Energy for Next Generation & Smart Community Initiative

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Latest Trends in Energy & Environment Policy in Japan & World

Japan suffered from devastating damage caused by the Great East Japan Earthquake and the great concern about the safety of nuclear energy has continued since then. We Japanese will have to continue to discuss intensively the question of the energy demand-supply structure for a long time hereafter.

Construction of a low-carbon society should be one of the most crucial issues in this century, in the light of not only global environment concerns but also the energy security concern worldwide beyond borders, so that a shift from fossil fuel energy sources to non-fossil fuel sources could be further accelerated.

Nuclear power and renewable energy sources have both been so far considered important potential non-fossil fuel sources to achieve a low-carbon society.

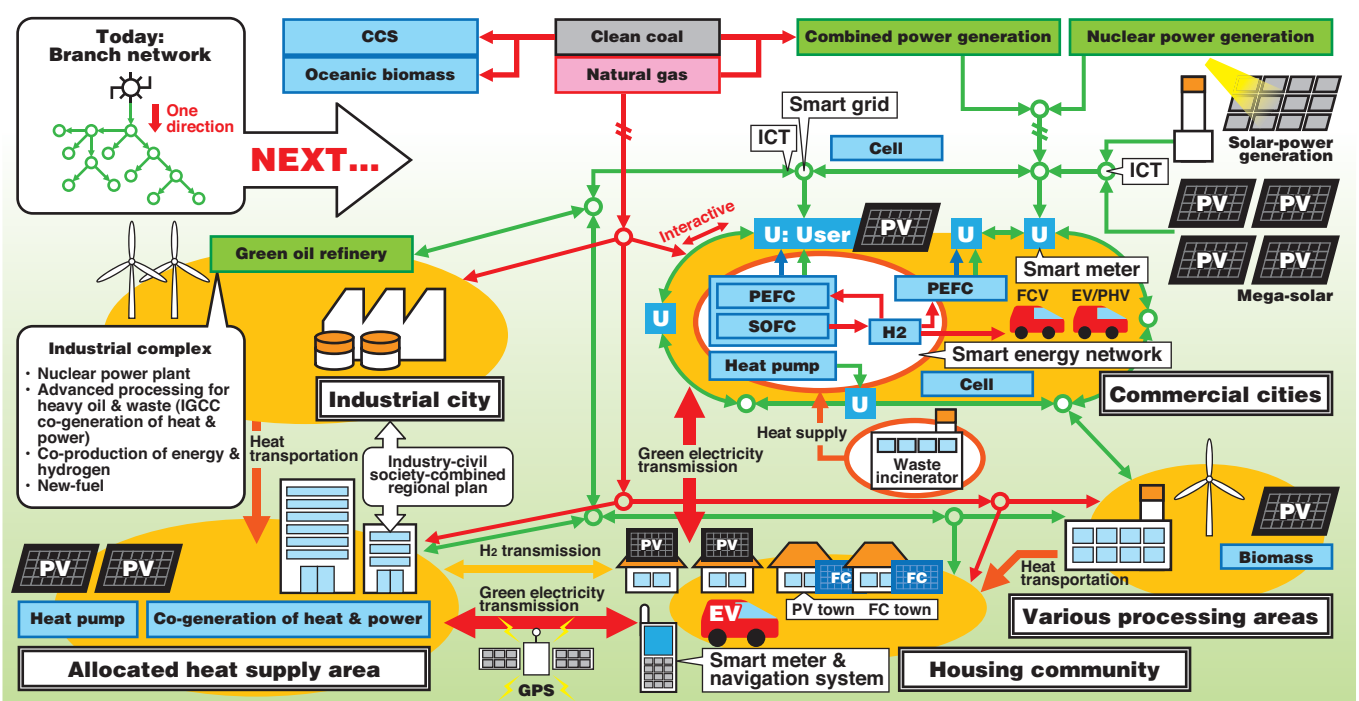
However, now, on the nuclear energy sources, a world-wide argument to pursue high-level elaboration of the control system of an artificially made product should be exploited, including the question of its economic profitability.

Meanwhile, an overwhelming majority of the people support the development and further utilization of renewable energy sources. However, there are not a few issues to be resolved to achieve this.

