FACT SHEET

Feed-in tariff

Key points

- ***A feed-in tariff is a widely used tool for developing the scale of renewable energy power for green growth.***
- ***A feed-in tariff can be adjusted to characteristics of the energy market, energy infrastructure and technological conditions of each country. This makes it a convenient tool for many countries.***
- ***A feed-in tariff has to be introduced carefully, especially in developing countries.***

Feed-in tariff explained

A feed-in tariff is an energy policy focused on supporting the development and dissemination of renewable power generation. In a feed-in tariff scheme, providers of energy from renewable sources, such as solar, wind or water, receive a price for what they produce based on the generation costs. This purchase guarantee is offered generally on a long-term basis, ranging from 5 to 20 years, but most commonly spanning 15–20 years.[1] The cost of the tariff payments are typically shared with the electricity consumers.

An inherent part of low carbon green growth is the transformation of the energy generation infrastructure away from the use of fossil resources, such as coal and oil, and towards renewable sources. A feed-in tariff is currently recognized to be the most effective policy to stimulate investments in renewable energies.[2] It has been responsible for 75 per cent of the global PV and 45 per cent of the global wind turbine deployment.[3]

Potential for change

In 2009, the global primary energy consumption amounted to about 11.16 billion tons of oil equivalent.[4] The share of the Asia-Pacific region in this global energy consumption has been rising steadily, accounting for 37 per cent in 2009.[5] By 2035, more than half of the global energy consumption will take place in developing and emerging economies in Asia alone (figure 1).[6] With the help of a feed-in tariff system for renewable energies, this rising energy demand could be met by an increasing number of renewable energy sources.

[1] Toby Couture, Karlynn Cory, Claire Kreycik and Emily Williams, *A Policymaker's Guide to Feed-in Tariff Policy Design* (Golden, CO, National Renewable Energy Laboratory, 2010). Available from www.aaec.arkansas.gov/Solutions/Documents/A%20Policymakers%20Guide%20to%20Feed-in%20Tariff%20Policy%20Design.pdf (accessed 09 February 2012).

[2] Mary Jean Bürer and Rolf Wüstenhagen, "Which renewable energy policy is a venture capitalist's best friend? Empirical evidence from a survey of international cleantech investors", *Energy Policy* (2009), vol.37, No. 12, pp. 4997-5006.

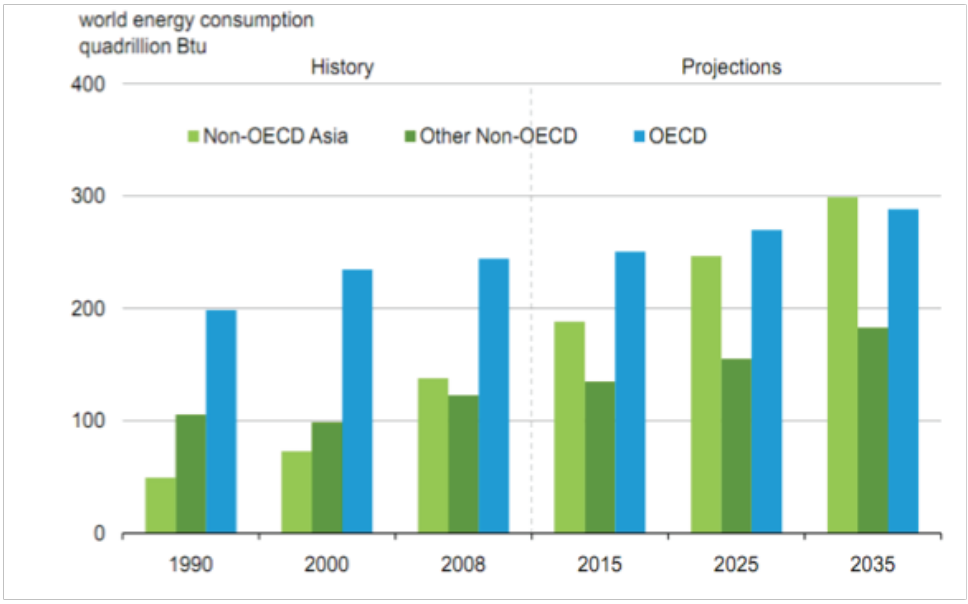
[3] Toby Couture, Karlynn Cory, Claire Kreycik and Emily Williams, *A Policymaker's Guide to Feed-in Tariff Policy Design* (Golden, CO, National Renewable Energy Laboratory, 2010). Available from www.aaec.arkansas.gov/Solutions/Documents/A%20Policymakers%20Guide%20to%20Feed-in%20Tariff%20Policy%20Design.pdf (accessed 09 February 2012).

