Feeding the grid RENEWABLY

Using feed-in tariffs to capitalize on renewable energy

February 2008

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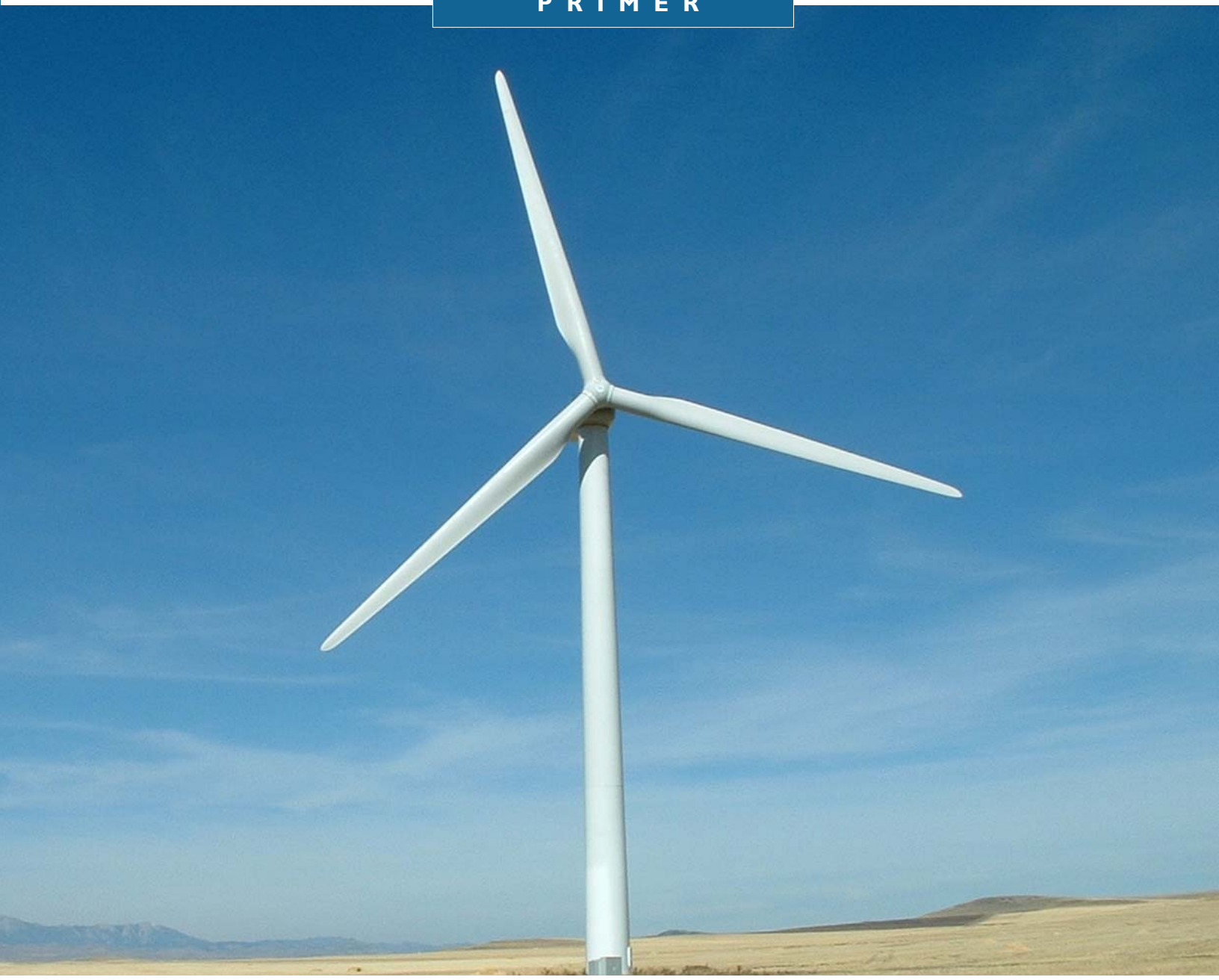

Compiled by: Roger Peters • Tim Weis

Renewable. It's Doable!

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Sustainable Energy Solutions

This primer is the first in the series *Making Renewable Energy a Priority*. It is accompanied by a fact sheet which summarizes the key points of the primer. Both can be downloaded at: re.pembina.org

Feeding the Grid Renewably

Using feed-in tariffs to capitalize on renewable energy

Overview

The global shift to renewable energy systems is now inevitable. Renewable energy systems offer us a way to tap into our vast national supply of sustainable resources and reduce our environmental impact while creating a long-term, secure energy supply.

Feed-in tariffs have been demonstrated to be the most effective policy mechanism that a country can use to foster the rapid development of renewable energy systems. Close to two-thirds of the world's wind energy and half of the solar PV systems have been installed as a result of feed-in tariffs.

The purpose of this document is to introduce the reader to the key elements of feed-in tariffs and the ways in which they function to achieve rapid renewable energy deployment.

The countries that first used feed-in laws regulating feed-in tariffs—notably, Germany, Denmark and Spain—have all developed robust manufacturing sectors in the renewable energy technologies they have supported by creating a long-term and stable market.

Germany has become a world leader in research and manufacturing of solar photovoltaic cells and wind turbines. They now generate more than 12% of their electrical needs from wind, solar, biomass, farm biogas and small hydro.

