日立総研

vol.4-1
2009年7月発行

特集 再生可能エネルギー普及に向けた動向

Government incentives for solar power development

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The European Union (EU) made a commitment in 2008 calling for 20 percent of final energy consumption to be derived from renewable energy sources by 2020, as compared to the actual level of 9.6 percent in 2006. The main pillar to achieve this commitment is to produce and use more renewable power, such as solar power, wind power and mini-hydro power. However, most of the renewable technologies are still not cost competitive compared to conventional generation technologies such as coal-fired and nuclear generation. To solve this problem, governments are obliged to offer financial incentives for renewable power development projects. Most EU governments also provide financial assistance for research and development for renewable power technologies, which along with the additional demand created by project-based incentives and thus a larger scale of economies for equipment production, is improving the cost competitiveness of renewable power.

This article begins with an overview of government incentives to facilitate renewable power development, then analyses those incentives in selected countries, and lastly discusses the sustainability of the incentives, with a focus on solar PV power.

1. Overview of government incentives

Renewable power development projects are still dependent on government incentives, although some of them can be financially feasible without them, e.g., onshore wind power in areas of good wind resources, or biomass power where low-cost fuel is available.

There are two types of government incentives, operating incentives and investment support. The latter includes direct subsidies for equipment purchasing, tax incentives and other investment-related support, whereas the former refers to incentives given to a unit of electricity produced using renewable power sources. Operating incentives are considered to be more efficient as they are given to results of an investment and as they create an incentive for better operation. Almost all EU governments also give investment support, but mostly to households and small businesses only.

There are three types of operating incentives, including:

- **Feed-in tariff (FIT):** Under an FIT incentive system, the grid operator is legally obligated to purchase all the output from the renewable power generator at a government-set price regardless of whether the output is needed to meet system demand. The FIT system guarantees developers predictable long-term cash-inflows.
- **Premiums:** Under a premium system, the renewable power generator sells his output on the wholesale market as all other generators do. There is no obligatory purchase of renewable electricity, although in some countries, renewable electricity is given priority for purchase. In addition to the income from the sale of electricity, the generator receives for each unit of electricity sold either a set amount (a fixed premium) or a variable amount calculated as the difference between the market price of electricity at the time of sale and a government-set target price.
- **Tradable green certificates (TGC):** Under a TGC system, the renewable power generator sells his output on the wholesale market as all other generators do. However, he receives a TGC for each MWh of electricity sold, in addition to the income from the sale of electricity. (In some countries, he may receive multiple TGCs per MWh of electricity sold for some technologies.) He then can sell those TGCs for an additional income to power suppliers or distributors who have a government-set quota, whereby they are obliged to present a set number of TGCs to the regulator every year.

The government incentives are designed to alleviate the difference in the generation cost between the renewable and conventional generation technologies. Table 1 compares the generation cost of selected generation technologies.

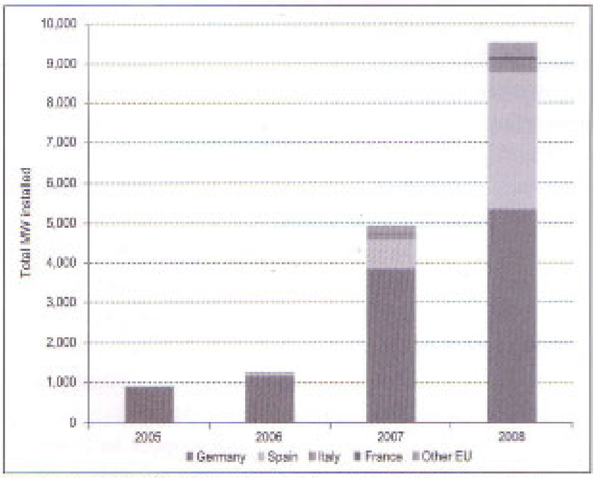
Table 1 Comparison of the levelised electricity generation cost of selected technologies (EUR/MWh)

	Technology		2005 cost	Projected cost for 2030
1	Natural gas	Open cycle gas turbine	45–70	55–85
		Combined cycle gas turbine	65–45	40–55
2	Oil: Diesel engine		70–80	80–95
3	Coal	Pulverised fuel	30–40	45–60
		Integrated gasification combined cycle	40–50	55–70
4	Light-water nuclear		40–45	40–45
5	Biomass generation		25–85	25–75
6	Wind	Onshore	35–175	28–170
		Offshore	50–170	50–150
7	Hydro	Large	25–95	25–90
		Small	45–90	40–80
8	Solar PV		140–430	55–260

Source of the data: IEA, 2005. Costs do not include grid-related investment costs or charges. Costs were converted from USD to EUR by the European Commission.

