Support schemes for renewable energy

the case for feed-in tariffs

PRADEEP K DADHICH
The Energy and Resources Institute

The promotion of renewable energy is in line with India's objective of achieving energy security in the framework of sustainable development. Renewable energy uptake can contribute to India's security of supply, and ensure long-term competitiveness since renewable energy options are low-cost in the mid and long term. In addition, they contribute substantially to reducing greenhouse gas emissions and mitigating climate change. An appropriate policy intervention is imperative to facilitate technology learning and cost reduction for promising renewable energy technologies.

To increase the uptake of renewable energy technologies for power generation, various mechanisms have been devised. This article focuses on two such mechanisms: feed-in tariff laws, and the quota model, their comparative advantages and disadvantages, and the scope for the mechanisms in India.

India's renewable energy potential

At present, India imports about 71% of its oil requirement, and its overall energy import dependence is likely to increase to over 90% by 2030 (TERI 2006). This situation clearly raises significant concerns for India's competitiveness and the security of its energy supply. As India's energy consumption grows, constraining the availability of fossil fuels, renewable energy sources can occupy an important place in India's energy mix.

India has good potential in the areas of solar energy, wind energy, and biofuels. The country is located in the equatorial sun belt of the earth, thereby receiving abundant radiant energy from the sun. The country receives about 5000 trillion kWh/year equivalent energy through solar radiation. The annual global radiation varies from 1600 to 2200 kWh/m^2, which is much more than most of Europe. At the present, with conversion efficiencies of 11%, solar photovoltaic systems can produce 1 MWh of power per day on 0.118 ha (hectares) of land. Similarly, with a conversion efficiency of 13%, solar thermal power systems can produce 1 MWh of power a day on 0.140 ha of land area. Considering that 17.45% of the country's land area is classified as wasteland, the vast scope for thermal power should be apparent. Further, given present yields of bio-diesel plantations, over 25% of the wastelands can displace 21% of current petroleum based transportation fuels. Surplus crop residues, estimated at 139 MT (million tonnes) per year, almost the same in coal-equivalent, form another significant renewable energy source at the village level.[1]

Wind energy and hydropower are now commercially established. The country's total wind potential is pegged at 45 000 MW (megawatt) in gross terms. Even while only 13 000 MW was considered feasible, these estimates have shown to be conservative. The country now has an installed wind power generation capacity of about 9500 MW. Other renewable sources include fuel wood plantations on wasteland and degraded forestland, and small hydro power.

Barriers to renewable energy

Several barriers have resulted in the slow uptake of renewable energy technologies vis-à-vis fossil fuel based technologies. These include costs, administration, and technical and legal concerns. Policies and government programmes are therefore required to support renewable energy technologies both in the short run as well as in the long run. The large subsidies supplied to the fossil fuel and nuclear industries even after several decades of support, form a barrier to up-take of renewables. Table 1 shows the barriers under the heads of costs, legal and regulatory issues, and market performance.

Renewable energy support schemes

Figure 1 depicts the existing support mechanisms that are available

[1]The total yield of crop residues each year is 546 million tonnes, but a major proportion gets absorbed in the rural economy.

Table 1 Barriers to renewable energy

Costs and Pricing	*Legal and regulatory issues*	*Market performance*
Subsidies for competing fuels	Lack of legal framework	Lack of access to credit
High initial capital costs	Restriction on sites and construction	Perceived technology performance and risk
Difficulty of fuel price risk assessment	Transmission access	Lack technical and commercial skills and information
Unfavorable power pricing rules	Utility interconnection requirements	
Transaction cost	Liability insurance and requirements	
Environmental externalities		

