

**RENEWABLE ENERGY FUTURE: CURRENT STATUS
AND POLICY CHALLENGES IN JAPAN**

EL FUTURO DE LAS ENERGÍAS RENOVABLES:
ESTADO ACTUAL Y DESAFÍOS DE LA POLÍTICA
IMPLEMENTADA EN JAPÓN

ARTÍCULO INÉDITO DE INVESTIGACIÓN

CÓMO CITAR ESTE ARTÍCULO (CHICAGO) Takahashi, Hisako. "Renewable Energy Future: Current Status and Policy Challenges in Japan." *Revista de Derecho Aplicado LLM UC* 1 (2018).
doi: 10.7764/rda.o.i.111

REVISTA DE DERECHO APLICADO LLM UC Número 1
Julio 2018
ISSN: 2452-4344

Recepción: 3 de abril, 2018
Aceptación: 11 de junio, 2018

Abstract

This work aims to describe, using the example of Japan, some practical policy challenges that emerge from the decision of a country to increase its use of renewable energy resources. The article firstly identifies Japan's policy objectives, then describes the current deployment of renewable energy in the country, and later analyzes the specific situations and challenges of each renewable energy resource. Finally, the article highlights in greater detail the challenges facing the enhancement of further renewable energy power generation, concluding that renewable energy policies should be crafted by multidisciplinary teams in which lawyers are required to deepen their interdisciplinary knowledge.

Keywords: renewable energy, climate change, solar PV, wind power, hydropower, geothermal, biomass

Resumen

Este trabajo tiene por objetivo describir, a través del ejemplo de Japón, algunos desafíos prácticos que surgen de la decisión de un país que espera aumentar su uso de recursos energéticos renovables. El artículo identifica en primer lugar los objetivos de la política energética japonesa, luego describe el despliegue actual de energía renovable dentro del país y finalmente analiza en mayor detalle las situaciones específicas y desafíos de cada tipo de recurso energético renovable. Por último, el artículo destaca en detalle los desafíos que enfrenta Japón al mejorar su generación de energía renovable, sacando en conclusión que las políticas sobre la energía renovable necesitan ser elaboradas por equipos multidisciplinarios donde los abogados deben profundizar sus conocimientos interdisciplinarios.

Palabras clave: energía renovable, cambio climático, energía solar fotovoltaica, energía eólica, energía hidroeléctrica, geotermia, biomasa

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I. Introduction

Climate change is having a profound and alarming impact worldwide, giving rise to increasingly significant social, economic, political, and international security challenges. In December 2015, 196 parties to the UN Framework Convention on Climate Change (UNFCCC) adopted the Paris Agreement, an international framework for a coordinated and integrated effort to tackle climate change. Becoming party to the Paris Agreement accelerated domestic discussions in each country about how to increase usage of renewable energy resources. This article will illustrate, using the particular example of Japan, some practical policy challenges that stem from the decision to pursue such an increase.

II. Policy objectives toward expanding the introduction of renewable energy based on the Paris Agreement

The Paris Agreement was adopted in December 2015, and came into force in November 2016 (Japan ratified it in December 2016).¹ The Paris Agreement stipulates that parties to the agreement are expected to prepare for mitigation measures of individual countries to be expressed in nationally determined contributions (NDCs).² Japan's "intended nationally determined contributions (NDCs)" towards post-2020 greenhouse gas emission reduction targets is at the level of a 26% reduction in Fiscal Year (FY) 2030 when compared to FY 2013.³

Based on international trends, Japan's aim to "reduce greenhouse gas emissions by 80% by 2050 as [a] long-term goal" was decided by the Cabinet in May 2016 as a "Global Warming Countermeasure Plan."⁴ Moreover, the Ministry of Economy, Trade and Industry (METI) considered ways to cope with global warming countermeasures targeting the year 2050 and have compiled the "Long-Term Global Warming Countermeasure Platform Report"

¹ Ministry of Foreign Affairs of Japan, "Deposit of the Instrument of Acceptance of the Paris Agreement," accessed April 20, 2018, http://www.mofa.go.jp/press/release/press14e_001313.html.

