expressed in this paper are solely those of the author, and do not necessarily represent the views of the National Institute for Environmental Studies (NIES).

number as 15% (base year: 2005) by 2020 (equal to 8% of reduction if base year is 1990). Soon, Japan had experience the political change to Democratic Party that declared the reduction number as 25% (base year: 1990) by 2020. This total emission target doesn't accord the concrete measurer in each area. There are the gap between the inclusive target and measure as far as that is concerned.

### **1.1 Framework of Research**

Recently, it is aimed at low carbon society which is inclusive action of whole society while it can be mentioned the efficient technologies or renewable energy as climate change mitigation. However, the complexity mechanism of society caused many complex issues other than too much of energy consumption. The balance between these fundamental issues and the mitigation options is required.

This paper discusses the quantitative picture and qualitative picture of policies and actual status based on scenario for future vision with both national and regional scales in Japan. Section2 mention about the scenario approach for both scales. As scenario and decision making are different stage, to point out how the policies have been going on and how to make, environmental policies were reviewed in section3. Following these discussion about national and local vision of scenario and policies, characteristics of municipalities are evaluated in quantitative manner in section4. And then, concluding remarks are given in section5 to show the challenge of low carbon society with better life.

## **2. SCALES FOR SCENARIO APPROACH**

### **2.1 What is the Scenario Approach?**

It is said that the measures and reduction potential have to be analysed to determine the national

reduction target. The other side, the changing of social and economic style can lead to reduce the emission. These aspects that depend on each other, are making arise the research of assemble the quantitative aspect of economical and social index and the qualitative aspect of storyline as scenario. The scenario planning is the approach to project the various available future states (Schwartz, 1991). Story and Simulation approach is the methodology to draw a future scenario combining quantitative and qualitative analysis (Alcamo, 2001). The projection of future state from scenario approach that includes the selectivity and arbitrariness is essential to discuss future with global environmental issues (Matsuo et.al. 2001).

### **2.2 Scenario and Modeling for Low Carbon Society in National Level**

The question of how to choose the pathway for low carbon society is to be considering in national level for one side. Scenario doesn't use only forecast but also backcast with the consideration of various uncertainties. Ehara et.al. drew two types of future vision for Japan. These visions include the normative message in snapshot of social picture for future (Ehara, et.al. 2007). Scenario is made to drive for these kinds of future vision. Radically, the reduction number is not the target but the constraint; however the first step to draw the vision is to set the target of policy on reduction number. In this Japan's future vision, the target is to reduce 60%-80% of CO2 emission compare to 1990 level with the condition of 2% of growth per capita for one side of vision and 1% of growth per capita for other side. Modeling calculation evaluates quantitatively the future scenario that is made from the future vision. Masui et al. show the pathway for social and economical picture in 2050 that realize the reduction target of 70% compare to 1990 level, with dynamic optimize

model of technical measurements. The result of this model that sets to start the carbon constriction from 2030 and to realize 70% of reduction in 2050 is that some measures are introduced before 2030 with the rise of GDP and all measures will be introduced after 2040 with the negative influence of GDP (Masui et.al. 2007). This is useful to examine the economic activities in national scale for mitigation; however it can't touch enough the indirect activities that also change the society for low carbon. It is important to recognize that CO2 reduction is the constraint while CO2 reduction is set as a target in the scenario for low carbon society. Although GDP is used for the wealth index, the other index like good life is to be considered generationally. It is needed to consult the local state so that the better life without GDP is considered.

### **2.3 Base of Scenario for Low Carbon Society in Local Level**

There are few researches about local level of future scenario. The existed data of local emission in a comprehensive way as public data is only the Environmental White Paper of Municipalities. A few available emission data in local area cause the difficulties to consider the scenario for future. There is one example of research which gathers the local data of transportation sector. It is estimated the reduction of 70% of CO2 emission in transportation sector in total by calculation of sum of four groups of cities that seeing the feature by dimension (Matsubishi, 2007).

Once the future vision in local is given, considering the scenario is the next stage. To draw the future scenario, the case studies that clarify the indigenous things are needed however the importance is not only increasing of case studies but also to pick up the local element that consist of national structure are important.

