Sustainable Future in Japan – from Energy Technology Aspects

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1. Introduction

Energy and environmental issues are serious concerns to Japan because Japan is densely populated and highly industrialized, and has small land with little energy resource. Japan has been tackling these issues vigorously. Above all, recognizing the significance of the Kyoto Protocol, which offers the international commitment to reduce greenhouse gases emission, the Japanese government and industries have been actively addressing the issue with great efforts. Reflecting the above circumstances, this Lecturer presents the current Japanese energy situation, some examples of countermeasures for CO_2 emission, and a more detailed explanation of typical technologies such as energy saving technologies, renewable energy technologies, and energy conversion technologies including nuclear energy. By introducing these features, this Lecturer offers some idea of the sustainable future in Japan, and expects it will be beneficial information for other countries, particularly for those who are thinking to adopt such programs in the future.

2. Key Features

2.1 Approach for the global warming and energy security in Japan

Global Warming is said to be the most critical environmental problem in the history of humankind. And it is also said to be caused by Green House Gas (GHG) emissions mainly produced by energy consumption, among others, fossil fuel combustion. Therefore, we understand that the energy security is closely related with Global warming. According to the report of the IPCC (Intergovernmental Panel on Climate Change), future increases in temperature and the level of the oceans will have overwhelmingly grave effects in such field of food supplies, water supplies and living conditions. In an attempt to prevent this, the UNFCC (United Nations Framework Convention on Climate Change) has discussed the global framework and found the approach to the first commitment period (2008~2012) by the Kyoto Protocol in 1997 which became in effective February 2005. Japan has made a commitment to reduce its total average GHG emissions by 6% against 1990 levels at the first commitment period. In 2003 however, it exceeded by 13 % the 1990 level. Therefore, Japan has to adopt every possible measure from the technical to the political. As to the technical measures, in addition to the existing approach, an additional approach has been proposed. It is composed of three (3) main measures, namely, “the further energy saving”, “the renewable energy or new energy sources”, and “the energy conversion including the nuclear”. Fig. 1 shows the trend and forecast of energy origin CO_2 in Japan.

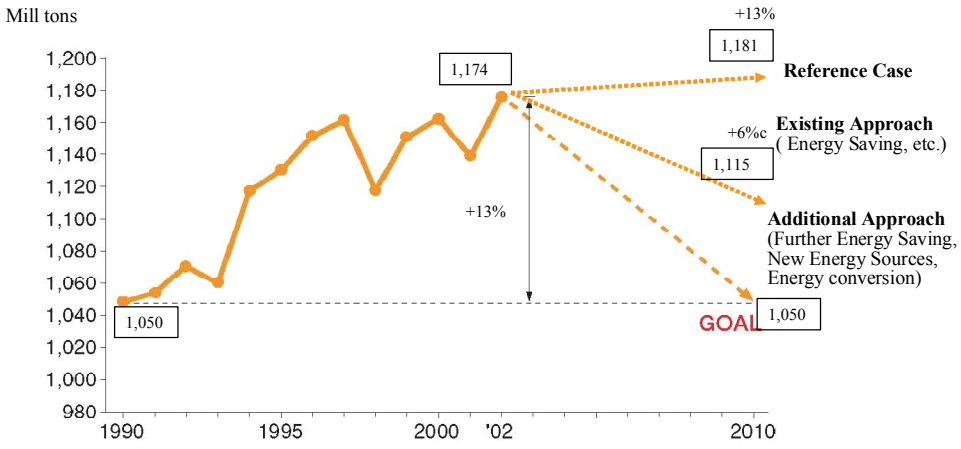

Fig. 1. Trend and forecast of energy origin CO_2 in Japan.

In order to meet the above target, the Japanese government has established "The Action Plan for achieving the Kyoto Protocol" in May 2005, based on the energy supply and demand forecast. And they have also established the "New National Energy Strategy of Japan" in May 2006 to meet the requirement of a longer period, such as by 2030.

