Asia-Pacific
Economic Cooperation

Utility-based Financial Mechanisms For Renewable Energy and Energy Efficiency

APEC 21st Century Renewable Energy Development Initiative (Collaborative VIII): Workshop on Recent Advances in Utility Based Financial Mechanisms that Support Renewable Energy and Energy Efficiency (EWG 02/2007)

Energy Working Group
Expert Group on New and Renewable Energy Technologies

March 2009

Report prepared for the APEC Expert Group on New and Renewable Energy Technologies by:

Dr. Cary Bloyd
Decision and Information Sciences Division
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 20905 USA
Email: bloyd@anl.gov
Phone: +1-301-651-8899
Fax : +1-301-388-0537

for
APEC Secretariat
35 Heng Mui Keng Terrace Singapore 119616
Tel: (65) 68919 600 Fax: (65) 68919 690
Email: info@apec.org Website: www.apec.org

APEC#209-RE-01.2

1. Introduction

Continued strong growth in electricity demand in the APEC region highlights the linkage between the energy needed to support sustainable development and concerns over the contribution of the electric utility sector to both global and local environmental issues. As APEC economies account for over 50% of the world energy demand, it is important that new energy production be based on best practices in the use of new and renewable energy technologies as well as cost effective energy efficiency measures. The electric utility sector is particularly important due to the size of investment that will be needed in the future. The electric utility sector is expected to account for about 49% of the projected \$3.4 to \$4.0 trillion investment needed for APEC's energy sector over the next two decades.[1]

Electric utilities across the APEC region have shown an increased interest in implementing grid-connected renewable energy systems as well as implementing various energy efficiency programs. The motivating factors for these activities include efforts to reduce green house gas emissions, increase energy security in their economies, improve the local environment, increase local employment, and for the economic benefits of using domestic energy resources.

Several policies and measures have been implemented globally targeted to promote greater use of renewable energy and energy efficiency. Financial mechanisms such as rebates and subsidies from utilities as well as various tax incentives from the governments have long been adopted. As many countries have liberalized their electric utility sectors, new approaches have been developed to find more effective means to promote renewable energy and energy efficiency activities.

In the US, each state implements its own electricity policies. Renewable Portfolio Standards (RPS) have been adopted widely in the US. RPS is projected to increase the use of energy from renewable sources in the US significantly in the future (projected at 60 GW by 2025). However, this will still be only 15% of projected electricity demand growth in that year.[2] The US thus needs to find other policies to accelerate renewable energy growth in addition to an adoption of RPS. Most states are adopting combinations of mechanisms to achieve their goal of increasing renewable energy generation.

Feed-in tariffs have been implemented widely in Europe and have proven to be effective renewable energy schemes that drive growth in renewable energy markets in several European countries—especially Germany and Spain. Net metering has some similar characteristics with feed-in tariffs. Both allow consumers to produce and supply their renewable electricity to the grid and be paid for it. One main difference is that net metering pays generators based on the retail rate or, more often, wholesale or "avoided cost" price, while feed-in tariffs normally pay the generators a pre-specified rate above the retail rate of electricity. The US has more experience with

---

[1] "APEC Energy Demand and Supply Outlook 2006", Asia Pacific Energy Research Center, Institute of Energy Economics, Tokyo, Japan, 2006, page 66. See wwww.iiej.or.jp/aperc

[2] Wiser, R. and Barbose. G., "Renewable portfolio standards in the United States: A status report with data through 2007", (LBNL-154E), Berkeley, CA: Lawrance Berkeley National Laboratory, 2008.

net metering than feed-in tariffs. Forty-four US states have currently adopted a net metering policy.

Renewable energy certificates and white certificates are market-based instruments that are tradable and are used to guarantee that certain amounts of electricity are generated from renewable energy sources, and certain amounts of electricity have been saved, respectively. White certificate markets have developed just recently and there is not much experience in the market at present.

This paper examines recent advances in utility-based financial mechanisms that support renewable energy and energy efficiency activities. The utility-based financial mechanisms reviewed here include renewable portfolio standards, feed-in tariffs, net metering, rebates and loan programs, renewable energy certificates, and white certificates. These mechanisms can be classified into four groups: quota schemes, performance-based incentives, capital payments, and market-based instruments. Some countries have more success with one mechanism over the others. This paper provides a discussion of policy effectiveness as well as some principal similarities and differences among these financial mechanisms.

2. Renewable Portfolio Standard

A Renewable Portfolio Standard (RPS) is a regulatory policy which places an obligation on electric utilities to produce a specified fraction of their electricity from renewable energy sources. Some states also allow energy efficiency measures to be counted as part of their RPS. Presently, a total of 28 US states are implementing an RPS and 5 states have a renewable energy goal (see Table 1). The targets of RPS are different in each state, for example, varying from 8% (in Illinois) to 25% (in New York) by 2013. Some states have set a target of using any combined qualified renewable energy resources to meet their RPS while others states have separated qualified renewable energy resources into different classes (or tiers) and set a certain target for each resource class to be utilized to meet the RPS. Wind, photovoltaics, biomass, hydroelectric, and land fill gas are the most common renewables that are qualified in the RPS of most states. Geothermal is also widely included in the states' RPS. In general, the qualified geothermal utilization is geothermal for electricity production. Arizona and Hawaii, however, have allowed both geothermal electric and geothermal heat pumps, and Nevada has included geothermal electric and geothermal hot water district heating systems, in their RPS. Most states clearly stated that fuel cells to be qualified in their RPS must use renewable energy fuels. However, Connecticut, District of Columbia, Maine, New York and Pennsylvania counted any fuel cells (using renewable or non-renewable fuels) in their RPS. Several states — including Colorado[3], Connecticut, Hawaii, Illinois, Nevada, North Carolina, Pennsylvania, and Vermont—have also allowed energy efficiency technologies to be counted as part of their RPS.

Pennsylvania is implementing an "Alternative Energy Portfolio Standard" (AEPS) instead of RPS, and established two categories of energy sources. Tier I sources include (new and existing) photovoltaic energy, solar-thermal energy, wind, low-

[3] Only in the Fort Collins.

impact hydro, geothermal, biomass, biologically-derived methane gas, coal-mine methane and fuel cells. Tier II sources include (new and existing) waste coal, distributed generation systems, demand-side management, large-scale hydro, municipal solid waste, wood pulping and manufacturing byproducts, and integrated gasification combined cycle (IGCC) coal technology. The AEPS calls for utilities to generate 8% of their electricity by using Tier I energy sources, and 10% using Tier II sources by May 31, 2021.

The RPS relies on the private market for its implementation as electric utilities buy electricity from private generators. With an obligation to meet RPS requirements, electric utilities have to make sure that sufficient amounts of electricity are purchased from certified renewable energy generators. Certified renewable energy generators earn certificates (Renewable Energy Certificates) for every unit of electricity they produce and can sell these along with their electricity to electric supply companies. Supply companies then pass the certificates to the state or regulators to demonstrate their compliance with their RPS obligation.