[4] Beyond Petroleum, *BP Statistical Review of World Energy* (London, 2010). Available from www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2008/STAGING/local_assets/2010_downloads/statistical_review_of_world_energy_full_report_2010.pdf (accessed 10 February 2012).

[5] ibid.

[6] Energy Information Administration, *International Energy Outlook 2011,* (Washington, D.C., 2011). Available from www.eia.gov/pressroom/presentations/howard_09192011.pdf (accessed 15 February 2012).

Figure 1: Global energy consumption by subregion (1990–2035)



Source: Energy Information Administration, *International Energy Outlook 2011* (Washington, D.C., 2011). Available from www.eia.gov/pressroom/presentations/howard_09192011.pdf (accessed 15 February 2012).

Successful feed-in tariff policies typically include three components:[7] 1) guaranteed access to the grid; 2) stable, long-term purchase agreements (typically 15–20 years); 3) payment levels to the renewable energy producer based on the costs of renewable energy generation; the actual payment amount is usually differentiated based on technology type, project size, quality of the resource and/or other project-specific variables (table 1).

How it works

A well-designed feed-in tariff can be both cost-effective and cost-efficient. The calculation of payment rates varies from country to country, depending on the national electricity infrastructure, energy prices and overall competitiveness of renewable energy compared with conventional energy sources. There are several variables that governments and policymakers can adjust to suit their country-specific characteristics and needs. Table 1 refers to some of the most commonly considered variables in the design of a feed-in tariff payment structure, ranging from the most basic to more sophisticated design options. The wide range of options provides flexibility for countries characterized by different requirements and economic conditions. Developing countries could start with a relatively simple design, such as a technology-specific feed-in tariff that is based on power generation costs. Over time, with technological advancement and in consideration of the economies of scale, more sophisticated design options could be added.

[7] Toby Couture, Karlynn Cory, Claire Kreycik and Emily Williams, *A Policymaker's Guide to Feed-in Tariff Policy Design* (Golden, CO, National Renewable Energy Laboratory, 2010). Available from www.aaec.arkansas.gov/Solutions/Documents/A%20Policymakers%20Guide%20to%20Feed-in%20Tariff%20Policy%20Design.pdf (accessed 09 February 2012).

Table 1: A spectrum of feed-in tariff design, adjustments and implementing options

Feed-in tariff configuration factors	• **Eligibility** determines which entities can participate (citizens, corporations, non-profit organizations, government entities, etc.) and whether there are limitations on which project types can qualify (technology, project size, location and in-service date). • **Contract duration** defines the period in which the feed-in tariff payments are awarded. Contract periods generally range from 5 to 20 years, with the majority lasting 15–20 years. Longer contract periods help to reduce payments and ensure cost recovery. • **Grid access** calls for clear protocols for transmission and interconnection issues to ensure that renewable energy projects can be connected to the grid in a timely way. • **Purchase obligations** (used by several countries) require energy providers, load- n system operators to purchase the entire output from eligible projects. • **Capacities** determine whether there is a limit on the renewable energy feed-in tariff programme, either restricting the promoted quantity of renewable energy or the project size due to the technology type or the total programme expenditure. • **Comprehensive revision** of the policy should be made mandatory every two to four years, including the tariff structure and implementing options. • **Forecasting obligations** for the output of renewable energy generators could help utilities and system operators to balance the variable output from different sources and technologies into the grid. • **Funding the feed-in tariff policy** will depend on how the legislation is proposed. Costs could be added to the rate base or by using tax revenues, carbon auction revenues or cost sharing among the energy providers. In any case, the financing mechanism should be fair and transparent, including the distribution of the incremental costs of new renewable energy capacity (including grid integration and balancing costs).
Feed-in tariff level factors	• **Provide a reasonable return**: The optimal tariff level varies on a national scale, due to the fact that hurdle rates for investments are orientated on the respective bank rates in every country. The tariff level should allow a payback period shorter than the length of the agreement. For instance, in Australia, the tariff should provide between five and ten years' time to pay off the upfront investment. The tariff could be set as a fixed-price feed-in tariff payment (independent of the market price of electricity) or premium-price feed-in tariff payment (adding a premium tariff to the spot market of electricity). • **Configuration by technology**: Costs to generate electricity differ depending on the renewable energy source (solar, wind, hydropower, among others). Payments should be adjusted accordingly to enable diversity of renewable energy technologies. • **Incorporate innovation:** The tariff should be designed to encourage the proliferation of innovative technologies; for instance, technologies that preserve open spaces, such as photovoltaic solar panels on rooftops. • **Consider size and location**: A variety of project sizes and locations should be incorporated. For instance, tariffs for smaller projects are usually higher. Feed-in tariff should vary according to each country's unique energy pricing structure and capacities.

