# FEED-IN TARIFF CASE STUDIES

## A White Paper in Support of
## The Hawaii Clean Energy Initiative

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# EXECUTIVE SUMMARY

This white paper detailing case studies from Europe, Canada, and the United States is provided to supply the Hawaii Clean Energy Initiative HCEI with background material on Feed-in Tariffs (FITs), a support mechanism for renewable energy (RE). Experience shows that successful RE support mechanisms must include two complementary measures:

1) Interconnection requirements that assure timely and fair access to the grid and;
2) Price mechanisms that contribute to revenue certainty and profitability.

There are two major types of renewable support mechanisms: quota systems such as renewable portfolio standards (RPS), and price systems such as FITs. FITs were first started in Germany around 1990, spreading regionally to other European countries (in 2008, some 16 European Union countries had a form of FIT, including Spain, Denmark, and Portugal) then westward across the Atlantic to at least two provinces of Canada (Ontario and British Columbia) and then southerly to a handful of American states, starting with California. FITs can work with RPSs if the latter are set as a quota, or goal, of RE penetration while the FITs act as more of an implementation tool.

FITs have evolved over time and benefit from innovation applied in diverse jurisdictions. There are several key features and findings to note:

- Successful FITs are not static. They are updated from time to time based on a learning curve and local experience of administrators, generators, and utilities. Germany repeatedly revised their FITs to reflect changes in RE production costs. In Spain, fixed price tariffs will be revised every four years taking into account whether goals have been met for different types of RE. Honing FITs provide additional consumer benefits though, to be successful, care must be taken so that financial disruptions and uncertainty are avoided.
- FITs prices started off as a %age retail electricity costs, however, as of 2008, Germany's RESA tariffs and most "smart FITs" are calculated by the cost of generation plus a profit. In Portugal, the electricity price received by the generator is a factor of annual hour produced, taking into account less windy and more windy sites for example.
- Today, tariffs are typically reduced annually to account for mastering the "experience curve." This is particularly applicable to Hawaii where fossil generation costs generally run higher than non-fuel, RE generation.
- Jurisdictions most often include priority grid access and priority electricity purchase provisions to ensure utilities cannot control, and thus limit, RE access.

According to World Future Council (WFC), the essential elements of a FIT policy include:

- Access, including the issues of interconnect, grid upgrades, transparency, and who pays for interconnection;
- Price (the tariffs), including the issues of technologies governed, priority of purchase, determining the right price, and how to pay for it; and

- "Supplementary objectives" including the issues such as meeting RE targets, progress reports, local content or local ownership requirements, and reducing administrative barriers.

In late 2005 a European Commission report found that FITs were currently cheaper and more effective than quota support systems in Europe, especially in the case of wind energy, at least in part because FITs reduced the risk to RE investors. This may not be the case everywhere, but a well design FIT is a competitive method of effectively and *cost*-effectively enabling RE while also providing consumer benefit.

Well designed FITs can provide superior penetration of RE at a seemingly reasonable cost. With wind, solar, biomass and other RE capacity, Germany in 2006 derived 14.2 % of its electricity from RE sources—at a cost of 3-5% increase in electric rates to consumers.

FITs can work with complementary support system components. California Assembly Bill (AB) 1969 of 2006 established a FIT for systems with a capacity of 1.5 MW and below, capped at 250 MW total statewide. Generators can choose 10-, 15-, or 20-year contracts, and can opt to sell either 100% of their power, or offset their retail load and sell only their excess electricity.

In summary, FITs have a long and relatively successful history and track record. As with any policy it must be well designed and adjusted to properly achieve its goals. High penetrations of RE and consumer value are achievable attributes of FIT schemes.

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# PART I. RENEWABLE ENERGY SUPPORT MECHANISMS

Since the energy crises of the 1970s, and with a more recent and growing concern over energy surety and global warming, many countries are interested in developing renewable energy (RE) technologies for electricity generation. Support mechanisms may be needed for some RE technologies to be cost-competitive with conventional fossil energy since it already benefits from indirect subsidies such as railway systems (coal), the defense of energy supply and delivery infrastructure (oil), etc.[1]

RE support mechanism must include two measures:

1. Interconnection to the grid, and a
2. Price for the electricity produced that contributes to profitability.

A valuable lesson learned about the necessity of both support mechanism measures comes from America's experience with the Public Utility Regulatory Policy Act (PURPA) of 1978 when President Carter told Americans that the energy crisis was "a clear and present danger to our nation" and drew out a plan to address it. The purpose of this law was to encourage energy conservation and to develop RE as national resources.

PURPA provided the first RE support mechanism requirement—interconnection—but failed to provide the second RE support mechanism—a price that would contribute to profitability**.** The general consensus is that PURPA was a failed policy; Independent Power Producers (IPPs) did not have sufficient leverage to negotiate favorable RE prices with the entrenched investor-owned electric utilities (IOUs). The California Public Utility Commission changed the equation in the early 1980's when it ordered the state's IOUs to offer standardized contracts to IPPs which provided favorable fixed tariffs for RE generation.[2] Over time these prices advantages were eroded by utilities until most contract prices were variable and determined by the price of natural gas.

Today, there are generally two major classes of RE support mechanisms:

1. Quota systems—such as a Renewable Portfolio Standard (RPS)—favor large, vertically integrated generators and multinational electric utilities, and are more difficult to design and implement than Price systems; and
2. Price systems—in the form "Renewable Tariffs," "Feed Laws," "Feed-In Tariffs," or "Advanced Renewable Tariffs"—depending on country, province or state—have a fairly successful and consistent record of offering equitable opportunity to all willing participants, regardless of size or business, in the market and stimulating rapid rates of growth.

1 ASSESSING THE COSTS OF ELECTRICITY, 2004, Dan Kammen
2 *Renewable Energy Policy Mechanisms*, Feb. 17, 2006, Wind Works

## A. Renewable Portfolio Standards—A *Quota* Support Mechanism

Renewable Portfolio Standards (RPSs) are Quota support mechanisms which require RE suppliers to deliver to consumers a portion of their electricity from RE sources by collecting tradable Renewable Energy Credits (RECs). The RPS support mechanism is a market-driven policy that ensures that a minimum amount of renewable energy is included in the portfolio of electricity resources serving a state or country. Because it is a market standard, the RPS relies almost entirely on the private market for its implementation, presumably resulting in greater competition, efficiency and innovation in delivering RE at the lowest possible cost.[3]

Renewable Energy Credits (RECs)—tradable certificates of proof that one kWh of electricity has been generated by a renewable-fueled source—are central to the RPS. RECs are denominated in kilowatt-hours (kWh) or megawatt –hours (MWh) and are a separate commodity from the power itself. The RPS requires all electricity suppliers to demonstrate, through ownership of RECs, that they have supported an amount of renewable energy generation equivalent to some %age of their total annual kWh sales.[4]

Currently there are 27 states plus the District of Columbia that have RPS policies in place. Four of these states have voluntarily rather than mandatory goals. Together these states account for more than 42% of the electricity sales in the United States.[5]

Although it is projected that RPS policies will require the development of over 60 gigawatts of renewable sources by 2025, this will only account for 15% of projected electricity demand growth in that year.[6] These gains are modest in comparison to the scenarios and potential for RE market growth[7] and job creation[8] that have been recommended by experts and industry organizations during the past few years. It is also worth noting that RPS mechanisms have tended to be most successful in stimulating new RE capacity in the United States where they have been used in combination with federal Production Tax Credits (PTCs). In periods where PTCs have expired, the RPS alone has often proven to be insufficient stimulus to stimulate large volumes of capacity.[9]

In order to meet increasingly aggressive environmental and economic development goals, US policy makers are looking at new ways to accelerate renewable energy market growth. Among the policy mechanisms emerging in the U.S. that are being considered are feed-in tariffs[10] which are being widely used in the European Union to help it reach its target for countries to generate 12.5 % of electricity from RE sources by 2010.

3 http://www.awea.org/policy/rpsbrief.html
4 http://www.awea.org/policy/rpsbrief.html
5 http://www.eere.energy.gov/states/maps/renewable_portfolio_states.cfm
6 Wiser and Barbose, 2008
7 American Council on Renewable Energy, 2007
8 Bezdek, 2007; Inslee and Hendricks, 2008
9 http://en.wikipedia.org/wiki/Renewable_Portfolio_Standard
10 http://onlinepact.org/fileadmin/user_upload/PACT/Misc/Feed-in_Tariffs_and_Renewable_Energy_in_the_USA_-_a_Policy_Update.pdf

## B. Feed-In Tariffs—a *Price* Support Mechanism

Feed-In Tariffs (FITs) are support mechanisms based on prices per unit of electricity that a utility or supplier has to pay for RE from independent generators.[11] The government regulates the tariff rate. Feed-in payments are regular grid power charges enhanced by mandatory price supports; no government funding is employed. Costs are shared equitably by all grid customers since utilities can pass those costs to rate payers regardless of their own participation in RE generation. In a key provision of FITs, the utility is obliged to connect RE power plants to their grid at any connection point that is technically and economically suitable—a concept that switches the "burden of proof" from the independent RE generator to the utility.

FITs (also known as "Feed Laws," "Electricity Feed Laws," or "Renewable Tariffs" e.g. in Europe;" "Advanced Renewable Tariffs," e.g. in Canada; or "Renewable Energy Payments" e.g. in the U.S.) were first used in European countries such as Germany, France, and Spain, and over time became more sophisticated by customizing the tariffs to RE resources, technologies, production, etc.

Under the German FIT legislation, RE technologies are guaranteed interconnection with the electricity grid, and are paid a premium rate that is designed to generate a reasonable profit for investors over a 20-year term. Tariffs are differentiated by technology such that each renewable resource type (e.g. solar, wind, biomass, etc.) can profitably be developed. This approach stands in contrast to the Public Utilities Regulatory Act (PURPA) in the US, under which long-term contracts are based on the avoided cost of conventional fuels. A portion of the German feed-in tariff rates decrease each year to allow for advancement in technology over time.[12]

"Advanced Renewable Tariffs" (ARTs) such as those used in some European countries are the modern version of FITs. ARTs differ from the simpler feed-in tariffs by:

- Technology
- Project size
- Resource productivity
- Periodic review period [13]

Below, in PART II, are case studies from Europe that detail the evolution of FITs in roughly chronological order, in the following geographical pattern:

- Starting in Germany around 1990, spreading regionally to other European countries (in 2008, some 16 European Union countries had a form of RT, including Spain, Denmark, and Portugal);
- Westward across the Atlantic to at least two provinces of Canada (Ontario and British Columbia);
- Then southerly to a handful of American states, starting with California.

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11 http://glossary.eea.europa.eu/EEAGlossary/F/feed-in_tariff
12 http://onlinepact.org/fileadmin/user_upload/PACT/Misc/Feed-in_Tariffs_and_Renewable_Energy_in_the_USA_-_a_Policy_Update.pdf
13 http://www.wind-works.org/articles/feed_laws.html#What%20are%20ARTs%20or%20FITs?

FIT case studies from Europe, Canada, and the U.S. follow. Special emphases will be given to the "pioneering" country of Germany and the state of California.