² United Nations Climate Change, "The Paris Agreement," accessed April 20, 2018, <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>.

³ Ministry of the Environment, "Submission of Japan's Intended Nationally Determined Contribution (INDC)," accessed April 20, 2018, <https://www.env.go.jp/en/earth/cc/2030indc.html>.

⁴ Ministry of the Environment, "Cabinet Decision on the Plan for Global Warming Countermeasures," accessed April 20, 2018, <https://www.env.go.jp/en/headline/2238.html>.

based on a global perspective.⁵ The Ministry of the Environment (MOE) also formulated a policy called “Long-Term Low Carbon Vision,” which focuses on how to achieve an 80% greenhouse gas reduction in Japan.⁶ METI’s and MOE’s policies are similar in that, on a long-term basis, it is necessary to greatly suppress energy demand, to promote electrification, and to promote low carbon electricity on the premise of improving quality of life.

In order to achieve the high target of an 80% reduction, Japan must optimize the configuration of the power supply used for power generation. Several methods can be considered to significantly reduce CO₂ emissions from the power supply and renewable energy. In general, the following methods can be considered: (i) decrease the amount of power generation, (ii) increase power generation efficiency, (iii) increase the ratio of power generated by natural gas fuel with low CO₂ emissions relative to calorific value, (iv) add CO₂ capture and storage process (CCS) to fossil fuel power generation, (v) increase the ratio of power generation by renewable energy, and (vi) increase the ratio of nuclear power generation.⁷ Among these options, the future potential for increasing the power generation ratio of renewable energy is still tremendous. Fundamental measures are needed to prompt a substantial and speedy introduction of a non-fossil power supply. Expanding nuclear power generation is a difficult proposition after the Fukushima nuclear plant disaster, so it is necessary to rely more heavily on renewable energy in order to realize a low-carbon society.

⁵ Ministry of Economy, Trade and Industry, “The Long-Term Climate Change Policy Platform Compiles a Report,” accessed April 20, 2018, http://www.meti.go.jp/english/press/2017/0414_001.html.

⁶ Ministry of the Environment, “Long-Term Low-Carbon Vision,” accessed April 20, 2018, <https://www.env.go.jp/en/headline/23n.html>.

⁷ See Hiroshi Komiyama and Koichi Yamada, *New Vision 2050: A Platinum Society* (Springer, 2018), doi: 10.1007/978-4-431-56623-6. Regarding the amount of electricity generated in (i), switching to highly efficient electric appliances, etc. has increased after the Great East Japan Earthquake, and the resulting electricity generation has already declined by about 10%. The annual amount of power generation is within 1000 TWh, and this trend will continue in the future. If the rate drops by 1% annually, electricity consumption will be about 650 TWh per year in 2050, 30% lower than the current rate. For products that directly use heat and components of fossil fuels, such as automobiles and water heaters, electricity will be used as a replacement in order to save energy, so demand will increase, but the annual amount of electricity generated will likely not exceed 800 TWh. Regarding power generation efficiency in (ii), large-scale solar power generation is expected to reach 30%, 1.5 times the present value. As for natural gas power generation, it is possible that when combined with fuel cells, power generation efficiency will reach nearly 70%, 1.2 times the present value. Regarding (iii), natural gas produces about half the CO₂ emissions that coal does and there is room to raise the usage ratio, but with society committing to an 80% reduction of CO₂ emissions, it will not become a main power source. With regard to CCS in option (iv), there are difficulties such as economic restrictions and restrictions on site conditions, but there is a possibility that it will be carried out in the future and it is worth considering. Option (vi) is not a major power supply generation scenario, at least considering present circumstances.

