## B-61 Estimation of GHG Emission and Policy Making Method Preventing Global Warming in Municipal Scale (Abstract of the Final Report)

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**Key Words** GHG, Climate Change Prevention Policy, Energy Consumption

1. Introduction

In Japan there are few municipalities that estimate the emission of GHG gases although effective climate change prevention policies have to be executed to achieve the target of Kyoto Protocol. It is immediately needed to establish method of estimating GHG emissions with available statistics by officers. It is important each policy measure is shown quantitatively and offered municipalities.

2. Research Objective

This study aims to estimate GHG emissions in Municipal Scale based on the available data and to present the effect of the policies quantitatively.

3. Research Method

In this study $CO_2$ emissions of all Japanese municipalities in household, business sector, and transport and industry sector are estimated in FY 2000 and FY 2010. On the purpose of estimating business sector's energy consumption (FY 2000), energy utilization data are gathered by prefecture, building use, building size and built year data. Furthermore energy consumption data of small-size office are gathered by questionnaire on Iwate Prefecture. On the purpose of estimating household's energy consumption (FY 2010), energy consumption intensity data are estimated by different households in all municipalities.

On the other hand, the amount of $CO_2$ emissions of transport section in municipal scale was estimated by the data such as the automobile origin destination survey(OD) data, the person trip survey(PT) data, the road census data and the fuel sales data.

Furthermore, the relation of climate change prevention policies and institute factors are analyzed and $CO_2$ reduction feasibility on several policies are estimated on each municipality type i.e. climate, urban or rural.

4. Result

In the result of estimating $CO_2$ emission on household, the municipalities which population is below 300,000 are occupied 60% rate in all Japanese municipalities. In the result of estimating $CO_2$ emission on business sector, the municipalities which population is below 300,000 are also occupied 60% rate in all Japanese municipalities.