# PART II. EUROPEAN FEED-IN TARIFF CASE STUDIES

Europe has been aggressive and successful in incenting RE via FITs for various reasons; a few will be noted here. Like America, Europe was gripped by the oil crises of the 1970's, as well as the Chernobyl catastrophe of 1986. Even greater radioactive fallout was experienced in parts of France than in Germany, however, but national defense strategy there included nuclear weapons and atomic power in an ancillary role, keeping RE out of the picture for quite some time.[14]

Unlike America, Germany experienced a blow to its national psyche as it witnessed the partial destruction—from acid rain—of its treasured Black Forest in the 1980's. The effects of acid rain from coal combustion on Europe's forest lands were noticed in the 1960's but the connection to sulfuric acid was not identified until the late 1970's. Following 1980, more damage of forests was observed in Central Europe with the harshest damage occurring in the former Eastern block countries. The situation was somewhat better in Germany, since many trees were sick, but only relatively few had died. By 1983, nevertheless, 30 to 40 % of all conifers showed symptoms of disease.[15] The development was particularly disturbing in Germany's Black Forest—covering one-third of West Germany and celebrated in the work of Wagner, Goethe, Brecht and the Brothers Grimm—which is considered to be 40 % "damaged" in 2004.[16]

More recently, Europeans appear to be more concerned with their dependence on fossil fuels, resultant global warming, and the threat of terrorism from unstable countries.

In reaction to some of these pressures, in late 2005 the European Commission adopted a report on the different support mechanism to incent RE which concluded that European Union (EU) governments needed to step up efforts to cooperate among themselves optimize their supports and remove administrative and grid barriers for green electricity. To remove those barriers, the Commission recommended that administrative requirements be reduced, emphasizing that clear guidelines, one-stop authorization agencies, pre-planning mechanisms and simpler procedures were needed. Transparent and non-discriminatory grid access must be ensured and necessary grid infrastructure development should be undertaken, with the associated costs covered by grid operators.

The report also found that FITs were currently cheaper and more effective than quota support systems such as RPSs, especially in the case of wind energy. One reason for quota systems being more expensive is probably the higher risk for investors due to the volatility in green electricity markets, the report finds.

20 countries in Europe currently use some form of FITs, including Germany, Spain, Denmark, Portugal, Switzerland, Greece, Turkey, France, Ireland, Italy, the Czech Republic, and The Netherlands. The Index of this document includes a chart on Levels and Duration of FITs in Europe.

14 Jeffrey Michel correspondence with author
15 http://www.biologie.uni-hamburg.de/b-online/e55/55a.htm
16 http://www.dw-world.de/dw/article/0,2144,1439662,00.html

Germany was a pioneer in FIT development, and several other European countries and two Canadian provinces adapted the German FIT model for their own purposes and goals. Select, illustrative European FIT models are detailed below with a special emphasis on Germany.

## A. Germany

### *Background*

FITs in Germany have evolved in complexity, and some energy experts may say appropriateness, over time, starting in 1990. The German model of FITs began in 1990 ("Stromeinspeisungsgesetz"),[8] was refined in 2000 ("Erneuerbare-Energien-Gesetz") and has been further refined in 2008.

- 1991: German Electricity Feed-In Law introduced early version in 1991 that required utilities to buy renewable power at 90 % of the retail rate for electricity.[17] A second aspect of this earlier approach was that each utility was required to provide full compensation for the feed-in of renewable power within its service area. This provision was obviously to the disadvantage of those utilities with a lot of wind, because they were paying far more than anyone else.[18]
- 2000: Germany passed the *Renewable Energy Law (REL)*, which set specific prices that independent renewable power producers could receive for each renewable energy source, although for a limited amount of time. The REL dictated that the costs of grid connection for RE projects are the responsibility of the utility, which can pass the costs on to consumers. The REL also dictated the rates paid by utilities when purchasing renewable generation and can more precisely target RE tariff by technology, the support necessary to make it competitive in the market varies. [19] FITs paid to producers constituted 3% of total power expenses invoiced to private households in 2006, with a similar number for 2007.[20]
- A 2004 law amended the FIT to introduce the provision that priority was to be given to electricity generated from RE sources; priority connections to grid systems must be given to such plants. The RE electricity generated was to be purchased, transmitted and paid for by the grid system operators as a priority. When the grid is operating at full capacity, conventional power stations must at times reduce their electricity production. The grid system operators also had to immediately expand their grids in line with the expansion of RE.[21]
- In July 2007, Germany's Ministry for the Environment issued revised rules for the country's groundbreaking *Renewable Energy Sources Act* (RESA). The RE sources for which the new law provides compensation payments that cannot otherwise be obtained at lower prices in the needed scale. Significantly increase the tariffs for offshore wind energy, hydroelectricity, and geothermal energy beginning in 2009; they also increased the tariff for wind energy on land.

17 *Renewable Energy Policy and Politics*, p. 55.
18 Jeffrey Michel, in correspondence with author.
19 Ibid, p. 11-14
20 Paul Gipe
21 EEG – THE RENEWABLE ENERGY SOURCES ACT

- As of 2008, Germany's RESA tariffs are calculated by the cost of generation plus a profit.[22]

Actual FIT payment levels were repeatedly revised to reflect changes in RE production costs. The German system for wind was adapted to allow for price reductions due to technological advances, but also price increases for developers installing wind projects on less windy sites. In this case, the driver was adapted to incorporate the objective of geographical diversity for wind development.[23]

Tariffs are typically reduced 1-5% annually to account for mastering the "experience curve." The graph at right illustrates an example the development of the experience curve of wind turbines as a relation between the cumulative installed capacity and the specific price of wind turbines expressed in € Cents/kWh. Depending on the type of RE technology, the FITs for new installations decrease by 1% for small hydro plants up to 5% for building integrated PV systems, adjusted as needed to meet goals.

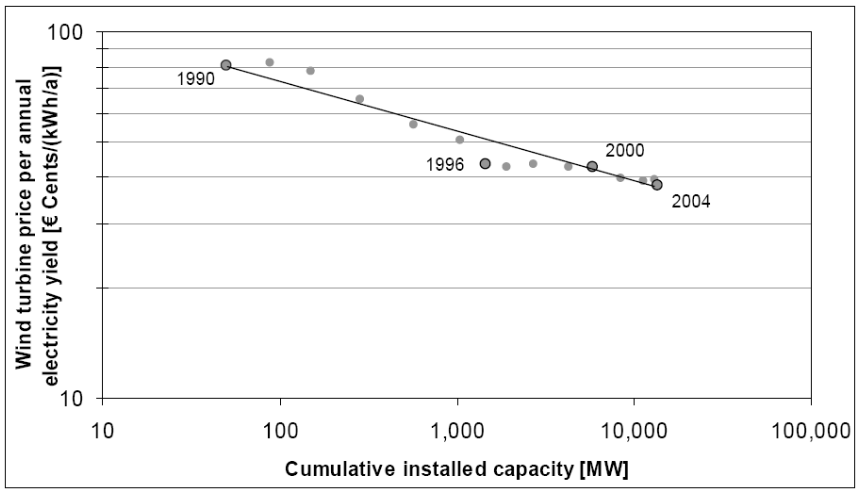
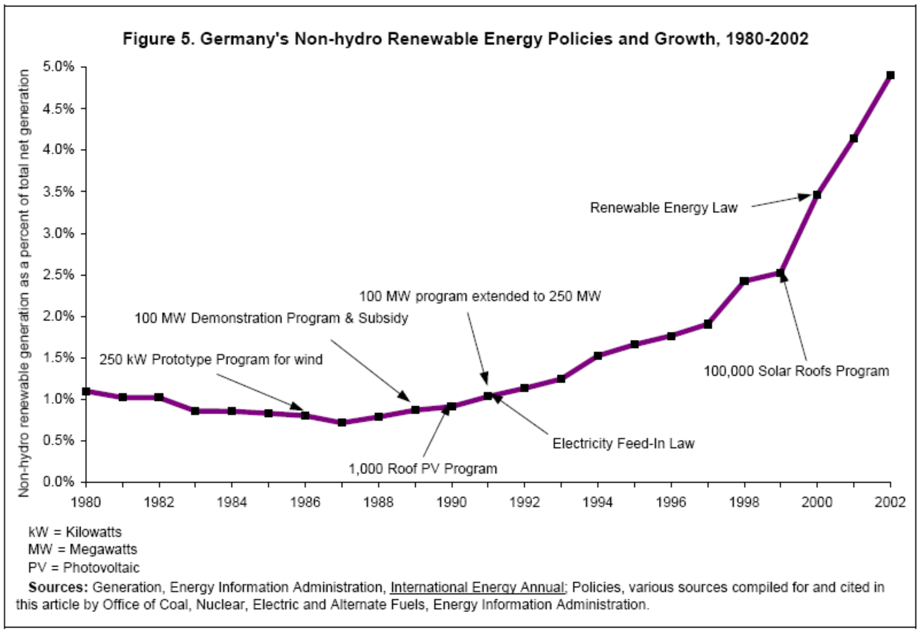



**Figure 3.15: Experience curve of onshore wind turbines in Germany**

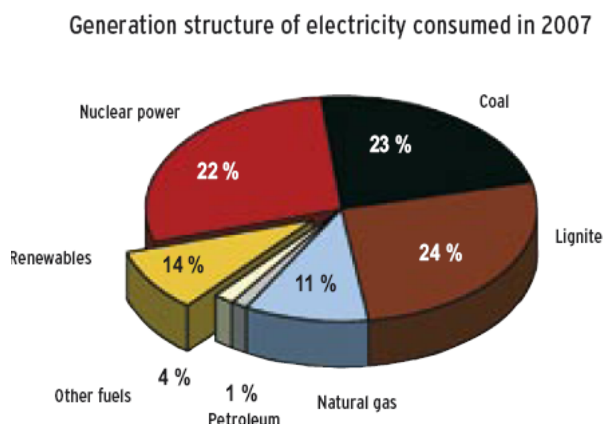
22 Paul Gipe communication with author
23 *Renewable Energy Policy and Politics*, p. 42.

***Results***

The chart at right shows RE penetration levels as certain FIT legislation passed. There's an obvious upward trend starting in the 1990s as the Feed-In Law and the Renewable Energy Law were passed.




In 2007, Germany had achieved 14% electricity generation from RE, as seen at right, according to a 2008 report from the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). [24] The BMU report also notes that the proportion of household electricity prices due to the FIT is currently about 5%, and this is not likely to show any marked increase in the future.




An interesting comparison of PV penetration can be seen from Germany as compared to California. Between 1996 and December 31, 2006, Californians placed 198 MW of PV systems on the roofs of their homes, businesses, government, and schools; in the same period, Germany installed 2700 MW of PV capacity using enhanced FITs. The RE generated by these installations rose 60 % in 2007 compared with 2006. This achievement is underscored by the fact that Germany gets an average of only 1,528 hours of sunshine a year, comparable to London's but one-third fewer sunshine hours than in Florence, and only half of San Diego's.

Germany has seen other benefits from this increasing RE penetration, including:

24 *Electricity from Renewable Sources: What Does It Cost Us?*, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2008.

