

No.57

Renewable Energy and Japan's Future

The accident at the Fukushima Daiichi Nuclear Power Station has reinvigorated discussion of renewable energy in Japan. How should Japan's energy policy and social systems be reconfigured when we take renewable energy into consideration? This issue of NIRA Policy Review reconfirms the importance of taking advantage of local knowledge and abilities in order to make the most of natural energy sources peculiar to specific areas and the necessity of changing existing systems hindering the expansion of renewable energy, in addition to highlighting certain issues related to power system reforms which would enable the exploitation of market mechanisms in this area.

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Towards a Market Offering Choice to Suppliers and Consumers

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What form should Japan's future energy mix take?

Japan's energy policy is presently being extensively reexamined, and questions concerning the energy mix (the future ratio of each energy resource), in particular how to expand the use of renewable energies, are becoming major political issues.

In this NIRA Policy Review special feature, we asked a number of experts holding a variety of perspectives to speak about the future of renewable energy. Even among experts, opinions differ regarding that future, a fact which in itself provides a clear representation of the uncertainty surrounding this topic.

It goes without saying that technological advances will be essential to the further spread of wind and solar power. While they are presently very expensive, the large-scale development of solar and wind power resources should result in a substantial decline in cost. Thus, the use of measures such as the introduction of a feed-in-tariff (FIT) system is necessary in order to provide momentum for the expansion of these energy sources. However, we still do not know what impact the FIT system will actually have on the expansion of renewable energies and the reduction of their cost. Differences in outlook on this point are visible in the holding of optimistic or cautious views of the future. For example, compare in this issue the opinion of Takeshi Wada, who is hopeful concerning the spread of renewable energy, with that of Akihiro Sawa, who believes that there are limits to the ability to supply power using renewable energy sources.

We should also take note of the fact that there are differing opinions concerning the rationale for promoting renewable energies. The three main criteria which should be taken into consideration when discussing energy policy are the reduction of energy costs, the guarantee of energy security, and environmental policies, such as the control of greenhouse gas (GHG) emissions.

Japan actively advanced the use of nuclear power because the technology fulfilled all three criteria: It reduced energy costs, promoted energy security by reducing dependence on oil and natural gas imports, and emitted virtually no GHG.

However, the accident at the Fukushima Daiichi Nuclear

Power Station reconfirmed the high radiation risk associated with nuclear power, and the social cost of nuclear power is now being fundamentally reconsidered. I do not intend, however, to discuss nuclear power policy here. It will suffice to indicate that the advantages offered by nuclear power - the fact that it reduces reliance on fossil fuel imports and produces no GHG emissions - remain important. These same advantages are also offered by renewable energies, and it is therefore only natural that this area is also attracting attention.

With regard to the disadvantages of renewable energies, we can point to high cost, and the fact that solar and wind power are unstable energy sources. The question is how to overcome these issues.

Advancing reforms of Japan's power system

Reforms of the power system will be essential in promoting the increased use of renewable energy. For example, Hokkaido is ideal for the production of wind energy. Unfortunately, because of the capacity of current electricity transmission lines, there is a limit to the amount of power that can be sent from Hokkaido to Honshu. Under present conditions, no matter how much wind power was generated in Hokkaido, it could not all be transmitted to Honshu.

Electricity suppliers are divided by region, and vertically integrated regional monopolies control all generation, transmission, distribution, and retail in their respective areas, making it difficult to promote the use of renewable energies over a wide area. Even if new companies attempt to enter the renewable energy market, they face numerous difficulties under the current Japanese power system.

Power system reforms are currently being discussed by the government, and these reforms are also necessary for the spread of renewable energy use. What we need are power transmission and distribution networks which cover wider areas, and which are independent of power producers.

As Hiroaki Niihara emphasizes in this issue, responding to fluctuations in electricity output on the consumer side ("demand

response," or DR) is also a key to expanding the use of renewable energies. To date, the ability to ensure supply corresponding to the amount of demand has been considered to represent stable supply in Japan's power system. As a result, the nation has grown increasingly dependent on nuclear energy due to its ability to stably supply large amounts of power. However, it will also be important to increase the ability to respond to fluctuations in supply by adjusting consumption. The adjustment of demand by DR is a technique that is already being used in Europe and the U.S. It will be necessary to design a system in which the introduction of smart meters enables a clearer understanding of power demand, providing increased incentive to reduce consumption during peak hours, thus promoting the conservation of energy.

Market mechanisms and the response to global warming

How should we reduce GHG emissions? What role will renewable energies play? In order to answer these questions, we must begin with the fundamentals.