Table 1: Renewable Energy Portfolio Standards in the US

States	Wind	PV	Solar Thermal	Bio-mass	Geo-thermal	Hydro electric	Fuel Cells	Land fill gas	Tidal/ Ocean	Wave	CHP/ Cogen	Anae Robic digestion	MSW	Bio diesel	Etha-nol	Co firing	Hy-dro gen	EE1/
Arizona	X	X	X	X	X2/	X	X	X			X	X						
California	X	X	X	X	X	X	X	X	X	X		X	X	X				
Colorado	X	X		X	X	X	X	X				X						X3/
Connecticut	X	X	X	X		X	X	X	X	X	X		X					X
Delaware	X	X	X	X	X	X	X	X	X	X		X						
District of Columbia	X	X	X	X	X	X	X	X	X	X			X			X		
Florida	X	X		X				X					X					
Hawaii	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
Illinois	X	X	X	X		X		X						X				X
Iowa4/	X	X		X		X		X				X	X					
Maine	X	X	X	X	X	X	X	X	X		X		X					
Maryland	X	X	X	X	X	X	X	X	X	X		X	X					
Massachusetts	X	X	X	X			X	X	X	X								
Michigan	X	X		X		X		X										
Minnesota	X	X	X	X		X		X				X	X			X	X	
Missouri	X	X	X	X	X	X		X										
Montana	X	X	X	X	X	X	X	X				X						
Nevada	X	X	X	X	X5/	X	X	X	X			X	X	X				X
New Hampshire	X	X	X	X	X	X		X	X	X		X		X	X		X	
New Jersey	X	X	X	X	X	X	X	X	X	X		X						
New Mexico	X	X	X	X	X	X	X	X				X						
New York	X	X		X		X	X	X	X	X		X		X	X			
North Carolina	X	X	X	X	X	X		X	X	X		X					X	X
North Dakota	X	X	X	X	X	X		X									X	
Oregon	X	X	X	X	X	X		X	X	X		X					X	
Pennsylvania6/	X	X	X	X	X	X	X	X	X		X	X	X					X
Rhode Island	X	X		X	X	X	X	X	X	X		X		X				
South Dakota	X	X	X	X	X	X		X				X	X				X	

Table 1: Renewable Energy Portfolio Standards in the US (Continued)

States	Wind	PV	Solar Thermal	Bio-mass	Geo-thermal	Hydro electric	Fuel Cells	Land fill gas	Tidal/ Ocean	Wave	CHP/ Cogen	Anae Robic digestion	MSW	Bio diesel	Etha-nol	Co firing	Hy-dro gen	EE
Texas	X	X	X	X	X	X		X	X	X								
Vermont	X	X	X	X		X	X	X				X						X
Virginia	X	X	X	X	X	X			X	X		X	X					
Washington	X	X	X	X	X	X		X	X	X		X		X				
Wisconsin	X	X	X	X	X	X	X	X	X	X								

Notes: 1/ Energy Efficiency

2/Include both geothermal electric and geothermal heat pump

3/ Energy efficiency is included only in the RPS of the Fort Collins and is not applied to other cities in Colorado.

4/ Iowa called it “Alternative Energy Law”.

5/ Include geothermal electric and geothermal hot water district heating systems

6/ Pennsylvania called it “Alternative Energy Portfolio Standards” and included “waste coal, coal mine methane, coal gasification, and other distributed generation technologies in its standards.

Source: Database of State Incentives for Renewable & Efficiency, see www.dsireusa.org

It has been argued that RPS mechanisms have tended to be most successful in the US in stimulating new renewable energy capacity where they have been used in combination with federal Production Tax Credits (PTC).[4] In periods where PTC have been withdrawn, the RPS alone has often proven to be an insufficient stimulus to provide incentives for large volumes of renewable generating capacity.[5]

There is also an argument that RPS creates "limited" long-term markets for renewable energy. The RPS is achieved by obligating electric suppliers to deliver to consumers a portion of their electricity from renewable energy sources. RPS is one of the quota scheme mechanisms, which generally do not create long-term certainty. A quota is set either for a period of time or for a quantity of power. Once that goal is reached, there is nothing to make electric suppliers obtain more renewable energy power, or keep renewable power producers from becoming uneconomic. In addition, RPS depends on competitive bidding and limits participation to only participants with high power in the market. This leads to the concentration of renewables into the hands of powerful generators.

3. Electricity Feed Laws

Electricity Feed Laws permit the interconnection of renewable sources of electricity with the electric-utility network and specify how much the renewable generators are paid for their electricity. Electricity Feed Laws are also known as Feed-in Tariffs, Renewable Tariffs, or Renewable Energy Producer Payments, and, in Ontario, Canada, Standard Offer Contracts. The modern version of Electricity Feed Laws is called Advanced Renewable Feed-in Tariffs.

Feed-in tariffs are payment per kWh for electricity generation fed back into the electricity grids from designated renewable electricity generation sources like solar PV systems or wind turbines. Investors receive a long-term contract, i.e., 20 years, from utilities to buy electricity from them at a guaranteed fixed price, assuring them a return on their investment. The payments are generally at a higher rate than retail prices of grid electricity to provide an incentive to the investors. In Europe, these fixed prices are structured either in the form of long-term payments based on generation cost plus a reasonable profit (as in Germany) or in the form of a fixed premium on top of the spot market price for electricity (as in Spain).[6] Feed-in tariffs offer equitable opportunity to all willing participants in the market.

---

[4] Companies that generate wind, geothermal, and "closed-loop" bioenergy are eligible for the federal production tax credit (PTC), which provides a 1.9-cent per kWh benefit for the first ten years of a renewable energy facility's operation. Other technologies, such as "open-loop" biomass, incremental hydropower, small irrigation systems, landfill gas, and municipal solid waste, receive a lesser value tax credit. See the Union of Concerned Scientists, http://www.ucsusa.org/clean_energy/solutions/big_picture_solutions/production-tax-credit-for.html

[5] http://en.wikipedia.org/wiki/Renewable_Portfolio_Standard

[6] Ragwitz and Huber, "Feed-in systems in Germany and Spain and a comparison," (2005) from "The Debate over Fixed Price Incentives for Renewable Electricity in Europe and the United State: Fallout and Future Directions", a white paper prepared for the Heinrich Boll Foundation, by Wilson Rickerson and Robert C. Grace, February 2007.

A feed-in tariff can be a net feed-in tariff or a gross feed-in tariff. A net feed-in tariff, also known as export metering, pays the system owner only for surplus energy he produces to the grid after his consumption, whereas a gross feed-in tariff pays for each kWh produced to a grid-connected system.

Feed-in tariffs have been claimed to be the most effective way to stimulate rapid growth of renewable energy market. After investment subsidies, feed-in tariffs are claimed to be the most widespread means of promoting renewable energy uptake in Europe. At present, feed-in tariff regulations for renewable energy exist in over 40 countries around the world including 18 European Union countries.[7] In 2006 Ontario became the first government in North America to establish a set of European-style feed-in tariffs, called the Standard offer Contract.[8]

Advanced Renewable Feed-In Tariffs (ART) is the modern version of Electricity Feed Laws. ART use a tiered system. For example, with wind energy, the price per kWh in each tier reflects the price needed for incentives in different regions during the first few years. During later years, wind power generators in areas with strong winds are paid less than those in low-wind zones. The actual price in later years is a function of the amount of electricity generated. Wind power generators producing more than a certain amount, reflecting a windy site, are paid a lower rate per kWh than the norm. Wind power generators producing less than the standard, reflecting a less windy site, are paid a higher rate. Germany and France are adopting ART for wind, and solar energy. Both set fixed prices during the first five years. Germany sets two tiers that apply across the entire country, and France sets three different tiers and different prices depending on location—metropolitan France, its old colonies (DOM-TOM) and Corsica. Germany paid all onshore wind projects beginning operation in 2004 at 0.087 €/kWh for the first five years of operation. After five years, the payment level at windy sites drops to 0.055 €/kWh. For generators at less windy sites, the higher payment level is extended for longer periods of time depending on the weakness of their wind resource.[9] France pays 0.03 €/kWh for windy sites, 0.08 €/kWh for less windy sites, and 0.06 €/kWh at sites between the two extremes.[10]

Feed law systems have resulted in the installation of eight times more wind capacity worldwide than quota systems. Neither net metering, renewable portfolio standards, tax credits, nor even PURPA (the US Public Utilities Regulatory Act), have produced more wind-generated capacity than the feed laws used in Europe.[11]

---

[7] http://www.energymatters.com.au/government-rebates/feedintariff.php

[8] Ontario Power Authority, 2007

[9] Wilson Rickerson and Robert C. Grace (2007), "The Debate over Fixed Price Incentives for Renewable Electricity in Europe and the United State: Fallout and Future Directions," a white paper prepared for the Heinrich Boll Foundation.

[10] Paul Gipe, "Electricity Feed Laws Power Renewable Energy," http://www.fuelandfiber.com/Athena/ElectricityFeedLawsNewAthenum.doc

[11] Bernard Chabot, an economist with France's Agency for Environment and Energy Management.