Photo: Gordon Howell

Just the Facts

- A *tariff* is not a tax, but a term commonly used in the utility industry for a rate paid to electrical generators.
- A *feed-in tariff* is a premium price that is set by the government for anyone who can supply (or feed) renewable energy into the grid.
- Feed-in tariffs are implemented when there is a political desire to make renewable energy a priority, combined with a willingness to share the cost of doing so until it becomes cost-competitive.
- The premium price is set so that the electricity produced will ensure a modest profit for the power producer, encouraging widespread investments.
- Once a feed-in tariff is in place, priority is given to connect any renewable energy project to the grid.
- Feed-in tariffs set no limit to amount of renewable energy feeding into the grid.
- Feed-in tariffs provide a long-term, stable market not only for investors but also for manufacturers and developers. This combination has resulted in significant cost reductions for renewable energy systems.
- Compared to other policy mechanisms, feed-in tariffs result in not only the most rapid but also the most cost-effective deployment of renewable energy systems.
- Countries with feed-in laws tend to have the most developed and dynamic renewable energy industries.

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How do Feed-In Tariffs Work?

Feed-in tariffs are legislated prices paid to producers of renewable energy over a guaranteed period, making the installation of renewable energy systems a worthwhile and secure investment. All energy users share the extra cost, thereby reducing it to a manageable level.

Renewable energy systems currently tend to be more expensive than conventional energy, but underlying feed-in tariffs is the assumption that the benefits of renewable energy are worth paying for.

The prospect of lower renewable energy costs in the future, coupled with the pricing of conventional energy sources to reflect their true environmental costs, will make feed-in tariffs unnecessary in the long run.

The price, or tariff, is set under legislation (through feed-in laws) that put a legal obligation on utility companies to buy electricity from renewable energy producers at a premium rate and give priority grid access.

Feed-in tariffs are sometimes also referred to as *electricity feed laws* or *advanced renewable tariffs*, but the concept of setting a long-term premium price for renewables is the same.

Photo: David Dodge, Pembina Institute

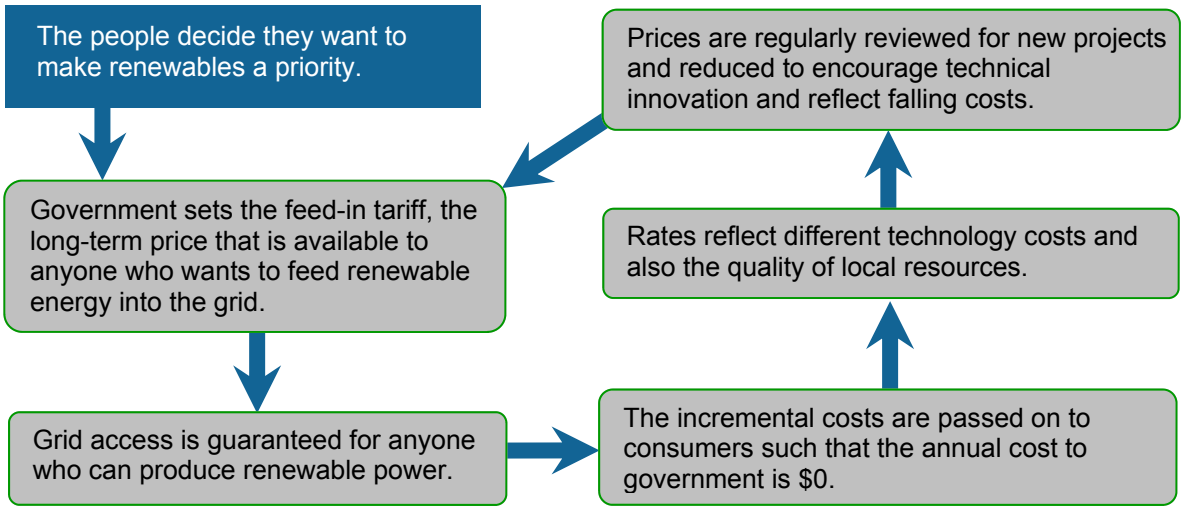
An effective law, such as the German Renewable Energy Sources Act, overcomes many barriers to market entry for renewable energy producers by:

- giving renewable energy priority access to the grid so that grid operators are obliged to purchase electricity from renewable sources;
- setting the tariff, or price, for renewable electricity for long, fixed periods;
- setting no limit on the amount of renewable electricity fed into the grid; and
- making participation simple for small-, medium- and large-scale producers.

There are a number of essential components to any feed-in tariff initiative:

1. The right to connect to the grid for anyone who wants to deliver renewable energy.
2. Fair prices are set for each renewable energy technology that can result in a modest profit for operators with a decent business case. Striking a balance is key and can be achieved through thorough consultations with expert stakeholders.
3. Prices are set to reflect the current costs of each renewable technological option at its proposed location. Because wind technology is more developed and cost-effective than marine technologies and solar thermal, for example, it is paid less. Likewise, since a windy site is more profitable than a less windy site, producers receive less for projects in windy areas and more for those in less windy areas.
4. Premium prices and conditions may be set for specific projects that a program wants to promote such as storage systems and First Nation or other community power initiatives.
5. Contractual long-term premiums (in Ontario and Germany, 20 years; in Spain, 25 years plus a reduced tariff for the remaining life of the system) are implemented to give financiers a loud and clear signal from government that it is serious about renewable energy development. This can lead to decisions to open new credit systems to finance projects and to invest in manufacturing plants.

6. Programs are reviewed periodically to make sure that prices are right (i.e., that projects are profitable but not wasteful of government and ratepayer resources), and that the renewable energy market is developing as planned.



What Makes Feed-In Tariffs So Effective?

Renewable energy faces a number of market barriers that a well-designed feed-in tariff can overcome:[1]

Barrier	Description	Solution
Access to capital	Renewable energy systems are capital-intensive, which banks are unfamiliar with.	A feed-in tariff opens the market to large and small investors, with stable long-term guarantees encouraging money-lending institutions to participate.
Historically distorted markets	Traditional investments and subsidies in competing energy sources such as nuclear as well as publicly funded transmission lines to traditional large energy generation stations without recognizing their environmental costs.	Guaranteed grid access ensures that transmission investments give renewable energy the equivalent priority that traditional energy benefited from, while price premiums account for the environmental benefits of renewables.
Regulatory and legal barriers	A lack of legal framework for small power producers, planning restrictions, grid access, and insurance requirements have made distributed power costly and time-consuming to pursue.	Simple interconnection process eliminates unnecessary paperwork. Regulatory institutions become familiar and efficient at processing applications.
Market barriers	Uncertainty and investment risk, lack of technical or commercial skills and information.	Stable markets send a strong signal to industry to invest in research and training, improving technology reliability and workforce competence.