III. Overview of the current deployment of renewable energy

Japan aims to ensure its energy supply by implementing a wider introduction of renewable energy and reducing reliance on nuclear power, in tandem with far-reaching energy conservation measures. After the start of the Feed-in Tariff (FIT) system in July 2012, the introduction of renewable energy expanded mainly to solar photovoltaic (PV) power.

Approval of biomass-generated power has also expanded rapidly, mainly with regard to general woody biomass. On the other hand, for wind power (especially offshore wind power), hydropower, and geothermal power, the introduction of new power supplies is strongly restricted (see Table 1).

Regarding the aforementioned, the Mitsubishi Research Institute evaluated the likelihood of achieving renewable energy introduction targets by 2030 based on its own estimates and hearing from operators as well as industry groups. The relevant data is displayed in the following chart:

Table 1. Current deployment of and prospects for renewable energy in Japan

RE resources	Capacity introduced under FIT (July 2012 - October 2017)	Equipment accreditation amount under FIT (July 2012 - October 2017)	Estimated introduction amount for FY 2030 (approx.)	Prospective likelihood of target achievement
Solar PV (residential)	4,398MW	5,146MW	9,000MW	Will be achieved
Solar PV (non-residential)	26,678MW	75,500MW	55,000MW	
Wind power	585MW	3,039MW	10,000MW	Will be achieved
Small- and medium-scale hydropower (Less than 30MW)	224MW	791MW	1,300 - 2,010MW	Still difficult
Geothermal	10MW	79MW	900-1,550MW	Very unlikely
Biomass	750MW	4,001MW	6,020-7,280MW	Still difficult
Total	32,646MW	88,558MW		

Source: Mitsubishi Research Institute

IV. Policy issues and recommendations for each renewable energy resource

In this chapter, we will analyze policy issues regarding the spread of renewable energy. We will focus on whether different types of renewable energy resources can meet the usage increase goals set by the Japanese government. Additionally, we consider measures that could be taken in each case to increase the use of a particular source of renewable energy.

A. Solar PV

Residential solar PV has already reached the FY 2030 energy mix target and it is possible that it will become significantly greater in conjunction with the promotion of ZEH (Net Zero Energy House).⁸ On the other hand, reaching the non-residential solar PV target may be challenging given market downturns accompanying reductions of purchase prices and transitions to a bidding system. In any case, it is still expected to reach the target.⁹

Today, the introduction of renewable energy is expanding under a FIT system, and solar PV power generation is being rapidly adopted because of its short development lead time. Solar PV generation is expected to be introduced on a massive scale in the future provided it keeps expanding in the Tokyo, Chubu, and Kansai areas.¹⁰

However, this power supply will vary in output depending on weather conditions. Especially when solar PV generation occurs on sunny days, the amount of power generation peaks in the daytime, the output drops sharply in the evening, and no power at all can be generated at night.¹¹ Thermal power generation can help with adjusting to fluctuation and demand, but when a variable power supply is introduced in large quantities, it is possible that conventional thermal power generation may not respond to sudden output fluctuations. Also, it may be assumed that the supply of electricity will exceed demand for seasons and days of the week with low power demand.¹² In order to ensure stable power supply, it is necessary to match supply and demand at every moment.

⁸ Agency for Natural Resources and Energy, “Policy Issues in the Era of Massive Introduction of Renewable Energy” [in Japanese], accessed April 20, 2018, http://www.meti.go.jp/committee/kenkyukai/energy_environment/saisei_dounyu/pdf/001_03_00.pdf.

⁹ See *supra* note 8.

¹⁰ Agency for Natural Resources and Energy, “Measures to Achieve Energy Mix in 2030” [in Japanese], accessed April 20, 2018, http://www.enecho.meti.go.jp/committee/council/basic_policy_subcommittee/022/pdf/022_006.pdf.

¹¹ See *supra* note 10.

¹² Mitsubishi Research Institute, “Pathways towards the Electric Power System in 2050” [in Japanese], *MRI Monthly Review*, August 2017, accessed April 20, 2018, <https://www.mri.co.jp/opinion/mreview/special/201708.html>.