Feed-in tariff adjustment factors	• **Fixed adjustments**: The feed-in tariff for new projects often decrease each year to incentivise technology improvement (tariff degression). • **Regular adjustments:** To avoid excessive rents, a feed-in tariff can be scheduled for periodical adjustments to updated energy market and technology conditions (for example, Germany adjusts every four years). • **Inflation adjustments**: Technological investment is subject to commodity prices. A feed-in tariff should be adjusted to help cover volatile prices.

Source: Toby Couture, Karlynn Cory, Claire Kreycik and Emily Williams, *A Policymaker's Guide to Feed-in Tariff Policy Design* (Golden, CO, National Renewable Energy Laboratory, 2010). Available from www.aaec.arkansas.gov/Solutions/Documents/A%20Policymakers%20Guide%20to%20Feed-in%20Tariff%20Policy%20Design.pdf (accessed 09 February 2012).

Strengths with the feed-in tariff

- **Flexibility:** As one of the most widely used mechanisms to promote power generation from renewable energies, a feed-in tariff possesses great flexibility in its design. Eligibility, contract duration, purchase obligation and capacities can be defined individually by each government. Additionally, the tariff level can be specified according to national market conditions, including the option to particularly promote certain renewable energy technologies, innovations or regional renewable energy development. Thus it easily can be adapted to varying levels of economic development and diverse policy priorities.

- **Investor confidence:** Ensuring long-term investment security through a feed-in tariff promotes investments in renewable energy industries and encourages manufacturers to expand the time horizon applied to the planning of their ventures. A profitability guarantee provided via a feed-in tariff also constitutes a strong incentive for private R&D investments, leading to cost reductions in innovation and technology developments.

- **Efficiency:** The simplicity, stability and fairness of a feed-in tariff mechanism leads to low administration and transaction costs, making it the most efficient policy for promoting renewable energy sources.[8]

- **Increased competitiveness:** Appropriately designed, feed-in tariff will increase the number of players in renewable energy market, which in turn promotes the competitiveness of the market and boosts R&D and innovations.

- **Social impact:** Effective implementation of feed-in tariff mechanisms also benefits the society as a whole by creating jobs and reducing carbon emissions and their negative accompanying effects. In the long run, feed-in tariff can be understood as a key driver for (local) economic growth and green industries in particular.

- **Comparative advantage:** The price guarantee and long-term policy certainty offered by a feed-in tariff have propelled some countries to the forefront of the global renewable energy industry and has created countless economic opportunities in new and emerging sectors, especially in the European Union and in China.

[8] Intergovernmental Panel on Climate Change, *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation* (Cambridge, United Kingdom, Cambridge University Press, 2011). Available from http://srren.ipcc-wg3.de/report (accessed 10 February 2012).

Challenges to using a feed-in tariff

- **Finding the right tariff level:** The tariff must be set at a level that enables businesses opting for renewable energies to compete against providers of conventional fossil resource-based energies. Finding this level, however, is not a static process. It demands flexibility and good knowledge of the mechanics behind the energy market. If a feed-in tariff is set too low, renewable energy providers will fall victim to the well-known market disadvantages experienced in industries that try to incorporate environmental and social externalities, and their investment will have little chance to pay off. If the tariff is set too high, it may provide unwarranted profits to developers and incur disproportional costs for the reduction of green house gas emissions on society, possibly disadvantaging more efficient reduction measures. Additional to the correct calculation of the tariff level at the point of introduction, it should be adjusted periodically, following signals from the renewable energy market and technology innovation sector.