In Japan, to expand the utilization of renewable energy sources, we started a new energy policy in November 2009, which would enable all the nation to join in promoting further development of renewable energy sources by electric power companies' purchasing excess electricity generated by solar power stations at a fixed price twice as high as their selling-price of the electricity, and adding it to the original electricity fee. Since we are trying to introduce a high-cost energy supply into the market by this policy, consumers need to bear the burden of the additional cost. We would need a political decision because of the nature of the additional burden of the high energy cost eventually to be paid by the nation. And before reaching a decision, a wide range of in-depth analysis from different perspectives must be done, since the burden to be borne by the nation is not necessarily small.

Concerning solar power generation, it has been pointed out that this could have an enormous positive impact upon not only the energy and environment policy but also the industrial and job creation policy as its synergy impact. We certainly remember clearly that not long ago a draft law to oblige the electric power companies to purchase in

Low-carbon energy demand-supply network



Note: IGCC (Integrated Gasification Combined Cycle), CCS (Carbon dioxide Capture & Storage), ICT (Information & Communication Technology), PEFC (Polymer Electrolyte Fuel Cell), SOFC (Solid Oxide Fuel Cell), PV (Photovoltaic power generation), FC (Fuel Cell), EV/PHV (Electric Vehicle/Plug-in Hybrid Vehicle)
Source: Compiled by author

principle all the electricity generated individually by any kind of renewable energy source at a fixed price was approved by the Diet.

Green Innovation

I believe that we can find the engine for growth of the Japanese economy in the 21st century in promptly creating an economic model for a low-carbon society. The dominant opinion in the world analytically as well as scientifically reinforced by intellectuals strongly encourages the realization of a low-carbon society.

I think the world is now at a turning point. We cannot draw a future picture of our society based on the existing knowledge and concepts of energy consumption and society as its background. We would need a shift in the energy paradigm in order to achieve a low-carbon society. Firstly, as I mentioned above, we would need "a change from fossil fuel to non-fossil fuel." Secondly, we would also need "turning fossil fuel energy into clean energy" or "creating a new technology to raise its energy efficiency." It would take another decade or two decades to resolve these two issues and achieve a new energy supply system.

We would need further R&D efforts and innovation definitely to encourage such a paradigm shift for a low-carbon society. Innovation can be defined as "structural reform of a socioeconomic system to be led by new knowledge and technology." In consistency with this definition, we need to clarify "a newly created value by a developed technology."

In the case of Japan, in most cases, a technology-leading approach seems to be adopted and thus there are many things to learn from the Western countries on their adoption of this approach. For example, solar power generation development is an innovation to create the value of realizing an affluent life through adopting a natural energy equally and fairly given to all human beings for a fulfilling life.