From the case study of governance of public transportation in local cities in Japan, Murayama suggested about the interactions among the issues through the scale. The key is scaling up the each issue in local while balancing of issues between global and local (Murayama, 2009). The quantitative and qualitative researches that connect of future scenario of global term to in local term are required.

## **3. SCALES FOR POLICIES OF MITIGATION**

### **3.1 Scenario and Decision Making**

Setting of the political target is important to consider the scenario. As political researches of the environmental issues and modeling researches of greenhouse gaz emission are operated individually, these researches don't go well with each other.

Existed researches of consideration of scenario by analyzing the feasibility is the quantitative evaluation of technological potential for CO2 reduction. Fujino et al. evaluated and developed Japan's scenario of technological potential for 70% of reduction by 2050 (Fujino, et al. 2007). Although this technical and economical quantitative feasibility is important, it is not directly linked to concrete decision making or policy. It is also important to recognize that scenarios stress irreducible uncertainties that are not controllable by the people making the decisions unlike forecasts (Peterson, 2003). Once the scenarios have been developed, the linkage between scenarios and decision making is required in the light of fruition of vision.

### **3.2 Research of Political Side**

Most of the researches of environmental issues in social science are in domain of economy, sociology, legal and political science. These research targets are almost local government level or case studies with

analyzing framework of actors (Mori, 2000). Mori indicated lack of the research on macroscopic analysis of central government and the characteristic of environmental issues, and the needs of consideration with historical institutionalism. To observe the process and institutional structure of Japan's mitigation policies, the past environmental policies until 1990 are given a quick once-over here. Government of Japan has been Liberal Democratic Party for 38 years until 1993, which takes an economical-line mainly. From 1960, as elicited the pollution, each ministries has committed the environmental issues as a connection of each interest and policies. From the situation that environmental policies are parallel in working-level of ministries, it can be said it is the policy region of non-decision (Mori, 2001). However, Liberal Democratic Party has to commit the environmental issues to correspond with opposition. Added to which, Environment agency was established in 1971 because the environmental issues became something that must be done. These means shifting environmental policy side are that the establishment is for political institution as the solution of government that harmonizes policies at the initiative of politicians (Mori, 2001). As the environmental impact assessment became a dead letter, the economic-line is still in policy. At the same time, Environmental Agency was seeking the original value (Mori, 2001).

The changing of governmental commitment is observed around 1989, to follow the global movement. Years of 1990 are the starting of environmental policies influenced by global moral tone. In 1990, the action program to arrest global warming was developed. As Japan doesn't have the comprehensive system of law about environmental issues including the prevention measure, Environment Agency prepared this kind of fundamental law. At this time, it is more smoothly

than environmental impact assessment because the government has made interest at international movement for global environment.

### **3.3 Mitigation Policies and Correspondence in Local**

This section focus on how the policies for climate change mitigation have been going on in Japan and the influence in local. Regarding the population of Japan, there is an increasing of 3 million in 1990s. It still increases until 1998. Now is a decreasing population period. In any case, government takes the helm to good compatibility between the environment and economic activity.

Kyoto Protocol was adopted at UNFCCC in 1997 which influence Japan's government to lead mitigation policies. In this regards, Law Concerning the Promotion of Measures to Cope with Global Warming (abbreviate as LCPM) was established in 1998 in the period of instability of government.

From 2001 to 2006, Liberal Democratic Party backed to the government party stability. An implied statement from the declaration of Prime Minister Koizumi was traditional economic growth line that the issues of climate change can be solved with science and technologies. In 2002, Japan ratified the Kyoto Protocol; however there is no grand action in political level. Proceedings were only for the energy policies in terms of energy securities and economy.

In 2005 the year that Kyoto Protocol entered into force, the government formulated a Kyoto Protocol Target Achievement Plan in accordance of LCPM.

In Third Basic Environmental Plan in 2006, the preparation of coherent data across the country about the environmental situation is required to the government while it is mentioned that the role of municipalities are important.

Next Prime Minister Abe declared in 2007 to take a course of environmental policy including the

medium-to long-term mitigation policy as a first time in political level. The helm is taken to climate mitigation policies at political level.

