Sustainable energy policy choice: an economic assessment of Japanese renewable energy public support programs

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Abstract

Given the associated environmental and economic benefits, electricity from renewable energy sources (RES-Es) is expected to play a significant role in shaping the human energy future. For the development of RES-E, the Japanese government introduced a national public support system based on a renewable portfolio standard (RPS) scheme.

There is, however, a gap in the international and domestic literature about the Japanese renewable deployment policy. As a result, lessons to be learned from the Japanese experience have not been shared by the academic community. This paper fills this gap by paying a focused attention on the Japanese renewable portfolio standard (J-RPS) scheme, with an assessment on whether the scheme is promoting effective and efficient RES-E development. It reveals how certain types of RES-Es are marginalized from the market under the RPS equimarginality rule. Clear policy recommendations are made for a better design of the J-RPS, based on the exclusive empirical analysis.

Keywords: renewable energy, feed-in tariff, renewable portfolio standard.

1 Introduction

With the scarce fossil fuel reserves, renewable energy deployment has been on the Japanese government energy policy agenda for decades. It had been especially so after the oil crisis, with a significant amount of government budget allocated to renewables research and development. Surprisingly little attention has been paid to public support for renewable energy deployment, where
government subsidy for specific renewable energy technologies had been the only explicit official mechanism for supporting renewables.

Against this background, in 2003 the Japanese government enacted a legislation based on the renewable portfolio standard (RPS) scheme, which requires electricity retailers to supply a certain amount of renewable electricity to grid consumers. The RPS legislation was expected to ensure market efficiency, as well as bringing a steady increase of renewable capacity.

There is, however, very little research conducted to evaluate the real effect of the Japanese RPS (J-RPS). This paper aims to establish the position of RPS in the environmental economics theory, and assess whether the Japanese RPS delivers the expected renewable capacity increase and efficiency gains. This paper is therefore structured as: 1) a general discussion on renewable public support schemes, 2) overviews on the Japanese RPS and an updated information on its effect on renewables development in Japan, and 3) discussion on market condition and RPS using the Japanese example, with concluding remarks.

2 Overviews on renewable public support schemes

2.1 Renewable energy sources: its barriers for common use

Renewable energy sources are defined as those that are replenished by natural processes at rates exceeding their use for human purposes (Eblen and Eblen [1]). If natural replenishment is either non-existent or slower than the rate of usage, the energy resources (e.g. nuclear and fossil fuels) are non-renewable. Renewable energy sources have several advantages over the conventional energy sources, being not likely to be depleted, and having less impact on the environment.

Although physically abundant as energy sources, there are several significant barriers upon transition to more common use of renewable energy technologies. Those barriers are generally identified as follows (Mendonca [2]):

1) Costs and pricing

Renewable energy technologies are regarded as having less impact in terms of environmental externalities, but the market often has a problem to sufficiently evaluate the externalities resulting from the use of conventional energy fuels. In addition, renewable energy sources have not received subsidies to the extent that conventional energy sources had. This constitutes another reason for renewable technologies being perceived as “expensive”.

2) Legal and regulatory

The development of renewable energy technology is frustrated by the lack of appropriate legal and regulatory frameworks. If restrictions are too strict, for example, on siting and construction for renewables, they often become major limitations on renewable development. The requirement of transmission access and utility interconnection could also be significant barriers for grid-connected renewable electricity.

3) Market performance

Lack of credibility, resulted from unfamiliarity with renewable energy technology can increase the perceived uncertainty and risks associated with
them. Basic information and understanding on the installation and operation of renewables many not be sufficiently shared among members of the society.

2.2 Public support schemes for renewables

Government intervention is theoretically justified as a means to correct the negative externalities relating to the use of conventional energy sources and technologies. Adding to that, government policy is highly important for the support of renewable energy technologies, especially to protect the technologies in their initial phases. Currently, there are broadly two major approaches for supporting renewable technologies (Menanteau et al. [3]).

2.2.1 Feed-in tariff

Feed-in tariff (FIT) consists of an obligation for electric utilities to allow electricity from renewable sources (RES-E) to be transmitted through the electricity grid (feed-in), and to purchase RES-E at a regulated price. It is generally known as a price-based approach that establishes a premium per generated kWh. Under FIT, the regulated price (tariff) determines the overall volume of RES-E production (Figure 1).

Since FIT normally contributes to the correction of price inequality between conventional and renewable energy technologies, it has been proved as a very powerful mechanism for RES-E deployment in many EU countries (e.g. Germany, Spain, etc).