[1] Beck, F. and E. Martinot. 2004. Renewable energy policies and barriers. In *Encyclopedia of Energy.* Ed. C. J. Cleveland, 365–383. London, San Diego: Academic Press/Elsevier Science.

Governments have predominantly used two methods to try to encourage renewable energy: namely, setting a quota or renewable portfolio standard for utilities to meet, or creating an open market for developers to feed-in renewable energy using feed-in tariffs. Both approaches incorporate the premium price paid for renewable energy into the rate base and therefore distribute the cost among all customers without government subsidy. A quick comparison between North America and continental Europe — both with roughly the same populations — can provide a useful illustration of how these two policy mechanisms have been used to stimulate renewable energy deployment.

By 2007, wind turbines supplied approximately 12.5% of Germany's national electricity needs, while supplying less than 1% of Canada's.

Photo: David Dodge, Pembina Institute

Quota Systems

The predominant policy method in North America has been to mandate renewable energy quotas and utilities, then issue tenders for developers to bid on projects to meet them. While the system guarantees that a certain number of renewable projects will be implemented, it offers no guarantee for investors or project developers that their project will be implemented. Proponents of this approach point out that the most cost-effective projects will be achieved through market competitiveness.

Opponents argue, however, that while quotas set a minimum, they also inadvertently set a *de facto* cap, or a maximum, which needs political will and engagement to continually revisit. By the end of 2006, this approach resulted in approximately 12,000 MW of wind power in the United States and Canada combined.[2]

Feed-in Tariffs

On continental Europe, feed-in tariffs have been the most common policy method for fostering renewable energy deployment. A feed-in tariff sets a long-term guaranteed price for developers of renewable energy. The conditions of the feed-in tariff are set the moment that a producer begins to sell power to the grid, and it is guaranteed for at least the first 20 years of operation. The price is set to ensure that the investment in renewable energy systems is a worthwhile and profitable venture, thereby encouraging broad uptake of such systems.

Renewable energy has a huge potential to reduce emissions, and feed-in tariffs have been demonstrated to be the most effective way to rapidly deploy renewable energy technologies.

Opponents to feed-in tariffs believe that fixing a price will not yield the lowest cost to consumers. However, a good feed-in tariff is based on known technology costs, and new contracts declining tariffs will be awarded over time as technology improves. This approach not only encourages market competitiveness, but also ensures that consumer prices are not over-inflated. By the end of 2006, close to 45,000 MW of wind power was installed through feed-in tariff mechanisms on continental Europe — almost four times that of North America.

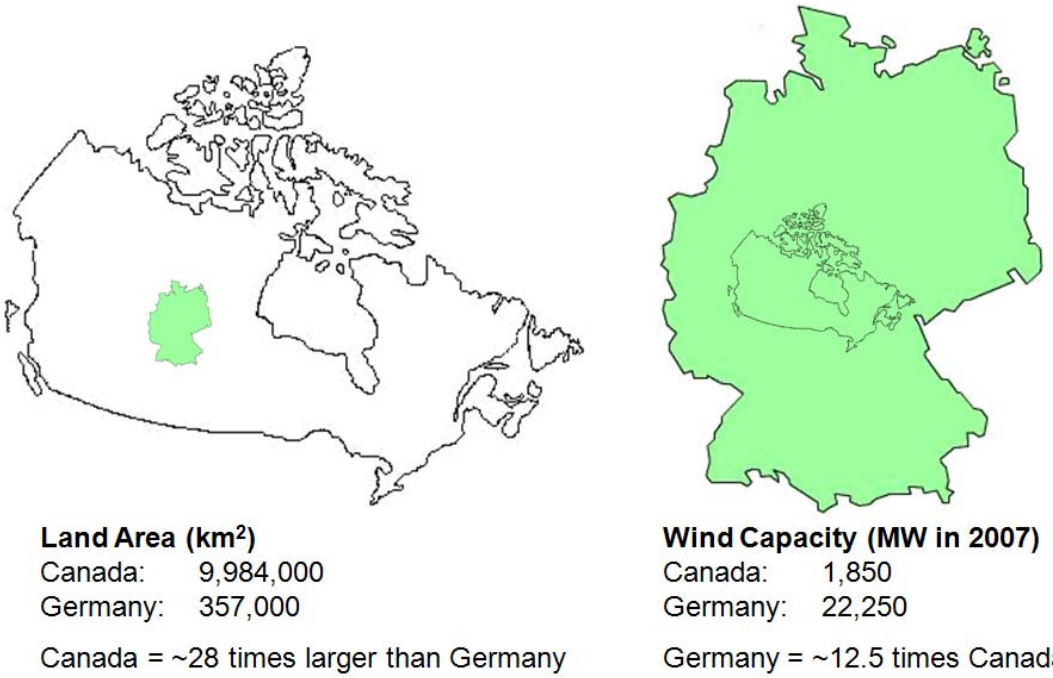
It is clear that feed-in tariffs have been dramatically more successful in encouraging wind and solar power than setting quotas.

[2] This number does not include the approximately 1,000 MW of wind power installed through feed-in tariffs in California in the early 1980s.

Other Benefits of Feed-in Tariffs

In addition to their success in implementing renewable energy, countries with the longest established feed-in laws (Denmark, Germany and Spain) have the overwhelming majority of jobs in these industries, with more than 215,000 people employed in renewable power in Germany alone. In Denmark and Germany, more than 50% of projects are owned by farmers or cooperatives. While competitive bidding processes tend to leave the market in the hands of large conglomerates, feed-in tariffs have managed to unleash the collective buying power of many small investors.