Germany

Germany is credited with implementing the most successful feed-in tariff laws. The Electricity Feed Act was introduced in Germany in 1991 to guarantee interconnection of renewable energy power with electricity grids. This 1991 Act required utility companies to purchase electricity generated from renewable resources at set rates (feed-in tariffs) at a percentage of the average retail rate, which varied from year to year. Wind and solar projects received 90% of the retail rate. Hydropower, biogas, and biomass plants under 500 kW received 80%, and over 500 kW but under 5 MW received 65% of the retail rate.[12] The ratepayers of each utility were responsible for the cost burdens within their utility territory. Total generation was capped at 10% of each utility's portfolio.

In the late 1990s, the retail rates began to fall which resulted in slow growth of renewable markets. The 1991 original scheme was amended and expanded in 2000, and has been responsible for the dramatic growth in Germany's renewable energy market, particularly the solar photovoltaic industry.

Under the new feed-in tariffs, power from renewable energy sources is paid at fixed price premium rates, targeting specific technology types. The 20-year long-term contracts are offered to renewable generators to secure a reasonable profit for their investment. The feed-in tariffs are differentiated based on costs of generation of individual technology plus a reasonable profit. Each technology is eligible for a different feed-in rate so that each renewable energy resource type can be profitably developed. The resource-specific feed-in tariffs are further differentiated by system size, installation type, and/or resource availability. Wind generators are differentiated by wind resource such that projects in better wind regimes received lower payments than those in lower wind regimes.

The 2000 feed-in tariffs were amended in 2004. The 2004 law adjusted the payments for biomass, PVs, and geothermal generators to more accurately reflected generation costs and to target specific applications, such as facade-integrated PVs; fuels such as manure and energy crops for biogas; and conversion technologies, such as fuel cells and organic Rankine cycles. The rates for some technologies were adjusted again in 2008.

The average level of feed-in tariff in 2005 was €0.0953 per kWh (compared to an average cost of displaced energy of €0.047 kWh). The total level of subsidy was €2.4 billion, at a cost per consumer of €0.0056 per kWh (3 % of household electricity costs).[13]

Under the German feed-in tariffs, the renewable generators receive a fixed payment for 20 years, but payment streams decline over time such that a generator beginning

---

[12] International Energy Agency (2008), "Global Renewable Energy Policies and Measures Database: Electricity Feed Law", see http//www.iea.org/textbase/pm/?mode=re&id=1057&action=detail

[13] HM Treasury (2006), *Stern Review on the Economics of Climate Change*, p. 367, Retrieved from http://en.wikipedia.org/wiki/Feed-in_tariffs_in_Germany

production in 2006 will receive a lower payment stream than a generator beginning production in 2005. This declining payment structure is designed in order to account for improved efficiencies from economies of scale and encourage cost reductions over time. In 2005, for example, the annual reductions are 1.5% for electricity from biomass and landfill gas; 5% for electricity from PV; 1% for electricity from geothermal; and 2% for electricity from wind. There is no decrease in the incentive for hydropower. In addition, the prices are revisited by parliament every four years to allow for adjusting the program to changes in the economy. German feed-in tariffs by technology and payment reduction rates, with installed capacity and output in 2005 are shown in Table 2.

Table 2: German Fixed Payments (2005)

Resource	Max Size	Payment (€cent/kWh)	Decrease in incentive (% per annum)	MW (2005)	GWh (2005)
Hydropower	500 kW	9.67	0.0%	4,680	21,524
	5 MW	6.65			
Landfill gas, sewage gas, mine gas	500 kW	7.67	1.5%	2,192	13,444
	5 MW	6.65			
Biomass	150 kW	11.5	1.5%		
	500 kW	9.9			
	5 MW	8.9			
	20 MW	8.4			
Geothermal	5 MW	15	1.0%	0.2	0.2
	10 MW	14			
	20MW	8.95			
	Above 20 MW	7.16			
Onshore wind	First 5 years	8.7	2%	26,500	18,428
	Up to 20 years	5.5			
Offshore wind	First 12 years	9.1	2%		
	Up to 20 years	6.19			
Photovoltaics	Ground mounted	45.7	5%	1,508	1,000
	Building mounted (30 kW)	57.4			
	Building mounted (<100 kW)	54.6			
	Building mounted (>100 kW)	54			

Source: Bundesministerium für Umwelt Naturschutz und Reaktorsicherheit (2004) and Staiss et.al (2006) from "The Debate over Fixed Price Incentives for Renewable Electricity in Europe and the United State: Fallout and Future Directions", a white paper prepared for the Heinrich Boll Foundation, by Wilson Rickerson and Robert C. Grace, February 2007, p7.

The German feed-in tariffs have resulted in significant expansion of renewable energy markets during the past decade, and Germany is now the world's largest market for photovoltaic systems and wind energy. In 2005, 10% of electricity in Germany came from renewable sources of which 70% was supported by feed-in tariffs. Germany more than doubled its national supply of renewable electricity between 2000 and 2007, and met its 2010 target of 12.5% renewable electricity three years ahead of schedule.[14] As a consequence of this success, Germany recently increased its renewable energy target to 27% of all electricity generation by 2020.

Spain[15]

Spain is another country where feed-in tariff policy has driven rapid growth of renewable energy markets. Spain was the first country to include a specific solar thermal feed-in tariff. In 2007, there were only 10 MW of solar thermal systems installed in the country, but as of March 2008, 270 MW additional capacity of solar thermal systems are under development.

The current feed-in policy in Spain is a result of various amendments to renewable energy policies and legislation. In 1997, Spain established a special regime for renewable energy targets that allowed generators to choose either a feed-in tariff, similar to Germany's, or a premium payment on top of the electricity market price. Both the tariffs and the premium payments were based on generation costs and differentiated by technology, and, for some resources, by size. Both the tariffs and the premium payments were adjusted annually by the government to take into account changes in the market. The payment burdens were distributed nationally. Generators over 10 MW would need to forecast their generation 30 hours in advance.

In 2004, the regime was amended to further differentiate resources by size, including an increase in the PV system size eligible for the most generous tariff from 5 kW to 100 kW. The annual tariffs were tied to the average annual retail price, rather than set by government. A full review of tariffs was scheduled for every 4 years. The contract length was set at the life of the system. More incentives were added for generators to choose the premium payment option. Unlike the German feed-in tariff, the Spanish feed-in tariff included capacity goals for each technology that would trigger a policy revision by the government when reached. The goals for each resource are 13,000 MW for wind, 3,200 MW for biomass, 2,400 MW for hydro, 200 MW for solar thermal, and 150 MW for PV.[16]

The tariff scheme was revised again in 2007. After the 2004 amendment to increase incentives for the premium payment option, the majority of renewable generators opted to take this option, rather than the tariff payment. Spot market prices increased more than the government projected. To control costs, the law removed the incentive for choosing the premium payment and established a floor and a ceiling value for the premium payment option. The annual adjustment in tariff was changed to tie it to the

---

[14] Bohme et al. (2008), "Development of Renewable Energies in Germany in 2007", Berlin, Germany: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit.

[15] Grace, Robert C., Rickerson, Wilson and Corfee, Karin (KEMA), "California Feed-in Tariff Design and Policy Options," California Energy Commission, Publication number: CEC-300-2008-009D.

[16] Del Rio Gonzalez, P. (2008) "Ten Years of Renewable Electricity Policies in Spain: An Analysis of Successive Feed-in Tariff Reforms", Energy Policy, 36 (8), 3345-3350.

consumer price index instead of average retail price.[17] The capacity goals for certain resources were raised. Biomass was further differentiated by fuel type and biomass tariffs were increased. Different incentives were offered for on-peak and off-peak generation. A generator received 104.62% of the payment for on-peak power, and 96.70% of the payment for off-peak power.

In 2008 the Spanish PV market increased four times larger than its capacity goal. The government thus introduced a cap of 300 MW on annual solar installations (200 MW for rooftop systems, and 100 MW for ground-mounted systems) and reduced the incentives to between 65% and 75% of their previous levels.[18]

There are several similarities between German and Spanish feed-in policies. Both schemes provide long-term contracts and fixed-price payments that encourage investor security. Both schemes provide payments based on generation costs for a specific technology. Both Germany and Spain evenly distributed the cost of their feed-in tariff policy nationally.[19] Several differences, however, are seen between these two schemes. Some of the key components of the feed-in policies in Germany and Spain are compared in Table 3.