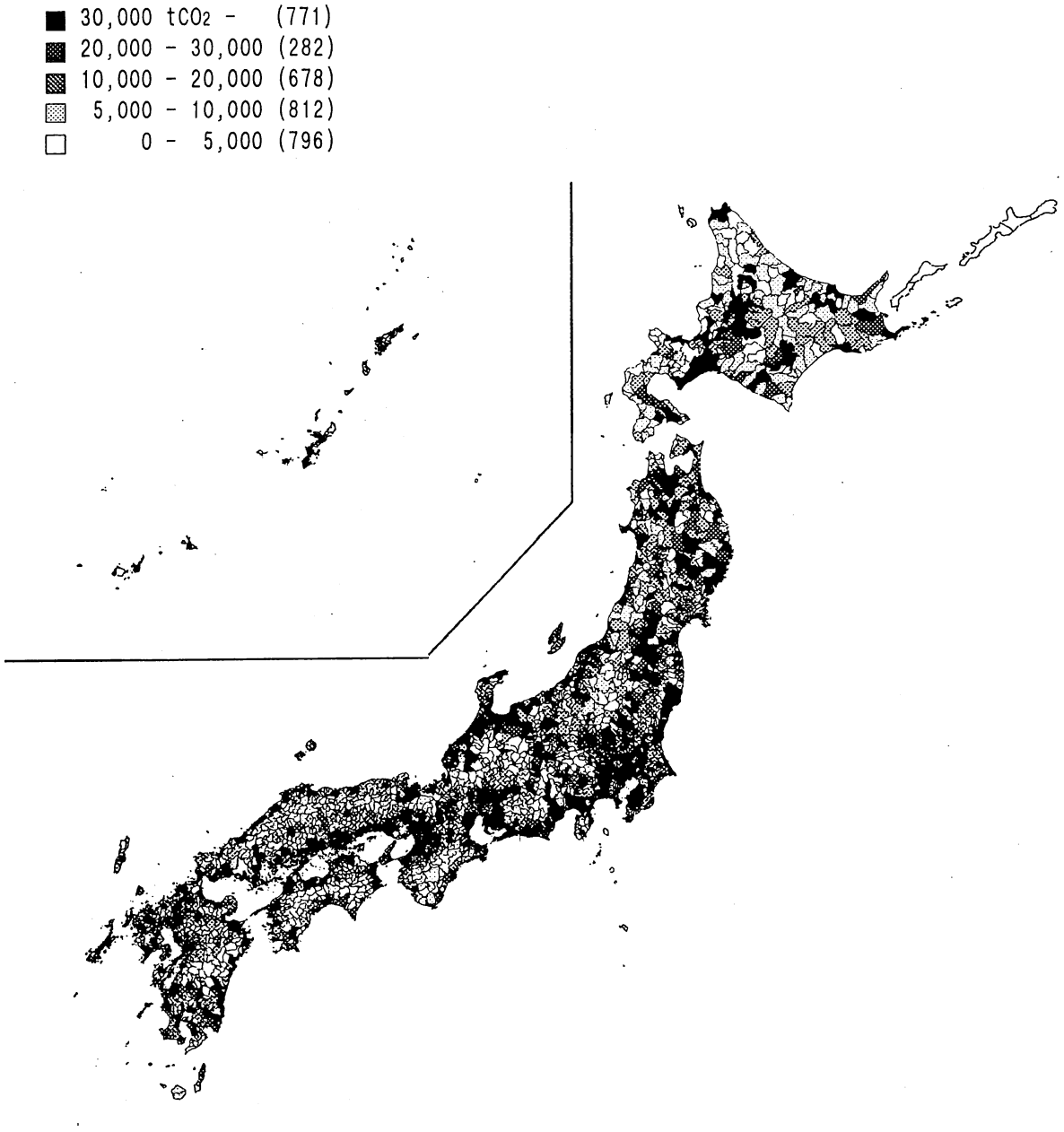


Figure-1 CO2 Emission in Household Sector (FY 2000)

In the result of estimating the future $CO_2$ emission (FY2010) on household and business sector, the 75% municipalities are reduced in population but 96% municipalities are increased in $CO_2$ emission. The transport $CO_2$ emission also increased in almost municipalities.