Germany, which arguably has the most successful feed-in tariff program in the world, has ramped up renewable production to more than 12.5% of its electricity supply, while employing more than 230,000 people in the industry by the year 2007.[3] German electricity costs have risen for a typical home by less than € 1.50 (~$2.20) per month as a result of its feed-in tariff.[4]



To date, Germany has more than five times as much installed wind energy per capita than Canada, despite the fact that it has significantly less geographic room for installations.

A well-designed and implemented set of feed-in tariffs will also:

- **Support installations of different sizes and technologies** to ensure that a variety of renewable technologies are used and that everyone can participate.
- **Promote innovation** by regular reductions in the price premium for new installations, motivating competition for technological efficiency.

[3] www.german-renewableenergy.com

[4] All funds are in Canadian dollars unless otherwise noted.

- **Drive economies of scale** as demands rise, thereby lowering costs further over time.
- **Promote market stability** since the system is not dependent on annual budgeting decisions, cutbacks or even a change in government.
- **Promote public support** for renewable energy as individuals, co-ops and private companies participate in the program; also promote awareness of the benefits of renewable energy through the increased visibility of renewable energy systems.
- **Create fair market** participation conditions for every energy provider.

Already applied in more than 20 countries, states and provinces around the world, feed-in tariffs have helped to accelerate the shift from fossil fuel energy to renewable energy. They have been a highly effective tool for boosting the viability, and hence value, of the renewable energy industry.

In addition to climate protection, renewable energy development also creates jobs, increases economic competitiveness and diversity, and strengthens local energy security. As the Stern Review on the Economics of Climate Change states, "feed-in mechanisms achieve larger deployment at lower costs" than other policy instruments designed to encourage renewable energy systems.[5]

In countries such as Germany and Spain, the demand for renewable energy systems has risen dramatically, and installation costs are coming down quickly. For example, the cost of solar photovoltaics dropped by 25% in 2006 in Germany, while the cost of wind turbines (primarily manufactured in Germany, Denmark and Spain) declined by almost 5% every year during the 1990s and early 2000s.[6]

The status of feed-in tariffs in Germany and several other countries is provided in Appendix A.

Proof of the effectiveness of the feed-in tariff model can be found in the following figures from Germany (www.german-renewable-energy.com):

- Over 230,000 renewable energy jobs created
- 97 million tonnes of CO_2 emissions avoided in 2006 through renewables
- 11.8% share of total gross electricity consumption from renewable sources in 2006
- 5.3% share of total primary energy consumption from renewable energy in 2006
- € 21.6 billion total turnover in 2006 through renewable energy (building and operation)
- € 8.7 billion investment per year
- A reduction of approximately € 5.40 in environmental damage per household per month.

All this at a cost of only about € 1.50 — that's about $2.20 — per household per month!

[5] Stern Review on the Economics of Climate Change. 2006. Available at: www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm

[6] The cost of wind energy has started to increase in recent years as the global demand has outpaced manufacturers' ability to supply equipment. As more manufacturing capacity is developed it is expected the costs will once again begin to decrease.

Elements of a Good Feed-In Tariff

Renewable sources of generation are capital-intensive, and thus require long periods of time to return their investments and earn a profit. Policies that support renewable energy systems require as a starting point:

- political will coupled with public demand for renewable energy
- willingness to pay a premium for renewable energy
- stable public policy.

As mentioned earlier, the essential elements of a feed-in tariff system are priority access to the grid (interconnection) and a price for the electricity produced that contributes to profitability (or at least the prospect of profitability).[7]

In an effective feed-in tariff system, grid access is simple and accessible; payments for delivered power is quick; and the regulatory process is straightforward and free of lengthy delays. Feed-in tariffs are most effective when they are the principle policy mechanism for fostering renewable energy, if not the only mechanism.

Finally, a good feed-in tariff system must:

1. Differentiate by application, size, location, and by resource.
2. Provide bonus payments for priority situations.
3. Provide protection from inflation.
4. Decrease prices over time to reflect cost reductions.

> "Revenues generated under the scheme must exceed the costs of generation (including financing costs) by a sufficient margin for profitability or development will either not proceed, or will proceed at a tepid, insignificant pace."
>
> — Paul Gipe, from *Renewables Without Limits* (2007)

Appendix B provides a summary of how each of these features is incorporated into feed-in tariffs and how the tariffs themselves are set.

Feed-In Tariffs Create a Competitive Marketplace

At first glance, it may appear that setting a premium price for renewable energy runs counter to a competitive marketplace. In practice, however, feed-in tariffs do encourage competition. While a feed-in tariff does fix a price, it leaves the market open to choose the most competitive manufacturer and allows the generators of power to choose their desired technology. Furthermore, as the feed-in tariff price drops, manufacturers must continually improve their costs.

The countries that initially implemented feed-in laws now have the most dynamic wind energy industry in the world. The countries that have relied on the use of government grants or renewable portfolio standards/obligations now have little or no competitive market.[8,9] In fact,

[7] www.ontario-sea.org/pdf/RenewablesWithoutLimits.pdf

[8] Butler, L. and K. Neuhoff. 2004. Comparison of feed in tariff, quota and auction mechanisms to support wind power development. Cambridge Working Papers in Economics (CWPE) 0503, CMI Working Paper 70. Available at: www.electricitypolicy.org.uk/pubs/wp

setting such quotas and then issuing competitive bids to meet those quotas has frequently resulted in winner-takes-all market monopolies, while concentrating all of the development only in the regions with the best resource.