Up to the present, Japan has relied on the use of nuclear power to control GHG emissions. With nuclear power no longer viable, the nation will move on to solar or wind power. Technologies are aggressively pursued one after another, one at a time. But this is no more than a shift from one type of "controlled economy" to another. Setting targets and attempting to achieve them, a method characteristic of controlled economies, remains undesirable even when applied to the promotion of renewable energies.

Tatsuo Hatta's remarks in this issue concerning the importance of market mechanisms are particularly interesting. The reality is that we do not know what type of renewable energy will be the most promising in 5 or 10 years. More general responses to environmental problems, such as the introduction of a carbon tax or emissions trading, will be necessary to allow the market greater freedom in the selection of appropriate technologies.

Rather than focusing exclusively on how to supply power, we need to discuss how the available power will be used. This also applies to renewable energy. In the case of wind power, we tend to imagine that wind power will be generated in Hokkaido and transmitted to Tokyo. As Professor Hatta points out, the incorporation of transmission costs in electricity fees could promote the building of more factories in Hokkaido and Tohoku to take advantage of cheap renewable energy, and might also promote more intensive use of power sources such as solar power and cogeneration in Tokyo, where power costs would increase.

The flexible systems we need

As Hiroaki Ikebe points out in this issue, enabling consumers to see the actual status of power supply will be important for the expansion of renewable energy. It will also be possible to provide consumers with more options, enabling them to choose renewable energy. This is also a major goal in the power system reforms currently under discussion.

In addition, as Dr. Wada and Junichi Fujino indicate, it will be necessary to increase the capacity for action in the field of renewable energy at the local community level. Even renewable energies entail a variety of environmental burdens. The development of these forms of energy also impacts on the interests of fisheries, the hot spring resort industry, and other businesses. Mr. Niihara points out that the exploitation of farmlands, the roofs of private residences, and other potential sources as important sources of wind and solar energy must also be taken into consideration in system design. Further, as Dr. Fujino suggests, the development of methods for the flexible integration of the renewable energies which most suit the characteristics of specific regions may also be an effective means of proceeding.

Even if the basic system design is conducted at the national level, local entities are essential in terms of collecting detailed data and implementing initiatives at the regional level.

With nuclear energy being seriously reconsidered, expectations are high for renewable energies. However, the problem is clearly not as simple as the replacement of nuclear power plants with solar and wind power plants. Efforts in a variety of areas will be essential, including reforms to the electricity system which allow for the promotion of renewable energy use, the enhancement of regional initiatives, and the relaxation of regulations.

Another important matter for discussion will be the effective deployment of a pricing mechanism incorporating electricity rates, carbon taxes, and other elements. There is considerable uncertainty regarding which types of renewable energy will be advanced by future technological innovations. In addition, there are also significant differences between regions in terms of the most suitable renewable energies. It is precisely for these reasons that flexible responses which make use of market mechanisms are so important.

Motoshige Itoh:

President, National Institute for Research Advancement (NIRA), 2006 – present.
Professor, Graduate School of Economics, The University of Tokyo, 1996 – present.
Holds a B.A. in Economics from the University of Tokyo and a Ph.D. in Economics from the University of Rochester. Rochester, N.Y.

Towards locally-driven development

Dr. Takeshi Wada

President, Japan Association on the Environmental Studies

Considering the aim of the Intergovernmental Panel on Climate Change (IPCC) to lower the greenhouse gas emissions of advanced nations in 2050 by 80-95% against 1990 figures, it will be necessary for renewable energy to represent 80% of Japan's power and over 50% of the nation's primary energy. Because every district of Japan possesses sources of renewable energy, this is not impossible.

To promote the spread of renewable energy, local communities must take charge of plant development themselves. Even in cases in which corporations build power plants, giving part ownership to local residents will ensure a smoother process. For example, local people may be opposed to wind turbines because of noise and other issues, but opposition will decline if they are given a share of the income from the facility. Similarly, in the case of geothermal power and offshore wind power developments, energy companies can avoid conflict with local entities by cooperating with individuals and organizations involved in the operation of hot springs and local fisheries from the beginning. The successful design of systems involving local entities will benefit the large-scale development of distributed renewable energy sources.

The use of renewable thermal energy will also be important in attempting to increase overall energy efficiency. Substantial energy savings can be anticipated from the combined use of thermal energy technologies, such as geothermal power and biofuel cogeneration.

Encouraging the introduction of energy-saving measures by making power use 'visible'

Mr. Hiroaki Ikebe

President and CEO, ENNET Corporation

As a Power Producer and Supplier (PPS), our company purchases surplus energy from power plants and factories and supplies it to consumers who have established contracts for blocks of 50kW or more of high-voltage electricity. Since the Great East Japan Earthquake last year, customers have expressed the desire to purchase 100% green energy. While we would like to respond to these requests by maximally exploiting renewable energy sources, we are constrained by the current electricity business system framework. For example, offering the option for 100% green energy is not particularly difficult with the use of IT; what is difficult is the fact that the current Law concerning the Promotion of Measures to Cope with Global Warming only allows a single GHG emission factor per power supplier. The system needs to be reformed to enable companies to offer a wider range of energy choices to customers.