- **Capacity and cost control:** Because a feed-in tariff can provide a strong incentive for renewable energy producers and manufacturers, policymakers need to ensure that there is a means to control the overall capacities and costs of its implementation. They have to make sure that public resources are managed efficiently and are not diverted away from other more pressing development goals.

- **Grid access:** The feed-in tariff requires a guaranteed, non-discriminatory access to the grid for all renewable energy producers, including residential, commercial and industrial customers; federal, state and local government agencies; and non-profit organizations. The grid access guarantee is important for both small-scale and larger industrial developments, at both the transmission and distribution levels. This presents a challenge for the energy infrastructure, which may need to connect often remote renewable energy sources to the well-established grid that is usually concentrated in an urban area. In addition, fluctuations in energy quantity supplied by renewable sources can affect energy security. Moreover, the grid access guarantee might weaken the incentive to place renewable energy plants in the most cost-efficient areas.

Examples

Box 1: Feed-in tariffs in selected European countries

Germany: Feed-in tariff legislation resulted in renewable energy development in which both small and large providers receive guaranteed profits from investing in renewable energy technology. Germany enacted its Electricity Feed Act (Stromeinspeisungsgesetz) in 1991, followed by the Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz) in 2000, which was renewed and updated in 2004 and 2009. Germany has since become the world's largest market in solar photovoltaic use (as of 2009) (figure 2).[9] Additional policies were applied to support further R&D investments and to ease access to capital. Policies also included stimulating heat and transport fuel markets by introducing investments grants and low-interest loans for renewable energy heat systems. As a result, the capacity of renewable energy has doubled since 2000 and has created about 280,000 new jobs in the renewable energy industry.[10] In fact, it has generated three times more jobs per megawatt of capacity than the coal-fired electricity industry.[11] This successful use of the feed-in tariff is expected to enable Germany to increase its targets of renewable electricity generation to 35 per cent of the total electricity by 2020 and to 80 per cent by 2050.[12]

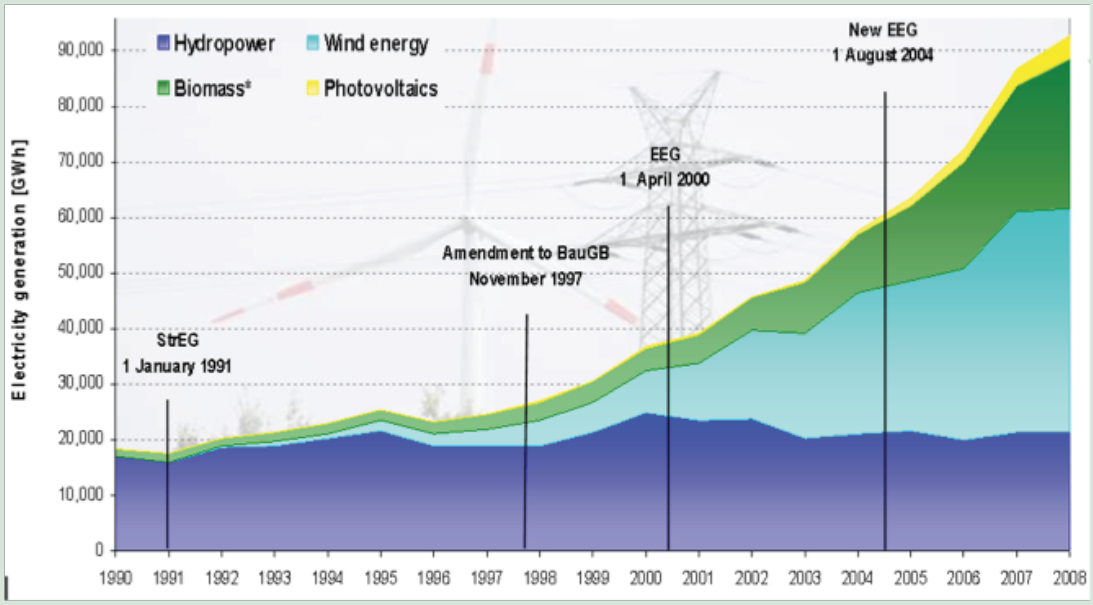
[9] Amber Sharick, *Renewable Energy Pricing: Context & the German Example* (Beijing, 2010). Available from www.cresp.org.cn/uploadfiles/1/1127/ms.amber_sharick.pdf (accessed 10 February 2012).