In the UK and elsewhere, grant schemes have been massively oversubscribed and have done comparatively little to stimulate the introduction of renewable energy manufacturing at the domestic level. Feed-in tariffs, on the other hand, can kick-start the domestic renewable energy market without large government subsidies.

Feed-in tariffs can be shaped according to a country's renewable resources, its electricity distribution system and its renewable energy targets. There are many design options to help take account of these variables, including some that make the system more compatible with liberalized energy markets (but that carry a higher investment risk). What's important is that each technology that is technically viable is supported. A feed-in tariff system will encourage diverse market development and maturity.

Feed-In Tariffs Create Community Benefits

In Denmark and Germany, much of the renewable energy generation is owned locally, either by people in the community or those nearby. Through a feed-in tariff system, homeowners, farmers and investment groups can quickly, easily and at little cost connect to the grid and sell their electricity for a profit. In Denmark, for example, almost 90% of the wind turbines are owned by landowners and co-ops. Having a stake in ownership can facilitate development by reducing opposition to new projects, thereby furthering the deployment of renewable energy systems. Ontario's Community Power Fund was set up to provide financing for community owned projects that utilize the Province's feed-in tariffs, for more information see www.cpfund.ca.

Summary

Feed-in tariffs, also referred to as advanced renewable tariffs or feed-in laws, have repeatedly been shown to be the most cost-efficient policy mechanism for encouraging the rapid deployment of renewable energy systems. Governments that are serious about encouraging renewable energy development increasingly understand that feed-in tariffs are the most effective policy instrument at their disposal.

A feed-in tariff is simply a guaranteed price set by the government for anyone who wants to sell renewable electricity to the grid, and a guarantee that they will have access to the grid to do so. The tariff is set so that a modest profit is ensured, thereby unleashing the collective capital resources of an entire province, state or country to contribute to the transition to renewable energy. The additional cost is shared by all customers without a government subsidy.

Germany has had the most success in rapidly transitioning to renewable energy systems through the use of feed-in tariffs. Germany currently generates 12.5% of its electricity from renewable sources, while employing more than 230,000 people in the renewable energy sector.[10]

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[9] Viertl, C. 2005. Political development of wind energy in Germany. Paper presented at Nature Conservation and Nuclear Safety conference, Federal Ministry for Environment. Available at: www.exportinitiative.de/media/article005737/BMU_Vortrag_Viertl_Frankreich_Wind_19102005_englisch.pdf

[10] German Federal Ministry of Economics and Technology, www.german-renewable-energy.com

Feed-in tariffs exist in more than 20 countries and are the prevailing policy for encouraging renewable energy systems, in part because "feed-in mechanisms achieve larger deployment at lower costs" than other policy mechanisms such as quotas, direct incentives or voluntary goals.[11]

Before feed-in laws can be enacted, there needs to be a strong political will to support renewable energy systems, and the willingness to pay a premium to do so. With that is in place, there are a number of other key components to successful feed-in laws:

1. The right to connect easily to the grid for anyone who wants to produce renewable power.
2. A premium price paid to producers to ensure a decent business case that is tailored to recognize the differences in each renewable technology as well as in project location.
3. Long-term contracts to create stability in the market. They send a strong signal to manufacturers and installers to make long-term investments, which drive costs down.
4. A regular review of the program to ensure that tariffs are set appropriately, and that they are lowered regularly as costs decrease.
5. No cap, or limit, on the amount of renewable power that can be developed.

For continuously up-to-date information on the status of feed-in law around the world, see:

- www.wind-works.org/articles/feed_laws.html
- www.feed-in-cooperation.org
- www.onlinepact.org

Additional copies of this publication and its accompanying fact sheet may be downloaded from:

- re.pembina.org
- www.canrea.ca

[11] Stern Review on the Economics of Climate Change. 2006. Available at: www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm

Appendix A: Status of Feed-In Tariffs Across the World

This Appendix summarizes the key features of the feed-in tariff programs in the following countries:

1. Germany
2. France
3. Spain
4. Italy
5. Canada
6. United States

Much of the information contained here is based on the Ontario Sustainable Energy Association's 2007 publication, *Renewables Without Limits: Moving Ontario to Advanced Renewable Tariffs by Updating Ontario's Groundbreaking Standard Offer Program*, authored by Paul Gipe (www.wind-works.org). For more information about any of these programs, download the report at www.ontario-sea.org/pdf/RenewablesWithoutLimits.pdf.

1. Germany

First feed-in law: 1991 (*Stromeinspeisungsgesetz*, StrEG)

Updates: 2000, 2004 (*Erneuerbare Energien Gesetz*, EEG)

Notes (2007): 22,000 MW of wind capacity and more than 4,000 MW of solar photovoltaics.[12] New renewable energy systems provided 12.5% of the country's electricity by the year 2007, and Germany has become the world leader in both wind energy and solar PV technology.

Table 1: German Biogas Prices, 2007

Biogas	Years	€/kWh	$/kWh
<150kW	20	0.110	0.17
<500kW	20	0.095	0.15
<5MW	20	0.085	0.13
<20MW	20	0.080	0.12

Table 2: German Solar Tariffs, 2007

Solar Photovoltaic	Years	€/kWh	$/kWh
Freestanding	20	0.380	0.542
<30kW rooftop	20	0.492	0.703
<100kW rooftop	20	0.468	0.668
>100kW rooftop	20	0.463	0.661
Facade cladding <30kW	20	0.535	0.764
Facade cladding <100kW	20	0.511	0.730
Facade cladding >100kW	20	0.506	0.722

[12] German Ministry of Economics and Technology, www.german-renewable-energy.com

Table 3: German Geothermal Tariffs, 2007

Geothermal	Years	€/kWh	$/kWh
<5 MW	20	0.146	0.224
<10 MW	20	0.136	0.209
< 20MW	20	0.087	0.134
>20 MW	20	0.069	0.107

2. France

First feed-in law: 2001

Updates: 2005, 2006 (Loi de Programme fixant les Orientations de la Politique Energétique, POPE)

Notes (2007): France surpassed 2,450 MW of installed wind capacity in 2007. Nearly all of it was installed under the country's system of feed-in tariffs which was launched in 2001. France has set a target of 12,500 MW of wind energy installed on land by 2010.