---

[17] Held A., Ragwitz, M., Huber, C., Resch, G., Faber, T. and Vertin, X. (2007), "Feed-in systems in Germany, Spain and Slovenia: A comparison", Karlsruhe, Germany: Fraunhofer Institut für Systemtechnik und Innovationsforschung.

[18] "Spain to cut subsidies for solar PV, not solar thermal", SustainableBusiness.com News (July 22, 2008), www.sustainablebusiness.com/index.cfm/go/news.display/id/16449

[19] Germany initially limited its feed-in tariff cost distribution within each utility service territory but eventually switched to a broader socialization system due to problems with cost imbalances and their effect on competition in the electricity market.

Table 3: Comparison of German and Spanish Feed-in Tariffs

Design Issue	Germany	Spain
Contract length	20 years	Project life
Tariff structure	Fixed payment	Fixed payment or fixed premium
Incentive basis	Generation cost	Generation cost
Differentiation Technology	Yes	Yes
Size	Yes	Yes
Resource quality	Yes	No
Tariff adjustment	Tariffs locked in for 20 years, applicable to a generator coming online in a particular year; for each subsequent year, the fixed 20-year rate declines according to a schedule that tracks experience curves	Annual tariff and premium rates pegged to CPI; Payment revised periodically by government; Premium payment sits atop variable wholesale electricity market price, but total remuneration is bounded by floor and ceiling
Tariff revision	4 years	4 years, or by capacity triggers
Policy caps	None	Technology-specific capacity triggers, with grid access deposits
Forecast obligation	No	Yes
Voltage support incentive available to generators	No	Yes
Peak generation differentiation	No	Voluntary

Source: KEMA, Inc.

Australia

Feed-in tariff legislation has been enacted by several State governments in Australia. Several States have also proposed solar photovoltaic feed-in tariffs schemes. There is no nationalized feed-in program, only State-run schemes.[20] A uniform federal scheme to supersede all State schemes has been proposed, but not enacted. Two state governments—including Western Australia (WA) and the Australian Capital Territory (ACT)—have enacted a gross feed-in tariff. Other State Government, including Victoria (VIC), South Australia (SA), Tasmania (TAS), Northern Territory (NT), and Queensland (QLD) have enacted net feed-in tariff schemes, meaning that

[20] The Federal Parliament of Australia has not yet enacted a national gross feed-in tariff scheme for renewable energy. However, a capital grant/rebate is offered of up to AUD 8,000 per household for domestic installations and 50% for school installations.

homeowners are only paid for the electricity exported to the grid minus what is consumed in the home at the time of generation.

Tariff rates vary among States. Victorian households with solar power systems will be paid a feed-in tariff starting in 2009 at AUS$0.60 per kWh for every unused kWh of power fed back into the state electricity grid, which is almost four times the current retail price for electricity and the highest feed-in tariff offered in Australia. South Australian residents will receive AUS$0.44 per kWh. Not all electricity companies in South Australia may choose to offer contracts and those that do may add to this incentive. The Australian Capital Territory's gross feed-in tariff pays around AUS$0.50 per kWh, almost four times the normal retail price. The current feed in tariff rate for Tasmania is AUS$0.20 per kWh. In Northern Territory, Alice Springs residents can receive a net feed in tariff rate of AUS$0.45 per kWh produced while other areas of the Northern Territory receive the rate of AUS$0.1438 per kWh. The feed-in schemes in Australia among states are shown in Table 4.

Table 4: Australia Feed-in Tariff schemes

State	Current Status	Max Size	Rate Paid AUS$ Per kWh	Program Duration (Years)	Model
VIC	Commences 2009	2 kw	$0.60	15	Net
SA	Commenced July 2008	10 kw	$0.44+	20	Net
ACT	Commences March 2009	30 kW	$0.5005 up to 10kW; $0.4004 up to 30 kW	20	Gross
TAS	Commenced	tbc	20c	tbc	Net
NT	Incentive is available for 225 rooftop PV systems in Alice Springs	tbc	$0.4576, capped at $5 per day; then reverts to $0.2311/kWh	tbc	Net
WA	Little activity since election commitment	tbc	Expected to be up to $0.60	Likely 2-9 years	Gross
QLD	Commenced July 2008	10 kW	44c+	20	Net
NSW	Under review, to commence in 2009	tbc	Not yet specified; expected $0.60	tbc	tbc

Note: "tbc"refers to "to be confirmed."
Source: http://www.energymatters.com.au/government-rebates/feedintariff.php

Canada

North America's first electricity feed law was implemented in Ontario, Canada. The feed-in tariff mechanism in Ontario is under the name Standard Offer Contracts (or also known as Advanced Renewable Tariffs). The contracts became available in Fall 2006, and included existing systems from January 1, 2000. The Standard Offer Contracts include many of the characteristic elements of European feed laws. The tariff paid for each kilowatt-hour generated is different for each renewable energy technology. Contracts are open to all parties and for 20 years—so it will be sufficient time to payback the investment. Ontario tariffs for wind, hydro, and biomass are adjusted for 20% inflation (compared to the 60% adjustment in France). There is no inflation adjustment for PV. Contracts under Ontario's Standard Offer Program are limited to 10 MW (while German's project size is limited to 20 MW). However, there is no limit of the program's total size (same as the German feed law).[21]

Ontario's prices under the Standard Offer Program are normally less than tariffs paid in Europe. In the case of solar energy, Ontario's price is US$0.3336 per kWh as compared to US$0.7217 per kWh in France or US$0.6057 per kWh in Germany. Table 5 compares Ontario's Standard Offer Contract Tariffs with feed-in tariffs in other countries.[22]

Table 5: Ontario's Standard Offer Contract Tariffs as Compared to Feed-in Tariffs in Other Countries (First year Renewable Tariffs in US$/kWh)

	Wind	PV	Hydro	Biogas	Program Duration
Ontario	0.0877	0.3336	0.0877	0.0877	20 years
Austria	0.0978	0.5960		0.2196	
Brazil	0.0715		0.0505	0.0631	
Czech Republic	0.1117	0.6002			
France	0.1062	0.7217	0.0711	0.1166	15 yrs for wind and biomass; 20 yrs for solar and hydro
Germany (2008)	0.1040	0.6057	0.0955	0.1403	20 years
Italy		0.7126			
Portugal	0.1024		0.1062		12 years
Spain (2007)	0.0981	0.5897		0.1750	
Turkey	0.0713				

Note: Tariffs were conversed from Euro.
Source: www.wind-works.org/FeedLaws/RenewableTariff.xls

Only recently, Prince Edward Island has established feed-in tariffs. The rate is $0.043 per kWh for wind, biomass, and solar with a $0.013 per kWh adder tied to the consumer price index. Systems in Prince Edward Island must be larger than 100 kW. Saskatchewan is also in a process of implementing a standard offer contract.[23]

[21] "North America's First Electricity Feed Law: Standard Offer Contracts in Ontario, Canada" by P.Gipe and B.Chabot, DEWI Magazin Nr. 29, August 2006; www.dewi.de/dewi/fileadmin/pdf/publications/Magazin_29/04.pdf

[22] www.wind-works.org/FeedLaws/Canada/Q&AonStandardOfferContracts.html

[23] Wilson Rickerson and Robert C. Grace (2007), "The Debate over Fixed Price Incentives for Renewable Electricity in Europe and the United State: Fallout and Future Directions," a white paper prepared for the Heinrich Boll Foundation.

United States[24]

The United States implemented a law called the Public Utilities Regulatory Act (PURPA) in 1978. PURPA permitted interconnection of renewable energy generators with the grid but did not specify the price—only the means for calculating the price. Electric Feed Laws are equivalent to PURPA with tariff prices being specified.

Six US states have introduced feed-in tariff legislation including California (CA), Michigan (MI), Illinois (IL), Minnesota (MN), Rhode Island (RI) and Hawaii (HI). In addition, eight states are surveying the idea of adopting feed-in tariffs in their states to increase renewable energy generation including Florida, Main, Massachusetts, New Jersey, New York, Vermont, Wisconsin, and Oregon. Feed-in tariff schemes vary among states as shown in Table 6.