- An increase in the number of people employed in the RE sector, increasing to more than 230,000; of these, 130,000 jobs can be directly attributed to the country's FIT.[25]
- German RE businesses are leading the world, and in 2006 had a global market share of 15%. Investments in electricity-generating equipment from Germany can increase from 9 billion euros (2005) to an estimated 20 billion euros in 2020.[26]
- By 2006, 45 million tons of $CO_2$ had been saved, with avoided external costs of around 3.4 billion euros which would have arisen if the electricity had been generated by fossil fuel power stations from coal, gas or oil.[27]
- As a result of the associated economies of scale and the global competition initiated among manufacturers, production costs have been reduced by 50 per cent since 1991.[28]

Stability of support may be considered the key ingredient in the success of the earlier German Electricity Feed-In Law, which remained largely unchanged for 10 years. The FITs are guaranteed over a sufficient period (usually 20 years) to insure cost recovery, avoiding the boom-bust cycles of the American RE industry caused by an inconsistency in the Federal Production Tax Credit.[29]

## B. Spain

### *Background*

Recent (2005-2006) Spanish FIT payments focused primarily on wind energy, and were set at between 80% and 90% of an "average reference tariff," with progressive wind pricing options paying 7.2 eurocents/kWh in 2005 that were fixed annually. Bilateral sales to distributors were set at the following levels:

- 90% of the average reference tariff (6.5 eurocents/kWh in 2005) for the first three years
- 85% of the average reference tariff for the next ten years
- 80% of the average reference tariff for remaining project life

A market sales option was also available, which set a market price plus a subsidy based on average reference tariff and additional market incentive. The subsidy was set at 2.9 eurocents/kWh in 2005 (40% of the average reference tariff); and the market incentive: 0.72 eurocents/kWh in 2005 (10% of the average reference tariff).[30]

In May 2007, Spanish ministers approved a new set of rules for RE, curbing profits for wind generators and setting incentives for other types of RE to boost their development.

25 EEG – THE RENEWABLE ENERGY SOURCES ACT
26 EEG – THE RENEWABLE ENERGY SOURCES ACT
27 EEG – THE RENEWABLE ENERGY SOURCES ACT
28 http://www.bmu.de/english/publication/publ/40067.php
29 *Renewable Energy Policy and Politics*, p. 55.
30 California Energy Commission IEPR Workshop Sacramento, Kevin Porter. Exeter Associates, Inc., August 22, 2006

- The new rules guarantee a return of 7 % to wind and hydroelectric plants that opt to sell power to distributors direct and a return of between 5 and 9 % if they participate in the electricity pool market.
- Larger solar power installations will receive a payment and a targeted return of 7 %, while those under 100 kW ones will stay the same.
- RE technologies such as biomass, biogas and concentrating solar power (CSP), which need a special impetus, will receive higher returns of 8 % if their production goes direct to distributors and between 7 and 11 % in the pool. New wind power parks will have to be built to withstand falls in tension in the grid without automatically disconnecting.
- Tariffs for PV, of €0.44/kWh; coupled with the higher insolation of Spain in comparison to Germany, will put Spanish PV incentives on a par with those in Germany.

| **Renewable Tariffs in Spain** | | | | |
|---|---|---|---|---|
| May 25, 2007, Royal Decrees 661/2007 for RES <50 MW | | | | |
| | Years | | 1.43853 | 1.34658 |
| | | €/kWh | CAD/kWh | USD/kWh |
| Wind Onshore | 20 | 0.073 | 0.105 | 0.099 |
| | +20 | 0.061 | 0.088 | 0.082 |
| Wind Offshoe | | | | |
| Photovoltaics | | | | |
| <100 kW | 25 | 0.440 | 0.634 | 0.593 |
| | +25 | 0.352 | 0.507 | 0.474 |
| >100 kW<10 MW | 25 | 0.418 | 0.601 | 0.562 |
| | +25 | 0.334 | 0.480 | 0.450 |
| >10 MW<50 MW | 25 | 0.230 | 0.331 | 0.309 |
| | +25 | 0.184 | 0.264 | 0.248 |
| Solar Thermal | 25 | 0.269 | 0.388 | 0.363 |
| | +25 | 0.215 | 0.310 | 0.290 |
| Geothermal, Wave, & Ocean Thermal | 20 | 0.069 | 0.099 | 0.093 |
| | +20 | 0.065 | 0.094 | 0.088 |
| Hydro | | | | |
| <10 MW | 25 | 0.078 | 0.112 | 0.105 |
| | +25 | 0.070 | 0.101 | 0.095 |
| >10 MW<50 MW | 25 | n/a | | |
| | +25 | n/a | | |
| Biomass | | | | |
| Energy Crops | | | | |
| <2 MW | 15 | 0.159 | 0.229 | 0.214 |
| | +15 | 0.118 | 0.170 | 0.159 |
| >2 MW | 15 | 0.147 | 0.211 | 0.197 |
| | +15 | 0.123 | 0.178 | 0.166 |
| Residual Ag Wastes | | | | |
| <2 MW | 15 | 0.126 | 0.181 | 0.169 |
| | +15 | 0.085 | 0.122 | 0.114 |
| >2 MW | 15 | 0.108 | 0.155 | 0.145 |
| | +15 | 0.081 | 0.116 | 0.109 |
| Forestry Wastes | | | | |
| <2 MW | 15 | 0.126 | 0.181 | 0.169 |
| | +15 | 0.085 | 0.122 | 0.114 |
| >2 MW | 15 | 0.118 | 0.170 | 0.159 |
| | +15 | 0.081 | 0.116 | 0.109 |
| Landfill gas | 15 | 0.080 | 0.115 | 0.108 |
| | +15 | 0.065 | 0.094 | 0.088 |
| Biodigester gas | | | | |
| <500 kW | 15 | 0.131 | 0.188 | 0.176 |
| | +15 | 0.065 | 0.094 | 0.088 |
| >500 kW | 15 | 0.097 | 0.139 | 0.130 |
| | +15 | 0.065 | 0.094 | 0.088 |
| Biomass liquids | 15 | 0.054 | 0.077 | 0.072 |
| | +15 | 0.054 | 0.077 | 0.072 |

New fixed price tariffs will be revised every four years taking into account whether goals have been met for different types of RE.

***Results***

From 2005-2006, Spain's FITs were responsible for a rapid growth in wind power, with wind supplying 9% of Spain's electricity consumption.[31]

In May 2007, Spanish ministers approved a new set of rules for RE, curbing profits for wind generators and setting incentives for other types of RE (hydro, CSP, PV, hydro, biomass, etc.) to boost their development and diversify Spain's RE generation portfolio.

31 http://en.wikipedia.org/wiki/Feed-in_Tariff

## C. Portugal

### *Background*

Despite the deployment of wind energy in some European countries in the mid eighties, the production of wind electricity in Portugal remained small and nearly unchanged until the mid 1990's. With RE (particularly wind in this country) technology coming to a more developed stage, and with RE-enabling national policies passed, a more supportive legal and financial framework for wind energy was put in place. Besides regulating and facilitating the access to power production by independent power producers, the price paid for RE was primed, thus creating a more attractive framework for market to grow on.

The evolution of Portugal's FIT follows:

- The revision of the FIT that was first established in 1988 played a key role in this market growth. This instrument is part of the Portuguese energy policy, for an increased use of national indigenous resources, thus improving security of supply and reducing GHG emissions.[32] Tariffs where then undifferentiated to all RE.
- In 1995, D.L. 186/95 and D.L. 313/95 introduced an autonomous regime for RE generation as part of the National Electrical System. Later, D.L. 168/99 introduced a complete change in the feed-in tariffs (increasing the price paid for RE), reorganized the regulatory process and changed the access mechanisms to grid connection. There was a general increase in the tariff, common to all RE technologies.
- In 2001, D.L. 339-C/2001 performed a further adjustment in the formulation that determines the feed-in tariff by introducing a coefficient Z that affects the environmental parcel differently according to the RE technology (see table below).

**Table I – *Prices range for the feed-in tariff according to the type of technology***

| *RES* | *Specification* | *Coef. Z* | *Feed-in tariff (EUR/MWh)* | |
|---|---|---|---|---|
| | | | *Minimum* | *Maximum* |
| Wind | Below 2000 h | 1,70 | 52 | 100 |
| | 2000 to 2200 h | 1,30 | 44 | 85 |
| | 2200 to 2400 h | 0,95 | 38 | 72 |
| | 2400 to 2600 h | 0,65 | 32 | 60 |
| | Above 2600 h | 0,40 | 26 | 52 |
| Solar PV | > 5 kWp | 6,35 | 150 | 285 |
| | < 5 kWp | 12,00 | 255 | 465 |
| Small hydro | | 1,20 | 42 | 82 |
| Wave energy | | 6,35 | 145 | 280 |
| Other | | 1,00 | 40 | 75 |

32 *Feed-in tariff for wind energy in Portugal*

### *Results*

A revised FIT for wind energy in Portugal had a strong and noticeable impact in its wind energy market, with installed wind capacity is growing exponentially since 1999.[33] A significant number of wind farms were erected and several projects are now at different planning stages.

- From 20 MW in 1997, the installed capacity was increased to nearly 200 MW by the end of 2002. In that year, the production of wind electricity amounted to 0.24 TWh.
- More than 60 MW was expected to be installed in 2003.

The FIT was the main cause for the current interest in wind energy. One attraction of the FIT is the positive discrimination of less windy sites and the price guarantee for 12 years, both of which bring wind energy to the category of financially attractive projects for investors.

Also the fact that municipalities now benefit directly from the income generated by those projects developed in the region turn out to be a major incentive to further projects.[34] D.L. 339-C-2001 defined that 2.5% of the price paid to wind farms for the electricity supplied to the grid must revert to the Municipality where the farm is located, were strongly stimulated to bring wind energy into their territory and also to be an active partner in a increasing number of wind projects.[35]

## D. France

### *Background*

France modeled its early FIT legislation after Germany's model. In 2006, the French Ministry for Industry, Finance, and Economics issued new tariffs for solar, wind, biogas and geothermal energy. The French program of Advanced Renewable Tariffs (ARTs) differentiates the price paid per kWh by:

- Technology,
- Location or size of the installation, and
- The number of years the generator has been in service.

The 2006 tariffs pay Euro 0.55/kWh for building-integrated PV, putting France on a par with world leader Germany. France also doubled payment for electricity from rooftop solar panels to Euro 0.30/kWh and provides a 50% subsidy on the cost of the solar panels and other equipment. The regional government of Rhone-Alps in southeastern France also provides an additional payment of Euro 0.30/kWh, bringing total payment for rooftop solar to Euro 0.60/kWh, more than that paid in Germany.

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[33] *Renewable Energy Policy and Politics, p. 55.*
[34] *Renewable Energy Policy and Politics, p. 55.*
[35] *Feed-in tariff for wind energy in Portugal*

| Advanced Renewable Tariffs in France Summary | | | | | |
|---|---|---|---|---|---|
| 26-Jul-06 | | | | | |
| | | Tariff | 1.43727 | 1.2629 | 2.020 |
| | Years | €/kWh | CAD/kWh | USD/kWh | NZD/kWh |
| Wind Energy on shore base rate | 15 | 0.082 | 0.118 | 0.104 | 0.166 |
| Wind Energy off shore base rate | 15 | 0.130 | 0.187 | 0.164 | 0.263 |
| Photovoltaics base rate* | 20 | 0.300 | 0.431 | 0.379 | 0.606 |
| Photovoltaics building integrated | 20 | 0.550 | 0.790 | 0.695 | 1.111 |
| Photovoltaics Region Rhone-Alps | 6 | 0.600 | 0.862 | 0.758 | 1.212 |
| Biogas <150 kW | 15 | 0.103 | 0.148 | 0.130 | 0.208 |
| *Plus 50% tax credit on hardware for residential use. | | | | | |

While the new tariffs did not increase the base rate for on shore wind energy in continental France, they doubled the amount of time that wind projects receive the premium payment from five to ten years. This significantly improves the profitability of wind turbines at moderately windy and windy sites. The new tariffs also substantially raised the tariffs for off shore wind turbines to Euro 0.13/kWh and also extended the premium period from five to ten years.

