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Feed-in Tariffs Go Global: Policy in Practice

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Renewable energy feed-in tariffs are growing in popularity as one of the most effective mechanisms of promoting renewable energy development.

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Globally, feed-in tariffs (FITs), also known as 'advanced renewable tariffs' (ARTs) or 'renewable energy payments' (REPs) in North America, have gone from strength to strength. Such schemes pay renewable energy producers a set rate (tariff) for each unit of electricity fed into the grid, and generally oblige power companies to purchase all electricity from eligible producers in their service area over a long period of time -- usually 15 to 20 years.

This policy has proven to be remarkably adaptable and effective, gaining popularity in both developed and developing countries. Interest in exploiting renewable energy sources — as well as the new industrial opportunities they offer — has been prompted by the emerging crises relating to energy and economics. And the implementation of best policies to support the deployment of renewable energies has received greater priority.

Why have feed-in tariffs become the policy instrument of choice for so many diverse economies around the world? It is because feed-in tariffs are empirically proven to promote the fastest expansion of renewable electric power, at the lowest cost. They also do so more simply, transparently and democratically than other schemes. Unlike other mechanisms, such as tax credits or research and development subsidies, feed-in tariffs need cost governments nothing, being usually funded through costs spread among all electric utility customers, as part of their regular bill. They are performance-based, only paying for the actual output of renewable electricity, not just given out as a grant for purchasing the equipment.

Feed-in tariffs work so well because they are simple and inclusive, allowing all players to invest. They are more transparent than other schemes, have lower administration costs, and when designed properly — and supported by appropriate planning laws — can get deployment moving very quickly. Experience in Germany shows that the feed-in tariff was instrumental in increasing the power generated by renewable energy resources from 6.3% in 2000 to more than 15% in 2008 — an increase of more than 200% in eight years.

Generally, feed-in tariffs also accelerate the cost reduction of renewable energy technologies, making them cost-competitive with conventional energy sources at a much faster pace. At that point, no more support will be necessary. The question of how long support is necessary also depends on the ambition of the country in question. Although they can be used to meet a minimal target, they can also be applied aggressively to redirect money flows in a significant way towards creating a domestic renewable energy industry large enough to compete in the global market.

That global market will only continue to grow as oil prices begin to rise in response to the peaking of global production, which as the IEA predicts in its World Energy Outlook 2008 will occur around 2020. The ultimate goal is to reach a point at which there is no longer any need to support the renewables industry. Indeed, much of the need for support is in response to a requirement to overcome some of the barriers to wider and faster deployment, for example the subsidies that are paid to the conventional energy industry.

Feed-in tariffs can foster technological development through rapid deployment and economies of scale. This decreases the technology specific generation costs of renewable energy sources and improves their competitiveness with conventional power plants. The greater the number of well designed feed-in tariff schemes today, the sooner the costs of renewable electricity will fall below the price of conventionally produced electricity.

Renewable energy sources are already cost-competitive with conventional energy sources such as coal, gas and nuclear in some regions at peak times. Once this is the case for more widespread circumstances, feed-in tariffs will have done their job and will only be needed in exceptional cases, if at all. The costs of wind energy and certain other renewable energy technologies are already in the range of the spot market electricity price in many countries. Once countries implement cap-and-trade schemes for carbon emissions, the price of conventionally produced electricity will further increase, making renewables even more competitive.

Even though solar PV is still more expensive than electricity sold on grey power markets, it will soon reach 'grid parity,' i.e. the price that final consumers pay for the electricity. In developing countries, most renewable energy technologies are more cost-effective than expensive electricity from diesel generators. By implementing feed-in tariffs, the remaining gap between the increasing costs of fossil fuels and the decreasing costs of renewable energy will be closed faster.

Design Options

Governments around the world have been experimenting with feed-in tariff schemes for more than three decades, starting with the PURPA Act in 1978. Today, empiric findings clearly indicate which design options should be part of a good feed-in tariff scheme and which features should be avoided.

An in-depth analysis of all 'basic,' 'advanced' and 'bad' feed-in tariff design options has been carried out in *Powering the green economy – The feed-in tariff handbook*, due in

November 2009 (Earthscan). When designing feed-in tariffs, policy makers try to balance the needs for investors and consumers. Good feed-in tariffs avoid windfall profits for producers but instead provide a stable investment framework, thus lowering the investment costs and the costs for the final consumers.