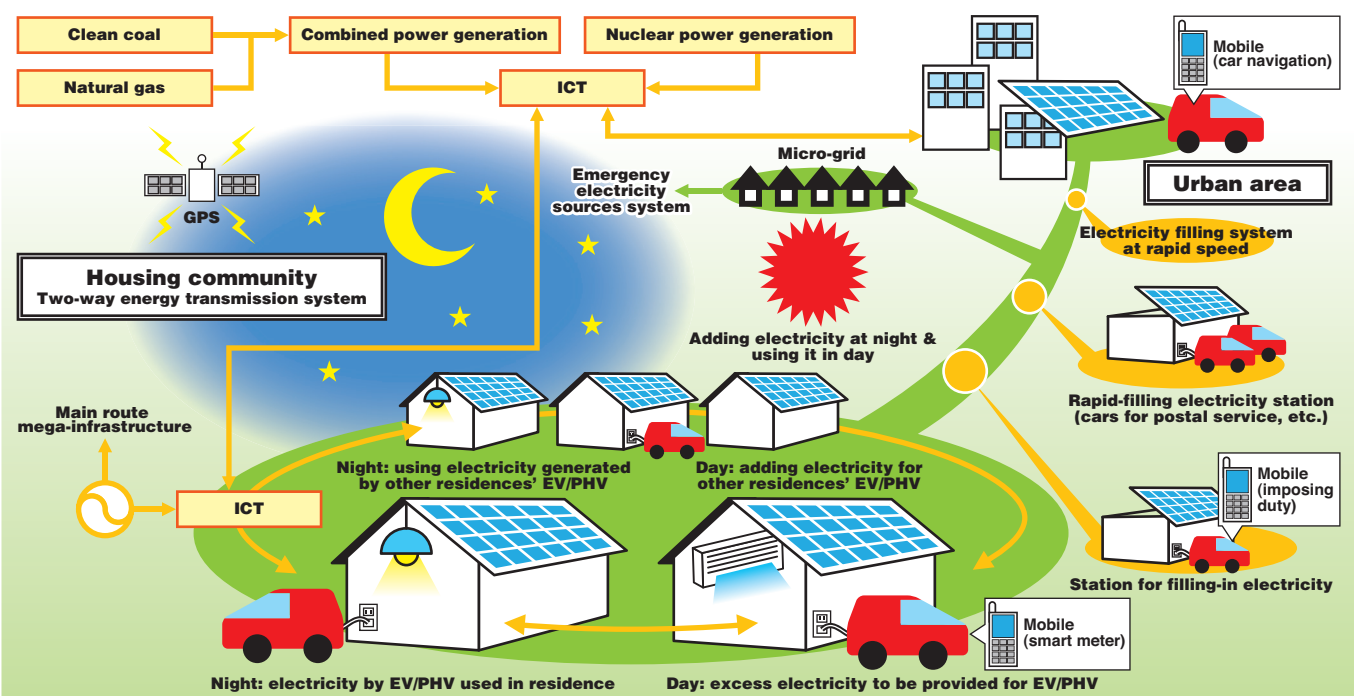
New Society Led by New Energy

It is highly appreciated that The Purchase of Renewable Energy at Fixed Price Act was passed by the Diet in Japan. However, since expensive electricity will be introduced to the market by this Act, we will need a policy to pay its cost and, in this law, the cost would be paid as an obligation by all the electricity consumers.

The obligation is a part of the electricity fee and if you refuse to pay it, your electricity supply will be suspended. Electricity is to be considered a minimum necessity for people's daily life or industrial activity and thus the obligation should be considered a tax for a specific objective. Any tax must involve people's interest and as such we need a national discussion on devising a system on it.

This law was one of three laws of which approval by the Diet would force then Prime Minister Kan to resign. Therefore, we cannot deny that the Diet could not spend enough time for discussion before its final approval due to the constraint of the political timeframe and in spite of that its fundamental structure was revised at the last minute.

This type of law had already been adopted by many countries in the world and in Japan under the LDP administration in 2009, this policy was started targeting only solar energy in the light of energy and industrial policy interests. They have expanded the target this time to other renewables such as wind power, small and medium-sized hydroelectricity, geothermal and biomass, and also concerning solar power it is obligatory in the current law to purchase all solar power including that for homes and offices, whereas only the excess electricity generated by private solar power generation to be used for private consumption was targeted by the previous law. In the previous law, the legislators drafting the law aimed at decreasing the nation's burden as much as possible. Then, in thinking about raising the energy self-sufficiency rate and reduction of CO_2 emissions, nuclear power



and renewables were considered the most effective tools in accelerating the change from fossil fuel to non-fossil fuel. And in terms of the volume, nuclear power was considered overwhelmingly more effective than renewables in achieving this purpose.

However, needless to say, after the Fukushima nuclear accident, the expansion of renewables is now considered the most promising alternative for nuclear power, of which the safety is no longer accepted. Under such circumstances, the current law has been drafted for immediate adoption by the Diet because of its urgent nature. And as such, the law largely stands on the side of the renewables business and in the process of revision at the final stage, it seems it will be revised even more in favor of these renewables business interests.

Below, I would like to clarify the key issues in its implementation.

First, on the purchasing price and purchasing period, though the original draft made them equal among all the renewables except solar energy, in the final draft, they have to be determined by the type, setting of their facilities, scale, etc. of the renewables.

This was inserted for consideration for more expensive renewals such as small and medium-sized hydroelectricity rather than for cheaper ones such as wind power. Since all the regional distinctions on the potential of the renewables can be properly taken advantage of all over Japan, this regulation is certainly fair to all the renewable producers. However, if the market mechanism does not work well among the renewables for business operation, then the nation's burden for the cost of the total introduced amount of the renewables will increase.

Therefore, it is important to set up each renewable's rational and clear target for the introduction amount. Without such numerical targets being scrutinized physically and economically, there would be no logical reasoning for any fixed price for purchase. It is vital to introduce such targets with timeframes.