In June 2008, French solar industry representatives and the European Photovoltaic Industry Association called for France to increase the ARTs for PV. They also called for removal of notorious barriers to interconnection.

***Results***

In 2007, France installed 35 MW of PV in contrast to neighboring Germany that installed 1,100 MW. Currently there is a backlog of 70 MW of PV awaiting interconnection in France. To create a stronger French PV industry, the delegates from Hespul, le Syndicat des Energies Renouvelables, Enerplan, and the EPIA called for a national target of 1,100 MW by 2012 and 7,000 MW by 2020 and a substantial increase in the country's feed-in tariffs. They asked that the government:

- Maintain the 0.571 Euro/kWh for building integrated PV,
- Increase the base tariff from 0.30 to 0.45 Euro/kWh for rooftop PV systems,
- Increase the base tariff from 0.312 to 0.38 Euro/kWh for ground-mounted PV systems up to 2,000 MW of total installed capacity,
- Maintain the differential tariffs for France's overseas territories,
- Maintain the 50% tax credit for residential PV systems, and
- Introduce a system of tariff degression only after 3-4 years of development.

The 2012 and 2020 targets for solar PV were contained in a major French environmental assessment "Le Grenelle" directed by French President Nicolas Sarkozy earlier this year. Current rates of development are woefully short of that necessary to meet the projections in Le Grenelle.

## E. Denmark

### *Background*

Denmark has a long tradition for broad political alliances on energy policies and the implementation of well-designed, consistent support mechanisms. Energy taxes, first passed in 1974 as a response to the energy crises, were kept high and not lowered after fossil fuel prices dropped in the 1980s. RE-enabling policies put in place in Denmark, include:

- Long-term financing which reduced the risk of building larger projects and encouraging local manufacturing;
- Open and guaranteed access to the grid where Transmission System Operators (TSOs) are required to finance, construct, interconnect, and operate the transformer stations and transmission and distribution infrastructure for RE technologies;
- A carbon tax on all forms of energy, adding around 1.3 euro cents per kWh of additional income for renewable energy generators;
- Streamlined permitting that made the Danish Energy Authority the "one-stop-shop" for tendering of bids for renewable energy construction; approval of pre-investigation of sites, environmental impact assessments, construction and operation; and licenses to produce electricity.[36]

Denmark applied FITs requiring utilities to buy all power produced from RE technologies at a rate equal to70-85 % of the consumer retail price of electricity in a given distribution area until end of 2002, and then switched to a quota model for a short time. Today Denmark combines different elements of the both price-based FITs and quota support mechanisms.[37]

The wind industry in Denmark also developed a system of cooperative turbine ownership, which gives farmers and nearby landowners an interest in projects. Individuals or local cooperatives own about two-thirds of land-based wind turbines in Denmark.

### *Results*

Denmark transitioned from being 99% dependent on foreign energy sources such as oil and coal in 1970 to having the highest contribution to electricity from new RE (20%) in the EU, according to a 2007 report from the Danish Energy Authority (DEA).[38] The DEA report cites the following data:

- Installed capacity = 3,118 MW (2004). 420 MW is off-shore (529 MW globally).
- Wind power supplies almost 20% of the gross electricity consumption (2005).
- The Danish wind turbine industry employs 20.000 persons and sells turbines for 4 Billion US$ (2005).

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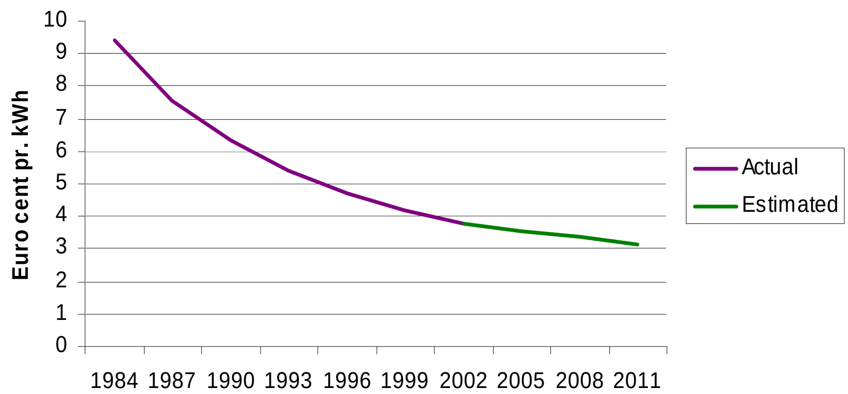
36 http://www.scitizen.com/stories/Future-Energies/2008/03/Is-the-Danish-Renewable-Energy-Model-Replicable/
37 http://www.eurosolar.de/en/index.php?option=com_content&task=view&id=156&Itemid=12
38 *Renewable Energy Technology Deployment and Danish Experiences*, Annette Schou, Danish Energy Authority, 2007.

- Most of the turbines are exported and Danish wind turbine industry serves 1/3 of the world market (2005).




As seen from these data, Denmark has seen economic benefits from high levels of RE penetration; it has become the unchallenged world leader in terms of wind technology, exporting US$7.45 billion in energy technology and equipment in 2005. Primary energy consumption nationally has grown only 4 % from 1980 to 2004, even though the economy grew more than 64 % in fixed prices.[39]

Increased RE penetration has had the effect of cutting production costs as seen in chart; DEA predicts that a wind mill on a good site will be competitive with a gas-fired power plant by 2010.[40]

Interestingly, almost all Danish wind farms are cooperatives, so local ratepayers have a financial interest in the turbines. Public opposition is a frequent barrier to the development of energy projects; project design can have a significant impact on the level of public support, or animosity. Cooperatives involving local citizens were created, producing a natural voting constituency invested in the technology, which helped propel the government towards RE-friendly policies.[41]

Two examples of the power of local ownership include:

- The small Danish community of Sydthy, Denmark boasts the highest per capita RE penetration in the world, primarily because of a strong link between local social acceptance of RE developments and local ownership, and therefore accruement of benefits. A stunning 58 % of the households in Sydthy have one or more shares in cooperatively owned wind turbines.[42]
- In 1997, Denmark held a national competition, with the selected winner expected to convert its energy supply to 100 % RE within 10 years. The Danish island of Samso won the competition; by 2007, 100 % of its electricity came from wind power and 75 % of its

39 http://www.scitizen.com/stories/Future-Energies/2008/03/Is-the-Danish-Renewable-Energy-Model-Replicable/
40 *Renewable Energy Technology Deployment and Danish Experiences*, Annette Schou, Danish Energy Authority, 2007.
41 *Renewable Energy Policy and Politics.*
42 *Renewable Energy Policy and Politics.*

> heat came from solar power and biomass energy. Nearly 4300 of the 4500 adults on the island have invested in the wind farms. The offshore wind turbines make surplus power to sell to the mainland of Denmark, making the projects more economically attractive to the residents.[43]

The country is not content to rest on its laurels. In January 2007, the Danish government presented a new long term energy strategy entitled *A Visionary Danish Energy Policy*. Specific energy targets for 2025 include:

- Reduction of the use of fossil fuels by at least 15%.
- The share of RE must be at 30% of total gross energy consumption by 2025.
  - This implies that more than half of the electricity consumed will be supplied by RE and
  - 10% share of generation biofuels for transport by 2020.
- Energy saving efforts will be increased by 1.25% annually with a view to holding overall energy consumption static until 2025.[44]

FIT case studies from Canada follow, in PART III.

43 *http://www.dailyreckoning.co.uk/article/27032006.html*
44 *Renewable Energy Technology Deployment and Danish Experiences*, Annette Schou, Danish Energy Authority, 2007.

# PART III. CANADIAN FEED-IN TARIFF CASE STUDIES

## A. Ontario

### *Background*

In December 2004, the Ontario Sustainable Energy Association (OSEA) was commissioned by the Ontario Ministry of Energy to propose a policy for developing community-owned renewable power projects in the province. OSEA submitted a detailed report on *Standard Offer Contracts* (SOC) for the Ministry in January, 2005. [45]

Realizing that the availability and capacity of RE resources set the technical limits on any clean energy initiative, ARTs in Ontario are differentiated by:

- Technology
- Project size
- Productivity of the resource.

SOCs were first available to developers during the fall of 2006. Prior to the Ontario Power Authority issuing a contract, the generator will be required to meet the following pre-conditions:

- Demonstrated site control (e.g. ownership, long-term lease, or firm option);
- Completed *Connection Impact Assessment* with the electricity
- Evidence of local support (e.g. community ownership);
- Environmental assessment underway (as may be required);
- Evidence of a commitment to fund the project by the lending institutions/investors; and
- Demonstrated access to fuel source, where appropriate.

For the first year of commercial operation, all RE projects (except PV) were paid a base rate of 11 cents per kilowatt hour for all kilowatt hours delivered. The rate escalates from 11 cents per kilowatt hour over the 20 year term of the contract. Projects that can demonstrate generation control will be eligible for an additional 3.52 cents per kilowatt hour for all electricity delivered during on-peak hours. A price of 42 cents per kilowatt hour for solar photovoltaic projects will be established in order to conduct price discovery on this technology. [46] ARTs for new projects are also subject to periodic review to determine if the program is sufficiently robust.

To achieve OSEA's target of 500 MW of community-owned RE by 2015, Ontario's SOC program must move quickly toward a modern system of Advanced Renewable Tariffs through a substantial revision of the program's objectives and the tariffs offered. Such a program would:

- Grant RE priority access to the grid, and would
- Grant RE priority of purchase.[47]

45 *Policies to Promote Non-hydro Renewable Energy in the United States and Selected Countries*
46 http://www.powerauthority.on.ca/Page.asp?PageID=834&ContentID=3304&SiteNodeID=132#Q2
47 *Renewables Without Limits*

***Results***

Ontario has seen 1,500 MW of contracts to date, including 800 MW of wind and 500 MW of solar PV. Only 50 MW has been installed through July 2008.[48]

## B. British Columbia

***Background***

British Columbia has a long history of low-cost and reliable electricity generation, but was required to import of 12.5% of its electricity requirements from Alberta and the United States in 2005, causing this Canadian province to commit itself to return the province to energy self-sufficiency by 2016 and challenged the province's largest producer and purchaser of power, BC Hydro, to ensure that 50% of new supply is delivered from certified BC Clean Electricity and non-nuclear sources.

The province's 2002 Energy Plan called for greater private investment to help deliver an, reliable, and environmentally responsible supply of electricity for BC. In response, BC Hydro attempted to secure power from the private sector using a tender scheme known variously as Calls for Power (CFP) or Calls for Tender (CFT). Under the tender model, providers compete for Electricity Purchase Agreements (EPAs) designed to deliver to BC ratepayers the least expensive supply of electricity. To date, the performance of these tenders has been disappointing in terms of capacity developed and generation achieved. Uncertainty, complexity and the (in) frequency of calls, among other things, have resulted in high rates of project attrition and made an already precarious private and renewable electricity industry in BC more risky.

In an effort to address its growing supply deficit, BC Hydro increased the award volume of its 2006 *Call for Power* from 2,500 GWh to over 7,100 GWh and accepted an average price of 7.95¢/kWh nearly 45% higher than the 5.5¢/kWh maximum it demanded under its 2002 Green Call for Power. Hydro has achieved some success with its Power Smart conservation program and taken cautious first steps toward net-metering and self-generation but these policies will not be enough to stem a shortfall approaching 20,000,000,000 kWh by 2025.