2.2 Further energy saving

The energy saving or energy conservation is one of the most effective measures in energy and environment approach. Japan has endeavored to adopt serious energy conservation measures especially after two oil crises, and has achieved one of the highest efficiencies in the world. However this time, it is asked to pursue higher level. It is therefore very tough for Japan, even though the economical benefit would be obtained by pursuing energy conservation at the same time. Therefore measures in all fields or sectors (e.g., industrial, municipal, transportation) have been discussed. As one of the typical methods to perform these energy saving technologies, the "Top Runner" Program has been introduced. This program requires manufacturers to meet target energy conservation standards in their appliances. The concept behind the formulation of these standards is to improve the energy conservation performance by as much as the best products presently available. Fig. 2 shows the concept of the top runner method.

2.3 Renewable energy

The renewable energy introduction is another effective measure because of good environmental advantages such as carbon-free, and abundance of theoretical resources. Typical renewable energies are Solar Power or PV, Wind Power, Biomass and/or Waste to Energy, Solar Thermal, etc. However, there are a number of drawbacks. For instance, their costs are so high compared to conventional energy, due to the poor energy intensity to be applicable, the lack of maturity for technology, or the low load factor. In addition, some of them are affected by environmental conditions. Therefore, the degree of actual application will greatly differ according to the geographic condition of each country. Enormous efforts including governmental support have been given for developing renewable technologies for promising technologies. However it should be noted that the share of the renewable energy among the total primary energy will not rise to the current level of fossil energy. Fig. 3 shows the outline of renewable energy in comparison with the alternative energy to oil, which is called new energy in Japan, and Fig. 4 shows the target of renewable energy expansion in the future.

2.4 Energy conversion (including nuclear energy)

The energy conversion is also very effective measure in energy and environment approach. In the narrow meaning, the energy conversion means converting oil or coal to natural gas especially as combustion usage. For example, the use of natural gas as the combined heat and power cogeneration (CHG) for the local heat and power supply is recommended. As to the power application, the highly efficient combined cycle is also recommended. We understand that the oil will be used in the field of transportation (automobile and airplane), or the chemical industry, or the textile industry, and so forth, where any better substitutes have not yet been found.

Nuclear energy is one of the important energies in Japan. Nuclear power plants in Japan have supplied about one third of the electricity demand at present and it is expected to play the role of base load power generation. Uranium is widely available in politically stable countries, making it a highly stable energy source. Also, nuclear power does not produce CO_2 in the generation process. Like other resources, reserves of uranium are limited, and if it is disposed of after being used once, reserve-production ratio is similar to other fossil fuel. However, more than 90% of spent fuel from nuclear power plants is composed of uranium and plutonium that can be recovered and reused as fuel. The remaining waste is disposed of as high-level radioactive waste. The burning of recovered plutonium and uranium at existing nuclear power plants is called "Pluthermal" generation in Japan and the (plutonium and uranium) combined fuel is called as MOX fuel. After performing test plants (including demonstration plant using existing plant), we will apply the technology widely for other nuclear plants.

2.5 Best mix of energy

As to the actual application of the above mentioned measures, it is desired to be performed under the commercial activities. Therefore, it is reasonable to start from adopting the energy saving, then move to the energy conversion, and finally move to the renewable energy introduction. However, it is to be noted that we should examine the most suitable combination from some view points, including economical standpoint, security standpoint, environmental standpoint, which differ according to the progress of technology, the change of social condition, or seriousness of climate change, etc. We call it the best combination. In order to get it, it is required of Japanese government to establish the energy plan or strategic policy by considering various conditions such as economic growth, population, by looking the longer time span. The above mentioned "New National Energy Strategy of Japan" is one example to set time span up to 2030 and "The Strategic Technology Road Map in Energy Field (Energy Technology