Table 6: US Feed-in Tariff Schemes

	Current Status	Max Size	Program Duration (years)	Model[1/]
CA	Commenced in 2006 and expanded in 2007	1.5 MW- system cap 478.4 MW-program cap	10, 15, or 20 years	Gross or net
MI	The bills were passed by the House; now in committee in the Senate	20 MW	20 years	Gross
IL	Opposed in the legislature, and amended to PV net metering bill	20 MW	20 years	Gross
MN	Referred to Committee on Finance (2/28/2008)	20 MW Generators must be majority-owned by Minnesotans.	20 years	Gross
RI	Referred to House Corporations (2/26/2008). The bill is being negotiated.	20 MW	20 years	Gross
HI	Not passed out of committee and will have to be reintroduced next session	20 MW Nameplate capacity = 5% of utility peak demand	20 years	Net

Note: [1/] "Gross" refers to 100% generation to utility, and "Net" refers to surplus of energy after consumption

Source: Feed-in Tariffs and Renewable Energy in the USA—a Policy Update, Rickerson, Bennhold and Bradbury (May, 2008)

---

[24] Rickerson, Bennhold, and Bradbury (2008), "Feed-in Tariffs and Renewable Energy in the USA—a Policy Update", North America Solar Center, Heinrich Boll Foundation (Washington DC), and WorldFuture Council.

California was the first state to develop feed-in tariffs, which were introduced in 2006. The program was for systems with a capacity of 1.5 MW and below, capped at 250 MW total statewide and limited to facilities sited at wastewater and water treatment facilities. The contracts are offered to generators for 10, 15 or 20 years. Generators can choose to sell either 100% of the total power or sell only their excess electricity after their own use. Unlike German feed-in tariffs, California's feed-in tariffs are based on time-of-delivery, not generation cost of individual technologies. All technologies are offered the same price, but this price varies depending on whether the electricity is generated during peak or off-peak times. In Southern California, peak payments can be up to $0.31 per kWh in the summer. In 2007 the program was extended to all customer-types and the cap was expanded to 478.4 MW. A recent bill (AB 1807 of 2008) is seeking to increase the system capacity limit to 20 MW and shift to a payment structure that is based on individual technology generation costs.

In addition to California, other state legislatures have introduced feed-in tariffs. These states designed their feed-in tariff structures similar to Germany with tariffs based on technology-specific payments. Michigan offers technology-specific payments for wind, hydropower, biomass or biogas, landfill gas, PV and geothermal in a sliding scale of capacity. Minnesota offers technology-specific payments similar to Michigan but does not cover geothermal. Illinois proposed a similar feed-in tariff structure to Michigan but it was opposed in the legislature and thus amended to be a PV net metering bill with a project cap at 2 MW, and pays all gross kWh PV generated through net metering at 200% of the retail price. The current feed-in tariff schemes in the US are compared in Table 7.

In addition to feed-in tariff bills at the state level, there is a significant effort to introduce national feed-in tariffs in the US. A national feed-in tariff bill, called a renewable energy payment (REP), was introduced to the Congress in May 2008. The bill includes three main design elements: 1) guaranteed interconnection through uniform minimum standards (e.g., the priority interconnection and transmission of power from new renewable energy facilities, which include renewable energy facilities 20 MW or less); 2) a mandatory purchase requirement through fixed-rate 20-year contracts (e.g., national REP rates at levels designed to provide for full cost recovery plus a 10% internal rate of return on investment; REP 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.); and 3) rate recovery through a regionally partitioned national system benefits charge on every electric customer in the US.[25]

[25] Rickerson, Bennhold, and Bradbury (2008), "Feed-in Tariffs and Renewable Energy in the USA—a Policy Update," North Carolina Solar Center, World Future Council, and Heinrich Boll Foundation.

Table 7: Feed-in Tariffs in the US

	Michigan	Illinois	Minnesota	Rhode Island	Hawaii
Wind	\$0.105 (<700 kWh/m^2/year) Linear in between 700 to 1,100 kWh/m^2/year \$0.08 (>1,100 kWh/m^2/year) \$0.25 (2000 sq ft swept area)	None	\$0.105 (<700 kWh/m^2/year) Linear in between 700 to 1,100 kWh/m^2/year \$0.08 (>1,100 kWh/m^2/year) \$0.25 (1000 sq ft swept area)	\$0.115 (<20 MW) \$0.105 (20MW to 50 MW)	None
Hydro	\$0.10 (<500 kW) \$0.085 (500 kW to 10 MW) \$0.065 (>10 MW, <20 MW)	None	\$0.10 (<500 kW) \$0.085 (500 kW to 10 MW) \$0.065 (>10 MW, <20 MW)	\$0.10 (<500 kW) \$0.085 (500 kW to 10 MW) \$0.065 (>10 MW, <20 MW)	None
Biomass/ Biogas	\$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)	None	\$0.145 (<150 kW) \$0.125 (150kW to 500 kW) \$0.115 (500 kW to 5 MW) \$0.105 (5MW to 20 MW) (60% or greater efficiency)	\$0.145 (<150 kW) \$0.125 (150kW to 500 kW) \$0.115 (500 kW to 5 MW) \$0.105 (5MW to 20 MW)	None

Table 7: Feed-in Tariffs in the US (Continued)

	Michigan	Illinois	Minnesota	Rhode Island	Hawaii
Landfill Gas	$0.10 (<500 kW) $0.085 (>500 kW) (or sewage treatment gas)	None	$0.10 (<500 kW) $0.085 (>500 kW) (60% or greater efficiency, or sewage treatment gas)	$0.10 (<500 kW) $0.085 (>500 kW) (or sewage treatment gas)	None
PV	$0.71 (façade cladding < 30kW) $0.68 (façade cladding 30 kW to 100 kW) $0.67 (façade cladding >100 kW) $0.65 (rooftop < 30kW) $0.62 (rooftop 30 kW to 100 kW) $0.61 (rooftop >100kW) $0.50 (ground mounted)	All gross kWh generated through net metering at 200% of the retail price	$0.71 (façade cladding < 30kW) $0.68 (façade cladding 30 kW to 100 kW) $0.67 (façade cladding >100 kW) $0.65 (rooftop < 30kW) $0.62 (rooftop 30 kW to 100 kW) $0.61 (rooftop >100kW) $0.50 (ground mounted)	$0.54 (rooftop < 30kW) $0.52 (rooftop 30 kW to 100 kW) $0.44 (rooftop >100kW to 2 MW) $0.48 (ground mounted)	$0.45

Table 7: Feed-in Tariffs in the US (Continued)

Technology	Michigan	Illinois	Minnesota	Rhode Island	Hawaii
Geothermal	$0.19 (<5 MW) $0.18 (5 MW to 10 MW) $0.115 (10 MW to 20 MW) $0.09 (>20 MW)	None	None	$0.19 (<5MW) $0.18 (5MW to 10 MW) $0.115 (10MW to 20 MW) $0.09 (>20 MW)	None
Other	None	None	None	Avoided cost times 1.15	None

Source: Rickerson, Bennhold, and Bradbury (2008), "Feed-in Tariffs and Renewable Energy in the USA—a Policy Update," North Carolina Solar Center, World Future Council, and Heinrich Boll Foundation.

Several states in the US have passed Community-Based Energy Development (C-BED) legislation, and thus a C-BED policy similar to feed-in tariffs is being considered. Minnesota is an example of a state considering C-BED feed-in tariffs. The C-BED structure is similar to that of feed-in tariffs in that utilities are required to develop 20-year contracts for renewable generators. However, utilities are not required to enter into C-BED contracts, and the contracts are negotiated rather than standardized. The C-BED policy in Minnesota covers wind and other technologies but did not establish technology-specific rates.