A good design of feed-in tariff scheme starts with a clear definition of the eligible technologies and plants. In order to choose the eligible technology the policymaker should have a good idea about the resource potential in a given country or region. Therefore, the mapping of the regional or national potential is an important first step. A large number of technologies should be covered by the feed-in tariff scheme, promoting both firm renewable energy technologies, including biomass, hydro power, concentrating solar thermal and geothermal, and fluctuating technologies, such as wind power and solar PV. This way, the policymaker can lay an early foundation for providing back-up power for renewable energy technologies from other renewable energy technologies — a prerequisite for the sought-after 100% renewable energy system.

By definition, feed-in tariff schemes should be technology specific. Providing specific support for each renewable energy technology is a major advantage of feed-in tariffs over other support mechanisms, such as Tradable Green Certificates or Renewable Portfolio Standards. It does not make sense to support all renewable energy technologies equally, simply because they all fall under the generic term ‘renewable energy.’ The requirements for large wind power projects are certainly different to the requirements of solar PV systems on, say the roof of a private household, and so are the costs for electricity generation. Depending on the technology, the generation costs of green electricity can range from 3–40 Eurocent/kWh (4–56 US cent/kWh). In Germany, for instance, onshore wind receives 5.0–9.2 Eurocent/kWh (7.1–13 US cent/kWh), depending on the location of the power plant. Solar PV receives up to 43.01 Eurocent/kWh (60.75 US cent/kWh) if on a home, or 31.94 Eurocent/kWh (45.11 US cent/kWh) if on a ground-mounted site.

Feed-in tariffs should therefore be calculated based on the generation costs of each technology. This approach will automatically lead to technology specific tariffs. A clear and transparent tariff calculation methodology should be developed by the responsible ministry, including investment costs, grid-connection costs, operation and maintenance costs, and fuel costs in the case of biomass and biogas.

In some countries, the tariff level has been related to the electricity cost for the final consumer or the avoided external costs. Both approaches, however, have proven to be hardly effective as the tariff level only coincidentally matched the generation costs of a specific technology. Basing the tariff level calculation on the generation costs is the best solution for providing sufficiently high tariffs on the one hand and avoiding windfall profits on the other hand. Good feed-in tariffs normally provide an internal rate of return of 5%–10%.

When the share of renewable electricity increases, certain countries have opted to also implement location-specific tariffs. This approach has so far only been used in the case of wind energy. Theoretically, location-specific tariffs can also be implemented for other

technologies with dispersed resource availability in a given countries, such as solar PV. Location-specific tariffs for wind energy will lead to a more evenly distribution of wind power plants in a given territory, since producers will not only be bound to the most windy spots. This can reduce local opposition to wind farms, as the windiest spots are normally located in touristy areas at the coastline or the top of mountains, where they are most visible. If this approach is chosen, all wind power producers normally receive a flat-rate tariff for the first few years of operation. In this time period, the average full-load hours are measured and the remuneration for the following years is fixed accordingly. This way, windfall profits for producers at very good locations can be avoided. Even though location-specific tariffs allow for wind power generation at less than optimal locations, the tariff scheme should nonetheless grant higher profitability rates at the most windy locations. Otherwise, the overall efficiency of the feed-in tariff scheme could be undermined.

A Sliding Support Scale

In order to avoid windfall profits and anticipate technological learning over time, many feed-in tariff schemes are automatically reducing tariff payment on an annual basis. The reduced tariffs, however, only affect new installation. The annual tariff reduction for new installations, so-called tariff degression, also provides an incentive for technology learning and cost reduction in the renewable energy sector, counteracting the argument that price-based support mechanisms hamper technological progress.

The degression rate depends on the expected learning potential of each technology. Rather mature technologies, such as wind power, normally have no or a very low degression rate, for example 1% per year. Other technologies with a larger learning potential, such as solar PV, might have a degression rate of up to 10% per year, putting pressure on the producers to continue research and development. Since anticipating the optimal degression rate is difficult, some countries have implemented the so-called flexible tariff degression – relating the degression rate to the market growth of a certain technology. In times of high market growth, the tariff will decrease more rapidly than in times of low market growth.