Japan has used explicitly the word “low carbon society” in policy from 2008. Prime Minister Fukuda made the speech in 2008 just before the summit, that Japan has the prospect of 14% of greenhouse gaz reduction compare to 2005 by 2020 with the title of low carbon society. Medium-to long-term 60-80% reduction target of greenhouse gaz is mentioned on Action Plan for Low Carbon Society which was approved in a Cabinet meeting.

According to municipalities, the theory that point out the lack of the local government is dominant until the conception of different theory that the political competitions from bottom up make a stipulation of the relation between local and central in 1980s (Muramatsu, 1988). By the same token, local governments had leadership to establish the Basic Environmental Code or Plan for the global environmental issues. In this regard, local governments are positive to take the mitigation in the proactive manner; however it can't be said that it promote the implementation of mitigation.

In accordance of LCPM, local governments including the big cities have to develop an implementation plan about its operation and activities within region, while the other cities are suggested to develop its plan. The driving power of development about regional comprehensive measurements plan is limited. The implementation plan formulated by the local government or municipalities is weighted toward the measure of short-term effectiveness or edification activities like promotion of public transportation. It can be said that the most of these plan in local cities are operated by central government with the reactive manner. On the other hand, few local cities are positive to take the innovative mitigation in the proactive manner; however the feasibility and effectiveness for

mitigated reduction target are not always related to the activeness for that target.

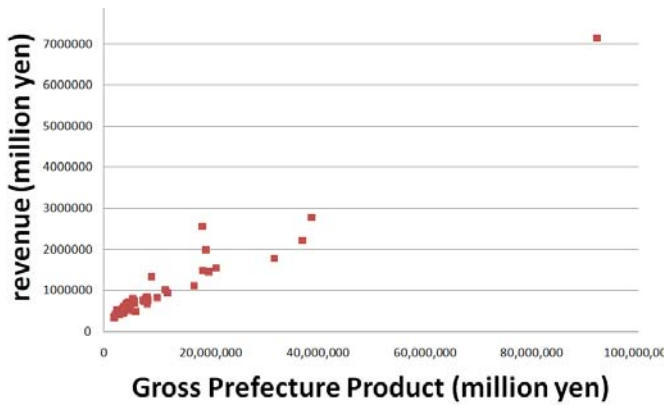
#### **4. CHARACTERISTICS OF MUNICIPALITIES**

How to formulate the comprehensive measurements to be a low carbon society in municipalities? Before consideration of governance, it is better to know the actual quantitative situation of CO2 emission. Trends of municipalities are considered here with the data of CO2 emission and some data of dimension about municipalities.

##### **4.1 Data of Municipalities**

The CO2 emission data is from White Paper on Environmental Policies of Municipalities in Japan that estimate each emission of Industrial, Commercial, Residential and Transportation sector per municipality. Because of boundary problems, it is difficult to classify the emissions of transportation or industry which belong interzone. In these records, industrial CO2 emission is estimated from the address of the office while transportation CO2 emission excluding the rails is estimated from the number of vehicles.

As the lack of the public comprehensive data of Gross Municipalities Product, revenues of municipalities are used here. The data of revenue is from Ministry of Internal Affairs and Communications. Fig.1 that shows relation between revenue and Gross Prefecture Product for 47 prefectures in Japan 2007, reveals a correlation. The number of municipalities utilized is about 1750 as data include.