Japan

Japan had the largest number of solar photovoltaic units installed in homes until fiscal 2005 when Germany surpassed this record due to the implementation of its feed-in tariff policy. Japan wants to implement a feed-in tariff system in fiscal 2010 where electric power companies are obligated to purchase surplus electricity generated by household solar cells. Feed-in tariffs in Japan focuses only on solar power and on the surplus electricity generated after home or factory usage. At present the utilities purchase electricity only voluntarily for about 23 to 25 yen ($0.243 to $0.264)[26] per kWh The feed-in tariff rate paid to investors will be guaranteed for 10 years at 50 yen (about $0.528) per kWh, about double current retail prices. The guaranteed price may come down when mass usage of solar panels reduces related costs.

The additional cost to electric power companies of introducing the system would be offset through slightly higher electricity rates, resulting in a rise in electricity price per family of up to 100 yen a month.

It costs about 2.5 million yen to install solar cells in a typical home. About 500,000 yen of this amount is covered by government subsidies.

Japan's industry ministry reinstated subsidies of household solar cell installations (repealed in fiscal 2005), starting in April 2009, at 70,000 yen ($740) per kW of solar panel to foster use of solar panels in homes.[27]

4. Net Metering

Net metering has some similar characteristics with feed-in tariffs. Both net metering and feed-in tariffs are a performance-based renewable energy incentive scheme. Both allows consumers to produce and be paid for renewable electricity that they supply to the grid. However, net metering schemes are not backed up by the special rules needed to achieve the price and access objectives of a feed-in tariff law.

Under net metering, consumers can offset the cost of electricity they buy from a utility by selling renewable electric powered they generate back to the utility. A consumer's electric meter can run both forward and backward in the same metering period, and the consumer is charged only for the net amount of electricity consumed. By definition, true net metering calls for the utility to purchase power at the retail rate and

[26] Use an exchange rate of $1 equals 94.59 Yen

[27] www.asahi.com/english/Herald-asahi/TKY200902260086.html

use one meter.[28] However, net metering rules vary significantly by country, state, and province. Dual metering is adopted in some states and countries, allowing the price paid by utilities for surplus power to be at a different rate from the price paid by consumers for using the power from utilities. From the point of view of a consumer, dual metering is less attractive than net metering as any surplus is often bought at a low price per unit, such as at the wholesale or "avoided cost" price, which is lower than the retail prices of electricity.

In the US, as part of the Energy Policy Act of 2005, all public electric utilities are required to make available upon request net metering service to any electric consumers that the electric utility serves. Currently, net metering is available in 44 US states and Washington DC.[29] New Jersey and Colorado are considered to have the best net-metering policies in the US as both have no limit on overall enrollment (but limit system size to be less than 2 MW each), roll over month to month and pay annually for excess generation at avoided-cost rate (New Jersey) or incremental cost (Colorado).[30]

As an example of net metering in other economies, Ontario allows net metering for up to 500 kW. Credits can be carried for 12 consecutive months. Any unused credits remaining at the end of 12 consecutive months are cleared at the end of that billing.[31] Areas of British Columbia serviced by BC Hydro are allowed net metering for up to 50 kW. At each annual anniversary, the customer is paid 5.4 cents per kWh if there is a net export of power. Systems over 50 kW are covered under the Standard Offer Program.[32]

There are several advantages associated with implementing net metering. Net metering is considered a low-cost, easily-administered mechanism for encouraging investment of small-scale renewable energy systems. Net Metering gives customers more flexibility, allows them to maximize the value of their production, and increases the value of the electricity produced by renewable generation. Net metering allows customers to "bank" their energy and use it at different times than it is produced. Renewable energy such as wind and solar energy is an intermittent resource and customers may not be using power as it is being generated and with net metering, consumers can receive full value for the electricity they produce without having to install battery storage systems—which directly affects the economics and pay-back period for the investment. Utilities also benefit from net metering because when

---

[28] http://apps1.eere.energy.gov/states/alternatives/net_metering.cfm

[29] Details on net metering policy in each US state can be found at http://www.dsireusa.org/library/includes/seeallincentivetype.cfm?type=Net&currentpageid=7&back=regtab&EE=0&RE=1

[30] Interstate Renewable Energy Council, http://www.irecusa.org/index.php?id=88

[31] "Net Metering in Ontario" http://www.energy.gov.on.ca/english/pdf/renewable/NetMeteringBrochure.pdf

[32] http://www.bchydro.com/planning_regulatory/acquiring_power/net_metering.html

customers are producing electricity during peak periods, the system load factor is improved.[33]

5. Renewable Energy Certificate

Renewable Energy Certificates (RECs) are also known as Green tags, Green Certificates, Renewable Energy Credits, or Tradable Renewable Certificates. RECs are tradable environmental commodities. One certificate represents proof that 1 megawatt-hour (MWh) of electricity was generated from an eligible renewable energy resource. About 25% of US utilities offer a green power program.

RECs can be sold, and the owner of the REC can claim to have purchased renewable energy. The consumer of RECs receives only a certificate. The energy associated with an REC is sold separately and is used by another party. Because RECs can be traded separately from electricity, that makes it possible for anyone to buy green power anywhere regardless of whether or not his/her utility offers green power.

In states with an REC program, a renewable energy generator is credited with one REC for every 1 MWh of electricity he/she produces. A certifying agency gives each REC a unique identification number to make sure it doesn't get double-counted. The renewable electricity is then fed into the electrical grid, and the accompanying REC can then be sold on the open market.

There are two main markets for RECs in the US—compliance markets and voluntary markets. Compliances markets are in US states with Renewable Portfolio Standard policies. Electric utilities in those states have a mandate to sell certain quantities of electricity that are generated from renewable energy sources. These utilities can then purchase RECs at the equal amounts to their requirement of electricity sales from renewable energy sources. Voluntary markets are ones where customers choose to buy power from renewable energy sources voluntarily. Renewable energy generators located in states that do not have an RPS can sell their RECs to voluntary buyers, usually at a cheaper price than compliance market RECs.

There is a long list of power generators that generate power from renewable energy sources and sell RECs.[34] However, there is no national registry or database of RECs issued at present. Several certification and accounting organizations attempt to ensure that RECs are correctly tracked and verified and are not double-counted. The leading certifiers are, for example, Green-e[35], and Environmental Resources Trust, Inc.[36]

Prices of RECs can fluctuate significantly. REC prices depend on many factors, such as the location of the facility producing the RECs, supply/demand situation, and the type of power produced. Some organizations sell as many RECs as possible and then

---

[33] http://apps3.eere.energy.gov/greenpower/markets/netmetering.shtml

[34] http://www.green-e.org/base/re_products?cust=r#res

[35] http://www.green-e.org/

[36] http://www.ert.net/

use the funds to guarantee a specific fixed price per MWh generated by a future wind farm, for example, making the building of the wind farm a financially viable prospect. The income provided by RECs, and a long-term stabilized market for tags can generate the additional incentive needed to build renewable energy facilities. Table 8 shows wholesale prices of RECs in the voluntary market in the US Midwest, West, and the national average in 2006.

Table 8: Wholesale/ Large Commercial Voluntary REC Prices in 2006

Unit: $/MWh

Generation Type	Midwest	West	National
Biomass		$3-10	$1-5
Solar		$18-21	$21
Wind	$1-4	$3-7	$1-4
Geothermal		$1-7	

Source: Evolution Markets. From Lori Bird, "Overview of Renewable Energy Certificate (REC) Markets," National Renewable Energy Laboratory, presented at the FTC Workshop, January 8, 2008.

Technologies qualified for RECs vary from one trading scheme to the other trading scheme. In general, the following generation technologies qualify as producers of RECs: solar electric, wind, wave and tidal, geothermal, lo impact-hydropower (such as small-run-of-the river facilities), biomass, biofuels, landfill gas, and fuel cells (that are powered by hydrogen produced by one of the above approved generators, not from fossil fuels).

Prices for RECs are set by supply and demand. A renewable energy production or consumption target is set, and the consumer purchases renewable energy from whoever provides it the most competitively. In principal, this system delivers the cheapest renewable energy, since the lowest bidder will win.