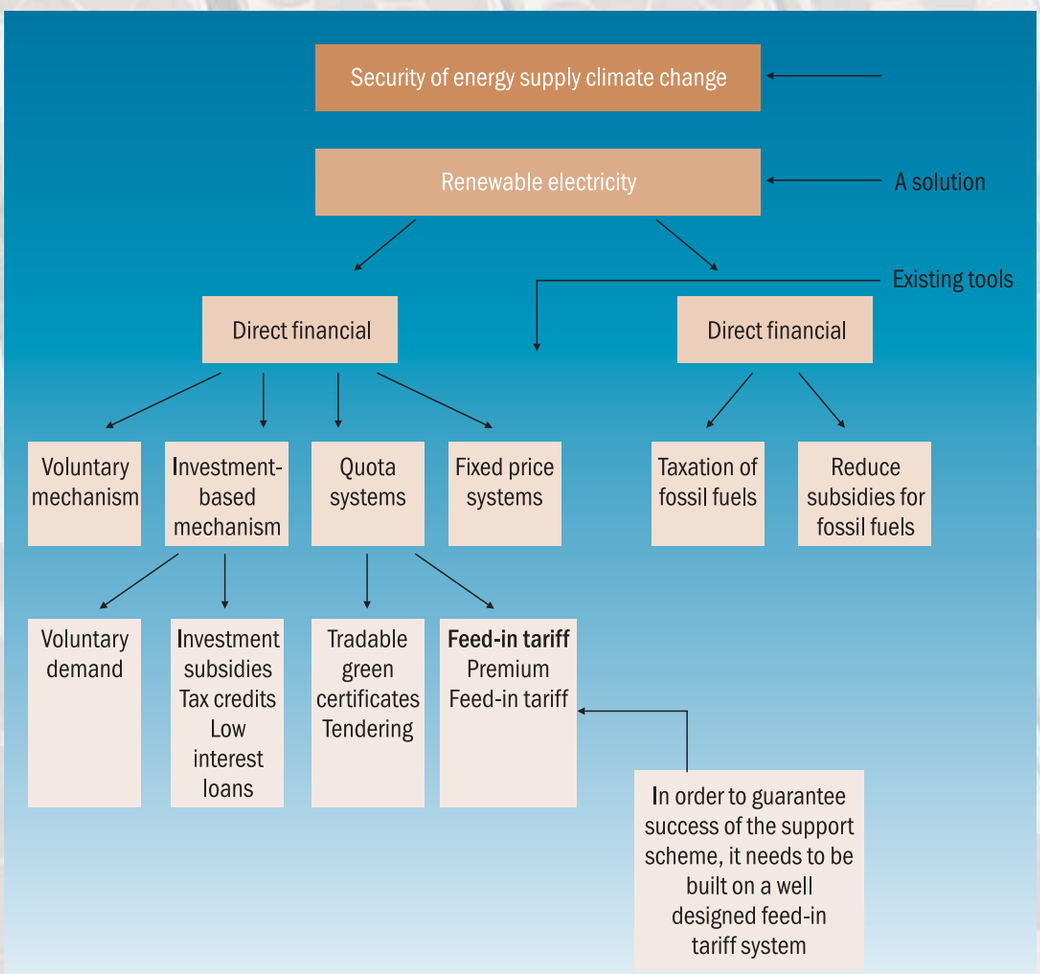

Figure 1 Original and structure of support mechanisms

and how they work. The following section provides details on two of the mechanisms—feed-in tariff laws and the quota model.

The feed-in tariffs model

The basic feed-in model can be considered a 'pricing law' under which producers of renewable energy are paid to set rates for their electricity, usually differentiated according to the technology used and size of the installation. The rate should be scientifically calculated to ensure profitable operation. The period for which the payment is made should also be set in law, and should cover a significant proportion of the working life of the installation. Grid operators are obliged to provide priority access to renewable energy installations.

The additional costs of these schemes are paid by suppliers in proportion to their sales volume, and are passed to the power consumers by way of a premium on the kilowatt-hour end-user price. In the best designs, the guarantee periods are long, thus providing investment certainty. A variant of the FIT (feed-in tariff) scheme is the fixed premium mechanism currently implemented in Denmark and partially in Spain. Under this system, the government sets a fixed premium or an environmental bonus, paid above the normal or spot price electricity to RE generators.

The quota model

The quota system is used extensively in the US, and

to a small extent in Europe primarily in the UK and Sweden. While feed-in laws set the price and let the market determine capacity and generation, quota systems work in the reverse. In general, governments mandate a minimum share of capacity or grid-connected generation of electricity to come from renewable sources. The share often increases over time, with a specific final target and end-date. The mandate can be placed on producers, distributors or consumers.