It is observed that solar PV was not able to compete with any conventional generation technology in 2005 and that will remain so even in 2030 unless it is built in an area of high solar irradiation. Disregarding any grid-related costs or charges or investment risk premiums, none of which are included in levelised generation cost, it is deemed that most solar PV projects would have been financially feasible with a FIT of 430 EUR/MWh in 2005. Today, with an assumption that the solar PV technology has improved since then, i.e., a better power conversion factor and lower equipment production cost, the FIT could be lower. (Again, grid related costs and charges and risk premium, which are project specific, are not included.)

Figure 1 exhibits the changes in the cumulative total of the installed capacity of solar PV system in the EU from 2005 to 2008. This figure indicates clearly the importance of government incentives to the deployment of solar power. Germany, despite the fact that the levels of solar irradiation are much lower there than those in southern European countries, has been the clear leader of solar PV power development because of their generous FIT. Similarly, the installed capacity in Spain shot up in 2008 because of their high FIT for that year. It is likely that we will soon see a sharp increase in the total solar PV capacity in Italy, where a generous FIT for the technology was introduced recently.



Source of the data: EurObserv'ER, Photovoltaic Barometer, 2009.

Figure 1 Cumulative total of the installed capacity of solar PV in the EU (2005 – 2008, MW)

Consumer grid parity, which is commonly defined as a situation where the levelised generation cost achieved by solar PV systems is equal to the retail electricity price paid by consumers, is generally projected to be realized by 2020 in most EU countries. Until grid parity is achieved, government incentives will remain as a driver for deployment of solar PV power. Domestic consumers paid on average 186.8 EUR/MWh in the EU in 2008.

2. FIT systems of selected countries for solar PV power

Most of the EU countries have chosen a FIT incentive system particularly for solar power. Although the details of the system of each country are different, there are a few common features. For example, small-scaled installations and installations integrated in the building, known as building-integrated PV (BIPV), are given higher incentives than large ground-based solar PV power plants. The following are brief descriptions of the FIT systems in Germany, France, Italy and Spain.

Germany

The FIT rates are guaranteed for 20 years in Germany, which means that an installation qualified for a FIT in the country will continue to receive a payment based on the same FIT rate for 20 years. Table 2 shows the latest FIT for solar PV. (The tariff rate applied to a new power plant is determined by the commencement year of its operation and it becomes lower every year by the degression rate.) The degression rates were raised from the 5 - 6.5 per cent degression from 2004 to 2008 to 8 - 9 percent, except where the tariff rate for BIPV of 1 MW or larger was reduced by 25 percent from 2008 to 2009. Larger degression rates may reflect an assumption that the total project cost of solar power development (or the cost of ownership of solar PV system) would decrease faster than in the previous four years.

Table 2 FIT for solar PV systems installed in Germany between 2008 and 2011 (EUR/MWh)

Category		2008		2009		2010		2011
		Tariff rate	Degression rate	Tariff rate	Degression rate	Tariff rate	Degression rate	Tariff rate
BIPV including roof-top system	Up to 0.03 MW	467.5	8%	430.1	8%	395.7	9%	360.1
	0.03-0.1 MW	444.8	8%	409.1	8%	376.4	9%	342.5
	0.1-1 MW	439.9	10%	395.8	10%	356.2	9%	324.2
	> 1 MW	439.9	25%	330	10%	297	9%	270.3
Other including ground-based system		354.9	10%	319.4	10%	287.5	9%	261.6

Source of the data: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, 2009.

France

The French FIT had two categories, BIPV and "other" until 2008, when an additional category for roof-top systems on commercial buildings was introduced (see Table 3). The French BIPV tariff rate is exceptionally high, and the introduction of the commercial buildings category separated from "other", and thus an effective increase in the tariff rate for commercial buildings indicates the French government's strong commitment to the deployment of building-attached or -integrated, non-ground-based solar PV systems. The FIT is guaranteed for 20 years.

Table 3 FIT for solar PV systems in France installed in 2009 (EUR/MWh)

Category	Tariff rate
BIPV (physically attached, aesthetical conformity to the existing environment required)	572
Commercial buildings (roof-top system)	450
Other (including ground-based system)	328

Source of the data: Ministere de l'economie de'industrie et de l'emploit.