RECs are currently in use in several countries including Poland, Sweeden, the UK, Italy, Belgium, and the US.[37]

One advantage of RECs is that it allows consumers to support renewable energy even when their utilities do not provide green power options. However, critics point out a flaw in this system is that it does not require any proof of displaced power from polluting sources. Since some renewable energy sources, most notably wind power, are intermittent and variable, their production does not displace an equivalent amount of other sources, diminishing the effective value of the RECs. There is also an argument concerning "additionality" with RECs. When there are voluntary REC purchases, it is difficult to prove that these purchases result in new renewable energy onto the electricity grid or they are simple payments to a project that would have existed even in the absence of the REC sales.

[37] For more information about REC in the US, see http://www.epa.gov/greenpower

7. White Certificate

White certificates are also known as Energy Savings Certificates, Energy Efficiency Credits or White Tags. Similar to RECs which are used for renewable energy electricity trading, White Certificates represent a specific, verified quantity of reduction in energy use. Each certificate is a unique and traceable commodity guaranteeing that additional 1 MWh of energy is saved and that the benefit of these savings has not been accounted for elsewhere. White certificates are given to the producers whenever an amount of energy is saved. The producers can use the certificate for their own target compliance or sell to other parties who cannot meet their required targets.

Australia was the first nation that commenced tradable energy efficiency certificates, starting in New South Wales (NSW) on January 1, 2003 and in the Australian Capital Territory (ACT) on January 1, 2005. The certificates are created as part of a larger baseline-and-credit emissions trading scheme called the Greenhouse Gas Reduction Scheme (GGAS). GGAS applies in NSW and the ACT which are part of a wholesale electricity market operating across a total of six jurisdictions of Australia. GGAS aims to reduce GHG emissions associated with the generation and use of electricity through project-based activities to offset the production of emissions. The GGAS legislation imposes benchmarks targets for GHG emissions on the electricity sector as a whole. These overall targets are implemented by setting individual benchmark emissions levels for certain obligated parties, principally electricity retailers. The obligated parties have to control their GHG emissions at their pre-set benchmark level. The obligated parties have an option of purchasing certificates called New South Wales Greenhouse Abatement Certificates (NGACs) to offset their excess emissions and surrender these certificates to the Scheme's Compliance Regulator. NGACs are transferable and tradable between parties. One NGAC represents one abated tonne of cabon dioxide equivalent. NGACs are created by accredited "Abatement Certificate Providers" undertaking several types of project-based activities that reduce or offset emissions. One of these activities, called "demand side abatement" includes energy efficiency projects. NGACs created as a result of energy efficiency project are white certificates. By the end of 2006, nearly 10 million energy efficiency certificates were created under GGAS.[38]

White Certificates have been used to some extent in Europe but not very much in the US at present. Three states—Connecticut, Nevada and Pennsylvania, however, allow white certificate trading. These states have adopted Renewable Energy Portfolio Standards that allow regulated utilities to meet a certain percentage of their projected power needs through energy efficiency. Utilities must meet their obligations by either reducing their consumers' energy usage, or by purchasing energy efficiency certificates (white certificates). The White Certificate markets are still very new in these states, and offer no experience to date.[39]

---

[38] David J Crossley, "Tradeable Energy Efficiency Certificates in Australia," Energy Futures Australia Pty Ltd, Sydney, Australia, email: crossley@efa.com.au

[39] Matthew Brown (2008), "White certificates for Energy Efficiency in the United States," InterEnergy Solutions, January 30, see http://www.interenergysolutions.com/blog/?p=85

Pennsylvania allows white certificate trading, but there have been few trades at this point. Energy efficiency can be used to meet what the state calls Tier II standards for the advanced energy portfolio standard, but it must compete with small hydro, waste coal and other more traditional resources. Nevada allows energy efficiency to meet up to 25% of the renewable energy portfolio standard and also allows trading. Regulations have been developed but programs have not yet existed, nor have trades been placed. An innovative feature in Nevada is that reductions that occur during peak periods receive double credit — providing greater incentive to these reductions.

The voluntary market for white certificates, where consumers may purchase energy efficiency certificates to reduce their carbon footprints, is still developing. There is still a lack of a good and widely accepted measurement and verification processes for trading White Certificates.

In Europe, several countries have implemented white certificate schemes or are seriously considering doing so. Italy started a scheme in January 2005. France started it in 2006. UK has combined its obligation system for energy savings with the possibility to trade obligations and savings. Denmark and the Netherlands are seriously considering introduction of a white certificate scheme in the near future.

Under the French White Certificates Trading program, suppliers of energy (electricity, gas, heating oil, LPG, heat, refrigeration) must meet government-mandated targets for energy savings achieved through the suppliers' residential and tertiary customers. Suppliers are free to select the actions to meet their objectives. They may, for example, inform customers how to reduce energy consumption, run promotional programs, or provide customers with good incentives. The suppliers who exceed their energy saving requirements can trade energy savings certificates. Energy suppliers who do not meet their obligation over the period (2006-2008) must pay a penalty of euro 0.02 per kWh. The first experimental phase of the scheme will run for three years from July 1, 2006 to June 30, 2009. It is expected that during this time, the scheme will result in 54 TWh of cumulated energy savings.[40]

The market for white certificates in the US can be expected to grow larger than the renewable energy certificate market because it requires less government approval and expense to install energy efficiency measures in factories and commercial buildings than to construct most renewable energy projects. One important issue is how to ensure that customers are not double counting their white certificates with other incentive programs for energy efficiency.

8. Capital Payment Incentives

Utilities offer various capital payment incentives to consumers for obtaining renewable energy systems or energy efficiency improvements. The typical incentives from utilities in the US include rebates and loans. A rebate, or up-front subsidy, is a direct payment to consumers to refund part of the installation costs of renewable energy systems, or buy down costs of energy efficiency equipment. Programs are available for both residential customers and non-residential customers such as

[40] http://www.iea.org/textbase/pm/?mode=pm&action=detail&id=2613

schools, non-profit organization, commercial and industrial customers. For example, utilities may offer rebates to their residential customers for the installation of energy efficient heat pumps and geothermal heat pumps, for insulation upgrades in their homes, or offer rebates for the purchase of Energy Star qualified household appliances (i.e., clothes washers, dishwashers, refrigerators). Some utilities offer low interest rate loans to its customers for a variety of energy efficient improvements ranging from replacement thermal windows and insulation upgrades to improving heating and cooling system installations. This will make the new equipment or home improvement project more affordable, and allow them to be paid over a period of time.

Buy-back programs are being offered to customers by some utilities. Buy-back programs for inefficient equipment such as old refrigerators, air conditioners, or back-up diesel generators will increase capital stock turnover for inefficient equipment. Such programs will help subsidize the replacement of inefficient equipment with newer and more efficient ones.[41]

It is argued that good public policy pays only for performance. Thus payments should be coupled with generation. Rebates or up-front subsidies pay based on nameplate capacity of the installed system and are independent of the actual power generated over time. They also provide no incentive for proper maintenance, which can lead to a shorter system lifetime. More and more US states have moved toward performance-based incentives (payment for generation) and away from up-front capital subsidies.

There are currently debates over the issue of capital payments (i.e., rebates or up-front subsidies) and performance-based or production incentives (i.e., feed-in tariffs and net metering). California's solar program is one example.[42] The California solar program provides up-front capital payments to new solar system installations, and there was a proposal to convert the program to production payments. There are both proponents and opponents on the issue. The solar industry was also split over the issue. Some manufacturers and dealers wanted to maintain the up-front capital payment, while other manufacturers and dealers wanted to move toward production payments.

California's buy-down program puts a solar premium of $2.50-$2.80 directly in the pockets of dealers and installers. Market prices for installed solar systems in California are approximately $2,500 per kW—more costly than in Germany. This "California premium" is likely due to the buy-down program's up-front subsidy. The buy-down program's proponents argued that the buy-down encourages homeowners to buy solar to take advantage of the subsidy while the production incentive requires homeowners to invest in solar, and that discourages residential solar sales. The performance-based incentive's advocates argued that without a production payment, there is no incentive to actually install systems that work. Indeed, California does not

---

[41] The list of financial incentives offered by utilities, and by federal government and state, in each US states can be found at
http://www.dsireusa.org/summarytables/financial.cfm?&CurrentPageID=7&EE=1&RE=1

[42] www.wind-works.org/FeedLaws/USA/Performance-BasedIncentivesorRenewableTariffsforPhotovoltaicsintheUSA.html

know how well the solar systems currently operating in the state are performing. They have only estimates.