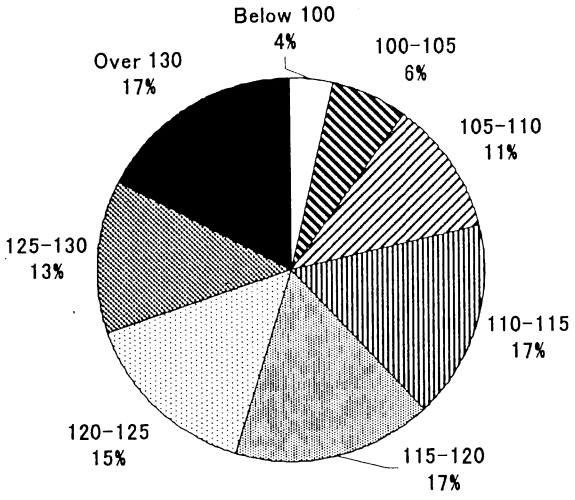


Figure-2 The Rate of Municipalities by $CO_2$ Emission Increasing Index

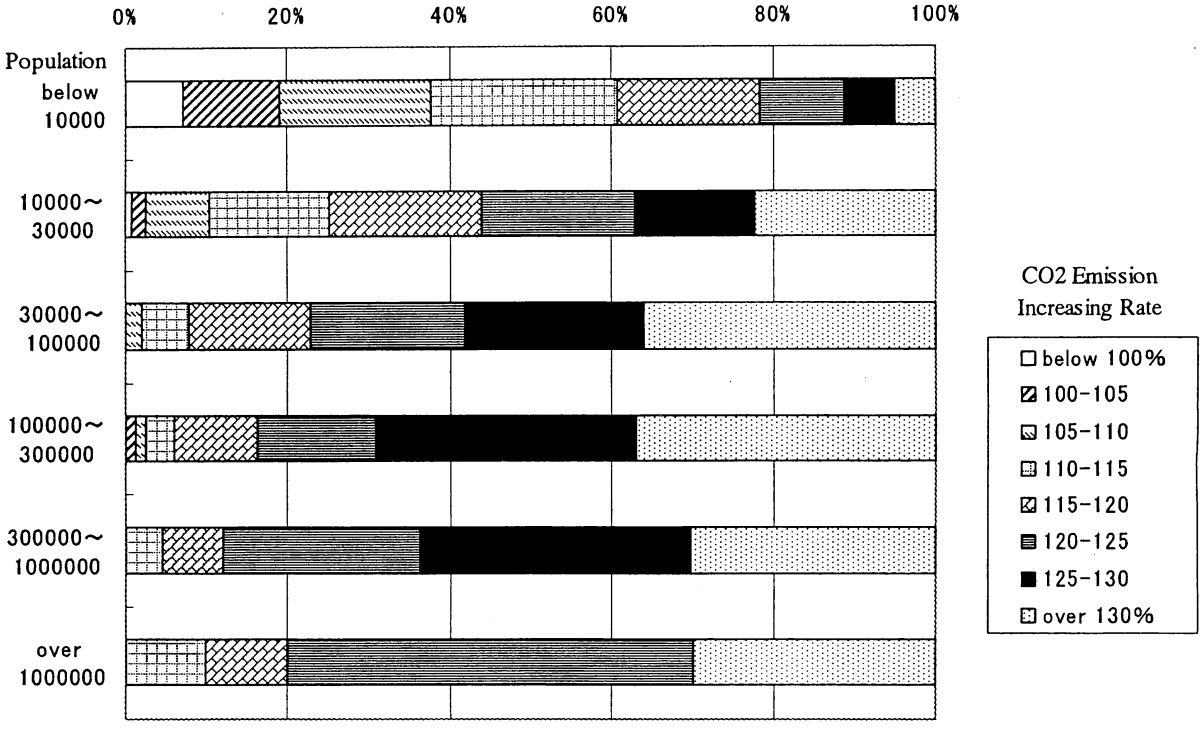


Figure-3 The Rate of Municipalities in Households and Business $CO_2$ Emission by Population and $CO_2$ Emission Increasing Ratio

$CO_2$ emissions from automobile of municipalities were estimated with OD data and aggregated in the registration area. Figure 2 shows the distribution of automobile $CO_2$ emissions per capita. Per capita $CO_2$ emissions of cities in Tokyo, Kanagawa, Saitama, Nara, Osaka, Kyoto and Hyogo prefectures are lower than others. Adding to these municipalities located in Tokyo and Osaka Metropolitan Area, cities in Okinawa, Hiroshima and Nagasaki prefecture have lower per capita $CO_2$ emissions.

Understanding of these differences of municipalities transport $CO_2$ emissions is thought to be useful to develop proper measurement for $CO_2$ reduction. The emission inventory with travel data table for each municipality and each mode was built which consist of trip number, average distance, average speed, and average load factor and so on. Using the emission-travel table, local governments could revise data and input predicted values on the cells to assess policy options which effect on these elements.

