

琉球大学学術リポジトリ

【《UH・UR合同シンポジウム》報告】 Present situation and prospect of Energy and Environment in subtropical archipelagoes

| | |
|-------|--|
| メタデータ | 言語: 出版者: 琉球大学国際沖縄研究所 公開日: 2014-12-24 キーワード (Ja): キーワード (En): 作成者: Tsutsumi, Jun'ichiro, 堤, 純一郎 メールアドレス: 所属: |
| URL | http://hdl.handle.net/20.500.12000/30095 |

《UH・UR 合同シンポジウム》報告

Present situation and prospect of Energy and Environment in subtropical archipelagoes

TSUTSUMI Jun'ichiro*

Abstract

After the great earthquake disaster in eastern Japan 2011, energy policy in Japan was also greatly changed. It is directly connected with the global environment. Archipelagoes in tropical and subtropical zones are regarded as extreme samples of the global environment and they are also good test fields for new energy technology. Hawaii-Okinawa new energy cooperation started in 2010 to stable supply of renewable energy in a limited area like an isolated island through a smart grid system. Present situations of renewable energy and smart grid system are mentioned with the global environment, and the prospect of them in archipelagoes is mentioned.

1. Introduction

Climate change is one of the most serious environmental problems in the world. The main reason of the climate change is a green house effect by green house gases (GHG). IPCC registered 6 kinds of the GHG as the causes of global warming. Carbon dioxide is a most considerable GHG and over 90% of anthropogenic emission of CO₂ is recognized as fossil fuel energy consumption. The climate change is hereby connected with energy through CO₂ emission, and energy itself becomes an important environmental problem.

Energy is an essential factor for various industries in many developed countries including USA and Japan. The Japanese government ratified the Kyoto agreement in 2002, while the US government decided not to join the world framework of reduction of CO₂ at that time. Main strategy of the Japanese government for the energy to reduce CO₂ emission had been to expand the nuclear power generation until the great earthquake

* Professor of Department of Civil Engineering and Architecture, Faculty of Engineering, University of the Ryukyus 琉球大学工学部環境建設工学科教授

disaster happened in the eastern Japan on Mar. 11, 2011 that caused the terrible nuclear accident.

Many Japanese people longed for the government to stop the nuclear power plants, while some economic organizations and industries could not help to oppose stopping them from the viewpoint of economic situations. Therefore, the Japanese government could not decide to sift energy resources from nuclear power to renewable energy clearly. Though all the nuclear power plants in Japan were stopped once by the government, one plant was allowed to restart in a couple of months. The concept of renewable energy includes carbon free energy like natural energy and carbon neutral energy like biomass energy.

However, small islands like Hawai'i and Okinawa are somewhat different from the main land of Japan, because the nuclear power plant is not adaptable to small islands. The actual situations of small islands are much more severe than larger areas, because the energy resource is limited. If the renewable energy is successfully realized in the small islands, it is also adaptable to various regions. The present situations of energy in Okinawa are described in this paper to predict and promote the renewable energy from the environmental point of view.

2. Present Energy Situations in Okinawa

Energy consumption and CO₂ emission in Okinawa and Japan in 2007 are indicated in Fig. 1 and Fig. 2, respectively. The energy consumption in Okinawa prefecture is only 0.7% in total Japan, while the total CO₂ emission is about 1.2% in 2007. The energy consumption is categorized into 4 fields, "Industry", "Commercial", "Domestic" and "Transport". "Industry" means energy consumption in factories and other industrial facilities, "Commercial" means buildings except residential houses, "domestic" means residential houses and "Transport" means fuels for transportation facilities. "Transport" is a largest part in the energy consumption of Okinawa, while "Industry" is largest in Japan. On the other hand, "Commercial" is the biggest resource to emit CO₂ in Okinawa, while "Industry" is still biggest in Japan.