Our company uses IT to offer our customers a service that makes their electricity usage and the electricity rates in effect at any given moment visible. Based on this newly visible information, customers alter their behavior and introduce special measures such as reducing power consumption during peak hours. This type of cooperation between the supply side and the demand side by means of IT has merits for both sides, and enables energy to be used in the most efficient way possible. We believe that this system will also promote the use of renewable energies.

When considering future ratios of renewable energies, the process by means of which issues are considered should be emphasized rather than specific numbers. I believe that both suppliers and consumers should engage in a comprehensive examination of the issues, taking into consideration the economic benefits, level of local self-sufficiency, and stability of renewable energies and fossil fuels, in addition to the potential for energy savings and negawatt production on both the supply and demand sides.

Expert Opinions

What is the Future of Renewable Energy in Japan?

Emitting no greenhouse gases and representing semi-permanent energy resources, expectations are high for renewable energies from the perspectives of both global warming and energy security. How should we envision the future possibilities for renewable energy in Japan? In this issue, specialists in environmental science, economics, and energy policy, in addition to representatives of government and business, offer their opinions.

Interviewer: Yuya Nishiyama, NIRA Senior Researcher Date: June 2012

A change in our thinking will expand the potential of renewable energy

Mr. Hiroaki Niihara

Director General, Energy Conservation and Renewable Energy Department, Agency for Natural Resources and Energy

The future is bright for sustainable energy in Japan. However, a change in our thinking regarding energy policy will be necessary in order to enable us to take advantage of this potential. First, it will be necessary to revise our single-minded focus on ensuring a stable supply of energy and to develop a new way of thinking, one that also takes into consideration adjustments on the consumer side. This would increase the potential for the use of renewable energy, which is characterized by significant output fluctuations. The Ministry of Economy, Trade and Industry (METI) Advisory Committee on Energy and Natural Resources has discussed increasing the use of renewable energy to make up 25-30% of Japan's total power supply by 2030. Radical reforms of business models and other factors will be essential to the achievement of this goal. Because of this, the feed-in tariffs (FIT) have been established to set pricing in order to help stabilize the renewable energy business.

Looking at the different types of renewable energy individually, to promote more widespread use of solar energy, the Japanese government is considering introducing the world's first "roof-lending" scheme, by means of which the roofs of private houses would be used for solar generation in order to smooth out fluctuations in solar power output. The large-scale use of farmlands would be an effective method of further development of wind power. However, at present it is difficult to change the use of farmlands. It would be necessary to conduct wind power developments in a manner which would not interfere with agricultural productivity. In the case of geothermal power, making plant development possible within natural parks will be essential. The first step will be to identify and move ahead with a small number of high-quality projects.

There are various restrictions on the development of power sources on farmlands and in natural parks and it will be essential to coordinate with entities outside the power industry. However, we will not achieve further development of renewable energy as long as the difficulty of such coordination prevents action. If I may put it this way, the question is one of structural issues within Japan itself. The relevant ministries and government agencies support the Agency for Natural Resources and Energy in relation to the expansion of renewable energies, and we will therefore continue to push ahead.

The tentative goal for renewable energy as a whole is to achieve a ratio of roughly 35% hydraulic power, 20% wind power, 20% solar power, 10% geothermal power, and 10% biomass power by 2030. It is most probable that the development of renewable energy will be led by solar power at first, with a later expansion in wind power.

Market mechanisms offer hope for renewable energy and co-generation in Tokyo

Professor Tatsuo Hatta

Visiting Professor, Faculty of Economics, Gakushuin University

Rather than rashly increasing the supply of renewable energies in a manner contrary to economic principles, we should allow market mechanisms to take their course. Thus we should remove the various obstacles that are unnecessarily hindering the spread of renewable energies in order to enable market mechanisms to function as they should. The most significant initiative here will be the introduction of "location-specific electricity transmission rates."

Presently, a high volume of power is being transmitted from the Tohoku area, the location of numerous power plants, to the Tokyo metropolitan area, where power demand far exceeds supply. Consequently, enormous electricity transmission facilities have been constructed between the two areas, and substantial transmission loss occurs in the transmission of power from Tohoku to Tokyo. Despite this, electricity transmission rates are not designed to depend on the direction of transmission. Therefore, market mechanisms do not function appropriately in decisions concerning the location of power plants and energy consumers.