With an increasing share of renewable electricity, policymakers will be looking for the implementation of design options to better integrate green power into the main electricity markets. Wind energy producers are sometimes obliged to forecast their production, but at the same time they might receive additional tariff payment for auxiliary grid services, such as the capacity to support voltage dips and the provision of reactive power for grid stability. Besides, producers that can control the timing of power output are sometimes paid higher tariffs during peak demand and a lower tariff in off-peak periods. Legislators can also grant additional tariff payment for the combination of several fluctuating and non-fluctuating technologies, for example the combination of electricity produced from wind power, biomass and solar power.

The most prominent design option for better market integration is the so-called 'premium' feed-in tariff. Under this scenario, the renewable power producer sells

electricity on the conventional power market and receives an additional premium feed-in tariff on top of the commercial value. Together, both remuneration components should provide enough income for sufficient profitability. Logically, this premium feed-in tariff is lower than the normal, fixed feed-in tariff, and in this case, the renewable electricity producer can no longer rely on the above mentioned purchase obligation. Premium feed-in tariffs are already in use in a number of European countries, including Spain, the Netherlands, the Czech Republic, Denmark and Slovenia.

Such tariffs should be optional to fixed feed-in tariff schemes as they normally favour large power producers such as utilities which have already gathered experience in selling electricity on the market. For small producers, such as a household with a roof-mounted solar PV panel, selling the electricity on the market is not an option as the transaction costs are typically too high. In order to avoid windfall profits, the legislator has to anticipate the market price of electricity as this becomes one component of the overall remuneration scheme. Since predicting electricity prices has become increasingly difficult in times of volatile fuel prices, it is recommended to implement both a price cap and floor. The cap prevents the overall remuneration exceeding a certain limit, thus avoiding windfall profits. The floor guarantees a minimum level of revenue for generators.

Where Are Feed-in Tariffs Programs in Existence or Being Explored?

**TABLE 1. FEED-IN
TARIFFS WORLDWIDE**

Africa

Algeria
Kenya
Mauritius
South Africa

Americas

Argentina
Brazil
Canada*
Ecuador
Nicaragua
United States*

Asia

India*
Indonesia
Korea (South)
Pakistan
Philippines
Sri Lanka
Thailand

Middle East

Israel
Turkey

Australasia

Australia*

Europe

Austria
Croatia
Cyprus
Czech Republic
Denmark
Estonia
France
Germany
Greece
Hungary
Ireland
Italy
Latvia
Lithuania
Luxembourg
Macedonia
Malta
Netherlands
Portugal
Slovak Republic
Slovenia
Spain
Switzerland
Ukraine

Feed-in tariffs are now in use in around 50 countries, states and

provinces. Table 1 (*left*) lists them as at the end of 2008. Countries with feed-in tariffs in jurisdictions below national level are asterisked (*). Feed-in laws are also under discussion or in development in such places as the UK, Finland, New Zealand, Japan, Nigeria, Malaysia, Singapore and Taiwan. Meanwhile, many states, provinces and territories in North America and Australia are interested, largely due to the huge job creation, technology export and energy security potential.

Anglophone countries have for some time been associated with an ideological type of opposition to feed-in tariffs, considering them insufficiently compatible with markets, as they ‘fix prices’. However, feed-in tariffs can integrate renewable energies into the conventional power market (see below) contradicting this argument. **It is something of a breakthrough, in the UK and US especially, that politicians are warming to the concept.** As already noted, the academic literature is quite unanimous in its appraisal of the efficiency and effectiveness of the various feed-in tariff support schemes. In view of the facts, and advocacy work which has been done by NGOs, trade associations and coalitions of diverse interest groups, the evidence in support of adopting a feed-in tariff is compelling.

The UK government intends to introduce a law in April 2010 for renewable electricity (and renewable heat a year later), and has enormous backing from a particularly knowledgeable and well organized advocacy coalition. There is already a sense that certain things will be done differently from other countries, including the funding mechanism, and it remains to be seen whether an effective mechanism will come forth.

Canada has had success with a new law for Ontario, which is part of the Green Energy Act — a much bigger bill aimed at promoting renewables and efficiency measures throughout the province, hopefully leading to the creation of around 90,000 jobs. It is undoubtedly very progressive by North America standards, and is likely to set the bar for policies across the continent for some time.