Table 4: French Wind Energy Tariffs, 2007

Wind Energy	Years	Hours	Capacity Factor	€/kWh	$/kWh
Continental	1-5			0.082	0.126
Low	6-15	2,400	0.27	0.082	0.126
		2,500	0.29	0.079	0.121
		2,600	0.30	0.075	0.115
		2,700	0.31	0.072	0.110
Medium	6-15	2,800	0.32	0.068	0.105
		2,900	0.33	0.063	0.097
		3,000	0.34	0.058	0.089
		3,100	0.35	0.053	0.082
		3,200	0.37	0.048	0.074
		3,300	0.038	0.043	0.066
		3,400	0.039	0.038	0.058
		3,500	0.040	0.033	0.051
High	6-15	3,600	0.041	0.028	0.043

Table 5: French Solar PV Tariffs, 2007

Photovoltaics	Years	€/kWh	$/kWh
Base (All) *	20	0.300	0.428
Building Integrated	20	0.550	0.785
Region Rhone-Alps Incentive **	6	0.400	0.571

* Plus 50% tax credit on hardware costs up to €8.00
** For systems <2kW

Table 6: French Biogas Tariffs, 2007

Biogas	Years	€/kWh	$/kWh
<150kW	15	0.09	0.139
>150kW <2,000kW	15	Linear interpolation between high and low	
>2,000kW	15	0.086	0.132
Biogas Premium (on-farm methane)		0.02	0.031

3. Spain

First feed-in law: 1994

Updates: 1999, 2004, 2006

Notes (2007): Spain has installed more than 15,140 MW of wind capacity to become the world's second largest market.

The Spanish program is substantially different than that of most other countries with feed-in laws. Spain provides two options for renewable generators: a system of relatively fixed tariffs, and a system that couples the wholesale price with a bonus payment. In the relatively fixed system, the tariff is calculated every year as a percentage of the Average Electricity Tariff (AET). For example, generation from solar PV is paid 575% of the AET. In 2007, the AET was € 0.0733 per kWh ($0.113 per kWh), such that the PV tariff in 2007 was € 0.421 per kWh ($0.60 per kWh) for electricity from solar PV.[13]

4. Italy

First feed-in law: 2004

Updates: n/a

Notes (2007): 2,725 MW of wind power

Table 7: Italian Solar PV Tariffs, 2007

	Base	Total (€)*	Total ($)
Ground-Mounted	**€/kWh**	**€/kWh**	**$/kWh**
1-3kW	0.40	0.51	0.728
3-20kW	0.38	0.49	0.700
>20 kW systems	**€/kWh**	**€/kWh**	**$/kWh**
<500 MWh/yr	0.36	0.46	0.650
500-1,000 MWh/yr	0.36	0.44	0.628
>1,000 MWh/yr	0.36	0.43	0.614
Partial Building Integrated (rooftop)	**€/kWh**	**€/kWh**	**$/kWh**
1-3kW	0.44	0.55	0.785
3-20kW	0.42	0.53	0.757
>20 kW systems	**€/kWh**	**€/kWh**	**$/kWh**
<500 MWh/yr	0.40	0.50	0.707
500-1,000 MWh/yr	0.40	0.48	0.685
>1,000 MWh/yr	0.40	0.47	0.671
Building Integrated	**€/kWh**	**€/kWh**	**$/kWh**
1-3kW	0.49	0.60	0.857
3-20kW	0.46	0.57	0.814
>20 kW	**€/kWh**	**€/kWh**	**$/kWh**
<500 MWh/yr	0.44	0.54	0.764

*Base plus net-metering bonus

[13] New Spanish tariffs were introduced May 25, 2007. Solar PV tariffs were increased slightly to € 0.44 per kWh ($0.63 per kWh). See www.wind-works.org/FeedLaws/Spain/SpanishList.html (accessed July 19, 2007).

5. Canada

Ontario

First feed-in law: 2006

Updates: due in 2008

Notes (2007): Ontario's Standard Offer Contract (SOC) program is the first program to use some form of feed-in tariffs in North America, although given its institutionalized restrictions, it is not considered by most to be a true feed-in law. The program is summarized below along with specific modifications recommended by the Ontario Sustainable Energy Association (OSEA). For more information, see OSEA's *Renewables Without Limits* (2007).[14]

Table 8: OSEA SOC Program Policy Proposal Summary

	Current	Action Needed
Tariffs		
Solar PV	Tariff $0.42/kWh	Raise base tariff to $0.80/kWh
	No inflation adjustment	Add inflation adjustment
	Non-differentiated	Differentiate tariffs by size
		Grandfather existing contracts
On-farm Biogas	Tariff $0.11/kWh	Raise tariff to $0.17/kWh
	Non-differentiated	Differentiate tariffs by size
		Grandfather existing contracts
Proposed Changes for Completion by March 20, 2008 Review		
Tariffs		
Wind onshore	Tariff $0.11/kWh	Raise tariff to $0.148/kWh
	Non-differentiated	Differentiate tariffs by resource intensity
	Inflation adjustment 20%	Increase inflation adjustment to 60%
Wind offshore	Not included	Add base tariffs of $0.186/kWh
		Differentiate tariffs by resource intensity
Solar hot water	Not included	Add base tariff of $0.10-$0.20/kWh
		Differentiate tariffs by application
Geothermal	Not included	Add base tariff of $0.224/kWh

British Columbia

The government introduced an Energy Plan in 2007 which includes a standing offer for "clean" electricity projects of up to ten megawatts.