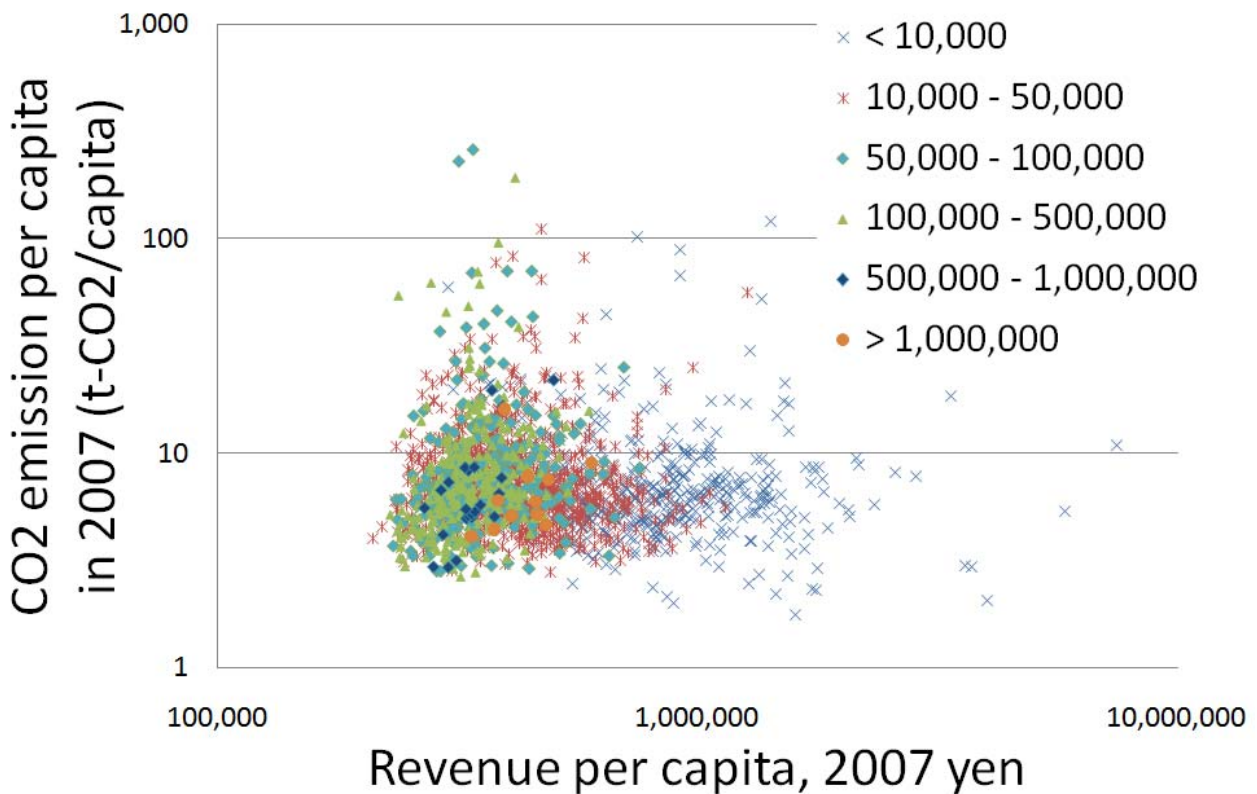


**Fig. 1 GPP and Revenue of Prefectures in Japan in 2007**

**4.2 Types of Municipalities by CO2 Emission and Revenue**

Regarding the relation between carbon emissions per capita and GDP per capita (2000) of 5 country groupings, the regression lines can be drawn for each group (Grubb, M., 2006). In a contrasting situation it is dispersed for the municipalities in

Japan as shown in Fig.2. This figure shows the relation between CO2 emission per capita (t-CO2) and revenue per capita (yen) in 2007 for each municipality of Japan, in logarithmic coordinates for both axes. The points of graph classify into six categories depending on the number of population. We can see two types of tendencies that the range of revenue is wide while CO2 emission is low and the range of CO2 emission is wide while revenue is low. The municipalities of which the population is between 10,000 and 50,000 spread with these tendencies. The broadening of the CO2 emission is observed additionally for the population number between 50,000 and 500,000. The group of which population is more than 500,000 and less than 1,000,000, is still low for both CO2 emission per capita and revenue per capita. The municipalities of which population is less than 10,000 are mainly still low for CO2 emission per capita with the broadening of the revenue per capita. The reason that some



**Fig. 2 CO2 Emission per Capita and Revenue per Capita in 2007 of each municipality of Japan (both axes are logarithmic coordinates)**

municipalities of which population is less than 10,000 show the high score of CO2 emission per capita, is almost high level of emission from industrial sector. The growth of CO2 emission from industrial sector in some municipalities is not always negative, if more than same amount of CO2 emission decrease in some municipalities by way of compensation. The analysis of the breakdown of revenue is required to estimate whether if it is possible to manage the social system for low carbon society. The revenue of municipalities is for various topics while the measures for low carbon society are not only the technological and economical one but also comprehensive sustainable and well-being one. It means that it is necessary to consider the possibilities of managing the revenues for low carbon society and well-being society in a ways of sustainability.