2.2.2 Renewable portfolio standard (RPS)

Renewable portfolio standard (RPS) requires electricity operators to supply a fixed quota of RES-E in the market. Tradable certificates (tradable green certificate, TGC) may be purchased for the fulfilment of the quota obligation. It is a quantity-based instrument, where regulators determine the RES-E sales volume and quotas are allocated among electricity operators (Figure 2).

The prices of RES-E purchase are open to individual contracts, thus it is to follow the equi-marginality rule, where RES-E at lowest price would be deployed.
The majority of the US states and some EU countries, together with Japan, have adopted the RPS scheme, though the target levels and details of policy designs vary.

3 The regulatory and other frameworks for RES-E in Japan

3.1 Historical overviews: net-metering and government subsidy

Renewable energy first won public recognition in Japan in 1960-70s, when the oil crisis hit the country’s economy. The Japanese government initiated a series of projects to support renewable technologies. Its primary focus, however, was mainly on technology research and development, while less attention was paid to public policy to support and deploy the renewables.

It was only after 1992, when “net-metering” was launched as a voluntary scheme by the electricity utilities, that the rate of deployment of, at least specific RES-Es (PV and Wind), gained the momentum. Net-metering enables customers to use their own electric generation to offset their consumption over a billing period. This offset means that customers receive retail prices for the excess electricity they generate.

This has been a crucial mechanism in supporting RES-E generation. Its introduction was clearly the turning point in the history of Japanese RES-E development. The deployment rate of RES-E has picked up since the beginning of 1990s when the net-metering started (Figure 3).

Apart from the voluntary net-metering scheme, a government subsidy program was in place from 1994 to 2005. Since there was a significant increase in renewable capacity and the average cost of a residential PV system dropped by more than half during 1990s, the effect of the subsidy program is often over-emphasised (Haas et al. [4]). It is important to remember that the capacity increase and cost reduction were the combined results of net-metering and the subsidy program.

It is, however, not clear whether the utilities will continue the voluntary net-metering scheme, because the costs associated with the power purchase are increasingly felt as a financial burden. This creates an uncertainty for future renewable development.
Figure 3: The Japanese residential PV growth, with an annual increase of net metering and subsidised PVs.

BOX 1

The main programs related to RES-E promotion in Japan before RPS introduction was summarised as follows:

1) Voluntary net-metering (Since 1992)
   The 10 main electric companies set the basic conditions for contracts with PV and wind power producers
2) Government subsidy program (1994-2005)
   Providing subsidies for initial investment for residential roof-top PVs

3.2 Adoption of RPS over FIT

Apart from the private sector’s voluntary net-metering scheme, there has been awareness that there should be an official program to support renewables more effectively. With the recognition that FIT being a powerful mechanism for RES-E development in several EU countries, a political initiative (the Parliamentary Initiative for Renewable Energy Promotion) was established by some members of the Parliament to address the introduction of FIT in Japan. The momentum for FIT was, however, lost when the government announced its intention to adopt a RPS-based system instead.

The Japanese government launched a RPS legislation (J-RPS) in 2003, which requires 30 electricity retail companies to supply RES-E. The eligible RES-Es are “new energies”, a unique definition by the Japanese government, meaning PV, wind, geothermal, small hydro-power (less than 1MW) and biomass. It is
notable that power from municipal waste incineration can be counted as "biomass" on the basis of biomass content in waste, though critics disagree with allowing power from waste being included into the green basket. The national target was initially set as 3.3 TWh in 2003 (1.35% of the total electricity sales), which gradually increases to 12.2 TWh in 2010, then 16 TWh in 2014 (about 1.6% of total electricity sales).

For the fulfillment of the quota, retail suppliers are either to 1) generate RES-E themselves, 2) purchase RES-E from RES-E generators or 3) purchase RPS certificates. The maximum certificate price is regulated as 11 JPY/kWh (approximately 9 US cents/kWh). The retail suppliers are allowed to carry out banking and borrowing.

3.3 Assessment of the Japanese RPS system

The Japanese government is highly optimistic about the effect of J-RPS in stimulating RES-E development. Unfortunately, this government view is widely shared by the academic community so far. It is stated, for example, that RES-E generation has steadily increased since the J-RPS introduction, and the trend is expected to continue. It is argued that the RES-E costs have declined and the certificates are at a stable price range of approximately 5 JPY/kWh (about 6 US cents/kWh) during 2003-5. Also, they explain that the J-RPS national target level is lower than those of the US and some EU member countries, mostly because large hydro and geothermal powers are ineligible under the scheme (Haas et al. [4]). The level of the national J-RPS target and how that relates to RES-E price range requires a more detailed assessment. An integrated evaluation of the Japanese RPS, thus, will be given in this section. Empirical research will be carried out by data obtained from official and other sources. The assessment criteria will be on the following aspects: effectiveness, transaction cost and equi-marginality.