Secondly, the METI minister determines the price for purchase, respecting the opinions of the Price-Setting Committee founded by agreement of the Diet, This decision should consider a wide range of interests, not only the producers' but also the consumers,' and also respond to economic changes as flexibly as possible. The current law encourages METI to secure profits for the producers in particular, in order to encourage creation of the renewables business. That would certainly be instrumental in promoting solar energy for those homes interested in setting up solar panels, with the result of prompting the development of the mega-solar system by this METI consideration, and thus a rapid decline in the price of solar panels.

On the other hand, it is necessary to avoid providing excessive benefits to the producers that also lead to an increase in the price of electricity. We should learn well from the European countries' experience on this policy and try to balance the benefits of producers and consumers.

Thirdly, the law adopted a measure to decrease the financial burden of the electricity-consuming industries. However, it would not be fair to replace the burden borne by those industries so far with the consumers' extra burden.

The law seems to assume to replace it with a different source of government revenue such as the revenue from taxes on oil and coal consumption. We need to ensure that we secure such budget sources in terms of fairness, as mentioned above.

Finally, the law clearly defines the obligation of the electric power companies to allow those renewables' power-producing facilities to be connected with their electricity provision system. However, according to the law, if there is an impediment to the smooth provision of the electricity supply, they do not have to do so. We need an open and transparent discussion on the definition of "impediment" and to convince both sides of the utility of the policy, to achieve the least national burden and the largest use of renewables.

It is to be added as well that the law is certainly meaningful in the sense that it started a national discussion in pursuing a national consensus on the usage of a wide range of energy sources on the basis of large-scale electricity sources and how to achieve an increase in national welfare with a renovated energy supply-demand structure.

New Energy in Future Generation & "Smart Grid"

A new energy infrastructure called "smart grid" has recently attracted much attention. This is a transmission and distribution system integrating the electricity generated by natural energy sources such as solar cells and wind power into the existing electricity supply system to the maximum. Today in many countries, mega-energy infrastructure such as fossil fuel and nuclear power dominates the core of the infrastructure for energy supply. For example, in China, 80% of the total electricity supply is occupied by coal thermal power and this flows into the demand side by a control system in which an equal amount of electricity is provided simultaneously for all the users. This system will be changed with the introduction of "smart grids." With a "smart meter" checking all the streams of energy from the demand side such as that generated by a solar cell in a home, it would be possible to create a new control system for electricity supply on both sides, the supply side with mega-infrastructure and the demand side by using ICT. By taking full advantage of natural energy sources with this system, we would be successful in reducing much of the energy supply cost and achieving a truly affluent human life.

A more advanced system is now under study in Europe. For example, in the Netherlands, they aim at the future energy supply infrastructure by using a navigation system with the function of highly developed information-assembling. Though Japan provides high-quality navigation equipment, Europe and the US are leading the technology to create this system. This can be a new leading energy supply system in the future, as follows.

As the generation cost of a solar cell decreases to the level of fossil fuel thanks to technological development in the future, all housing can be equipped with a solar cell.

Under such circumstances, the electricity generated by the homes could have a certain impact on the total electricity provision control system. In particular, in the case of solar cells, the electricity generated is dependent on the weather and how long the sunshine continues each day. Therefore, we would need a navigation system to check each area's generated power and forecast an optimal supply and the system would be eventually be a key to the whole electricity supply-demand control system. With a combination of smart meter and navigation, we can get data of each home's generated power and with a combination of mobiles (ICT) and navigation, we could minimize the waste of electricity in such a way as to turn on a washing machine when we have extra electricity exceeding the electricity for daily use from solar cells, etc., or transfer the extra electricity in a sunny area to a rainy area. In short, the energy supply

system itself would be a smart one. In addition, as hybrid cars and electric cars prevail, the extra electricity can be used for transportation as well, since those cars run by electricity.

This could eventually result in realizing a system optimizing the whole regional energy supply with control by navigation, which would enable us to achieve structural reform of the socio-economic system led by new knowledge and technology, and thus bring the creation of new value. It even has the potential to fully electrify a village without electricity.

Optimization of Urban Energy Supply System & "Smart Energy"

Japan has a responsibility to clearly show the world a grand design of low-carbon energy supply-demand structure based on energy-saving, and autonomous and environment-friendly technology and social systems, as a model nation of a low-carbon society.