In response to such problems, Japanese infrastructure has been retrofitted to allow greater introduction of renewable energy. To be specific, power supply adjustments have been made possible by suppressing thermal power generation, utilizing pumped-storage power generation, and using interconnection lines between regions that can allow power to be shifted between power supply areas. Moreover, already in some areas there are rules to control the output of renewable energy.¹³ In fact, on remote islands serviced by the Kyushu Electric Power Company, such as Tanegashima, Ikijima and Tokunoshima, the operator has repeatedly controlled their renewable energy output.¹⁴ In the future, as nuclear power generation is expected to restart to a certain extent,¹⁵ if the introduction and expansion of renewable energy progresses further, it is assumed that output control will be performed not only in remote islands but also in a wider area.

In order to raise the ratio of non-fossil power supplies, it is desirable to make use of surplus electricity by solar PV generation as much as possible. The following three measures should prove effective:

(i) *Demand response*. If it is possible to shift the electricity demand consumed at night to daytime without losing its utility, it will be possible to effectively utilize surplus electricity during the day while suppressing nighttime thermal power generation by that amount.¹⁶ For example, a heat pump water heater (so-called Eco Cute), which is now becoming popular, usually boils hot water using electricity at night. This device makes it possible to shift the demand to the daytime by shifting its operations from nighttime to daytime to the extent that it does not cause a hot water shortage.¹⁷ There is also a possibility of a shift in demand for pumps used in water supply and sewage systems, refrigeration and cold storage equipment at warehouses, and vending machines.¹⁸

¹³ Organization for Cross-regional Coordination of Transmission Operators, “Verification Results on Fairness in Suppressing Output of Renewable Energy Generation Facilities in a Remote Island” [in Japanese], accessed April 20, 2018, http://www.meti.go.jp/committee/sougouenergy/shoene_shinene/shin_ene/keitou_wg/pdf/013_01_00.pdf.

¹⁴ See *supra* note 13.

¹⁵ Some nuclear power plants are still in operation and others may be restarted (or new plants may be built) based on the decision of the Nuclear Regulation Authority.

¹⁶ See *supra* note 10.

¹⁷ See *supra* note 12.

¹⁸ See *supra* note 12.

Economic incentives are considered necessary in the short term in order to encourage customers to shift such demand. However, when a large amount of surplus power is generated, daytime power generation costs become cheap, so it is expected that demand will naturally shift to daytime if it is reflected in the price of electricity in real time.¹⁹

(ii) *Utilization of storage batteries.* If surplus electric power in the daytime can be stored in batteries, it can be effectively utilized by accessing it at nighttime. The cost of solar PV generation and storage batteries is expected to drop in the future, and the power generation costs resulting from this combination will be lower than the purchased power price (this is called “storage parity”).²⁰ When storage parity is achieved, the solar-PV-plus-storage-battery system will spread autonomously, and effective utilization of surplus electric power will be promoted. Also, as electric vehicles become more popular, utilizing the car battery for storage will be useful to the extent that it does not affect the car’s operation.²¹

(iii) *Conversion to hydrogen and other resources.* Instead of storing surplus power as electricity, it is possible to use energy more flexibly by converting it to another energy form such as hydrogen or methane. In the case of hydrogen, we can generate heat by using hydrogen in a fuel cell; hydrogen can also be used effectively in fuel cell vehicles.²² Overseas, technological development to convert energy to methane and liquid fuels is progressing. The merit of this development is that it can utilize existing energy infrastructure (such as city gas supply infrastructure).²³

In addition to the utilization of surplus electricity, which is considered an effective measure to ensure a stable supply of electric power, it is necessary to expand the capacity of interregional interconnection lines, review their usage rules, and make use of other

¹⁹ See *supra* note 12.

²⁰ Mitsubishi Research Institute, “Basic Investigation to Promote Introduction of Renewable Energy Resources: Survey on the Degree of Influence of Solar Singularity” [in Japanese], accessed April 20, 2018, http://www.meti.go.jp/meti_lib/report/H28FY/000305.pdf.