[10] ibid.

[11] United Nations Environment Programme, *Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World* (New York, 2008). Available from www.unep.org/labour_environment/PDFs/Greenjobs/UNEP-Green-Jobs-E-Bookp85-129-Part2section1.pdf (accessed 09 February 2012).

[12] Amber Sharick, *Renewable Energy Pricing: Context & the German Example* (Beijing, 2010). Available from www.cresp.org.cn/uploadfiles/1/1127/ms.amber_sharick.pdf (accessed 10 February 2012).

Figure 2: The development of feed-in tariffs and renewable energy in Germany



Source: Amber Sharick, *Renewable Energy Pricing: Context & the German Example* (Beijing, 2010). Available from www.cresp.org.cn/uploadfiles/1/1127/ms.amber_sharick.pdf (accessed 10 February 2012).

Spain: The feed-in tariff mechanism to stimulate the use of renewable energy was introduced in 1998. Due to the favourable payment levels adopted in the Royal Decree 661/2007, accompanied by long-term contracts (usually 25 years), the renewable energy industry has experienced an explosive growth. According to International Energy Agency estimates, 560 MW and 2,760 MW of solar photovoltaic capacity were added in 2007 and 2008, respectively.[13] Excessive remuneration for the photovoltaic installations, however, prompted the solar market to virtually ignite in 2008, resulting in a 500 per cent expansion.[14] This development quickly became unsustainable for the Spanish Government and led to a more specific law for solar technologies (Royal Decree 1578/2008). The new legislation included a cap on the photovoltaic capacity installed (500 MW in 2009–2010 and 400 MW in 2011–2012),[15] more restrictive requirements for renewable energy generators and differentiated feed-in tariff payments to achieve a better allocation of photovoltaic installations. A tariff adjustment mechanism was initiated to automatically correct the tariff according to the market development.

Application in developing countries

For developing countries, typically those featuring relatively non-liberalized power markets and fledgling levels of a renewable energy industry, one of the biggest challenges is securing sustainable funding mechanisms for a feed-in tariff. Although developing countries often possess a huge number of untapped renewable energy resources, the costs of promoting renewable energies via a feed-in tariff can be quite high because they lack sufficient grid infrastructure. Additionally, the opportunity costs for the public resources that flow into feed-in tariff financing are high in countries with pressing development issues, such as high poverty levels or unemployment rates, prevailing diseases or elevated child mortality rates.

To fill the financial void, developing countries can use revenues from international carbon trading schemes (such as through the Clean Development Mechanism) or regulate the number of eligible renewable energy projects to control the costs. In any case, they need to incorporate cost-controlling mechanisms from the beginning of the feed-in tariff application.

[13] Claire Kreycik, Toby Couture and Karlynn Cory, *Innovative Feed-In Tariff Designs that Limit Policy Costs* (Golden, Colorado, National Renewable Energy Laborator, 2011). Available from www.nrel.gov/docs/fy11osti/50225.pdf (accessed 09 February 2012).

[14] LeRoy Paddock and David Grinlinton, *Legal Framework for Solar Energy* (Washington D.C., George Washington University, 2009). Available from http://solar.gwu.edu/Research/GW%20Solar%20Legal%20Framework%20Report_March2010.pdf (accessed 09 February 2012).

[15] ibid.