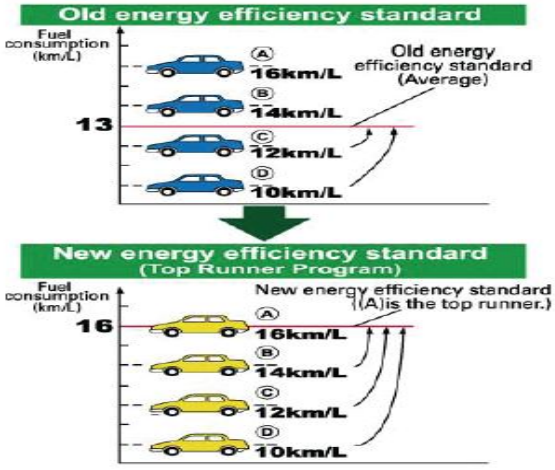

Fig. 2. Concept of the top runner method [source: The Energy Conservation Center, Japan].

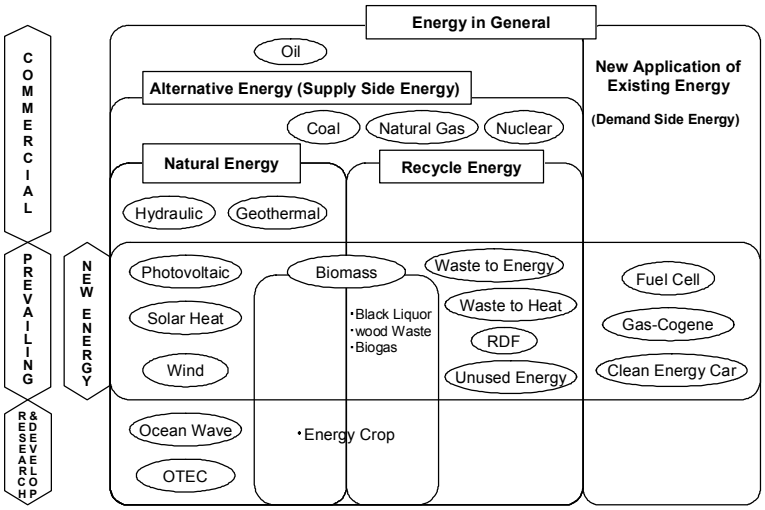

Fig. 3. Comparison of renewable energy (natural energy) and new energy in Japan [source: New Energy Foundation, Japan].

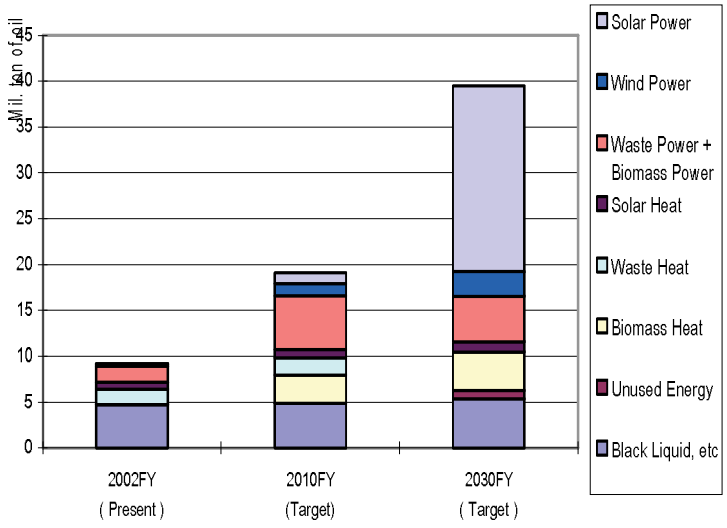

Fig. 4. Target of renewable energy in future [source: METI].