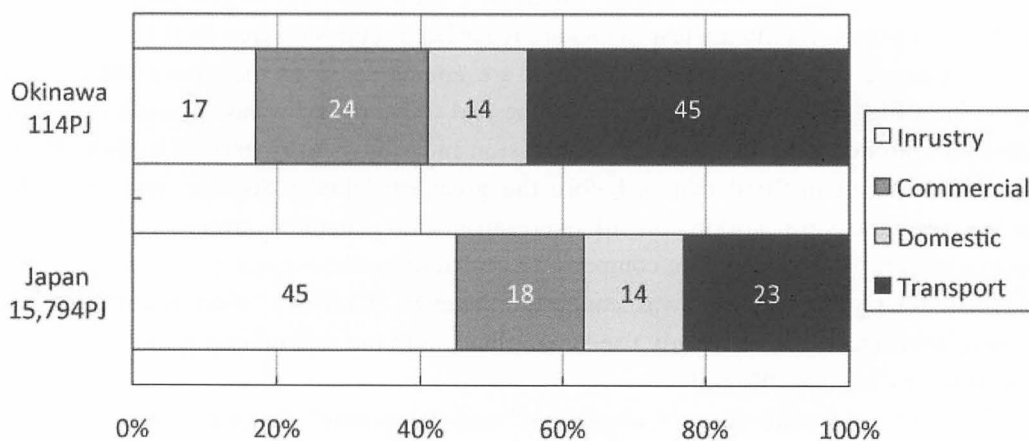


Fig.1 : Energy consumption in Okinawa and Japan in 2007FY

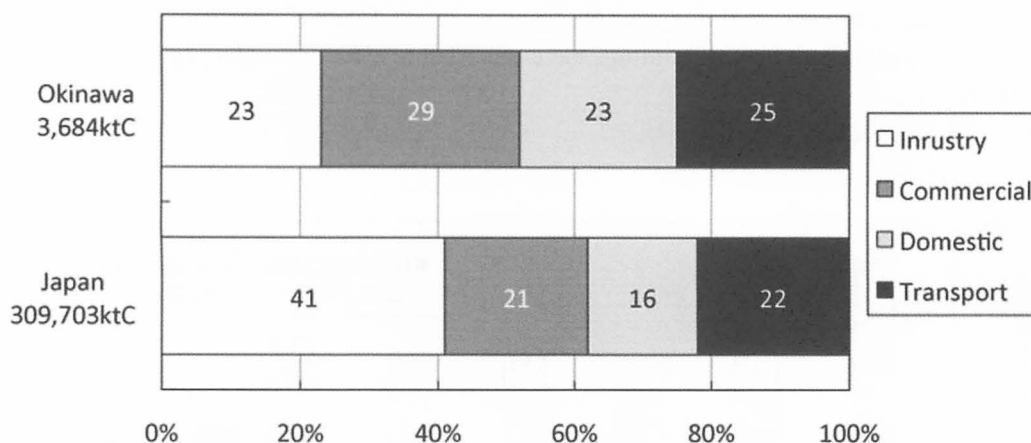


Fig.2 : Carbon dioxide emission in Okinawa and Japan in 2007FY

Ratios of 4 fields in the total energy consumption in Okinawa are considerably different from all over Japan. The difference comes from the framework of industries. The tertiary sector of industry is prevailing in Okinawa, while the secondary sector is major in Japan. These ratios of CO₂ emission are almost the same as the ratios of energy consumption in Japan, though these ratios are relatively different in Okinawa.

The relation between energy resources and CO₂ emission is a most important reason of the difference. “Transport” energy consists of mainly liquid fuels, for example gasoline, diesel fuel and jet fuel, and most of “Commercial” and “Domestic” energy is covered by electric power. The fuels have their own CO₂ emission rates as well as their own heating values as shown in Fig. 3. CO₂ emission rates from electric power

generators are different by the energy resources. Coal plants emit largest amount of CO₂ and then oil plants, finally nuclear plants are regarded as emission free facilities.

10 electric power companies in Japan are compared from the viewpoint of CO₂ emission in Fig. 4. They are compared by the real CO₂ emission and adjusted emission. Adjusted emission rate means the CO₂ emission rate adjusted by carbon credits. These data are acquired in 2010 that is before the great earthquake disaster, and about 50 nuclear reactors were working in all over Japan and generated around 30% of total electric power. “Kansai” electric company depended upon the nuclear plants most largely, and the real CO₂ emission rate was smallest. However, “Okinawa” electric company has no nuclear reactor and has mainly used coal plants, and the real emission rate was about three times as large as “Kansai”.

The CO₂ emissions from “Commercial” and “Domestic” depend upon the energy resources of electric power generation. The CO₂ emission rate of “Okinawa” electric company is larger than other electric companies remarkably. This is the reason why there is clear difference between the energy consumption and the CO₂ emission in Okinawa. It is also clear evidence that the energy resource of “Okinawa” electric company and energy savings in houses and buildings have remarkable effect on reducing CO₂ emission in Okinawa.