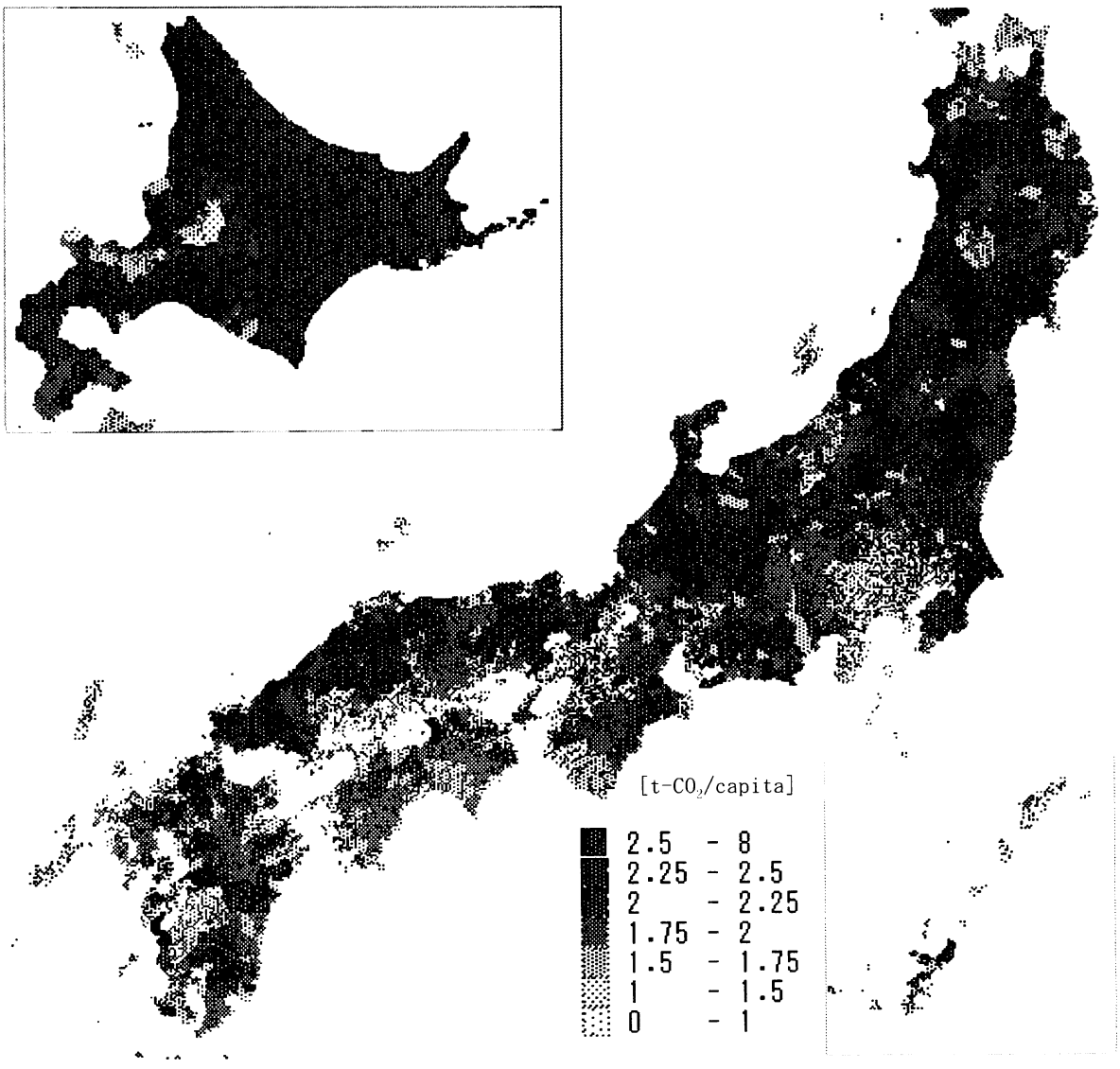


Figure-4 Automobile $CO_2$ emissions on Japanese municipalities

In this study all municipalities were classified according to 1) regional division provided in the Law concerning the Rational Use of Energy, 2) agricultural regional division, 3) the population rate of the DID (Densely Inhabited District) into 30 types and the effect of $CO_2$ reduction measures of each municipality in household and business sector was quantitatively estimated. By analyzing the $CO_2$ reduction amounts of measures by 30 municipality types, it was found out that effective measure for each municipality type is different and mainly it is determined by meteorological factor in household and determined by meteorological factor and urbanization degree in business sector. Furthermore the simple estimation sheet which can calculate the amount of $CO_2$ reduction effect of each municipality by inputting the amount of introduction of measures was made to contribute offering the basic information when considering $CO_2$ emission reduction policy.

Table-1 The $CO_2$ Reduction Amounts of Measures by 30 Municipality Types (Household)