The BC Sustainable Energy Association (BCSEA) in February 2007 responded positively to the province's new BC Energy Plan which includes implementation of Standard Offer Contracts like those in Ontario. The Energy Plan includes a goal that 50% of new power demand in BC should come from conservation, by reducing the amount of energy used, instead of generating new energy. The Plan also introduces a Standard Contract Program for small RE generators under 10 MW, similar to the program introduced in Ontario. [49]

48 Paul Gipe
49 http://www.wind-works.org/FeedLaws/Canada/CanadaList.html#British%20Columbia

In April 2008, BC Hydro launched its Standing Offer Program (SOP) to advance the province's goals of becoming electricity self-sufficient by 2016 and generating 90 per cent of electricity in the province from RE sources. The SOP offers a standard contract with set prices and a streamlined administrative process to give smaller scale projects the opportunity to contribute to B.C.'s supply of clean electricity. Specifically, the SOP targets projects that generate up to 10 MW of power, that are located in B.C. and that use proven technologies.[50]

Feedback received through extensive stakeholder engagement influenced the design of the Standing Offer Program, resulting in revisions to the draft program rules and contract. These revised terms and conditions were part of the program application filed with the British Columbia Utilities Commission (BCUC) for regulatory review; the BCUC approved the program in March 2008.[51]

***Results***

The program is too new to evaluate, but it is interesting to note that the BC Energy Plan includes a goal that 50% of new power demand in BC should come from conservation instead of generating new energy.

The Energy Plan also restricts projects to a 10 MW cap—which would seem to favor small onsite power producers and IPPs rather than large commercial ventures. However, the program has been widely criticized as likely ineffectual due to the timid nature of the tariffs and the low project size cap.[52]

FIT case studies from the U.S. follow, with special emphasis on California, in PART IV.

50 http://www.bchydro.com/news/2008/apr/release55742.html
51 http://www.bchydro.com/news/2008/apr/release55742.html
52 Paul Gipe, in correspondence with author

## PART IV. AMERICAN FEED-IN TARIFF CASE STUDIES

The past two years have seen a remarkable shift in the US policy landscape as numerous states have introduced feed-in tariff legislation to supplement and even complement RPS policies. Proposals for a federal FIT have also been developed.[53] By 2006, several U.S. states had established limited policies similar to Germany's Renewable Energy Sources Act, or that shared some FIT design features, but no state had yet introduced feed-in legislation. In 2008, six states have introduced FIT bills, and another eight states have considered, or are considering, similar legislation.[54] Details on a few state-specific FIT models can be found below; a *Summary of State Feed-In Tariff Bills and Laws*[55] can be found in the Index of this document.

In addition to the state-level FIT bills, there is a significant effort to move FIT legislation forward at the federal level. In May, 2008, Congressman Jay Inslee (WA-1st-D) introduced a national FIT bill, which he refers to as a renewable energy payment (REP). The bill includes three main design elements that are modeled on the most successful national policies in Europe:

1. Guaranteed interconnection through uniform minimum standards,
2. A mandatory purchase requirement through fixed-rate 20-year contracts and
3. Rate recovery through a regionally partitioned national system benefits charge.

Under the proposed law, the Federal Energy Regulatory Commission (FERC) would set standards for the priority interconnection and transmission of power from new "renewable energy facilities," (REF) which include renewable energy facilities 20 MW or less. The FERC and the states would then be required to implement these standards within their own respective areas of jurisdiction when renewable energy facility owners request interconnection. The FERC would set minimum national REP rates at levels designed to provide for full cost recovery, plus a 10% internal rate of return on investment, for commercialized technologies under good resource conditions.

REF rates would be differentiated on the basis of energy technology, the size of the system, and the year that the system was placed in service. Utilities would still earn any associated RECs in order to help meet RPS requirements.

53 http://onlinepact.org/fileadmin/user_upload/PACT/Misc/Feed-in_Tariffs_and_Renewable_Energy_in_the_USA_-_a_Policy_Update.pdf
54 http://onlinepact.org/fileadmin/user_upload/PACT/Misc/Feed-in_Tariffs_and_Renewable_Energy_in_the_USA_-_a_Policy_Update.pdf
55 http://onlinepact.org/fileadmin/user_upload/PACT/Misc/Feed-in_Tariffs_and_Renewable_Energy_in_the_USA_-_a_Policy_Update.pdf

## A. California

This state has played a leading role in developing FITs in the US, much like Germany has done in Europe. California Assembly Bill (AB) 1969 of 2006 established a FIT for systems with a capacity of 1.5 MW and below, capped at 250 MW total statewide. Generators can choose 10-, 15-, or 20-year contracts, and can opt to sell either 100% of their power, or offset their retail load and sell only their excess electricity. Unlike in the German law, California's FIT rates are based on time-of-delivery, rather than the generation cost of individual technologies. This means that all technologies are offered the same price, but that this price varies depending on whether the electricity is generated during peak or off-peak times.

In Southern California Edison territory, peak payments can be up to $0.31/kWh in the summer (Rickerson et al., 2008). The original program was limited to facilities sited at wastewater and water treatment facilities, but the California Public Utilities Commission (CPUC) extended the program to all customer-types, and expanded the cap to 478.4 MW in 2007. Subsequent bills have sought to expand both the overall program cap and the individual project cap, and a recent bill (AB 1807 of 2008) is seeking to increase the system capacity limit to 20 MW as well as to shift to a more European-style structure based on technology-specific payments.

In a parallel effort, the California Energy Commission (CEC) has been exploring feed-in tariffs through its Integrated Energy Policy Report (IEPR) process. The CEC (2007) published its 2007 IEPR, which concluded that the current state RPS needs "greater transparency, less complexity, and full valuation of renewable energy". In order to achieve these goals, the IEPR recommended that "the CPUC…immediately implement a feed-in tariff…for "all renewables up to 20 megawatts in size" and that the CEC should "begin a collaborative process with the CPUC to develop feed-in tariffs for larger projects." The CEC IEPR process is ongoing, and the 1.5 MW feed-in tariffs have only recently become available to generators, so it remains to be seen how these policy efforts will impact California's markets or set a precedent for the rest of the United States.

A report done for CEC in 2008 lays out the advantages of an innovative "two-part tariff" for California, based on the design of "forward capacity markets" which have shown enhanced coordination of new capacity entry, lower risk premiums, and more stable prices in Independent Standard Operator-New England (ISO-NE). The proposed two-part tariff consists of:

- A capacity payment that is determined through an auction price, and
- An energy payment that is tied to the spot market price of electricity.

The capacity auction for specific RE technologies is held several years in advance to allow winning bidders time to build capacity; and winning auction prices are guaranteed for a predetermined number of years. The forward capacity market also includes a "pay-for-performance" incentive based on generators' availability when spot market energy prices are above a set amount (based on estimated variable operating cost of a peaker. [56]

56 *Achieving California's 33 % Renewable Portfolio Standard Goal*, KEMA Inc., January 2008.

## B. Michigan

Several states introduced FIT bills modeled closely after Germany's 2004 Renewable Energy Sources Act. Representative Kathleen Law (D) introduced the "Michigan Renewable Energy Sources Act" (HB5218) in September 2007. The bill was inspired by Ontario's Standard Offer, but contained higher tariffs, especially for PV. The bill enables generators to receive 20-year, technology-specific payments for wind, hydropower, biomass, landfill gas, geothermal, and solar electricity. Wind systems are eligible for a sliding scale of payments that start at $0.105/kWh for systems that produce 700 kWh/m2 of swept area per year, and progress downward to $0.08/kWh for systems that produce 1,100 kWh/m$^2$ per year. Small wind turbines (2,000 sq. ft of swept area or less) are eligible for a $0.25/kWh tariff.

The Michigan bill stipulates that parallel tariffs and all future tariffs be determined by the cost of generation plus a fair profit. The bill describes how to calculate a fair profit by the use of the Profitability Index Method.

The bill has been referred to committee, but is on hold while the legislature focuses on an RPS bill for Michigan. There is support for the bill both within the administration and the House, but it is unlikely that it will make further progress until the end of this legislative session, and considerable opposition is expected in the Senate.

Following the introduction of HB 5218, the "Michigan model" was used as the starting point for similar bills in several other Midwestern states, such as Illinois and Minnesota.

## C. Minnesota

In Minnesota, Representative David Bly (D) introduced a bill (HF3537) based on the Michigan model. The bill's structure is similar to Michigan's, although there are no rates for geothermal resources, and small wind generators are limited to systems with 1,000 square feet of swept area or less.

The Minnesota bill differs significantly in that generators must be majority-owned by Minnesotans as defined in the state's Community-Based Energy Development (C-BED) statute. Minnesota has an established history of cooperative ownership, and several recent studies have advocated for the establishment of feed-in tariffs to support community-owned wind (Farrell, 2008; Kildegaard, 2006, 2007; Windustry, 2007).

The concept of community-based feed-in tariffs builds on the precedent set by the state's C-BED law. The C-BED tariff structure is similar to that of FITs in that utilities are required to develop 20-year contracts for renewable generators. Unlike feed-in tariffs, however, utilities are not required to enter into C-BED contracts, the contracts are negotiated rather than standardized, and the contracts were at first only available to wind power. The C-BED statute originally limited the contracts to a net present value of 2.7¢/kWh over the 20 year period. This corresponds to roughly 4.7 to 6.3 ¢/kWh for discount rates of 6% and 10% respectively. Subsequent 2007 legislation eliminated the 2.7 ¢/kWh cap and extended the C-BED to other technologies in addition to wind, but did not establish technology specific rates.

Tariffs would be tied to the costs of generation plus a fair and reasonable profit. After grappling with how best to define what is a "fair and reasonable profit," Representative Bly chose a 10% rate of return.

In the Minnesota bill tariffs are reviewed every two years and there are specific provisions for transparency, reporting requirements, and the issuance of regular progress reports.

## D. Hawaii

Hawaii saw several pieces of tariff legislation during the 2006-2007 session, with one house bill (HB 1748 (Saiki) and two senate bills (SB 1223 (Menor) and SB 1609 (Hanabusa). All three bills contained language establishing a 20-year, $0.70/kWh tariff for PV systems up to 20 MW in size.

Unlike the Michigan-style FITs, which assume that 100% of the system output is fed into the grid, the proposed Hawaii tariffs apply only to excess electricity from net-metered systems, so are not technically FITs but more accurately described as payment for net generation under a net metering policy. The tariff is capped at 5% of utility peak demand.

In January 2008, HB 3237 (Thielen), which included a broad package of RE legislation, also contained a PV tariff similar to that in the other bills, but with a rate of $0.45/kWh. None of the bills were passed out of committee.[57]

57 http://onlinepact.org/fileadmin/user_upload/PACT/Misc/Feed-in_Tariffs_and_Renewable_Energy_in_the_USA_-_a_Policy_Update.pdf

# PART V. FEED-IN TARIFF CONSIDERATIONS FOR HAWAII

The State of Hawaii depends on imported fossil fuels to meet over 90% of its energy needs, making the state vulnerable to supply disruptions and high energy prices. Recent reports, including the draft EPAct Sec. 355 report on Hawaii's oil dependence, estimate that Hawaii can meet a very high %age (e.g. 70-80%) of its future energy needs by tapping into its local, clean, energy sources such as wind, solar, geothermal, wave, current, OTEC, and bioenergy. In doing so, the state would become far less dependent on imported fossil fuels and the effects of international oil market vagaries.