The proposed system of location-specific electricity transmission rates decomposes the existing transmission rates, which are charged to pairs of generators and electricity users, into injection rates for sellers and reception rates for buyers, with each rate differentiated by location. In this system, some parties involved will receive subsidies (negative rates), instead of paying a fee. For example, increases in power generation in the Tokyo metropolitan area would lead to reduced electricity transmission in the existing direction of transmission. Thus, subsidies would be paid to generators in Tokyo. On the other hand, increase in power consumption in Tohoku would also reduce electricity transmission in this direction, warranting subsidies to users in Tohoku. By contrast, increases in power generation in Tohoku and in power consumption in the Tokyo metropolitan area would increase electricity transmission in this direction, warranting high rates for both parties.

As a result of this reform, both the buyers' price and the seller's price would increase in the Tokyo metropolitan area and decrease in Tohoku. In the case of Tohoku, the lower buyers' price would attract factory construction. In the case of the Tokyo metropolitan area, the higher seller's price may lead to an increase in the supply of renewable energies, as well as cogeneration, without distorting the market mechanism.

Interest in renewable energies originates from the necessity of responding to global warming. The introduction of a carbon tax on all carbon dioxide-emitting fossil fuels would be an effective method of realizing this policy goal. This would give renewable energies an additional advantage over non-renewable energies.

Clear policy goals are essential as the basis for discussion

Mr. Akihiro Sawa

Executive Senior Fellow, The 21st Century Public Policy institute

Energy policies have three important aspects: stability of supply (energy security), economic efficiency (economy), and prevention of global warming (environment). It is necessary to establish a clear order of priority for these policy goals before considering the energy balance. At present, however, discussions are being advanced while this order of priority remains vague. The introduction of renewable energies was originally intended as a measure to respond to global warming by reducing the use of fossil fuels. The issue of renewable energies is therefore unrelated to the recent nuclear plant accident.

Excessive reliance on a specific energy source can be dangerous due to a decline in the stability of supply; thus, the availability of a variety of energy sources is crucial. In this sense, renewable energies represent just one of the possible options. Among renewable energies, biomass and geothermal power offer stable sources of energy. The output of solar and wind power is unstable, and these sources should be considered as a means of reducing greenhouse gas emissions rather than for their stability.

Renewable energy facilities are only developed in locations deemed to be profitable, but these are limited in quantity. It therefore becomes progressively more difficult to develop facilities. The Japanese government is discussing the possibility of increasing its ratio of renewable energy to 25-35% of Japan's total energy supply, but even if every suitable area is developed, achieving this goal will remain challenging. If the goal is to secure a certain amount of renewable energy, the best course of action is not the feed-in tariffs (FIT), but to require energy companies to supply a specific quantity of energy from renewable sources.

Formulating local renewable energy plans based on wide-ranging information and diverse perspectives

Dr. Junichi Fujino

Senior Researcher, National Institute for Environmental Studies

Japan possesses abundant natural resources and is blessed with numerous sources of renewable energy. However, there are many facets to renewable energy, and societies focus on different facets at different times. The distribution of sources of renewable energy varies from region to region, and renewable energies may also result in environmental problems depending on how their development is carried out.

In developing renewable energies, it will be important to view the situation from numerous perspectives and choose methods that are rooted in the local community. To this end, transition management must be implemented to initiate the trend towards a sustainable, locally-led society. Giving local governments authority over energy-related personnel, products and finances will result in local communities and entities having greater involvement and say in renewable energy development.

Creating the most effective renewable energy plan requires a variety of data from each individual region of the country, including the distribution of renewable energy sources, energy supply and demand predictions, economic forecasting, information regarding urban planning, and demographic trends. Unfortunately, almost no local governments have access to even basic data, such as the status of power supply and demand in their regions. The development of a network that provides access to the necessary data and enables the sharing of past examples of successes and failures across a wide area will stimulate the renewable energy developments that are needed in specific regions.

What's NIRA?

The National Institute for Research Advancement (NIRA) is an independent, private-sector research institute which defines urgent policy issues and formulates bold and timely policy proposals, seeking to contribute to the revitalization and further development of Japanese society and the Japanese economy.

Utilizing a network of scholars, researchers, and specialists in a wide range of subjects, NIRA works for the public benefit from a fair and neutral perspective, attempting to reinvigorate policy debate and contribute to the process of policy formation in Japan. The institute focuses on domestic social and economic policy, international relations, and regional issues in Japan as its principal areas of research.

Established in 1974 as a government-authorized independent research institution, NIRA became an incorporated foundation in 2007, and since February 2011 has been recognized as a Public Interest Incorporated Foundation.

National Institute for Research Advancement (NIRA)
4-20-3 Ebisu, Shibuya-ku, Tokyo 150-6034, Japan
(URL:<http://www.nira.or.jp/english/>)

For more information : info@nira.or.jp
Tel +81-3-5448-1735 Fax +81-3-5448-1743