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Journal of Nuclear Materials 329–333 (2004) 1–4
journal of nuclear materials
www.elsevier.com/locate/jnucmat

Japanese policy on the science and technology research

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Abstract

Science and technology policy in Japan with special emphasis on energy research was presented beginning with an introduction of the Council for Science and Technology Policy. The fact that in the year 2000 in Japan, petroleum and coal, which are sources of greenhouse gas, contributed about two-thirds of the total energy production is pointed out as the key issue of energy and the environment. As one of the action to solve the problem, Japan emphasizes research of innovative energy technology. As a policy, Japan will not only participate but will invite ITER as host, the international thermonuclear experimental reactor project. Japan, as one of the leading countries in fusion research, seeks a broad viewpoint for advanced science and technology because fusion is related to the frontiers of physics. Cost effectiveness and public understanding are required in all the scientific programs.

1. Introduction

Japan's Council for Science and Technology Policy (CSTP) had its origin in 1959 and was reorganized in 2001 into the present form of the council. It consists of 14 members from academia, industry and the cabinet. Official regular meetings are held every month. The Prime Minister is the chairman, currently Mr. Junichiro Koizumi. In addition to this regular official meeting, many sub-committees are organized to cover various fields of science and technology and related issues. The council is responsible for planning and implementing science and technology policies, aiming at achieving high levels of science and technology research, improving the welfare of people, contributing to the progress of science and technology in the world, and advancing the sustainable development of human society.

The organization of the Japanese government, after the reform of 2001, is shown in Fig. 1. One of the aims of this reform was to strengthen the leadership of the Prime Minister. The Prime Minister is able to have several ministers of state, one of whom is responsible for science and technology policy. Based on legislation there are four high level councils in the cabinet office, and the CSTP is one of the two chaired by the Prime Minister. As a function of the CSTP, the Prime Minister and other Ministers are given advice regularly and over 60 recommendations and decisions in science and technology policy were reported in the past three years. Another mission of the CSTP is to review the performance of research of all ministries and coordinate joint inter-ministerial research programs.

2. Science and technology policy

The science and technology policy in Japan is based on the Science and Technology Basic Law enacted in 1995 [1] . Based on this law, the Science and Technology Basic Plan was first issued in 1996, and was renewed in March 2001 [2]. In the plan, four major important fields of focus for national efforts are prioritized as shown in Fig. 2: life science, information technology/telecommunications, environmental science, and nano-technology/materials. Another four areas following them are considered to be the basis of all science and technology. Energy is one of these four basic areas, to which special attention must be paid.

There areas, energy, manufacturing, infrastructure of society, and space/ocean (frontier), are also regarded as

0022-3115/$ - see front matter
doi:10.1016/j.jnucmat.2004.04.338

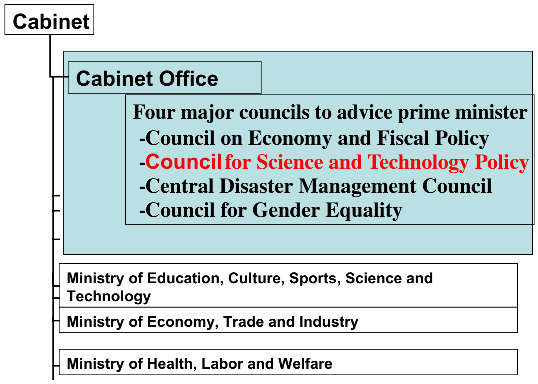

Fig. 1. The organization of the Japanese government and the position of the Council for Science and Technology Policy, after the reform of 2001.

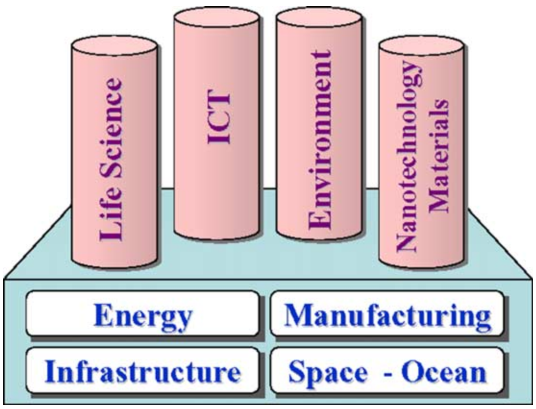

Fig. 2. The four priority areas and four fundamental areas in Japanese science and technology policy.

important infrastructure of the entire science and technology research in this country. Since environmental science, and energy are intimately interrelated, subcommittees or working groups are formed to oversee both environmental and energy sciences.