BC Hydro released draft rules and agreement for the SOC on June 20, 2007.[15] Under British Columbia's program, energy is purchased at a price of between $0.065 and $0.079 per kWh, depending on the location of the facility within the province. Projects that meet the EcoLogo clean energy guidelines receive a top-up of $0.0305 per kWh.[16]

[14] www.ontario-sea.org/policy.php

[15] www.bchydro.com/info/ipp/ipp51323.html

[16] www.environmentalchoice.com

6. United States

The World Future Council is mounting a feed-in tariff campaign in the United States under the title "Power to the People."[17] Bills to adopt feed-in tariffs are being drafted in several states, including Michigan, Illinois, Minnesota and California as well as in the U.S. Senate and the U.S. House of Representatives. Two states of particular note are Michigan and California.

Michigan

In September 2007, Michigan State Representative Kathleen Law introduced HB 5218 which calls for a full system of renewable tariffs modeled after those in Germany.[18] The bill was introduced with the goal to create new job opportunities in Michigan.

California

The California Energy Commission recommended that the state adopt feed-in tariffs to spur on renewable energy development. Its recommendations are contained within the Energy Commission's 2007 *Integrated Energy Policy Report*, which concluded in part that the state's current programs have failed to deliver significant amounts of new renewable energy generation and would not meet its renewable energy goals without corrective action.[19]

[17] www.worldfuturecouncil.org/action_kits.html

[18] www.legislature.mi.gov/(S(gx5ww1jybj5si4nxfutpuy45))/mileg.aspx?page=getObject&objectName=2007-HB-5218

[19] www.energy.ca.gov/2007_energypolicy/index.html

Appendix B: How Feed-In Tariffs are Set

This appendix provides information on the way governments set feed-in tariffs:

- how the actual prices paid under feed-in tariffs are determined;
- how feed-in tariffs differentiate by application, size, location, and by type of renewable resource;
- bonus payments for specific situations;
- inflation indexing; and
- degression (lowering) of tariffs over time to reflect cost reductions.

The information contained here is based on the Ontario Sustainable Energy Association's 2007 publication *Renewables Without Limits*, authored by Paul Gipe (www.wind-works.org) which can be downloaded at: www.ontario-sea.org/pdf/RenewablesWithoutLimits.pdf.

Tariff Determination

Tariffs are ultimately determined by a political process. In Germany, France and Spain, tariffs are set according to an estimate of the cost of production and an allowance for a reasonable profit:

- In Germany, the government hires consultants to conduct cost studies. The studies are then presented to stakeholder groups, and Parliament makes a determination on the tariffs.
- In France, the ADEME (Environment and Energy Management Agency) proposes revisions to the tariffs, as do stakeholders. The elected government seeks guidance from the Régie (the Energy Board) to make its final determination.
- In Spain, the process is similar to that in France for determining the base tariff, the multiplier and any bonus payments that apply.

Feed-in tariffs for solar PV in Germany and France are significantly greater than the retail rate for electricity and are set independently of retail rates and therefore do not vary with changing retail conditions.

There is no connection between retail rates and any of the tariffs for renewable energy in Germany, France or Italy. In order to determine the feed-in rate in these countries, they estimate what it costs to generate electricity from each renewable technology. Once the tariff needed is determined, the price is indexed to the average electricity tariff, thus linking to any increase in the price of electricity.

Tariff Differentiation

Tariffs can be differentiated within each technology by size, application, location or resource quality. Differentiation encourages a wide range of technology applications, thereby maximizing diversity. For example, solar PV integrated into a building receives one tariff, while the same panels installed on a roof receive another, and those installed on the ground might receive yet another.

Differentiation by Application

Tariffs are thus used not only to reflect the costs of generation but also to fulfill other societal objectives. Germany, for example, has comparatively higher tariffs for solar panels on rooftops than on the ground in order to encourage people to use roof space.

Table 9: German Solar Tariffs, 2007

Solar Photovoltaic	Years	€/kWh	$ /kWh
Freestanding	20	0.380	0.542
<30kW rooftop	20	0.492	0.703
<100kW rooftop	20	0.468	0.668
>100kW rooftop	20	0.463	0.661
Facade cladding <30kW	20	0.535	0.764
Facade cladding <100kW	20	0.511	0.730
Facade cladding >100kW	20	0.506	0.722

Differentiation by Size

Tariffs can also be varied by size to encourage small projects. Small projects may not be profitable with tariffs that are set based on larger projects that benefit from economies of scale. Again, Germany's program serves as a good example: there, generation from biogas declines stepwise for projects larger than 150 kW.

Table 10: German Biogas Tariffs, 2007

Biogas	Years	€/kWh	$ /kWh
<150kW	20	0.110	0.17
<500kW	20	0.095	0.15
<5MW	20	0.085	0.13
<20MW	20	0.080	0.12

Differentiation by Location

Tariff rates can also be varied to encourage the development of technologies in regions that would otherwise be more difficult to develop for logistic reasons such as offshore wind. In the Canada, for example, Arctic or First Nation communities might be good candidates for a differentiated tariff. Differentiation by location ensures that projects are accessible across the jurisdiction. Greece differentiates its tariffs for projects located on the mainland from those located on the Greek islands.

Table 11: Greek Solar Tariffs, 2007

Solar Thermal	Years	€/kWh	$ /kWh
<5MW Mainland	20	0.25	0.385
<5MW Islands	20	0.27	0.416
>5MW Mainland	20	0.23	0.354
>5MW Islands	20	0.25	0.385

Differentiation by Resource

Differentiating a tariff by resource intensity helps to ensure that projects are located throughout the country or province and not concentrated only in the windiest and sunniest locations. This type of differentiation helps increase the accessibility to development and the volume of projects that can be developed. Dispersed projects minimize fluctuations in generation due to resource

variability. They also reduce the impacts and upgrades required to the local grid in any one part of the country or province, while spreading development across the landscape.