Italy

The current FIT was introduced in 2007 with an annual degression rate of 2 percent. It is valid until the country's cumulative total of the solar PV capacity reaches 1,200 MW, although it may be revised in 2010. The FIT in Italy is guaranteed for 20 years. The FIT rate for ground-based systems of 20 kW or over is more generous than that of other EU countries (see Table 4).

Table 4 FIT for Solar PV systems in Italy installed before December 2009

Capacity (kW)	Ground based	Building-attached (BAPV)	Building-integrated (BIPV)
1–3	392	431	480
3–20	372	412	451
>20	353	392	431

Source of the data: Gestore dei Servizi Elettrici.

Spain

The Spanish FIT for solar PV power was revised drastically in September 2008 after a significant surge of the installed capacity in 2007 and 2008 (see Table 5). Many landowners built small capacities of solar PV, taking advantage of the high tariff rates for small capacities available under the previous tariff, and a small number of developers provided grid connections to those installations and operated them as if they were large solar parks. In 2008, the high tariff rates were substantially reduced. Under the new tariff, while a new category of BIPV was set up, similar rates are offered to all categories. This in turn means that not-particularly attractive rates are offered to BIPV development.

Table 5 FIT for solar PV systems in Spain installed before 28 September 2008 and thereafter

Category		Duration	FIT rate (EUR/MWh)
A. Prior to 28 September 2008 Revision			
All	≤100 kW	25 years	440.381
	100 kW to 10 MW	25 years	417.5
	10–50 MW	25 years	229.764
B. After 28 September 2008 Revision			
BIPV	≤20 kW	25 years	340
	>20 kW	25 years	320
Other, including ground-based	>50 MW	25 years	320

Source of the data: Comision Nacional de Energia.

For budgetary purposes, governments often set a maximum capacity total for a year for the application of FIT by developers. In Spain, this capacity cap was reduced substantially for solar PV to a total of 500 MW for 2009, as compared with 2,670 MW of the actual capacity addition in 2008 (see Table 6). The Spanish new capacity caps indicate their intention to emphasize BIPV development.

Table 6 Capacity cap for solar PV power in Spain (2009-2011)

Category		Capacity cap in 2009 (MW)	Capacity cap in 2010 (MW)	Capacity cap in 2011 (MW)
BIPV	≤20 kW	27	30	33
	>20 kW	240	265	292
Other, including ground-based	>50 MW	233	207	162
Total		500	502	487

Source of the data: Comision Nacional de Energia.

As noted earlier, it is the general trend in EU countries to provide more incentives to BIPV and other small installations at the expense of large ground-based solar PV plants.

3. Sustainability of incentives

While the European solar PV sector grew significantly in percentage terms, incentives given to the sector have became a concern, particularly in Germany and Spain, the two European leaders of solar power. Today, in many EU countries, the sustainability of those incentives is an issue among those government officials who are involved in the deployment of renewable power, although canceling incentives is not an available option.

The German government estimates that EUR8.5 billion was paid out in total to renewable electricity generators under the FIT in 2008, up from EUR7.6 billion in 2007. An estimated 23 percent of that payment went for solar PV generation in 2008 although solar PV accounted only for 4 percent of renewable electricity generation. As the FIT incentives are funded not by the government's budget but by an additional charge placed on consumers' electricity bills, they cost a German household an estimated EUR3.10 a month in 2008. Consumers are paying also for grid enhancement to accommodate power from renewable power plants, which are often located in remote areas.

In Spain, as noted earlier, a drastic reduction in the capacity cap was implemented after a rush for FIT applications by solar PV power developers in 2008. In 2006, the Dutch government, because of rising costs, effectively cancelled their renewable electricity incentives, although a new government subsequently re-introduced them in the following year.

Governments are concerned about the fact that an increasing number of households have difficulty in paying electricity bills, not only because of an additional charge to support incentives, but also because of the recent high energy prices. Government expenditures for income support are increasing because of the current recession and high prices of commodities, including energy.

Governments are monitoring changes in the level of the public acceptance of paying more to reduce the level of greenhouse gas emissions. A survey was conduced in the EU countries in May 2008, asking whether respondents are willing to pay more for renewable electricity. A relatively high percentage of respondents replied in positive: 42 percent in France and Germany, 41 percent in Italy and 40 percent in Spain. Although the survey results may not reflect fully the current economic conditions, it is safe to assume that there continues to be strong support for renewable electricity, and it is this public support that allows governments to keep incentives for renewable electricity.