This working group has selected prioritized areas of energy policies for the coming five years as follows: (1) R&D for transforming the overall energy system, encompassing supplies, transport, conversion and consumption. Renewable energy is especially of great importance. (2) R&D for enhancing energy-related infrastructures such as fuel cells, solar panels, and green core technology. (3) R&D for energy safety and security, which are especially important in nuclear fission reactors. (4) R&D for assessing and analyzing the energy system from social and economic viewpoints. Energy is a key issue of the national economy and security. It is of special importance for Japan, since Japan depends highly on imported energy sources. For the future, the entire energy system must be totally remodeled, from generation to transport, storage and delivery. Such a remodeled energy system may contribute to solving the world global environmental problem while maintaining sustainable economic growth.

3. Fusion as an innovative candidate energy source

Fig. 3 shows energy sources in Japan in the year 2000. Petroleum and coal that are sources of greenhouse gas provide about two-thirds of the total energy. This profile must be changed in the future in order to reduce carbon-dioxide emissions. Fig. 4, developed by the working group of energy and environment of the Council for Science and Technology on future energy supply in the world, projects possible future scenarios of energy supply. Energy demand continues to increase and fossil energies remain to supply the major part of the demand. Carbon-dioxide sequestration is expected to increase by technology innovation. It is important, however, to increase carbon-free sources such as renewable energy and nuclear fission. Furthermore,

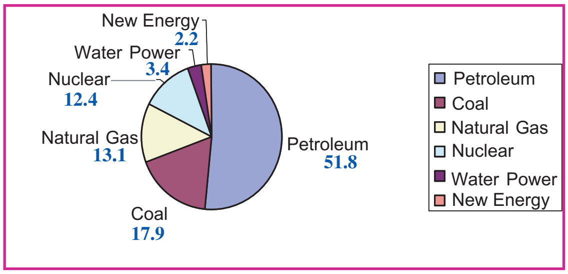

Fig. 3. Current energy sources in Japan.

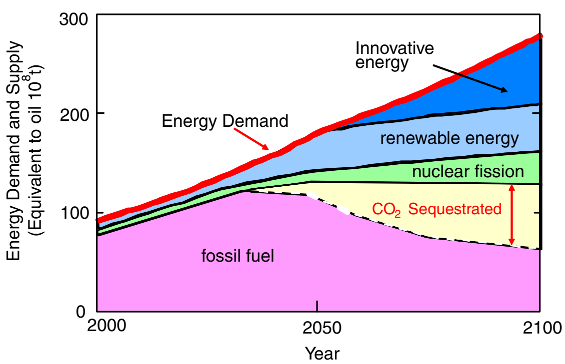

Fig. 4. Future world energy sources and the expected role of fusion as an innovative energy.

innovative energy sources are strongly expected to supply approximately 15% of the entire demand by the end of the 21st century. Nuclear fusion is one of the most promising candidates to fill the increase in demand.

The International Thermonuclear Experimental Reactor, ITER, is one of the most important milestones in the long-term strategy for nuclear fusion as an energy source. An international consortium has done a feasibility study for ITER, and the final plan was announced. The CSTP has the ultimate responsibility to decide the policy of the Japanese government on this issue of the ITER project, and it was intensively investigated, and the result was reported on May 29, 2002. It was concluded that it is desirable for Japan to participate in the ITER project, and, moreover, it is meaningful to host ITER in Japan. It is appropriate for Japan to promote the ITER project as a government-wide effort. The cabinet immediately approved this recommendation, and Japan has decided to invite the ITER project to Rokkasho-mura, Aomori-prefecture, in the northern part of Japan.

The Japanese strategy for fusion development takes a staged approach. Currently, break-even with the JT-60 Tokamak has been achieved, where fusion energy generated is more than the energy needed to heat the plasma. ITER, an experimental reactor, is the next step. With this device, it is expected that fusion will achieve the long-burn. Upon achievement of the technical objectives of ITER, the first fusion generation station will be designed and planned for construction – a demonstration reactor, called DEMO, hopefully by 2030.