The conversion of California's entire solar program to performance payments hinged on how the transition would be made from the existing buy-down subsidy. The mix of incentives in the current program is the result.

Participants in the California process warn that new programs should be designed to avoid buy-down payments from the start. Once capital subsidies have been put in place, it is very difficult to wean dealers from them and substitute performance payments.

The issue of capital payments versus performance-based incentives (PBI) was addressed directly in the California Solar Initiative, which began in January of 2007. In this initiative, the state defined a capital payment called the Expected Performance-Based Buydown (EPBB) to pay for small solar systems (less than 50 kW in size) and a PBI to pay for larger solar systems (equal to, or greater than, 50 kW). The current payments for EPBB are set at $2.50 per watt for residential and commercial users, and $3.25 per watt for government and non-profit users. A PBI payment of $0.39 per kWh is paid to residential and commercial customers, and $0.50 per kWh to government and nonprofit customers. The maximum payments for both EBPP and PBI will decrease over time as more systems are installed. The stated goal of the overall initiative, known as the Go Solar California campaign, is to install 3,000 MW of new grid-connected solar power by 2017.[43]

9. Concluding Remarks

Different renewable energy policies have been adopted to date and there are continuous debates over the merits and success of each policy scheme. The utility-based mechanisms mentioned in this paper are compared in Table 9. Renewable Portfolio Standards (RPS) are widely implemented in the US and Europe. More recently, feed-in tariffs have been implemented in Europe and claimed to be the principal policy driving renewable energy markets for several countries in Europe at a faster rate than seen with RPS. Due to the success of Germany in expanding its renewable energy market by adopting feed-in tariffs, feed-in schemes in various versions (i.e., advanced renewable feed-in tariffs, renewable energy producer payments, or standard offer contracts) have been adopted in other countries and it is considered the world's most widespread national renewable energy policy.

[43] California Solar Initiative Program Handbook, January 2009, see www.gosolarcalifornia.org

Table 9: Comparisons of the Utility-based Mechanisms

	Type of Mechanism	**Process**	**Price**	**Participants**	**Issue**
RPS	Quota system	Use bidding tender system; Quantity of capacity is determined politically, and price is derived from bidding	Competitive price to meet defined target	Large corporation	Quota system for large corporation
Feed-in tariffs	Performance-based/ production incentives	Price is determined politically, and the amount of capacity that results is a function of an open market	Non-market price mechanism; Fixed payment above retail price	Small consumers	Difficult to determine "right" tariff rate
Net metering	Performance-based/ production incentives	Utilities use avoided cost to determine payment rate.	Wholesale or avoided cost prices; below retail rate	Small consumers	Not enough incentive to invest
Rebates/ Loans	Capital payment Incentives	Utilities set up the programs and determine the payment rate	Determined by utility	Small consumers	No incentive to maintain the system
Renewable Energy Certificates	Market-based Mechanism	Production or consumption target is set, consumers purchase from the lowest bidder.	Determined by demand and Supply	Small/large consumers	Argument on additionality
White Certificates	Market-based Mechanism	Producers of energy saving receive the certificates for their own compliance or sell to others who can't meet their required targets	Determined by demand and Supply	Small/large consumers	Double counting with other programs

RPS vs Feed-in tariffs.

RPS is a bidding or tendering system. A quantity of capacity is determined and the price per kWh is derived from bidding among would be developers. In the tendering system, a regulatory agency issues a call for tender of a specified amount of generating capacity. Companies then propose projects and submit bids to provide that capacity at a certain price. The agency typically selects the lowest bidders. In comparison, prices for feed-in tariffs are first determined, and the amount of capacity that results is a function of an open market. Feed laws are simple, offer transparency, and provide a stable policy framework on which manufacturers and developers can build businesses. Engineers and economists calculate the price per kWh needed to spur development for various technologies. They report their findings to a legislative assembly that determines the final price. Prices can thus be tailored to technologies and to regions.[44]

An advantage of feed-in tariffs is that they can be structured to create incentives for renewable energy where the resource is comparatively weak, e.g., pay more for wind power in less windy areas.

With feed-in tariffs, the financial burden falls upon utility ratepayers. Feed-in tariffs reward the number of kWh produced over a long period of time. Because the rate is set by the authorities, getting the price right can be challenging. If the price is too high, it will introduce the risk of overpaying and overstimulating the market. As this high tariff paid to the owner of the system is charged across the board to utility ratepayers, too high of rate adds more burden to customers. If the price is set too low to provide adequate returns to eligible projects, it will have little effect on stimulating development of new renewable energy generation.

It is often argued that feed-in tariffs, which are fixed price policies, are inherently more costly than RPS because they do not encourage renewable energy competition. A competition between renewable energy generators under RPS brings down renewable energy certificate (REC) prices, which create an efficient incentive that supports renewable energy capacity at a minimum cost to society. The counter argument for feed-in tariffs is that the fixed price payment of feed-in tariffs create low risk, stable investment climate while investors under RPS face risks from a volatile electricity market and a volatile short-term renewable energy credit market. The risks raise the cost of capital used to finance renewable energy projects and renewable energy policies, and make RPS more costly than feed-in tariffs.

A study by the Commission of the European Communities (CEC) in 2005 which compared the effectiveness and efficiency of different policies found that risk played an important role in policy efficiency.[45] The study concluded that feed-in tariffs are more efficient and less costly than RPS policies due to the higher risk premium requested by investors and the high administrative costs under RPS policies as well as

---

[44] Paul Gipe, "Unlike tax credits, feed laws don't lead to the boom and bust cycle common to the North American Wind Industry," see www.sustainablebusiness.com/index.cfm/go/news.feature/id/1060

[45] Commission of the European Communities (2005), "The Support of Electricity from Renewable Energy Sources," Brussels.

the still immature REC market. CEC found that the incentive level payments for wind projects, for example, were typically higher in countries with RPS markets than they were in countries with feed-in tariffs, and wind generators typically receive greater windfall profits under RPS than under feed-in tariffs.[46]

One study on best practices for feed-in tariffs concluded that successful feed-in tariffs have the following characteristics, and Germany has been cited as the basis for many of these best practices.[47]

- Long-term guaranteed payments that adequately reflect generation costs and profit
- Incentive levels that decrease over time, i.e. "tariff digression"
- Incentive levels that are specific to certain renewable energy technologies (i.e. PV, wind, biomass, etc.)
- Incentive levels that are tailored to achieve specific policy goals, i.e. development in different wind regimes, use of certain conversion technologies, etc., i.e. "stepped tariff"

European analysts have concluded that RPS have not been as effective in Europe as feed-in tariffs have been. Many countries in Europe are adopting feed-in tariffs in combination with RPS. Most of the US states that are proposing feed-in tariff policies also adopt RPS policies. Rather than viewing feed-in tariffs as a competing policy with RPS, states and countries can view feed-in tariffs as another tool to be adopted to reach existing RPS goals. The countries with proven success in feed-in tariffs like Germany and Spain have undergone several amendments before reaching their present success. APEC economies would be well advised to study the existing feed-in polices and tailor them to fit their renewable energy markets.

[46] Wilson Rickerson and Robert C. Grace (2007), "The Debate over Fixed Price Incentives for Renewable Electricity in Europe and the United State: Fallout and Future Directions," a white paper prepared for the Heinrich Boll Foundation.

[47] Klein, et.al., "Evaluation of different feed-in tariff design options: Best practice paper for the International Feed-in Cooperation", Karlsruhe, German and Laxenburg, Austria: Fraunhofer Institut fur Systemtechnik and Innovationsforschung and Vienna University of Technology Energy Economics Group.

Produced for:
APEC Secretariat
35 Heng Mui Keng Terrace Singapore 119616
Tel: (65) 68919-600 Fax: (65) 68919-690
Email: info@apec.org Website: www.apec.org

APEC#