²¹ See *supra* note 20.

²² Agency for Natural Resources and Energy, “A Consideration of Policies regarding Energy Conservation, Hydrogen, and Renewable Energy” [in Japanese], accessed April 20, 2018, http://www.enecho.meti.go.jp/committee/council/basic_policy_subcommittee/025/pdf/025_005.pdf.

²³ See *supra* note 22.

distributed power sources such as cogeneration plants.²⁴ However, in order to expand interconnection line capacity, we have to consider issues such as long lead times and burdensome costs.²⁵ Another idea is to shift the electricity demand physically to areas with large solar PV and wind power introduction potential, and positively introduce solar PV and wind power to areas with high electric power demand.

Renewable energy is a distributed type power supply that is physically close to customers. Efforts such as shift of demand and utilization of storage batteries become effective in making the best use of the characteristics of renewable energy.²⁶ Of further help would be the construction and operation of a new electric power system that can overcome the conventional idea of generating electricity according to demand. Additionally, society should make maximum use of demand-side resources and technologies for converting resources to energy other than electricity.

B. Wind Power

Total wind power (including offshore wind power) is expected to reach its FY 2030 energy mix target.²⁷ Wind power introduction has been making progress under the FIT system, as has the accumulation of achievements and knowledge by developers (including large companies). Therefore, the introduction of wind power by 2030 is expected to exceed the expected FY 2030 energy mix target.²⁸

Notwithstanding the aforementioned, some measures could be taken in order to further promote the introduction of wind power in the future. For instance, it is necessary to address the uneven distribution of wind resources and solve the problems leading to system restraints, including strengthening regional interconnection lines and regional power transmissions.²⁹

²⁴ See *supra* note 10.

²⁵ See *supra* note 10.

²⁶ See *supra* note 12.

²⁷ Mitsubishi Research Institute, “Medium- and Long-Term Renewable Energy Introduction Strategy Investigation Report for the Realization of a Low-Carbon Society” [in Japanese], accessed April 20, 2018, <http://www.env.go.jp/earth/report/h29-03/index.html>.

²⁸ See *supra* note 27.

²⁹ Japan Wind Power Association, “Toward Expanded Introduction of Wind Power Generation” [in Japanese], accessed April 20, 2018, <http://jwpa.jp/pdf/20160229-JWPA-WindVisionReport1.pdf>.

In addition, the following actions should prove effective in improving the business environment: (i) accelerate and rationalize the environmental assessment process; (ii) establish smooth and reliable operation of the agricultural land conversion permit system; (iii) relax regulations related to the installation of wind power generation in agricultural land and forests; (iv) review regulations/systems for smooth implementation of replacement/re-powering; (v) summarize and review regulations/systems related to offshore wind power generation; and (vi) collaborate with port measures and fishery policies. ³⁰

The Japanese government is supporting a pilot project of floating wind power generation stations off the Fukushima coast. ³¹ In addition, as a step in rationalizing procedures for environmental assessment, the Japanese government is implementing pilot projects to shorten the period of environmental assessments of wind and thermal power generation. Currently, the process takes from 3 to 4 years. ³²

C. Small - and medium - scale hydropower

If the current pace of development is maintained, even though the lower target equipment capacity for FY 2030 (1,300MW) is achievable, the upper target (2,010MW) will be very difficult to reach. ³³

Regarding small and medium-scale hydropower, promising development spots have been only roughly investigated and developed, and there is also a shortage of workers who are responsible for electric power civil engineering and operations. ³⁴ Given this situation, it will be important not so much to investigate and develop new spots, but to improve upon accredited equipment that is not operating (or else not operating at its full potential).

In addition to challenges such as the adjustment of water rights and wait times for the delivery of power generation equipment, a serious challenge for small and medium - scale hydropower operators is that they have not yet earned sufficient income to reinvest in watersheds and the development of new power supplies. It is suspected that construction of the grid connections has also become financially burdensome and contributes

³⁰ See *supra* note 29.