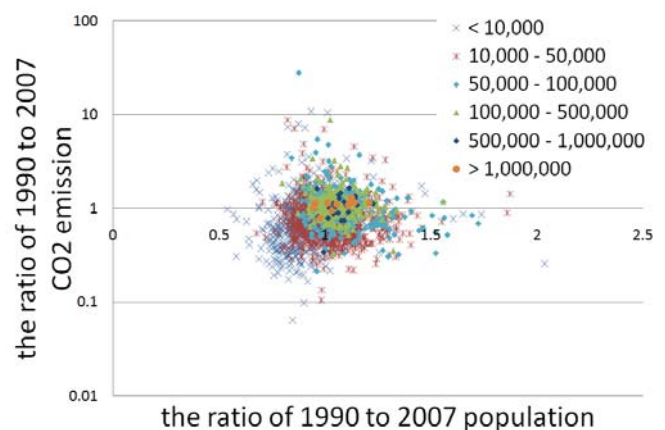
#### 4.3 Passage of CO2 Emission and Population

The social situation is changed in several years. If the augmentation of population makes the increment of CO2 emission then does the decreasing of population make the decrement of CO2 emission? The answer is no because the CO2 emission includes the emission from industrial and commercial sector which are not concernment directly with population in local.

Fig.3 shows the relation between the ratio of 1990 to 2007 of CO2 emission with logarithmic coordinates and the ratio of 1990 to 2007 of population. The graph classify into six categories depending on the population number. The group which the population of municipality is more than 1,000,000, increases the ratio of population with just such augmentation of CO2 emission. The tendency of groups is almost on the line from the ratio of CO2 emission and population are low to both are high, respectively from the group of less than 10,000, of 10,000-50,000,

50,000-100,000, to 100,000-500,000. The smaller the population of municipalities the wider range of the ratio of CO2 emission. The population of smallest group almost decreased however there are some municipalities that the CO2 emission increased largely. It can't be said from these increasing that the amount of CO2 emission is large; however the causal factors are required to estimate.

There is the number of municipalities that the CO2 emission decreased with the augmentation of population. The possible reason of these decreasing of emission without the movement of industries or effectiveness of technologies is the changing of life style. Proportion of these account and process of changing are required to estimate.



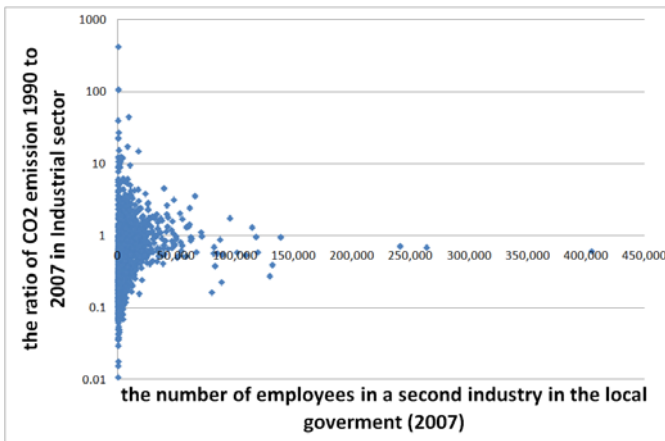
**Fig. 3 The Ratio of 1990 to 2007 of CO2 Emission and Population (vertical axis is for logarithmic coordinates)**