| NO | Climate Area | Urban-Rural Area | Improvement Efficiency in Electricity and Heat Instrument | | | | | | | | | | High-Efficiency Heat Water Supply | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Air Conditioner (heat) | Air Conditioner (cool) | TV | Refrigerator | Washer | Personal Computer | Oil Hot Water Supply | Gas Range | Fluorescent Light | Light Bulb | Hide Heat Recycle | Heat Pomp |
| 1 | I | Urban A | 34 | 9 | 62 | 204 | 11 | 9 | 19 | 6 | 24 | 49 | 31 | 146 |
| 2 | | Urban B | 36 | 9 | 62 | 204 | 11 | 9 | 20 | 5 | 25 | 51 | 21 | 151 |
| 3 | | Rural Plane | 38 | 10 | 62 | 204 | 11 | 9 | 21 | 6 | 27 | 55 | 19 | 160 |
| 4 | | Rural Middle | 37 | 10 | 62 | 203 | 11 | 9 | 19 | 6 | 25 | 51 | 20 | 150 |
| 5 | | Rural Mountair | 35 | 9 | 62 | 203 | 11 | 9 | 17 | 7 | 23 | 48 | 21 | 140 |
| 6 | II | Urban A | 32 | 9 | 62 | 204 | 11 | 9 | 18 | 6 | 23 | 47 | 28 | 138 |
| 7 | | Urban B | 59 | 23 | 64 | 203 | 11 | 8 | 7 | 7 | 31 | 63 | 45 | 94 |
| 8 | | Rural Plane | 63 | 30 | 66 | 206 | 11 | 8 | 9 | 9 | 35 | 73 | 46 | 109 |
| 9 | | Rural Middle | 62 | 31 | 65 | 203 | 11 | 8 | 9 | 8 | 34 | 71 | 46 | 115 |
| 10 | | Rural Mountair | 59 | 30 | 66 | 205 | 11 | 8 | 9 | 8 | 33 | 67 | 44 | 122 |
| 11 | III | Urban A | 42 | 26 | 66 | 201 | 11 | 8 | 8 | 6 | 30 | 62 | 65 | 122 |
| 12 | | Urban B | 51 | 38 | 66 | 201 | 10 | 8 | 8 | 8 | 32 | 66 | 60 | 116 |
| 13 | | Rural Plane | 52 | 47 | 64 | 194 | 10 | 8 | 9 | 9 | 37 | 76 | 63 | 130 |
| 14 | | Rural Middle | 60 | 61 | 70 | 210 | 11 | 9 | 8 | 10 | 36 | 73 | 63 | 152 |
| 15 | | Rural Mountair | 64 | 91 | 73 | 221 | 12 | 9 | 7 | 9 | 35 | 72 | 58 | 194 |
| 16 | IV | Urban A | 33 | 70 | 47 | 140 | 8 | 7 | 2 | 7 | 21 | 42 | 87 | 64 |
| 17 | | Urban B | 42 | 88 | 59 | 177 | 10 | 8 | 4 | 8 | 27 | 56 | 76 | 137 |
| 18 | | Rural Plane | 44 | 89 | 58 | 174 | 9 | 8 | 6 | 10 | 30 | 62 | 75 | 147 |
| 19 | | Rural Middle | 49 | 102 | 63 | 193 | 10 | 8 | 6 | 10 | 31 | 65 | 61 | 178 |
| 20 | | Rural Mountair | 49 | 104 | 63 | 193 | 10 | 8 | 5 | 9 | 32 | 65 | 60 | 191 |
| 21 | V | Urban A | 13 | 70 | 38 | 150 | 9 | 6 | 1 | 7 | 19 | 39 | 54 | 135 |
| 22 | | Urban B | 25 | 79 | 47 | 161 | 9 | 7 | 3 | 8 | 24 | 48 | 47 | 116 |
| 23 | | Rural Plane | 23 | 91 | 46 | 160 | 9 | 6 | 3 | 9 | 24 | 50 | 48 | 156 |
| 24 | | Rural Middle | 25 | 88 | 46 | 158 | 9 | 7 | 3 | 8 | 24 | 50 | 48 | 139 |
| 25 | | Rural Mountair | 31 | 99 | 53 | 174 | 10 | 7 | 4 | 8 | 26 | 53 | 48 | 166 |
| 26 | VI | Urban A | 13 | 813 | 79 | 342 | 20 | 15 | 6 | 7 | 64 | 131 | 34 | 109 |
| 27 | | Urban B | 16 | 949 | 79 | 342 | 20 | 15 | 8 | 7 | 74 | 153 | 34 | 127 |
| 28 | | Rural Plane | 16 | 946 | 79 | 342 | 20 | 15 | 8 | 7 | 74 | 152 | 33 | 126 |
| 29 | | Rural Middle | 14 | 858 | 79 | 342 | 20 | 15 | 7 | 6 | 67 | 138 | 32 | 114 |
| 30 | | Rural Mountair | 13 | 800 | 79 | 342 | 20 | 15 | 7 | 6 | 63 | 129 | 30 | 107 |
| Mean | | | 46 | 91 | 61 | 189 | 10 | 8 | 7 | 9 | 31 | 63 | 60 | 150 |
| Standard Deviation | | | 21 | 115 | 17 | 53 | 3 | 2 | 7 | 3 | 10 | 20 | 29 | 89 |

5. Discussion

In the result of analyzing $CO_2$ emission on household and business sector by population amounts, middle and small municipalities are occupied 60% rate. This fact presents the importance of climate change prevention policies on these cities.

For estimating business sector $CO_2$ emissions, the number of workers by each business must be gathered by each municipality. For estimating transport $CO_2$ emissions, aggregated estimations of rural municipalities into counties were shown to avoid uncertainties of the result because of small municipalities have only a few samples. Furthermore if we to promote global warming prevention policies we have to establish appropriate plans or set up taskforces of stakeholders.

By analyzing the $CO_2$ reduction amounts of measures by 30 municipality types, it was found out that effective measure for each municipality type is different and mainly it is determined by meteorological factor in household and determined by meteorological factor and urbanization degree in business sector. And the priority of these measures was positioned from a view point of the $CO_2$ reduction effect by municipality types.

**Reference**

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