3.3.1 Effectiveness

The J-RPS target was established as 1.35% of the total electricity sales in 2010, and 1.6% by 2014. The low level of the J-RPS level is usually explained by the exclusion of hydropower (Haas et al. [4]). A detailed comparison without hydropower component, however, clearly reveals that renewable targets in many countries are significantly higher than that of Japan (Figure 4).

The level of the J-RPS target, in fact, seems to be too low to reflect the physical potential for renewable development. Since 2003, the RPS initial year, a significant amount of banking has accumulated, to the extent that the banking amount reached to 6.8 TWh in 2007. This is sufficient to supply over 90% of 2008 target of 7.5 TWh (Figure 5). The extremely high level of banking is proof that the initially established J-RPS targets are too low to reflect the RES-E potential in Japan.

3.3.2 Cost and equi-marginality

The low target level has resulted in many undesirable effects for the deployment of RES-E. One of the advantages of quota-TGC (tradable green certificate)
Figure 4: Target level without hydropower contribution. Hydropower contribution level (taken from 1997 data) is deducted from 2010 target level for neck to neck comparison. The Japanese target is significantly lower than others.

Figure 5: The Japanese RPS targets and the level of banking. The official targets are nominal. The compulsory targets, as legally binding targets, can be satisfied by the banking from previous years.
Figure 6: The price level for J-RPS eligible renewable technologies.

is to create a certificate market that could raise necessary funding for RES-E generation. The J-RPS target, however, is too low to create a TGC market, as there is little incentive for TGC purchase. The level of certificate price is virtually fixed at “stable range”, because of the absence of the TGC market (Figure 6).

Figure 7: Shares of power produced by J-RPS eligible renewable technologies.

The price inelasticity relates to another problem as to the kinds of RES-E being developed. The eligible J-RPS renewables includes power from municipal waste incineration as “biomass” (the biomass rate is calculated on the basis of its inclusion in municipal waste). Power from “biomass” including waste
incineration dominates more than half of the J-RPS contracts, reflecting its relatively inexpensive price range compared with the prices of other RES-E technologies (Figure 7). It is notable that power from incineration of waste are heavily subsidised by public funds, in terms of e.g. waste collection and construction of incineration facilities.

This means the equi-marginality rule inherent to the RPS scheme, is applied in the selection of RES-E technologies, to the extent that RES-Es which are more environmentally desirable, but in their initial development stages, are forced into the competition with the subsidised energy technology. As a result, economically competitive (subsidised) RES-E wins market penetration, while economically less competitive RES-Es are marginalized from the market. Figure 8 demonstrates the marginalisation of environmentally desirable but economically less competitive RES-Es.

![Figure 8: The marginalisation of less competitive RES-Es.](image)

### 4 Conclusion

Japan, as a country with high technological capacity, is a leader in solar and other renewable energy technologies. With the increasingly potent effects of climate change, and as a country that hosted one of the historic conferences of the United Nations Framework Convention on Climate Change (UNFCCC), Japan has sufficient reasons to deploy renewable energy technologies. The energy policy and regulation of the country, however, do not necessarily address the potential for the renewables.

The great opportunity for RES-E development has been lost due to the lack of an ambitious renewable target being adopted in the J-RPS system. The absence of an ambitious target seems to have resulted in several negative effects.
1) The RES-E potential are overlooked and underdeveloped. The level of the J-RPS target is embarrassingly low, to the extent that majority of the target can be satisfied by the accumulated banking.

2) As the TGC market is underdeveloped, the generators are forced into a contract with the utilities, which fixes the price of the certificate at the minimum level.

3) With the equi-marginality rule in operation, only the currently most economically competitive energy technology is deployed, while less developed RES-E technologies being marginalised from the market.

In order to boost RES-E development, the current J-RPS needs, at least, to address the following issues:

1) To establish a higher national target, with individual targets for each sources of RES-E at different stages of development;

2) To recognise the significance of fixed-price payment on RES-E deployment, as just demonstrated by the utilities' voluntary net-metering. Net-metering works as a mechanism to concentrate on prices and stabilises the long-term cost-benefit balance related to RES-E investment.

Currently, J-RPS targets have become more of a limitation than a stimulating objective. Having regard to the fact that many EU countries are actively promoting RES-E through a FIT system, there seem to be much for Japan to learn from their experiences, because FIT, without subscribing to a regulatory quota, will not operate as a limiting factor to renewable development.

References