Parenthetically, five recommendations were made to the government related to the support of ITER. (1) ITER must be promoted as a national project with a government-wide effort and the necessary budget. However, such budget must be provided as a part of the nuclear category of the science budget. No additional funding will be allocated from other budget categories of the government. (2) The ITER project must be managed within the projected schedule and budget. (3) The ITER project must be supported but at the same time no other scientific field should be sacrifices for this budget. This decision requires that other domestic fusion programs be strictly reviewed and restructured in order to organize systematic collaboration with ITER, Large Helical Device (LHD), and other fusion research. (4) ITER will be a new type of nuclear facility. Fusion devices are expected to have some advantages from the aspect of nuclear safety, but the importance of safety should not be underestimated. Researchers in fusion are asked to continuously explain the importance of fusion energy to the public. (5) The fusion community must make every effort to develop fusion as a viable energy source. Materials is one of the major issues requiring advances to realize fusion.

Therefore this conference is a good opportunity to accelerate research on materials and to promote fusion research towards the goal of energy demonstration.

4. Fusion facilities in Japan

Japan is one of the leading countries in fusion research. Besides one of the largest super-conducting helical devices, LHD, and also the large Tokamak JT-60, several unique fusion research centers are located in Japan, including a laser nuclear-fusion facility in Osaka. These fusion facilities are asked to be restructured for a more efficient and effective research and development system by organizing a network of collaboration.

Fusion is not to be studied only from the aspect of energy development but also from the broader viewpoint of advancing science and technology research. The CSTP emphasizes four major fields to be prioritized. Although energy is not one of these four, fusion research is related to those prioritized areas. For instance, fusion is a candidate for environmentally-friendly energy production. Fusion energy will be able to contribute to reforming the energy supply system. Fusion has the possibility to supply not only electricity but also hydrogen for other future applications. Materials science is one of the most important areas for fusion reactor. The Carnegie group consisting of either science ministers or science advisors to the president or prime minister in the G8 parties and in the EU, had a meeting in November 2003 in Tokyo. Large-scale facilities for science and technologies including ITER were discussed. It was agreed that materials science is very important for the future of fusion research.

5. Advanced technologies and fusion

Fusion research, where extreme conditions are required for materials, provides good opportunities for nano-technology based materials science. Many of the material researchers belong to both fusion and nano-technology research, and are experts in these fields. Fusion also contributes to other advanced technologies such as super-conducting magnets, microwave generators, ultra-high vacuum, and other related areas.

Fusion is also related to the frontiers of physics. Plasma research requires large-scale numerical calculations, and fusion studies become the driving force for super-computers. Remote control of experiments is one of the interesting attempts, since fusion facilities are expensive, and not many devises are operated in the world. With the advanced information and telecommunication technology, fusion experiments will be performed by researchers from all over the world without visiting the actual facilities but by using Internet communication. ITER may be used in such a manner, regardless of its location.

Environmental science is one of the priority areas. Forecasting global climate and minimizing greenhouse gas emission are urgent research projects for all countries. To achieve the goal of decreasing carbon-dioxide in the atmosphere, it is understood that no single measure can solve the problem. In the short-to-medium range, efforts to develop new energy sources such as fuel cells, expansion of Biomass and Solar Power generation, methods to increase energy efficiency, and the development of energy saving technologies are expected to be implemented. At the same time, the development of innovative energy technologies that can replace fossil energy is important as a long range effort.

6. Conclusion

Nuclear fusion is one of the most important options for future energy production, and ITER is the most feasible step to achieve this goal. The CSTP carefully reviewed the proposal for ITER and, for the following reasons, decided to support the proposal. (1) Fusion is expected to potentially provide large-scale clean energy in the future. (2) ITER is an internationally well-organized project with participation of major world countries. (3) Appropriate studies were done for planning and demonstrating the feasibility of experimental fusion reactors. The CSTP pointed out the following two points. (1) It is imperative to promote research on materials. (2) Cost effectiveness must always be kept in mind, and also public understanding is of great importance. Japan is expected to continue to contribute and show leadership in nuclear fusion and materials research.

References

[1] Science and Technology Basic Law, Law no. 130 of 1995. Effective on November 15, 1995.
[2] The Science and Technology Basic Plan, March 2001 and effective through 2005.