The *Hawaii Clean Energy Initiative (HCEI)* is an innovative Partnership between the U.S. Department of Energy (DOE) and the State of Hawaii formed to help Hawaii meet its clean energy goals. In January 2008, the DOE Energy Efficiency and Renewable Energy Assistant Secretary signed an historic Memorandum of Understanding (MOU) with Hawaii Governor to formally kick off the Initiative with a goal to achieve a 70% reliance on RE, after reducing energy demand through energy efficiency and conservation, within a generation—best illustrated below in Scenario 8.[58]

| | 2030 End-state for Each Scenario (installed capacity) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| Efficiency | 220 | 220 | 220 | 220 | 495 | 495 | 495 | 495 |
| Biomass - direct firing | 93 | 93 | 120 | 120 | 56 | 56 | 83 | 83 |
| Wind | 276 | 1076 | 276 | 1076 | 223 | 1023 | 260 | 1060 |
| Geothermal | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 |
| Hydro | 36 | 36 | 40 | 40 | 24 | 24 | 24 | 24 |
| Solar (residential roofs) | 182 | 182 | 205 | 205 | 166 | 67 | 179 | 179 |
| Solar (commercial roofs) | 633 | 633 | 712 | 712 | 578 | 232 | 622 | 622 |
| Solar (utility scale) | 29 | 29 | 29 | 29 | 22 | 22 | 29 | 29 |
| MSW | 77 | 77 | 79 | 79 | 77 | 77 | 77 | 77 |
| Ocean energy | 53 | 53 | 53 | 53 | 53 | 3 | 53 | 53 |
| Dispatchable | 271 | 271 | 301 | 301 | 235 | 235 | 261 | 261 |
| Non-dispatchable | 1209 | 2009 | 1316 | 2116 | 1065 | 1370 | 1167 | 1967 |
| **Electricity Sector Clean Energy %** | **46%** | **65%** | **46%** | **63%** | **58%** | **70%** | **57%** | **70%** |
| Oil reduction (million bbls in 2030) | 10.0 | 14.0 | 11.5 | 15.5 | 12.5 | 15.1 | 14.0 | 17.3 |
| CO2 avoided (million tons in 2030) | 5.1 | 7.2 | 5.9 | 7.9 | 6.4 | 7.7 | 7.2 | 8.8 |
| **Transportation Sector Clean Energy %** | **30%** | **30%** | **57%** | **57%** | **30%** | **30%** | **57%** | **63%** |
| Oil reduction (million bbls in 2030) | 4.7 | 4.7 | 9.0 | 9.0 | 4.7 | 4.7 | 9.0 | 9.9 |
| CO2 avoided (million tons in 2030) | 2.0 | 2.0 | 3.8 | 3.8 | 2.0 | 2.0 | 3.8 | 4.2 |

Using lessons learned from European, Canadian, and American experiences with FITs, those persons interested in facilitating a policy and regulatory environment conducive to helping Hawaii meet its clean energy goals could perhaps consider these potentially effective RE support mechanisms.

Some specific considerations on FITs for Hawaii follow.

58 HCEI Working Group outputs

## A. Combining Quota + Price Support Mechanisms

For states such as Hawaii which have set aggressive RE penetration goals, an RPS-like RE quota may serve as a guidepost. The State, through its RPS, and the HCEI have already set such quotas, so no wheels need to be reinvented in this respect.

An enabling and complementary support mechanism could be a FIT whose price levels are set by real-world signals—such as energy conservation and efficiency, RE resource availability, RE technology type and capacity factor, time-of-use approaches, FIT prices set by costs of generation + reasonable profits, etc.—and then assessed and adjusted as needed to meet that state's RE penetration goals.

## B. Elements of Successful FIT Design

The *World Future Council (WFC)*[59] has developed a *Feed-in Tariff Design Guide* that helps countries, provinces and states tailor their FIT legislation as part of their Policy Action on Climate Toolkit (PACT). According to WFC, the essential elements of a feed-in tariff policy include:

- Access, including the issues of interconnect, grid upgrades, transparency, and who pays for interconnection;
- Price (the tariffs), including the issues of technologies governed, priority of purchase, determining the right price, and how to pay for it; and
- "Supplementary objectives" including the issues such as meeting RE targets, progress reports, local content or local ownership requirements, and reducing administrative barriers.[60]

Of note on access to the grid, WFC recommends that an obligation in law on the distribution system operator or transmission system operator to connect eligible plants up to the grid is fundamental. To connect to the regional or national electricity grid, the project developer must normally apply formally to the local distribution network operator, who will have to make a connection offer. This generally includes information about the work involved in physically connecting to the grid. Normally, FIT laws include provisions for cost sharing between producers and grid operators, as the costs for grid connection have an important impact on the economic viability of a project, and on how much electricity can be produced.

The three methods of charging for grid connection can be distinguished and although these are often not included in the law itself, WFC recommends that they should be.

- The WFC-recommended shallow method of connection charging minimizes the costs for producers, and allows the expected cost of their projects to be estimated at an early stage.

59 World Future Council is a non-profit that unites fifty highly respected figures from across the globe and from all walks of life to create a strong ethical voice to represent future generations. Selected through a global consultation process involving 2,500 civil society organizations, the Council members bring with them a wealth of experience and expertise.

60 http://onlinepact.org/features.html

Producers will pay for the costs of the equipment needed to connect their plant physically to the nearest point of the electricity distribution grid; and grid operators will pay any costs for reinforcement of the network—costs which are passed to the final consumer by including them in the system charges. The advantage of this method is that producers will tend to choose the location for their renewable energy plants based on resource, not grid, availability. The disadvantage is that this could cost more if grid extensions are needed for the best resource locations.

- The deep method puts higher costs on producers. Experience has shown that this charging method is one of the major barriers to increasing electricity production from RE sources.
- The mixed method combines the shallow and deep methods as a "compromise" between the two objectives of giving some locational incentives and reducing the burden on the producer to pay grid reinforcement costs.

There are immediate costs in introducing a FIT law, and it is important to consider ways of helping to finance these, such as through a cost sharing mechanism for all electricity consumers or a fund**.**

- Most FIT countries have implemented a cost sharing mechanism by equally distributing the additional cost onto the electricity bills of all end-users. Usually the local grid operator is obliged to purchase and transmit the generated "green" electricity and pay the producer the fixed tariff. The grid operator will then pass the related costs on to the next entity along the line until it "reaches" the final electricity consumer.
- An alternative to a cost sharing mechanism is to set up a fund, particularly where additional costs to the end consumer are deemed politically or morally unacceptable. The fund's income can come, for example, from taxing conventional energies, a share that all electricity consumers have to pay as a proportion of their electricity bill, or other sources that might be specific for a region or country.

In the larger picture, the overall financial benefits of a FIT law should be kept in mind when legislatures are conducting policy cost/benefit analyses. For example, in 2006 the financial benefits of Germany's FIT law were estimated to be €9.3 billion (taking into account avoided fuel imports, avoided negative external effects and the "merit-order effect") compared with an increased cost to consumers of €3.3 billion. Benefits in Hawaii should be higher because of their reliance on imported oil for electricity generation.[61]

Re FIT pricing, WFC recommends that for technologies are specified, that size categories are chosen, and that payments are guaranteed for a certain number of years (which most European countries are doing.) These choices are driven by the need to get the price right.

61 Renewable Energy Sources Act, Progress Report 2007, pursuant to Article 20 of the Act, Draft, prepared by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), Summary, 5.7.2007, section 5.

## C. Getting the FIT Payment Price Right

Tariffs (or prices) tend to be based on either average generation costs of the RE generator or avoided external costs**.**

- The main factors affecting the average generation cost of a particular technology include plant investment costs (including material and capital costs), grid-related and administrative costs (grid connection cost, costs for the licensing procedure, etc.), operation and maintenance costs, and fuel costs (in the case of biomass and biogas).
- External costs arise when the social or economic activities of one group have an impact on another group and when that impact is not fully paid for by the first group. For setting tariffs (or prices), external costs related to climate change, health and building damage from air pollution, agricultural yield loss, and energy supply security should be considered. Avoided costs that would be involved in generating the electricity from non-renewable sources and the avoided grid losses can be taken into account.[62]

Experience from Europe and other regions of the world suggests that setting tariffs on the basis of average generation costs supports a quick uptake of RE, while the avoided cost approach only coincidentally leads to an optimal tariff (or price). Today, most EU countries that apply FITs use the concept based on electricity generation costs (often with IPP profit margins built in) to determine the tariff level.[63]

In its early FIT models, Germany formulated tariff levels at 90% of retail prices, but realized that a better, more reasonable approach was to set tariffs based on the cost of generation + a fair and reasonable profit—a principle also being applied in France, Spain, and being proposed in several U.S. states such as California. Profit must be sufficient to drive development, and could be aligned with Capital Recovery Factors (CRF) that have been used in utility rate regulation in North American for many years. Regulatory commissions determine the costs of generation from a technology or a particular power plant and then determine what is the revenue required to earn a profit based on these costs, or “revenue requirements.” Regulatory commissions also determine what the acceptable or "reasonable" rate of return that is permitted to a utility based on the cost of capital.

- Using the cost recovery model, it is logically consistent to award different tariffs for different technologies just as it is to award different revenue streams to different power plants. This leads to tariff differentiation by technology.
- It is also logically consistent to award different tariffs for different resource intensities notably in the case of wind energy where the cost of generation is markedly determined by slight differences in wind speed. This leads to tariff differentiation by resource intensity or productivity—enabling higher prices for RE in areas of lower RE resources.

The preferred model of calculating tariffs for many European and Canadian FIT rate makers is the French Chabot Profitability Index Method (PIM), an approach to the levelized cost of energy (LCOE) developed by Bernard Chabot of France's *Agence de*

62 http://onlinepact.org/p3a.html

63 *Evaluation of different feed-in tariff design options - Best practice paper for the International Feed-in Cooperation*, a research project funded by the German Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).

*l'Environnement et de la Maitrise de l'Energie* (ADEME). The PIM is based on the assumption that an investment in an RE project must be profitable (or at least be cost neutral) for the investor. PIM values are derived by calculating the Present Value of the Cash Flows divided by the Present Value of the total Installed Cost.

The PIM can be used to increase or decrease the margin of profit on a technology, i.e. there is a fixed or desired Rate of Return derived from the Average Weighted Cost of Capitol based on a targeted RE site, e.g. for wind energy. The PIM is varied to increase the margins on windy sites, e.g., to a targeted upper limit while decreasing those on less windy sites. This system encourages economic efficiency by more greatly rewarding those at windy sites than those at less windy sites, i.e. those at windy sites will make proportionally more money than those at less windy sites. Above the targeted upper limit, the margin or PIM is capped to prevent unfair or "excessive" profits above what is necessary for rapid development of new RE generation.

As the RE generation costs vary according to technology, a FIT design should provide technology-specific tariff levels. The following factors influence the power generation costs and therefore should be taken into account when the tariff levels are determined:

- Investment for the plant
- Other costs related to the project, such as expenses for licensing procedures
- Operation and maintenance (O&M) and other annual recurring costs
- Fuel costs (in the case of biomass and biogas)
- Inflation
- Interest and principal payments for the invested capital
- Profit margins for investors
- In the United States, federal tax credits, capital subsidies, and other supports where applicable, must be carefully accounted for.

This list closely resembles the LCOE method used in Chabot’s PIM, as well as by the U.S. Department of Energy.