³¹ Fukushima Offshore Wind Consortium, “Fukushima Floating Offshore Wind Farm Demonstration Project,” accessed April 20, 2018, <http://www.fukushima-forward.jp/english/gaiyou/index.html>.

³² See *supra* note 31.

³³ See *supra* note 27.

³⁴ See *supra* note 27.

to the continued non-operation of accredited hydropower equipment. Generally, when hydropower areas are located in mountainous areas, it is difficult to share costs between multiple power plants, and grid connection costs will inevitably increase.³⁵ After understanding more accurately the reason why non-operating power generation equipment is accumulating, it would be possible to consider measures to mitigate construction costs.

D. Geothermal

It is very unlikely that geothermal power generation will reach its FY 2030 energy mix target, considering the low success rate of drilling and the long development lead time.³⁶

Since the majority of geothermal power projects are in the early stages of development, it is important to increase the success rate of drilling by improving exploration technology.³⁷ It is important to continuously conduct surveys on geothermal resource potential for continued future development.³⁸ Also, shortening the environmental assessment review period will assist in the expansion of thermal power generation. The Japanese government set a goal in 2013 to speed up this review process for wind and geothermal power generation.³⁹

E. Biomass

The amount of accredited equipment under the FIT system is expanding rapidly, mainly with regard to general woody biomass.⁴⁰ Although it is possible to reach the FY 2030 energy mix target if all accredited equipment under the FIT system is in operation, the probability of achieving the target is low because of the current uncertainty concerning the procurement of biomass fuel.⁴¹

³⁵ See *supra* note 27.

³⁶ See *supra* note 27.

³⁷ See *supra* note 22.

³⁸ See *supra* note 22.

³⁹ Prime Minister of Japan and His Cabinet, “Japan Revitalization Strategy” [in Japanese], accessed June 13, 2018, https://www.kantei.go.jp/jp/singi/keizaisaisei/pdf/saikou_jpn.pdf.

⁴⁰ See *supra* note 8.

⁴¹ See *supra* note 27.

Indeed, for biomass power generation, it is necessary to build a supply chain to securely procure fuel.⁴² Financial resources of up to 10 billion yen are also required to support the costs of the project, and the hurdle for commercialization of biomass is very high.⁴³ Moreover, from the perspective of long-term energy supply and demand, it is assumed that around 80% of the newly introduced amount of biomass power generation is dependent on Palm Kernel Shell and import chips (general wood and agricultural crop residues).⁴⁴ Taking into consideration the future momentum of global warming countermeasures and international economic trends, there is concern about the supply/demand situation of imported biomass.

To respond to the risk associated with imported fuel procurement, one strategy is to diversify the risk by enhancing the supply of domestic biofuels. In particular, unused thinned timber is expected to be promoted under the current forestry policy in Japan.⁴⁵ At present the total amount of economically feasible installed capacity for unused thinned timber biomass power generation is estimated to be only about 160MW.⁴⁶ In order to realize the introduction of 400MW in the 2030 energy mix, large increases in the scale and efficiency of operations outlined in Japan's Forest and Forestry Basic Plan will be necessary.⁴⁷

Although biomass power generation is making progress nationwide, the capacity already certified but not in operation has reached 3,250MW (as of the end of October 2016).⁴⁸ Therefore, in promoting biomass power generation using unused thinned timber, it is necessary to focus on areas with relatively low economic efficiency and to increase the scale and efficiency of the operations. It remains a priority to determine the collective power supply of unused thinned timber and to match it with the wood biomass power plant generation currently planned and in operation. Information provided by local municipalities (providing the forestry association with information on intention and the amount of resources acceptable by biomass power plant), feasibility studies, and additional financial support would help to enhance the utilization of unused thinned timber.

⁴² See *supra* note 27.

⁴³ See *supra* note 27.