I am convinced from our scientific study that leading high-tech energy-saving equipment and new energy sources autonomously working in local areas would perform a cluster on an appropriate scale in the foundation of mega-infrastructure consisting of nuclear power, coal and natural gas.

In order to create a grand design for an urban energy supply system to be adopted by a low-carbon society, it would be necessary to achieve a network of new energy-saving systems through introduction of the Building Energy Management System (BEMS), with the assumption of the commercial and business facilities in the city as high-quality energy-saving bases.

If these wide-area BEMS are founded in urbanized areas and facilitated with the most advanced super-energy-saving ICT infrastructure, they could be used as a two-way remote control infrastructure to be used by small and medium-sized facilities as well, and thus they would have great potential to reduce CO_2 emissions.

Waste incineration plants and sewage plants, producers of biomass energy in urban areas, are also very important in drawing our grand design.

Low-carbon cities would function only if a network infrastructure enabling the effective use of the tremendous amount of waste heat in the cities, in other words, recycling infrastructure, is accommodated.

This energy management system would be indispensable to achieve a low-carbon society as a smart energy network to be used for not only electricity supply but also heat supply, and would be a stepping-stone to develop a more advanced system for reduction of CO_2 emissions.

On the other hand, a hydrogen society based on fuel cells will definitely arrive with the progress of electrification. In the future, we will have a smart network with control for optimizing the power stream of a wide range of local energy distribution systems with artificial brains in the spots of electricity consumption, linked to a large-scale electricity distribution system. The system can provide not only electricity but also heat and hydrogen. Such an integrated system would realize an ultimate energy-saving by its appropriate management and be a public infrastructure of a low-carbon society to maximize the use of renewables, and thus could achieve the minimum cost of the energy supply to the entire society. We Japanese have already shown this to the world in Aichi EXPO as a micro-grid system to be used for a low-carbon society in 2030, as a pioneer in this area.

What is Our Grand Design of the Energy Supply System for 2050?

I do not think it would be feasible to choose a single option in the energy supply system. There would be many countries choosing nuclear power while raising its security level. Whatever Japan may do, newly emerging countries would have no option but to pursue high economic growth and that would result in the increase of energy consumption. We would have only limited alternatives for energy sources enabling us to achieve sustainable growth. Comparing the amount of energy produced, 1 gram of uranium would correspond to three tons of coal. Assuming that, it is difficult to imagine that the world would give up nuclear power. In particular, the industrial sectors would need mega-infrastructure and they would have no option but to be dependent on either fossil fuel or nuclear power. As long as nuclear energy is considered cheaper, the world demand for nuclear energy would most likely continue to grow. In that case, they would have to use it with the most advanced technology. Then, Japanese technology and experience would be very helpful.

On the other hand, it may be necessary to change our perception of nuclear power as a cheap energy, since more consolidated measures to strengthen its security not only for new facilities but also for the existing ones are inevitable, and will push up the cost of nuclear power supply. It is not only such a cost-benefit of nuclear power but also public opinion about nuclear power that must be taken account of in reconsidering its merits and demerits.

Fossil fuel can be a stable supply of energy, but has demerits such as a high degree of CO_2 emissions and the possible exhaustion of resources. Natural energy's running cost is cheap, but its supply is not stable. There are advantages and disadvantages of each energy source. Nuclear power, fossil fuel and natural energy can restrain each other from rising costs and thus only the best mix of these energy sources could be a solution for the energy problem and the "Smart Community Initiative" described in this article could provide us with a promising solution.

Innovative systems would not require a complete replacement of the existing sources such as coal, natural gas, and nuclear power with natural energy sources. Though an agricultural country may fulfill its domestic demand with only natural energy, any industrial or commercial country would be running short of electricity with only natural energy. It would be necessary for them to make the existing energy mega-infrastructure environment-friendly and keep its stable supply and on this basis, reform the whole energy structure into a low-carbon one. We should introduce to the neighborhood of the electricity consumers the natural energy power systems and create a network of these local energy systems and integrate them with the existing base system.

What is most important in achieving this is utilization of ICT as an information infrastructure. I would like to conclude this essay by stressing that active development of the so-called "Green by ICT" creating a new model of green business such as the "Smart Grid" by using information technology could have a big impact on the construction of new energy systems. JS

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