#### 4.4 Passage of CO2 Emission by Sector and Employees

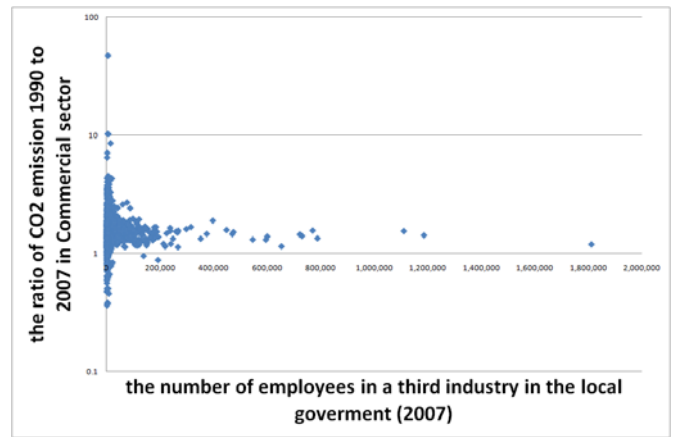
The graphs from Fig.4 to Fig.6 show the relation between the ratio of 1990 to 2007 of CO2 emission, respectively in industrial sector and the number of employees in a second industry in the local government in 2007 (Fig.4), in commercial sector and the number of employees in a third industry in the local government in 2007 (Fig.5) and in residential sector and the number of households in

the local government for municipalities in Japan in 2007 (Fig.6).

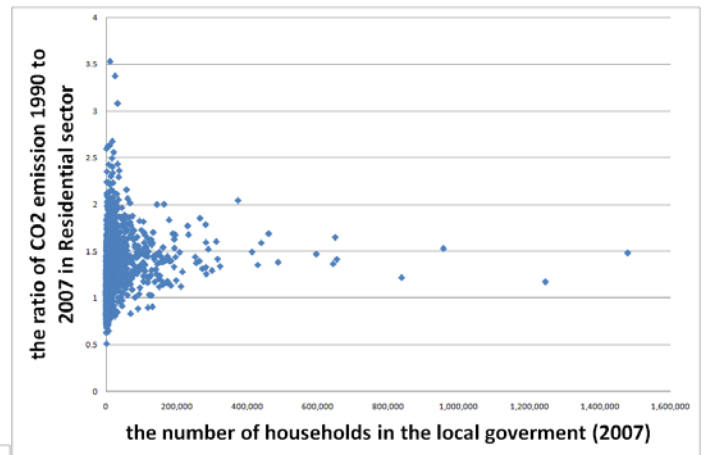
The ratio of growth and the decreasing of CO2 emission from industrial sector are similar regardless of employees while the smaller the number of employees in each municipality, the wider the range of rate (Fig.4). Most of the municipalities increased the rate of CO2 emission from residential. The number of municipalities of which the employees are less than 10 thousand is large while the smaller the number of employees in each municipality, the higher the ratio of emission (Fig.5). There is a lack of policies of government in smaller organizations differently from the large organization. Consideration of policies for smaller organization from the local government side would be better to take measures. By the same token, as the number of household in each municipality places a disproportionate emphasis on small numbers with high rate of increasing of emission, consideration of policies from the local government side would be better (Fig.6).



**Fig. 4 The Ratio of 1990 to 2007 of CO2 Emission in Industrial Sector and the Number of Employees in a Second Industry in the Local Government (2007) for Municipalities of Japan**



**Fig. 5 The Ratio of 1990 to 2007 of CO2 Emission in Commercial Sector and the Number of Employees in a Third Industry in the Local Government (2007) for Municipalities of Japan**



**Fig. 6 The Ratio of 1990 to 2007 of CO2 Emission in Residential Sector and the Number of Households in the Local Government (2007) for Municipalities of Japan**

## 5. CONCLUDING REMARKS

From the reviews of the available emission data and the mitigation policies it can be pointed out that, although it is needed to discuss each future vision and scenario in local areas, emission data of current status are not considered with small scale in most of situations. One of these reasons is that the boundaries of emissions are not always clear. Even so, these phenomena can't lead the systems of cities to innovative changes. It is necessary to join the qualitative policies and quantitative vision to manage



a future scenario as the structural issues.

Low carbon society is not an objective, but the constraint of the activities of cities. It can be said that one of the collective idea among the various social aims is to do for better life. It is demanded not only the technologies itself but also rethinking to create the social system that provide better life. Coinstantaneously, the mitigation as constraint needs to approach with global and long term scale.

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