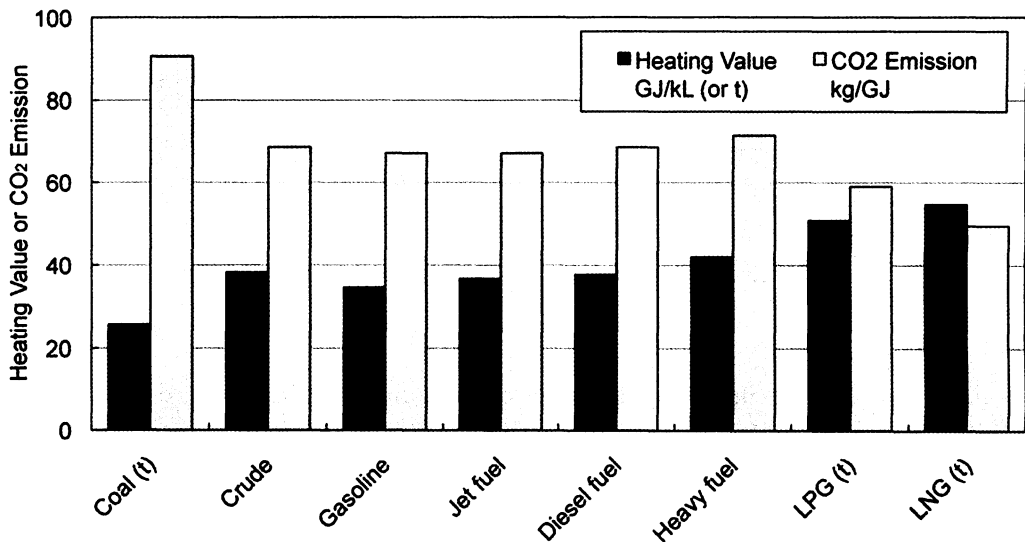


Fig.3 : Carbon dioxide emission rate by fossil fuels

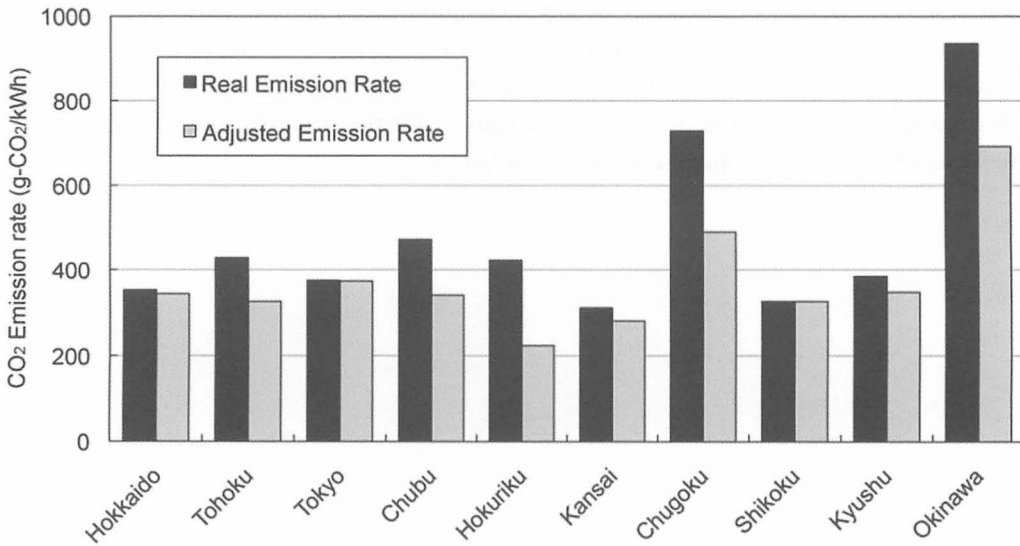


Fig. 4 Carbon dioxide emission rate of 10 electric power companies in Japan

3. Conclusions — Energy Strategy and its Application in Archipelagoes

The effects of the global warming are found clearly as the trend of temperature increasing, localized special heavy rain and sea level rise. These phenomena are very serious on low latitude archipelagic environment. It is necessary to make some strategies and develop new technologies to stop the global warming, to avoid its serious effects and to adapt the living environment to the present situation. The primary action is to reduce the CO₂ emission that is directly connected with the strategy of energy.

There are four ways of energy strategies to reduce CO₂ emission. These are “Carbon free energy”, “Carbon neutral energy”, “Carbon reduction” and “Carbon sink”. Carbon free energy is represented by natural energy, for example, solar, wind, marine and geothermal energy. Carbon neutral energy is almost the same meaning as biomass energy. These two types of energy are included in the renewable energy. Carbon reduction means energy savings. Carbon sink is absorption of CO₂ by trees in the Kyoto protocol, but the absorption by the sea is considered much bigger and it is a characteristic point in archipelagic regions. However, it is not proved clearly by scientific data.

There are two major problems to sift the energy resources to renewable energy. One is the cost of renewable energy that is much higher than ordinary fossil fuels. The other is stability of energy supply. Research and development of higher technologies are required to solve these problems. Some advanced technologies should be considered here. One is the electric energy storage system, concretely rechargeable battery to stabilize the electric power supply. Direct current is preferable to alternative current for this system.

Another is local energy resource for local consumption and it should be controlled by the demand side. It comes down to a smart grid system. The third is solar thermal energy. It is useful in low latitude regions with smaller investment than photovoltaic system. Hawai'i and Okinawa should act the role as leaders for the research and development of renewable energy in subtropical archipelagic regions.