France, for example, uses a mechanism for determining site productivity which is based on a trial period after which the productivity and the subsequent tariff are determined.

Table 12: French Wind Energy Tariffs, 2007

Wind Energy	Years	Hours	Capacity Factor	€/kWh	$/kWh
Continental	1-5			0.082	0.126
Low	6-15	2,400	0.27	0.082	0.126
		2,500	0.29	0.079	0.121
		2,600	0.30	0.075	0.115
		2,700	0.31	0.072	0.110
Medium	6-15	2,800	0.32	0.068	0.105
		2,900	0.33	0.063	0.097
		3,000	0.34	0.058	0.089
		3,100	0.35	0.053	0.082
		3,200	0.37	0.048	0.074
		3,300	0.038	0.043	0.066
		3,400	0.039	0.038	0.058
		3,500	0.040	0.033	0.051
High	6-15	3,600	0.041	0.028	0.043

Resource differentiated tariffs also help to:

- Reduce (but not eliminate) development pressure on the windiest sites.
- Reduce (but not eliminate) social friction by spreading development among many sites.
- Increase program flexibility by lessening pressure to get prices exactly right the first time.
- Reduce development risk by tailoring the tariff to meet actual production.
- Enable fair profits at medium wind sites while limiting excessive profits at windy sites.

Bonus Payments and Short-term Flexibility

Bonus payments can be used to help encourage a specific type of technological innovation. In France, on-farm biogas generation receives bonus payments for the environmental benefits associated with reducing the field application of animal wastes (manure).

Table 13: French Biogas Tariffs, 2007

Biogas	Years	€/kWh	$/kWh
<150kW	15	0.09	0.139
>150kW <2,000kW	15	Linear interpolation between high and low	
>2,000kW	15	0.086	0.132
Biogas Premium (on-farm methane)		0.02	0.031

Similarly, when the French wanted to stimulate greater solar PV development, they faced a political obstacle to raising the new base tariff of $0.46 per kWh any higher. The French chose to use a bonus payment instead. By including a bonus payment of € 0.25 per kWh for building integrated solar PV, they were able to raise total tariffs for solar PV to € 0.55 per kWh ($0.85 per kWh). As a result, the new French tariffs became competitive with those in Germany.

Table 14: French Solar PV Tariffs, 2007

Photovoltaics	Years	€/kWh	$/kWh
Continental (Metropolitan)			
Base (All) *	20	0.300	0.428
Building Integrated	20	0.550	0.785
Region Rhone-Alps Incentive **	6	0.400	0.571

* Plus 50% tax credit on hardware costs up to € 8.00
** For systems <2kW

Inflation Indexing

Tariffs can also be indexed to account for inflation of operations and maintenance costs. Programs in Germany and Spain represent two extreme responses to inflation. Germany's EEG does not account for inflation and actually includes an annual degression in the tariff for new projects. Until recently, the tariffs in Spain increased exactly alongside the inflation in electricity prices under the fixed-tariff option. France operates in between Germany and Spain by having the tariff increase with 70% of inflation.

Tariff Degression

For technologies with rapidly falling costs, such as solar PV, tariff degression offers authorities a means for stimulating development while warding against potentially overpaying for the technology.

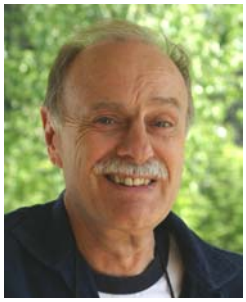
France and Germany, for example, incorporates price degression in each succeeding year of their programs. That is, each project receives the same price from one year to the next after the project is connected, but in each succeeding year new projects receive a lower price.

For example, solar tariffs in the German program start with the highest price and degress, or decrease, the most rapidly. Tariffs for solar PV decrease 5% per year. In 2004, Germany paid € 0.574 per kWh for solar PV; in 2005 it paid €0.545 per kWh; by 2007, it was paying only € 0.492 per kWh.

Similarly with wind energy, German tariffs decrease 2% annually, as do those in France.

About the Authors

Roger Peters, M.Eng, P.Eng.



ROGER PETERS is a professional chemical and environmental engineer with 30 years experience in energy efficiency and renewable energy. At the Pembina Institute, Roger guides the organization's work on national renewable energy and energy efficiency policy, and has authored several reports on the innovative financing of energy efficiency improvements. He has also gained substantial expertise on climate change, providing assessments and technical assistance to project developers on the use of the Clean Development Mechanism (CDM) and other sources of carbon financing. Roger has significant international experience in Asia, Latin America and Africa, with projects on energy efficiency and rural energy funded by the World Bank, the Global Environmental Facility and the Canadian International Development Agency (CIDA).

Tim Weis, M.Sc., P.Eng.

TIM WEIS is a senior technical and policy analyst who has focused his technical research with the Pembina Institute on renewable energy. Tim has co-authored numerous reports and manuals on renewable energy development in First Nations communities. He has developed software to complete community energy baseline inventories and has assisted more than 20 communities at various stages of development of renewable energy projects. Tim is also currently completing his PhD at the Université du Québec à Rimouski where he studies wind energy development in remote Canadian communities. Tim has a Master of Mechanical Engineering degree where he studied ice adhesion to wind turbine blades.

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About the Pembina Institute

The Pembina Institute creates sustainable energy solutions through research, education, consulting and advocacy. It promotes environmental, social and economic sustainability in the public interest by developing practical solutions for communities, individuals, governments and businesses. The Pembina Institute provides policy research leadership and education on climate change, energy issues, green economics, energy efficiency and conservation, renewable energy, and environmental governance. More information about the Pembina Institute is available at www.pembina.org or by contacting info@pembina.org.

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