Evaluation on Regional Consumption Structure and Direct and Indirect Carbon Dioxide Emission of Household Sector

Summary

To build a zero carbon emission society, it is necessary to focus on not only direct carbon dioxide (CO_2) emissions by energy consumption in the household sector, but also indirect CO_2 emissions at the stage of manufacturing of consumable goods, such as foods and housing. For the household sector, direct CO_2 emissions were ascertained by region, and indirect CO_2 emissions were ascertained by end-use item, and then a future prediction of them was extended to 2030. Compared to 2015, while direct emissions decreased, the emissions after adding indirect emissions increased. Regionally, the emissions in the urban areas and surroundings increased, but in other regions, particularly in the Tohoku district, emissions were on a declining trend. It is necessary to take global warming countermeasures, getting the whole industry involved, to help to promote reductions of both direct and indirect emissions by taking into account regional characteristics of consumption.

Proposals for Policy Development

- To promote decarbonization while maintaining the economic level, it is desirable to establish a system in which a generous subsidy is allocated to low-income families to make it easy for them to shift to consumption leading to low carbon emissions even if rather expensive.
- The consumption expenditure and CO_2 emissions of the household sector are affected by not only annual income but also regional characteristics, and so it is necessary to establish a system by taking into account regional characteristics, instead of a nationwide uniform system. In addition, the reduction of CO_2 emissions by consumption activities of the household sector may greatly affect not only the electricity generation sector and household sector but also the industrial sector, and therefore it is necessary to promote effective reductions in CO_2 emissions.
- Therefore, for effective policy planning, it is proposed to promote investigation and estimation, in particular by taking into account spatial distribution on the demand side.

1. Estimation of carbon dioxide emissions

Itemized data tabulated in the National Survey of Family Income and Expenditure [1] was used to estimate family expenditure in 2030 by means of multiple regression analysis. Then, based on the estimated family expenditure, CO_2 emissions of the household sector were derived. It was shown that, while direct CO_2 emissions decreased by about 10.2% compared to 2015, the sums of direct and indirect CO_2 emissions increased by 1.3%. Moreover, the sum of direct and indirect CO_2 emissions are summarized for top items in Table 1 [2], and the rate of change relative to 2015 of the sum of direct and indirect CO_2 emissions are plotted by prefecture for four energy-related items in Fig. 1.

When viewing the increase or decrease of CO_2 emissions of the fuel type items, it is shown that the CO_2 emissions per household by "petroleum products" and "city gas" increased in the urban areas and surroundings, but in the Tohoku district, the CO_2 emissions by "petroleum products" and "city gas" decreased, clearly revealing regional variations.

2. Analysis of estimated future scenarios

Three future scenarios were analyzed from the viewpoint of CO_2 emissions from electricity generation or electrification of energy equipment. The total sum of CO_2 emissions of the 47 prefectures was compared among these three scenarios (Table 2).

Table 1 Sum of direct and indirect CO_2 emissions for top items

2015 Top Items	CO_2 emissions (million ton CO_2)	2030 Top Items	CO_2 emissions (million ton CO_2)
Electricity	201.22	Electricity	193.21
Gasoline	73.07	Gasoline	60.00
City gas	37.54	City gas	38.99
Liquefied propane	25.61	Liquefied propane	20.33
Food	11.34	Food	13.56
Kerosene	9.99	Purchase of automobiles	9.65
Water and sewerage charges	7.23	Expenses of repair and maintenance work	9.62
Household head pocket money	6.39	Household head pocket money	7.79
Money gifts	6.10	Money gifts	6.34
Purchase of automobiles	5.71	Water and sewerage charges	6.25

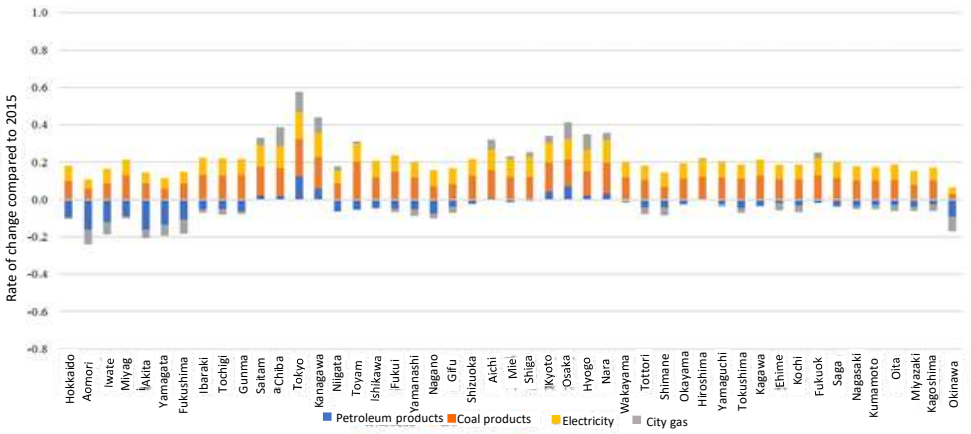

Fig. 1 Rate of change relative to 2015 of the 2030 sum of direct and indirect CO_2 emissions per household

Table 2 Total sum of CO_2 emissions of the 47 prefectures for three scenarios

	Sum of CO_2 emissions (million ton CO_2)	
	Direct emissions	Sum of direct and indirect emissions
Year 2015	208.97	356.39
Year 2030	187.71	361.11
Scenario 1 (70% reduction of CO_2 emissions from electricity generation)	119.22	230.71
Scenario 2 (Electrification of energy equipment)	161.78	355.57
Scenario 3 (70% reduction of CO_2 emissions from electricity generation and Electrification of energy equipment)	59.08	187.81

Scenario 1: Based on a prediction that CO_2 emissions associated with electricity consumption can be reduced by 70%, the emission factor of electricity generation CO_2 emissions is reduced by 70%.

Scenario 2: 100% Electrification of "Gasoline" by assuming the shift from gasoline vehicle to electric vehicle (EV), as well as 100% electrification of "City gas" and "Kerosene"

Scenario 3: Scenario 1 + Scenario 2

In Scenario 2 of electrification of energy equipment alone, the direct emissions were about 23% reduced compared to 2015, but the sum after adding the indirect emissions remained at about a 0.2% reduction. In Scenario 3, where CO_2 emissions from electricity generation were reduced by 70%, the direct emissions fell by 71.7%, and the sum of direct and indirect emissions fell by 47.3%. At LCS, structural changes throughout the whole industry are examined, including further electrification, such as vehicle electrification, and increase of the proportion of renewable energy in the electricity generation mix. Owing to such structural changes, CO_2 emissions of the household sector will likely change more significantly.

[1] Ministry of Internal Affairs and Communications, "National Survey of Family Income and Expenditure" https://www.e-stat.go.jp/stat-search/files?page=1&toukei=00200564 (Day of access: Sept. 12, 2020)

[2] Ministry of Internal Affairs and Communications, "2015 Input-Output Tables for Japan" https://www.e-stat.go.jp/stat-search/files?page=1&layout=datalist&toukei=00200603&tstat=000001130583&cycle=0&year=20150&month=0 (Day of access: Aug. 24, 2020)