## D. Evaluating the Costs of FITs

In an article for Renewable Energy World, solar expert Marcus Maedl (who has worked in both Germany and the U.S.) reviewed the costs of FITs to German ratepayers, and then had his calculations reviewed by Reiner Brohm from the German Solar Industry Association.[64]

Mr. Maedl first notes that the German FIT approach has demonstrated with hard facts that it is the best, most efficient and most cost effective incentive program there is. His data show that in 2007 Germany had 47% of all new RE installations and Spain had 25%; and that in 2008, those two countries will likely again have 2/3 or 3/4 of the world's new

64 In correspondence with author.

RE installations. Corroborating data show that, in 2007 alone, Germany installed more PV systems than the U.S. has ever installed in history.[65]

Mr. Maedl's conclusion is that Germany and Spain prove that FITs are functioning models that yield results, and that two factors figure in to FITs' success:

- No quota,
- 20-year guaranteed revenue, and
- Financing security—since the bank financing the RE project knows that the government guarantees payments and the equipment manufacturers guarantee production, risk is minimized.

He goes on to show that under recent German FIT legislation starting in 2004, utilities had to pay the market rate for RE, but since they are allowed to redistribute the additional cost to the general public in the form of higher electricity rates, the utilities were not taken advantage of. He notes that the increase of FIT payments, as of 2008, has been EU € 0.007 (US $0.01) per kWh for German rate payers.[66]

Looking at the program from a pure economic viewpoint, Mr. Maedl believes the ultimate measure is the "cumulative additional net cost" which shows how much extra money Germany has dished out for RE from the start of the FIT program by comparing FIT payments to the alternative of purchasing electricity from the utilities at market rates. That final number for Germany is around $47 billion, or $573 per person, over 20 years. The author of this paper has access to the spreadsheet behind these calculations and would be glad to share it.[67]

## E. Sustainable Utility Business Models

To incent high penetration levels of RE, the state of Hawaii could devise a way to incent more RE with support mechanisms such as FITs, while providing financial viability to its conventional utility. FITs would inevitably alter the conventional utility business model, yet the role and business sustainability of the conventional utility is critical to the success of a FIT model. Without a sustainable business model for the utility, third-party companies could, e.g., cut into a utility's customer and asset base through, e.g., power purchase agreements (PPAs).

If FITs were enacted, conventional utilities could simply pass increased charges from RE purchases through to ratepayers. Rate increases in Europe have been modest to date; in Germany, ratepayers have seen a 1-5% increase in rates, depending on data analysis.

As part of a FIT paradigm that featured higher and higher RE penetration levels, interconnection costs, installation time, and administrative hassles could also be minimized to increase utility revenue streams from RE generation. The costs and time

65 http://www.renewableenergyworld.com/rea/news/reinsider/story?id=52156
66 http://www.renewableenergyworld.com/rea/news/reinsider/story?id=52156
67 With permission from Marcus Maedl.

needed to interconnect RE can account for up to half of the upfront (installed) cost of some RE systems. To reduce this cost, Hawaii could mandate the use of utility-owned and operated inverter/meters with automatic meter reading, that separates customer consumption from the RE production meter, and allows the continuation of net metering and enable utility-owned RE assets.[68]

A conventional utility could unbundle generation and T&D business units—perhaps by selling off generation assets, or have separate and competing business units under an umbrella group—allowing the utility to focus on generation only.

- The RE generation business unit could become eligible for FIT payments like any IPP and like some European utilities such as Germany's utilities RWE and E.ON and Spanish utility Iberdrola do (see below).[69] Conventional utilities may be ideally positioned to be RE generators since they have millions of customers under contract already.
- The T&D, or energy management, business unit could create revenue streams from the overall management of electricity, perhaps in the same vein as Denmark's Transmission System Operators (TSOs), which are required to finance, construct, interconnect, and operate the transformer stations and transmission and distribution infrastructure for RE technologies. So called "transmission tariffs" are already common in Northern Europe, and are based on real costs in Norway and Sweden, while Denmark and Finland use average costing.[70]

There are European models acting as precedents for the unbundling of utility business units. According to RE grid integration expert Thomas Ackerman,[71] German, Swedish, English utilities (and a few other countries) are all unbundled into generation, distribution, transmission and retail parts. Mr. Ackerman notes that the unbundling is different in the different countries, e.g. in Germany it is only an accounting unbundling (so all companies are still owned by the same company), in other countries they are completely separated.

In consideration of an independent RE generation model, Germany's utilities RWE and E.ON are both heavily invested in independent RE generation in Germany, as well as in other European countries where they do not own local distribution assets:

- In November 2007, RWE said it would form an RE generation operation in a new unit starting on Feb. 1, 2008, with plans to generate more than 20% of its power production from RE sources by 2020, from 5% currently. The new unit will invest at least EUR1 billion ($1.4 billion) per year from 2008.[72]
- RWE, in February 2008, announced it will install 280 MW of wind energy generation sources in Poland.[73]
- In April 2008, E.ON unveiled plans to channel €6 billion ($10.5 billion) by 2010 into new RE projects across Europe.[74]

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68 James White, in communication with author.
69 Thomas Ackerman, in communication with author.
70 *Competition in European Electricity: A Cross-Country Comparision*, Jean-Michel Glachant, 2003.
71 In correspondence with author.
72 http://www.geni.org/globalenergy/library/technical-articles/finance/dow-jones-news/rwe-forms-new-renewables-unit-to-invest-eur1-billion-year/index.shtml
73 http://www.rwestoen.pl/index.php?id=881&L=1
74 http://renewenergy.wordpress.com/2008/05/05/monday-manifesto-eon-chief-executive-wulf-bernotat/

- In 2008, E.ON is one of two remaining partners in London Array, a £2 billion ($3.5 billion) project to build the world's largest offshore wind farm in the Thames Estuary.[75]
- In August, 2008, E.ON said it is considering a £300m ($525 million) investment in building a 150 MW biomass power plant in Great Britain.[76]

Spanish utility giant Iberdrola is similarly invested in RE generation assets, and is an open advocate for FITs as effective RE support mechanisms:

- In a 2006 presentation, Iberdrola notes, "The Spanish and German experience with a Feed-in tariff system and incentives for energy quality is a success case."[77]
- In a 2007 paper, Iberdrola concludes: "Recent experiences show that feed-in tariff (sic) are more effective and efficient than the traded green certificates. These last ones show, theoretically, efficiency advantages because they are market based, but in practice they are more expensive to the customer, they mean higher risks for the investor that must be compensated with a higher return."[78]

The APPENDIX follows.

75 http://renewenergy.wordpress.com/2008/05/05/monday-manifesto-eon-chief-executive-wulf-bernotat/
76 http://www.guardian.co.uk/business/2008/aug/20/utilities.renewableenergy
77 *Iberdrola Renewable Energies*, Andres Bartrina, June 2006.
78 *Contribution From Iberdrola to the Ad Hoc group 9: Furthering economic and environmental performance of EU enterprises,* 22 marzo 2007.

# APPENDIX

## A. 2006 Level and Duration of FIT Support for European RE Generators[79]

Table 3.3: Level and duration of support for RES-E plants commissioned in 2006

| | | Tariff level in 2006 [€ Cents/kWh] and duration of support for different technologies[1)] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Country | | Small hydro | Wind onshore | Wind offshore | Solid biomass | Biogas | PV | Geothermal |
| **Austria** | | 3.8 - 6.3 *13 years* | 7.8 *13 years* | - | 10.2 - 16.0 *13 years* | 3.0 - 16.5 *13 years* | 47.0 - 60.0 *13 years* | 7.0 *13 years* |
| **Cyprus** | | 6.5 *no limit* | 9.5 *15 years* | 9.5 *15 years* | 6.5 *no limit* | 6.5 *no limit* | 21.1 - 39.3 *15 years* | - |
| **Czech Republic** | **fix** | 8.1 *15 years* | 8.5 *15 years* | - | 7.9 - 10.1 *15 years* | 7.7 - 10.3 *15 years* | 45.5 *15 years* | 15.5 *15 years* |
| | **premium** | 10.5 *15 years* | 12.5 *15 years* | - | 10.0 - 12.0 *15 years* | 9.9 - 12.5 *15 years* | 49.0 *15 years* | 18.0 *15 years* |
| **Denmark** | | - | 7.2 *20 years* | - | 8.0 *20 years* | 8.0 *20 years* | 8.0 *20 years* | 6.9 *20 years* |
| **Estonia** | | 5.2 *7 years* | 5.2 *12 years* | 5.2 *12 years* | 5.2 *7 years* | 5.2 *12 years* | 5.2 *12 years* | 5.2 *12 years* |
| **France** | | 5.5 – 7.6 *20 years* | 8.2 *15 years* | 13.0 *20 years* | 4.9 – 6.1 *15 years* | 4.5 - 14.0 *15 years* | 30.0 – 55.0 *20 years* | 12.0 – 15.0 *15 years* |
| **Germany** | | 6.7 - 9.7 *30 years* | 8.4 *20 years* | 9.1 *20 years* | 3.8 - 21.2 *20 years* | 6.5 – 21.2[2)] *20 years* | 40.6 – 56.8 *20 years* | 7.2 – 15.0 *20 years* |
| **Greece** | | 7.3 - 8.5 *12 years* | 7.3 - 8.5 *12 years* | 9.0 *12 years* | 7.3 - 8.5 *12 years* | 7.3 - 8.5 *12 years* | 40.0 – 50.0 *12 years* | 7.3 - 8.5 *12 years* |
| **Hungary** | | 9.4 *no limit* | 9.4 *no limit* | - | 9.4 *no limit* | 9.4 *no limit* | 9.4 *no limit* | 9.4 *no limit* |
| **Ireland** | | 7.2 *15 years* | 5.7 - 5.9 *15 years* | 5.7 - 5.9 *15 years* | 7.2 *15 years* | 7.0 - 7.2 *15 years* | - | - |
| **Italy** | | - | - | - | - | - | 44.5 – 49.0 *20 years* | - |
| **Lithuania** | | 5.8 *10 years* | 6.4 *10 years* | 6.4 *10 years* | 5.8 *10 years* | 5.8 *10 years* | - | - |
| **Luxembourg** | | 7.9 – 10.3 *10 years* | 7.9 - 10.3 *10 years* | - | 10.4 - 12.8 *10 years* | 10.4 - 12.8 *10 years* | 28.0 - 56.0 *10 years* | - |
| **Netherlands** | | 14.7 *10 years* | 12.7 *10 years* | 14.7 *10 years* | 12.0 - 14.7 *10 years* | 7.1 - 14.7 *10 years* | 14.7 *10 years* | - |
| **Portugal** | | 7.5 *15 years* | 7.4 *15 years* | 7.4 *15 years* | 11.0 *15 years* | 10.2 *15 years* | 31 - 45 *15 years* | - |
| **Slovakia** | | 6.1 *1 year* | 7.4 *1 year* | - | 7.2 - 8.0 *1 year* | 6.6 *1 year* | 21.2 *1 year* | 9.3 *1 year* |
| **Slovenia** | **fix** | 6.0 - 6.2 *10 years* | 5.9 - 6.1 *10 years* | - | 6.8 - 7.0 *10 years* | 5.0 - 12.1 *10 years* | 6.5 - 37.5 *10 years* | 5.9 *10 years* |
| | **premium** | 8.2 - 8.4 *10 years* | 8.1 - 8.3 *10 years* | - | 9.0 - 9.2 *10 years* | 6.7 - 14.3 *10 years* | 8.7 - 39.7 *10 years* | 8.1 *10 years* |
| **Spain** | **fix** | 6.1 - 6.9 *no limit* | 6.9 *no limit* | 6.9 *no limit* | 6.1 - 6.9 *no limit* | 6.1 - 6.9 *no limit* | 23.0 - 44.0 *no limit* | 6.9 *no limit* |
| | **premium** | 8.6 - 9.4 *no limit* | 9.4 *no limit* | 9.4 *no limit* | 8.6 - 9.4 *no limit* | 9.4 *no limit* | 25.5 *no limit* | 9.4 *no limit* |

1) For the countries using a different currency than Euro, the exchange rate of the 1st of January 2006 is used [OANDA Corporation 2006].
2) The maximum value given for Germany is only available if all premiums are cumulated. This combines the enhanced use of innovative technologies, CHP generation and sustainable biomass use.