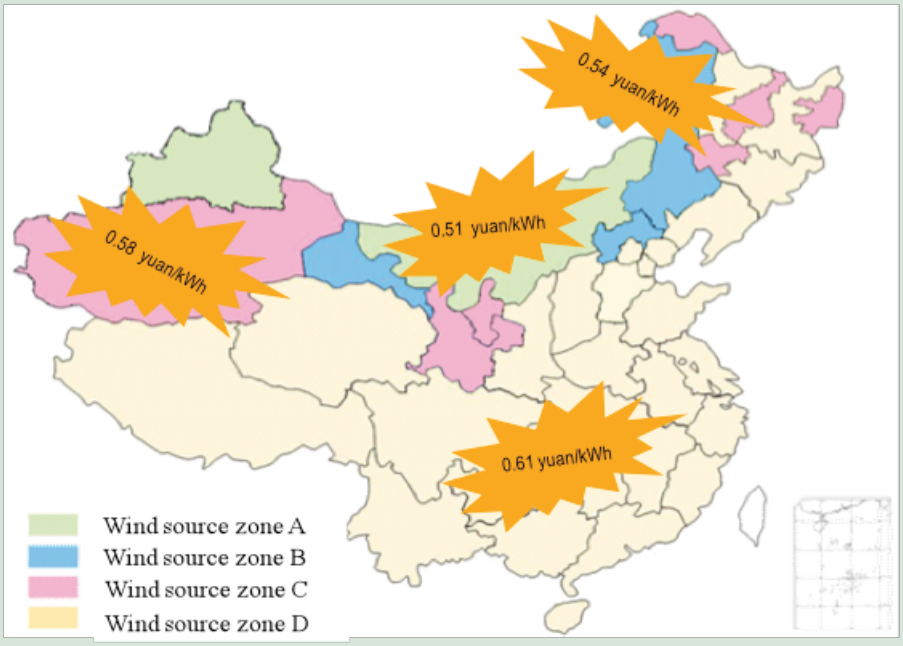
Box 2: Feed-in tariffs in selected countries in the Asia-Pacific region

Both industrialized and developing countries in the Asia-Pacific region are using a feed-in tariff in their policy framework, including Australia, China, India, Indonesia, Japan, Kazakhstan, Malaysia, Mongolia, Philippines, Republic of Korea, Sri-Lanka, Taiwan Province of China and Thailand.

Japan: The Government implemented an excess electricity purchase scheme under the electricity buyback programme in 2009 in which electricity utilities were required to pay 48 yen for excess electricity generated from photovoltaic sources over a guaranteed contract period of ten years.[16] Although the programme helped to promote electricity conservation, the Government recently enacted the Law on Special Measurement Concerning Procurement of Renewable Energy Sourced Electricity (August 2011), which includes a feed-in tariff mechanism. The scheme will start in July 2012 and utilities will have to buy electricity from photovoltaic, wind, biomass, geothermal and small hydropower generators. The goal is to increase the current 3 per cent of renewable energy share in Japan's power generation to 10 per cent by 2020.[17]

China: The Government inaugurated its feed-in tariff for wind power featuring varying tariff levels that were based on regional wind resource distribution in 2009 (figure 3). Since then, China has become the world's largest installer of wind energy plants.[18] The cumulative capacity of wind power installation reached 44.7 GW, which generated 50 TWh of green electricity in 2010[19] and covered about 1 per cent of the country's total electricity demand.[20] Although it may sound slight, this 1 per cent, or 50 TWh, is equal to the total annual amount of electricity produced in the whole of New Zealand.[21]

Figure 3: Feed-in tariffs for wind power in China



Source: Extracted from Liping Jiang et al., "Wind Energy in China", *IEEE Power & Energy Magazine* (2011), vol. 9, No. 6, pp. 36-46.

[16] Junko Edahiro, "Japan Begins Feed-in Tariff Scheme to Accelerate Renewable Energy Promotion", *Japan for Sustainability*, Newsletter No. 110, October 08, 2011.

[17] Japan Renewable Energy Policy Platform, *Renewables Japan Status Report 2010: Executive Summary* (Tokyo, 2010). Available from www.re-policy.jp/jrepp/JSR2010SMR20100427E.pdf (accessed 09 February 2012).

[18] Amber Sharick, *Renewable Energy Pricing: Context & the German Example* (Beijing, 2010). Available from www.cresp.org.cn/uploadfiles/1/1127/ms.amber_sharick.pdf (accessed 10 February 2012).