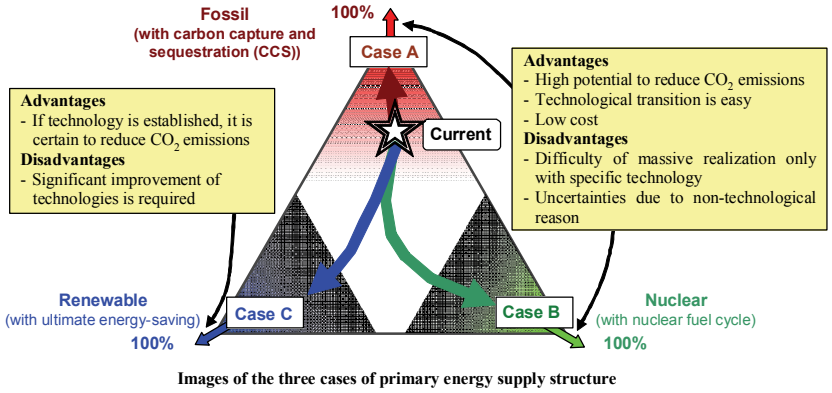

Fig. 5. The strategic technology road map in energy field (Energy Technology Vision 2100) [source: METI].

Vision 2100), established in October 2005, is another example to set longer time span up to 2100. In the Road Map the back-cast approach was adopted in order to look the present technologies from that point. Fig. 5 shows the typical figure of the study of the Road Map.

3. Conclusions

1) Today people in the world are facing unprecedented problems in various fields. Especially the energy matter in conjunction with environmental (global worming) matter offers one of the biggest concerns to us.

2) Japan has endeavored to adopt energy conservation measures, and has obtained the higher efficient technology level in the world. However, it is asked to perform further advanced energy conservation to meet with the requirement by Kyoto Protocol. For it, three (3) main approaches are introduced, namely further energy saving, adopting renewable energy, and energy conversion including nuclear.

3) Japanese Government recently established "New National Energy Strategy of Japan" and "The Strategic Technology Road Map in Energy Field (Energy Technology Vision 2100)," in which clear but also very tough targets are shown.

4) It is desirable that the experiences of Japan tackling these problems will be useful or utilized for other countries, where the energy and global warming issues are expected to be discussed in great concern in the near future.

4. References and Bibliography

1. METI Ministry of Economy, Trade and Industry, 2005, "The Strategic Technology Road Map in Energy Field (Energy Technology Vision 2100)," October.
2. METI, 2005, "New National Energy Strategy of Japan," May.

Speaker's Biography

Kiichiro Ogawa was born in Japan and obtained his bachelor degree in Mechanical Engineering from Kyushu University in 1965. From 1965 to 1994 he worked as an Engineer, Researcher, Manager, and Deputy General Manager of the prime mover division of Mitsubishi Heavy Industries Ltd. In May 1994, he moved to The Institute of Applied Energy where he has been engaged in research works on the waste to energy or biomass energy technologies in line with the managing affairs as a director of the department. In 2000, he was awarded the Ph.D. degree from Kyusyu University.

As to the outward activities, he was assigned as a special committee member by METI (Ministry of Economy, Trade and Industry) to examine the explosion accident of the RDF firing power plant in Mie Prefecture in 2001.

He has served as the chairman of the waste to energy committee organized by the New Energy Foundation which was established by METI from 1999 to present.

Experience:

2006.7 - Present:	Research Fellow of the Institute of Applied Energy
1995 - 2006.6:	Director, Energy Technology Information Center of the Institute of Applied Energy
1994 – 1995:	Senior Researcher of the Institute of Applied Energy
1988 – 1994:	Deputy General Manager of the R&D department of Mitsubishi Heavy Industries Ltd.
1986 – 1988:	Project Manager at the headquarters of Mitsubishi Heavy Industries Ltd.
1975 – 1985:	Senior Engineer at the headquarters of Mitsubishi Heavy Industries Ltd.
1965 – 1975:	Engineer for boiler basic design at Hiroshima Works of Mitsubishi Heavy Industries Ltd.