There are two main types of quota systems used today: obligation/certificate also known as the RPS (Renewable Energy Portfolio Standard), and tendering systems. Under RPS, a target is set for the minimum amount of capacity or generation that must come from renewables, which should increase over time. Investors and generators then determine how they will comply, in terms of the type of technology to be used except in the case where specific targets are established by technology types. They determine the developers to do business with, and the price and contract terms they will accept. At the end of the target period, depending upon the policy design, electricity generators and suppliers must demonstrate (through the ownership of credits that they earn through transactions) that their targets, in order to avoid paying a penalty. Producers receive credit in the form of green certificates for the electricity they generate from renewables. Those with surplus of certificates can trade or sell them; and those with too few can build their own renewables capacity, buy electricity from other plants using renewables (which generally includes a bidding process), or buy credits from others. Once the system has been established, the government's role includes the certifying of credits, and compliance monitoring and enforcement (Swain 2004).

The advantages and disadvantages of these mechanisms, along with investment subsidies and voluntary demand, are compiled in Table 2. Many studies that have involved a comparative analysis of the different mechanisms that support renewable energy

Table 2 Evaluation of different support mechanism for RETs

Support mechanism	*Investor security*	*Simplicity*	*Proven success*	*Cost effectiveness*	*Guarantying a mix of different technologies*
Feed-in tariff	Very high	Very high	Very high	Very high	Very high
Quota systems	Very low	Very low	Very low	Very low	Very low
Investment subsides	Good	High	Good	Good	Good
Voluntary demand	Low	High	Low	Very high	Very low

Table 3 Feed-in tariff levels in select European countries as of 2006

Tariff levels in 2006 (€ cents/kWh and duration of support for different technologies)

Country	*Small hydro*	*Wind onshore*	*Wind offshore*	*Solid biomass*	*Biogas*	*Photovoltaic*	*Geothermal*
Austria	3.8–6.3 13 years	7.8 13 years	–	10.2–16.0 13 years	3.0–16.5 13 years	47.0–60.0 13 years	7.0 13 years
Cyprus	6.5 no limit	9.5 15 years	9.5 15 years	6.5 no limit	6.5 no limit	21.2–39.3 15 years	–
Denmark	–	7.2 20 years	–	8.0 20 years	8.0 20 years	8.0 20 years	6.9 20 years
France	5.5–7.6 20 years	8.2 15 years	13.0 20 years	4.9–6.1 15 years	4.5–14.0 15 years	30.0–55.0 20 years	12.0–15.0 15 years
Germany	6.7–9.7 30 years	8.4 20 years	9.1 20 years	3.8–21.22 20 years	6.5–21.22 20 years	40.6–56.8 20 years	20 years
Spain							
Fixed	6.1-6.9 no limit	6.9 no limit	6.9 no limit	6.1–6.9 no limit	6.1–6.9 no limit	23.0–44.0 no limit	6.9 no limit
Premium	8.6-9.4	9.4	9.4	8.6-9.4	9.4	25.5	9.4

Source (Klein, Held, Ragwitz, et al. 2006)

[2]The maximum value for Germany is only available if all premiums are cumulated. This combines the enhanced use of innovative technologies, CHP generation and sustainable biomass use.

technologies have concluded that FITs have produced the most quick and low-cost deployment of renewable energy technologies in countries that have implemented them well.

Table 3 shows the feed-in tariffs of select European countries. The most successful cases of implementation of FITs are in Germany and Spain. As of 2006, about 41 countries had adopted FITs. India has been the first developing economy to have adopted the mechanism in 2005.

The Indian experience

India, as stated, is the first developing country to adopt the feed-in tariffs system in 2005. The central regulatory authority has also announced the adoption of RPS by all states in India, such that at least 10% of power is generated from renewables by 2012. Early this year the Ministry of New and Renewable Energy announced two feed-in laws for (1) grid-connected solar-PV-based power generation and (2) grid-connected solar-thermal-based power generation. In both these cases, the time period is 10 years and the maximum capacity set is 10 MW. The central subsidy per kWh for PV and for solar thermal is Rs 10 and Rs 12 respectively. This will be in addition to the state subsidy. This policy makes renewable power generation an attractive option for renewable energy technology developers and investors. It will be seen in the coming years how these policies facilitate the up-take of renewable energy technologies.

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