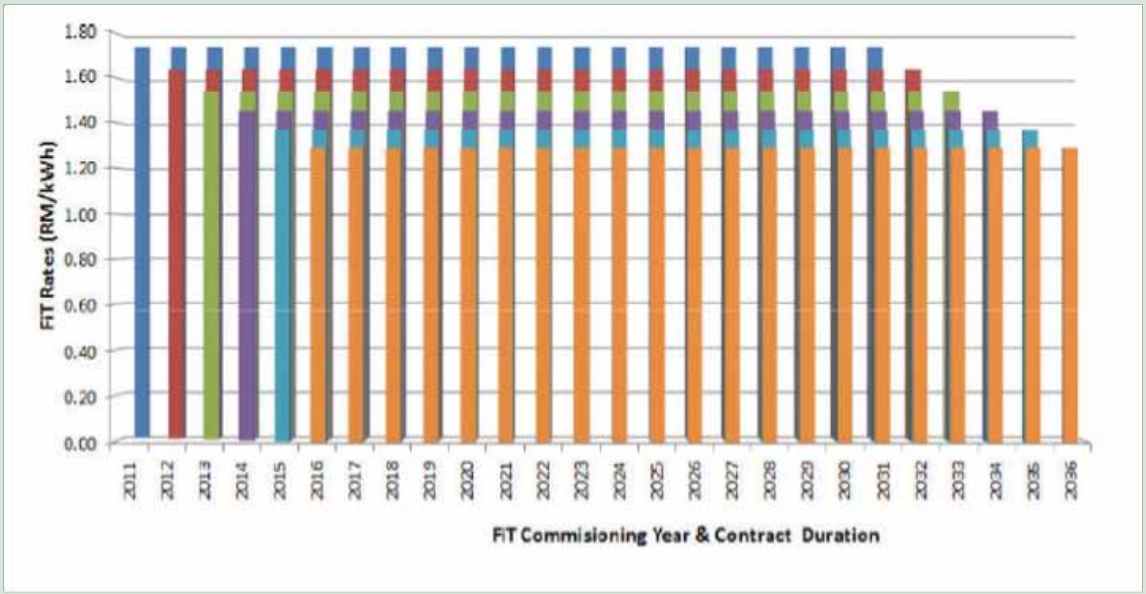
[19] Global Wind Energy Council, *Global Wind Report: Annual Market Update 2010 Wind report 2010* (Brussels, 2011). Available from www.indianwindpower.com/pdf/gwecReport_2010.pdf (accessed 10 February 2012).

[20] International Energy Agency and Energy Research Institute, *Technology Roadmap: China Wind Energy Development Roadmap 2050* (Beijing, the People's Republic of China, 2011). Available from www.iea.org/papers/roadmaps/china_wind.pdf (accessed 09 February 2012).

[21] Organisation for Economic Co-operation and Development website "Statistics from A to Z". Available from www.oecd.org/document/0,3746,en_2649_201185_46462759_1_1_1_1,00.html (accessed 1 March 2012).

Malaysia: In April 2011, the Government introduced an advanced renewable tariff system, which includes specific targets for each renewable energy technology. The scheme applies to renewable power plants generating up to 30 MW. The technologies included under the feed-in tariff mechanism are small-scale hydropower, biomass, biogas, waste and solar photovoltaic. The tariff payment rates include an automatic annual reduction that is based on the renewable energy source (figure 4) to stimulate rapid investment. It basically means that the sooner the renewable energy generators are connected to the grid, the higher the tariff payment will be that they receive. The plan is to expand the share of renewable energy to 5.5 per cent by 2015 and to 9 per cent by 2020.[22]

Figure 4: Renewable energy feed-in tariff degression in Malaysia



NOTE: The different colours indicate maximum tariff rates for contracts starting at different dates.
Source: David Jacobs, *FIT for Malaysia: Assessment of the Proposed Malaysian Feed-in Tariff in Comparison with International Best Practise* (Berlin, 2010).

Further reading

A Policymaker's Guide to Feed-in Tariff Policy Design, by Toby Couture, Karlynn Cory, Claire Kreycik and Emily Williams (Golden, CO, National Renewable Energy Laboratory, 2010). Available from www.aaec.arkansas.gov/Solutions/Documents/A%20Policymakers%20Guide%20to%20Feed-in%20Tariff%20Policy%20Design.pdf

Innovative Feed-In Tariff Designs that Limit Policy Costs, by Claire Kreycik, Toby Couture and Karlynn Cory (Golden, CO, National Renewable Energy Laboratory, 2011). Available from www.nrel.gov/docs/fy11osti/50225.pdf

Legal Framework for Solar Energy, by LeRoy Paddock and David Grinlinton (Washington, D.C., George Washington University, 2009). Available from http://solar.gwu.edu/Research/GW%20Solar%20Legal%20Framework%20Report_March2010.pdf

[22] David Jacobs, *FIT for Malaysia: Assessment of the proposed Malaysian Feed-in Tariff in Comparison with International Best Practise* (Berlin, 2010). Available from www.mbipv.net.my/dload/Jacobs+FIT_for_Malaysia+final.pdf (accessed 9 February 2012).