79 *Evaluation of different feed-in tariff design options - Best practice paper for the International Feed-in Cooperation*, a research project funded by the German Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).

## B. Summary of State Feed-In Tariff Bills and Laws[80]

**Appendix 1: Summary of State Feed-in Tariff Bills and Laws**

| Bill | Status | Project Cap | Reasonable Profit | Contract length in years | Incentives | Electricity | Review | Interconnection costs | Wind |
|---|---|---|---|---|---|---|---|---|---|
| Minnesota HF 3537 (Bly) | Referred to Committee on Finance (2/28/2008) | • 51% ownership by Minnesotans (residents, LLCs of residents, non-profits, governments, tribal councils, electric cooperatives; see 216B.1612, subdivision 2, paragraph (c)) • 20 MW • Distribution grid only, with option to extend to transmission if RPS not met | 10% or higher | 20 | No other state and federal incentives | 100% to utility | 2 years | Utility | • $0.105 (< 700 kWh/m2/year) • linear in between 700 to 1,100 kWh/m2/year) • $0.08 (> 1,100 kWh/m2/year) • $0.25 (1000 sq. ft. swept area) |
| | **Hydropower** | **Biomass or Biogas** | **Landfill Gas** | | **PV** | | **Geothermal** | | **Other** |
| | • $0.10 (< 500 kW) • $0.085 (500 kW to 10 MW) • $0.065 (10 MW to 20 MW) | • $0.145 (< 150 kW) • $0.125 (150 kW to 500 kW) • $0.115 (500 MW to 5 MW) • $0.105 (5 MW to 20 MW) (60% or greater efficiency) | • $0.10 (< 500 kW) • $0.085 (> 500 kW) (60% or greater efficiency) (or sewage treatment gas) | | • $0.71 (façade cladding < 30 kW) • $0.68 (façade cladding 30 kW to 100 kW) • $0.67 (façade cladding > 100 kW) • $0.65 (rooftop < 30 kW) • $0.62 (rooftop 30 kW to 100 kW) • $0.61 (rooftop > 100 kW) • $0.50 (ground mounted) | | None | | None |
| **Bill** | **Status** | **Project Cap** | **Reasonable Profit** | **Contract length in years** | **Incentives** | **Electricity** | **Review** | **Interconnection costs** | **Wind** |
| Rhode Island H 7616 (Sullivan) | Referred to House Corporations 02/26/2008 | • 20 MW | 10%-30% | 20 | None | 100% to utility | 2 years | Utility | • $0.115 (< 20 MW) • $0.105 (20 MW to 50 MW) |
| | **Hydropower** | **Biomass or Biogas** | **Landfill Gas** | | **PV** | | **Geothermal** | | **Other** |
| | • $0.10 (< 500 kW) • $0.085 (500 kW to 10 MW) • $0.065 (10 MW to 20 MW) | • $0.145 (< 150 kW) • $0.125 (150 kW to 500 kW) • $0.115 (500 kW to 5 MW) • $0.105 (5 MW to 20 MW) | • $0.10 (< 500 kW) • $0.085 (> 500 kW) (or sewage treatment gas) | | • $0.54 (rooftop < 30 kW) • $0.52 (rooftop 30 kW to 100 kW) • $0.44 (rooftop 100 kW to 2 MW) • $0.48 (ground mounted) | | • $0.19 (< 5 MW) • $0.18 (5 MW to < 10 MW) • $0.115 (10 MW < 20 MW) • $0.09 (> 20 MW) | | All others: avoided cost x 1.15 |

80 *Policy Update from WFC*

| Bill | Status | Project Cap | Reasonable Profit | Contract length in years | Incentives | Electricity | Review | Interconnection costs | Wind |
|---|---|---|---|---|---|---|---|---|---|
| Michigan HB 5218 (Law) | Referred to Energy and Technology Committee, 9/15/2007 | • 20 MW<br>• Electric distribution grid only | 10%-30% | 20 | Reduce rates to reflect any other incentives | 100% to utility | 2 years | Utility | • $0.105 (< 700 kWh/m2/year)<br>• linear in between 700 to 1,100 kWh/m2/year)<br>• $0.08(>1,100 kWh/m2/year)<br>• $0.25 (1000 sq. ft. swept area) |
| | **Hydropower** | **Biomass or Biogas** | **Landfill Gas** | | **PV** | | **Geothermal** | | **Other** |
| | • $0.10 (< 500 kW)<br>• $0.085 (500 kW to 10 MW)<br>• $0.065 (10 MW < 20 MW) | • $0.145 (< 150 kW)<br>• $0.125 (150 kW to 500 kW)<br>• $0.115 (500 MW to 5 MW)<br>• $0.105 (5 MW to 20 MW) | • $0.10 (< 500 kW)<br>• $0.085 (> 500 kW)<br>(or sewage treatment gas) | | • $0.71 (façade cladding < 30 kW)<br>• $0.68 (façade cladding 30 kW to 100 kW)<br>• $0.67 (façade cladding > 100 kW)<br>• $0.65 (rooftop < 30 kW)<br>• $0.62 (rooftop 30 kW to 100 kW)<br>• $0.61 (rooftop > 100 kW)<br>• $0.50 (ground mounted) | | • $0.19 (< 5 MW)<br>• $0.18 (5 MW to 10 MW)<br>• $0.115 (10 MW 20 MW)<br>• $0.09 (> 20 MW) | | None |
| **Bill** | **Status** | **Project Cap** | **Reasonable Profit** | **Contract length in years** | **Incentives** | **Electricity** | **Review** | **Interconnection costs** | **Wind** |
| Hawaii HB 1748 (Saiki), SB 1223 (Menor), SB 1609 (Hanabusa) | Carried over from 2007 | • 20 MW<br>• nameplate capacity = 5% of utility peak demand | N/A | 20 | Ineligible if claiming income tax credit | Premium excess net metering | N/A | Generator | None |
| | **Hydropower** | **Biomass or Biogas** | **Landfill Gas** | | **PV** | | **Geothermal** | | **Other** |
| | None | None | None | $0.70 | None | None | | | |
| **Bill** | **Status** | **Project Cap** | **Reasonable Profit** | **Contract length in years** | **Incentives** | **Electricity** | **Review** | **Interconnection costs** | **Wind** |
| Hawaii HB 3237 (Thielen) | Referred to EEP/WLH/TRN, CPC, FIN, 1/25/2008 | • 20 MW<br>• nameplate capacity = 5% of utility peak demand | N/A | 20 | Ineligible if claiming income tax credit | Premium excess net metering | N/A | Generator | None |
| | **Hydropower** | **Biomass or Biogas** | **Landfill Gas** | | **PV** | | **Geothermal** | | **Other** |
| | None | None | None | $0.45 | None | None | | | |

| Bill | Status | Project Cap | Reasonable Profit | Contract length in years | Incentives | Electricity | Review | Interconnection costs | Wind |
|---|---|---|---|---|---|---|---|---|---|
| Illinois HB 5855 (May) | Amended to PV net metering bill (see below), 3/12/2004 | • 20 MW<br>• Electric distribution grid only | 10%-30% | 20 | Reduce rates to reflect any other incentives | 100% to utility | 2 years | Utility | • $0.105 (< 700 kWh/m2/year) • linear in between 700 to 1,100 kWh/m2/year)<br>• $0.08 (> 1,100 kWh/m2/year)<br>• $0.25 (1000 sq. ft. swept area) |
| | **Hydropower** | **Biomass or Biogas** | **Landfill Gas** | | **PV** | | **Geothermal** | | **Other** |
| | • $0.10 (< 500 kW)<br>• $0.085 (500 kW to 10 MW)<br>• $0.065 (10 MW < 20 MW) | • $0.145 (< 150 kW)<br>• $0.125 (150 kW to 500 kW)<br>• $0.115 (500 MW to 5 MW)<br>• $0.105 (5 MW to 20 MW) | • $0.10 (< 500 kW)<br>• $0.085 (> 500 kW)<br>(or sewage treatment gas) | | • $0.71 (façade cladding < 30 kW)<br>• $0.68 (façade cladding 30 kW to 100 kW)<br>• $0.67 (façade cladding > 100 kW)<br>• $0.65 (rooftop < 30 kW)<br>• $0.62 (rooftop 30 kW to 100 kW)<br>• $0.61 (rooftop > 100 kW)<br>• $0.50 (ground mounted) | | • $0.19 (< 5 MW)<br>• $0.18 (5 MW to 10 MW)<br>• $0.115 (10 MW 20 MW)<br>• $0.09 (> 20 MW) | | None |
| **Bill** | **Status** | **Project Cap** | **Reasonable Profit** | **Contract length in years** | **Incentives** | **Electricity** | **Review** | **Interconnection costs** | **Wind** |
| Illinois HB 5855 (May) Amendment Number 001 to 16-107.5 of the Public Utilities Act | Referred to Rules Committee 3/14/2004 | • 2 MW<br>• 1% of customer's previous year's peak demand | N/A | N/A | N/A | Net metering | N/A | | None |
| | **Hydropower** | **Biomass or Biogas** | **Landfill Gas** | | **PV** | | **Geothermal** | | **Other** |
| | None | None | None | | All gross kWh generated through net metering at 200% of the retail price | | None | | None |
| **Bill** | **Status** | **Project Cap** | **Reasonable Profit** | **Contract length in years** | **Incentives** | **Electricity** | **Review** | **Interconnection costs** | **Technology tariffs** |
| California AB 1969 (2006) (Yee) | Approved by Governor (9/29/2006) | • 250 MW program cap (proportionate caps for each utility)<br>• 1.5 MW system cap<br>• Water and wastewater facilities only | N/A | 10, 15, 20 | RECs transfer to utility | 100% or net metering | N/A | N/A | TBD |

| Bill | Status | Project Cap | Reasonable Profit | Contract length in years | Incentives | Electricity | Review | Interconnection costs | Technology tariffs |
|---|---|---|---|---|---|---|---|---|---|
| California SB 451 (2007) (Kehoe) | Vetoed (10/13/07) because of REC transfer issue | • 1,000 MW program cap (proportional caps for each utility)<br>• 1.5 MW system cap | N/A | 10, 15, 20 | RECs transfer to utility | 100% or net metering | N/A | N/A | TBD |
| **Bill** | **Status** | **Project Cap** | **Reasonable Profit** | **Contract length in years** | **Incentives** | **Electricity** | **Review** | **Interconnection costs** | **Technology tariffs** |
| California AB1807, AB1920, AB1714 | In committee | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| **Bill** | **Status** | **Project Cap** | **Reasonable Profit** | **Contract length in years** | **Incentives** | **Electricity** | **Review** | **Interconnection costs** | **Technology tariffs Wind** |
| Vermont S 209 (Lyons) | Passed and signed | None, slight differentiation between < and > 1MW | N/A | 15 | RECs transfer to utility | To utility | 2012 | N/A | TBD |