The United States has seen laws introduced in the municipality of Gainesville, Florida, and the states of Vermont and California, although the latter is very limited in scale and scope. Vermont has a much more full-featured law, and looks impressive. Many more states are now working on legislation and campaigns. At the federal level, Representative Jay Inslee (D-WA) proposed a national feed-in tariff in 2008, backed by many renewable energy companies and organizations, However, the bill did not even pass committee stage in the House of Representatives. Another federal bill was introduced in 2009, but faces criticism for creating meaninglessly low tariffs.

Australia has also seen calls for federal-level legislation, but despite a national renewable energy target of 20% by 2020 being set, so far the action has again been at the state and territory level — with eight either in place or proposed. Policy design differs from one jurisdiction to another, as do tariff levels, eligible technologies, and so on. The purpose is mainly to encourage the uptake of small-scale renewables — typically targeting solar PV under 30 kWp at the time of writing.

Many would like to see more technologies being supported, including wind, bioenergy and even large-scale power systems, such as solar. The majority of state-based feed-in tariffs are 'net' meaning they only pay for the excess electricity exported (production minus consumption) to the grid, instead of the total 'gross' generation. This difference can significantly impact the incentive received and therefore the payback period of the renewable energy system. There have even been protest rallies and online petitions for net schemes, and against gross feed-in tariffs. In November 2008, the Council of Australian Governments (COAG) agreed to investigate the harmonization of feed-in tariff legislations; COAG then set out 'National Principles for Feed-in Tariff Schemes'. These principles do not appear to support the implementation of a gross feed-in tariff, but do seek to streamline the state-based feed-in tariffs to be nationally consistent.

Besides these examples, many developing countries and emerging economies have currently implemented, or plan to implement, feed-in tariff schemes, including Argentina, Brazil, China, Ghana, Malaysia, Kenya, Nigeria, Pakistan and South Africa. Renewable energies have an incredible potential in those countries, considering the fact that 1.6 billion people around the world have no access to electricity.

Furthermore, feed-in tariffs can also operate in monopolized or oligopolized markets, as the combination of tariff payment and purchase obligation establishes a stable framework for independent power producers. African countries are especially interesting in this respect, as they show that nowadays renewable energy sources are an essential part of each and every energy mix. The cost analysis of the Kenyan feed-in tariff scheme, for instance, reveals that the promoted renewable energy technologies — wind, biomass and hydro power — are already more cost efficient than conventional diesel generators. In the light of increasing prices for conventional energy sources, renewable energy technologies can stabilize or even decrease energy costs.

When implementing feed-in tariffs in developing countries, certain special design options have to be considered. First, the financing mechanism may have to be modified as electricity consumers in these countries are usually more vulnerable to electricity price increases. The tariff payment is normally financed by distributing costs amongst all ratepayers. In developing countries, some of the additional costs might have to be covered by a national fund for renewable energy deployment. This approach could undermine the stability of the support mechanism as governmental money or money from international donors will be included. Second, developing countries might need to limit the installed renewable capacity in order to control costs for the final consumer. Even though such caps have had disruptive effects in the case of many industrialized countries, developing countries often still have national plans for future investment in new power generation capacity.

Feed-in tariffs can also be adopted to promote renewable energies in mini-grids — small-scale electricity networks based on a local and often isolated distribution system. Recently, the Joint Research Centre of the European Commission adapted feed-in tariffs to those actors involved in typical mini-grids. These modifications merely refer to the financing mechanism, since costs that occur in an isolated mini-grid cannot be distributed

equally amongst all electricity consumers in a given country. According to those involved in the power production business — Independent Power Producers, Renewable Energy Service Companies or private households — the money flow has to be adopted, including revenue sources from the national level.

The Feed-in Tariff Goal

Despite the fact that feed-in tariffs have proven to be the most successful support mechanism in bringing about new renewable power at low costs, the specific design is crucial for effective and efficient support. The experience with this policy instrument all over the world clearly indicates which best practice design criteria will have to be included in well-functioning feed-in tariffs.

Today, many countries have overcome their ideological barriers towards ‘fixed price’ support mechanisms as their performance is clearly superior to other support instruments. The 50 countries, states and provinces all over the world that already operate with feed-in tariffs, play an important role in the global transition to a renewable energy-based system. They can also contribute to overcoming the current economic crisis and powering the green economy.

Miguel Mendonça and David Jacobs are co-authors of Powering the Green Economy: The Feed-in Tariff Handbook, due to be published in November 2009 by Earthscan.

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