⁴⁴ Japan Woody Bioenergy Association, "Wood Biomass Energy Data Book 2018," accessed April 21, 2018, <https://www.jwba.or.jp/app/download/13159696992/Data+book+2018+%28English+version%29.pdf?t=1523342683>.

⁴⁵ See *supra* note 27.

⁴⁶ See *supra* note 27.

⁴⁷ Forestry Agency, "Forest and Forestry Statistics Manual 2017" [in Japanese], accessed April 21, 2018, http://www.rinya.maff.go.jp/j/kikaku/toukei/youran_mokuzi2017.html.

⁴⁸ See *supra* note 44.

V. Conclusions

Expanding renewable energy resource use over the medium to long term is desirable not only in order to achieve a reduction of greenhouse gas emissions, but also from the viewpoint of energy security. To achieve desired renewable resource targets, however, further renewable power generation should be enhanced and a variety of challenges must be tackled, including constructing new electric power systems, promoting ways to store energy surpluses, reducing financial burdens for electricity consumers and accelerating the environmental assessment process.

The analysis in this paper has provided a starting point for understanding Japan's current challenges for renewable energy resources. A brief review of the main points is in order. For solar PV and wind power, output fluctuates largely depending on natural conditions. In order to generate as much surplus electricity as possible by solar PV, measures such as demand response, utilization of storage batteries, and conversion to hydrogen and other resources should prove effective. In order to reach the FY 2030 target for solar PV, it is essential to develop regional interconnection lines as well as improve regional power transmission. For wind power, measures that improve the business environment, such as an acceleration of the environmental assessment process, would also be worth considering.

In addition, it is important to note that energy generation costs after the implementation of the FIT system have imposed heavy financial burdens on electricity consumers. Solar PV and wind power should be introduced to the extent that electricity costs are lower than they currently are, taking into consideration requests for a reduction of financial burdens on electricity consumers.

Because hydropower, geothermal power, and biomass power can be operated stably regardless of natural conditions, they should be introduced to the maximum feasible extent, taking into account restrictions on location and fuel supply. When these constraints are overcome, the resulting power is expected to further increase. As for small- and medium-scale hydropower, various challenges related to why non-operating equipment is accumulating should be tackled. These challenges include the adjustment of water rights and delivery waiting periods for power generation equipment, insufficient income for reinvestment in or development of new power supplies, and high construction fees for the grid connections that make possible the operation of accredited hydropower equipment. As for geothermal, it is very unlikely that geothermal power generation will reach its FY 2030 energy mix target, considering the low success rate of drilling and the long development lead time. However, a shortening of the environmental assessment review period is still required to encourage expansion of thermal power generation. As for biomass, to respond to the risk of procuring too little imported fuel, the supply of domestic biofuels should be enhanced. In addition, to promote biomass power generation from accredited equipment under the FIT system, it is crucial to determine the collective power supply of unused thinned timber and match it with woody biomass power plant generation (both current and planned).

To further promote the massive introduction of renewable energy resources, the government, in cooperation with energy providers, should consider the construction and operation of a new electric power system. Institutional design that takes advantage of market mechanisms, such as forming an electric power market in which customers can easily participate, will be a crucial factor. Further policy investigations should be conducted to create a truly functional and desirable electricity market for consumers.

A better understanding of these issues above will enable a greater introduction of renewable resources in Japan to address climate change. More research and experience are needed to fully evaluate the benefits these resources bring and what role they will play in Japan.

The case of Japan also shows us that each renewable energy resource exists within a particular market and presents unique challenges, and that a wide range of actions are required to tackle them. Crafting a legal framework to develop the correct incentives for storing energy or accelerating the environmental assessment process is an extremely complex task. As such, it must be undertaken by an interdisciplinary team capable of dealing with environmental engineering, economic, and of course environmental policy and legal issues. We can expect that lawyers with the ability to integrate and deepen their knowledge and experience across disciplines will be actively involved in addressing these challenges. ■

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