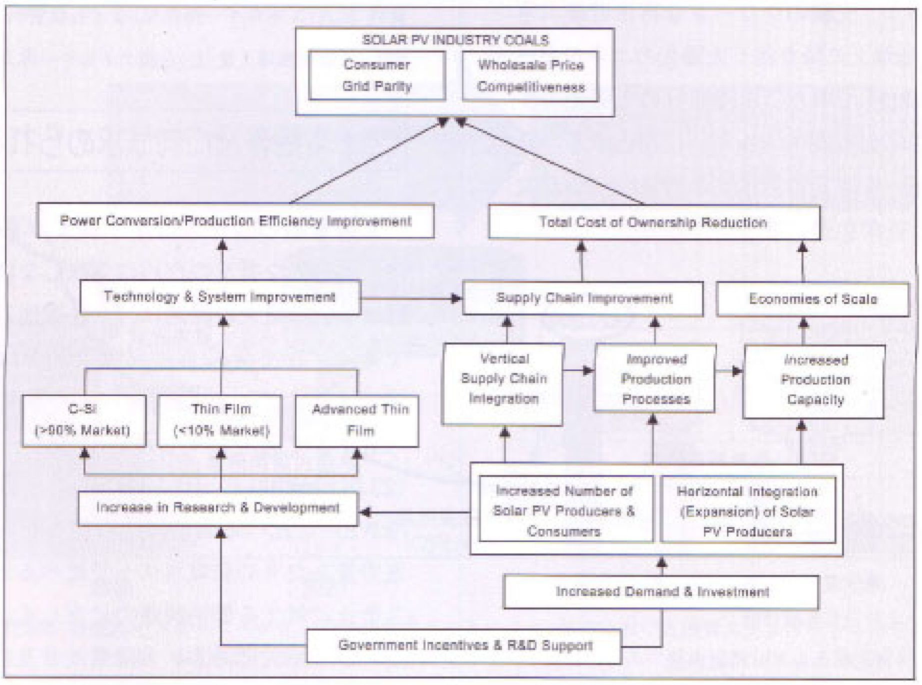
Whether the incentives spent are benefiting the domestic population is another concern for the government. Large ground-based PV power plants are often built by a few large multinational companies. Although those projects generate jobs for the local population, including operation and maintenance work for local sub-contractors, the efficiency of job creation for those projects is not as high as that for BIPV and other small-scaled projects, which tend to be implemented by local system integrators. Most governments now believe that job creation for the local population is more important than creating an additional demand by incentives. Job creation obviously helps government justify a high cost of incentives.

The current levels of incentives are very likely to continue to fall. The degression rates the German government has set for the two years are 8 – 10 percent, while the degression rate of Italy is 2 percent. For private-sector companies involved in the sector, the issue is how quickly they can reduce the costs of their products and services, so that they require lower amounts of incentives. Figure 2 illustrates the dynamics of the sector toward its goals. The sector can take two actions to reduce current generation costs of renewable power: to improve the power conversion factor to increase the production efficiency and thus output, and to reduce the total project cost or the cost of ownership. The latter has been pushed by a strong demand backed partially by incentives. This push could decline as the incentives decrease substantially. Then, as the figure shows, the supply chain improvement, which can be achieved by vertical supply chain integration and improved production processes, will increase its importance for companies in pursuing a cost reduction.

4. Conclusion

When the FIT was revised in Spain in 2008, ending generous incentives for ground-based solar PV systems, some of the international companies decided to shift their focus to other markets, including Italy and the USA. Those companies have already acquired local companies in those new markets, increasing their presence there. This regional expansion and horizontal integration is one way of coping with decline in the level of incentives in certain countries. Another measure that can be taken is to improve the supply chain, which includes M&A of companies who are in other parts of the supply chain, i.e., vertical integration. This M&A is also already happening.

The growth of the renewable power sector is still driven by incentives. However, once the grid parity is achieved, the sector will grow more rapidly without incentives. Even earlier, if the price of a greenhouse gas emissions credit increases dramatically, the sector will not require any incentives from the government.



Source of the data: "The European Solar Power Sector Analysis: Vertical Integration and Progress Toward Grid Parity", London Research International, to be published in July 2009.

Figure 2 Diagrammatic representation of the solar PV industry