IS CALIFORNIA THE NEXT GERMANY?

RENEWABLE GAS AND CALIFORNIA'S NEW FEED-IN TARIFF

Biogas production has boomed in Germany, in part due to a feed-in tariff that improves project economics. Recently, the California Energy Commission recommended a feed-in tariff for small generators under 1.5 megawatts in size.

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IN THE January 2008 issue of *BioCycle* ("Farm-Based Digester Conference Highlights"), Phil Lusk stated that California is "exploring 'feed-in tariffs' similar to those received by European power producers who are paid a high fixed price for feeding renewable electricity into the grid." The article's implication is that European-style feed-in tariffs could provide the digester market in California a significant boost.

California has since gone public with the results of its "exploration," and news that the state has put a "feed-in tariff" in place has caused a stir in energy industry circles during the past few weeks. But what exactly is a feed-in tariff? How does the European feed-in tariff model compare to what California has proposed? And what are the implications of the feed-in tariff for renewable gas in California? This article explores these questions through a review of how Germany and California have structured their respective policies.

In 2005 there were 2,680 biogas systems installed throughout Germany totalling 650 MW. By the end of 2007, installed capacity had nearly doubled to 1,271 MW.

THE GERMAN EXAMPLE

Germany has made impressive strides in renewable energy development during the past decade. Starting with a relatively small amount of installed capacity in the 1990s, Germany is now the world's largest market for wind and solar power. In 2000, Germany derived only 6.3 percent of its electricity from renewable energy sources. By 2006, that figure had doubled to 11.6 percent, and Germany satisfied its 2010 target of 12.5 percent at the end of 2007. The German government has since committed to increase its share of renewable electricity to 25 to 30 percent by 2020, and has stated that renewable energy growth will keep the country on track to continue decommissioning its fleet of nuclear plants.

The primary driver for renewable electricity in Germany has been the so-called "feed-in tariff" that has been in place since 2000. The tariff requires that utilities connect renewable energy generators to the grid, and establishes premium payments for renewable electricity. The payments are guaranteed for 20-years, and are set at levels designed to provide renewable energy investors with a reasonable profit. To encourage price reductions over time, the payment level that generators can lock into de-

creases by a certain percentage each year such that a generator who installs a plant in 2009 would receive a lower 20-year rate than a generator who installs a plant in 2008. The rate at which the payments decrease is examined every two years by the German government to determine whether the decline needs to be sped up or slowed down. The European Commission has concluded that the investor security and policy certainty created by the feed-in tariff model have made it the most effective, and economically efficient, renewable energy policy in the European Union.

In the U.S., state Renewable Portfolio Standards (RPS) and federal tax incentives have been the predominant policy mechanisms used to stimulate renewable energy investment. During the past two years, a number of states also have explored ways to "import" feed-in tariffs and emulate the German success with renewable energy. California has been at the forefront of this effort. In its 2007 Integrated Energy Policy Report, for example, the California Energy Commission (CEC) recommended that feed-in tariffs be adopted "in the immediate future" in order to meet the state's proposed target of 33 percent renewable energy by 2020 — a goal similar in its ambition to Germany's. While the CEC recommendation has yet to be implemented, the state recently introduced a more targeted feed-in tariff for small generators under 1.5 megawatts in size. Biogas, wastewater digester gas and landfill gas are eligible for funding under the California feed-in tariff.

Will the new policy create market growth comparable to Germany's? The sections below review the German experience with renewable gas under its national feed-in tariff, and discuss the implications of California's inaugural effort to craft feed-in tariff policy.

Table 1. German feed-in tariff rates for wastewater digester gas[1]

Resources	*2004 Rate ($)*	*2008 Rate ($)*
Wastewater digester gas (≤ 500 kW)	0.113	0.10
Wastewater digester gas (≤ 5 MW)	0.095	0.09
Wastewater digester gas (> 5 MW)	Market price	Market price

[1]Assuming currency conversion rate of 1 Euro = 1.4689 US $

RENEWABLE GAS MARKETS IN GERMANY

In the U.S., the intent of some renewable energy policies, like RPS, is to create competition between renewable technologies such as wind, landfill gas and solar. In Germany, each type of renewable technology is given a separate rate that allows it to be developed profitably. Wastewater digester gas systems, for example, receive a fixed price payment that varies by system capac-

ity. The annual rate of decline for payments is 1.5 percent. A small system (i.e. 500 kW or under) that entered into service in 2004, would have locked into a fixed payment of $0.113/kWh for 20 years, whereas the same system would receive only $0.106/kWh if it were to come online in 2008 (Table 1). Wastewater digesters over 5 MW in size do not get a specific feed-in tariff and sell power at wholesale.

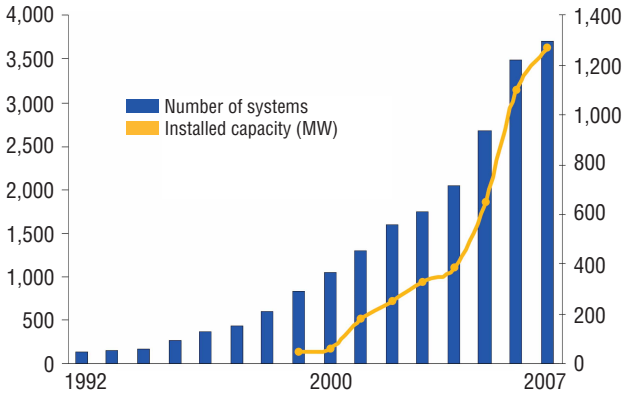
By the end of 2006, there were 290 wastewater digester gas systems totaling 123 MW supplying electricity in Germany. From 2000 to 2006, annual electrical output from wastewater digester gas systems grew at an average annual rate of 4.8 percent, and totaled 936 GWh in 2006. According to a German research institution, the Zentrum für Sonnenenergie und Wasserstoff-Forschung (ZSW), however, the impact of the feed-in tariff on wastewater treatment plant development in Germany is minimal when compared to the law's impact on resources like wind and solar power. One reason is that the wastewater digester gas market is almost saturated, with most of the available resource already developed.

A second reason is that renewable resource operators in Germany have three options for their electricity. They can 1) sell their output at the feed-in tariff rate; 2) sell output at the wholesale market rate; or 3) offset retail electricity. For photovoltaic generators, the feed-in tariff is so high that it makes sense to sell 100 percent of system output at the feed-in tariff rate rather than trying to reduce retail electricity purchases. For wastewater treatment plants, however, the retail rate at which they purchase grid electricity is typically higher than the feed-in tariff rate, so it is more profitable to use anaerobic digester electricity to reduce facility grid electricity consumption. ZSW reports that only 18 percent of wastewater digester output was sold at the feed-in tariff rate in 2006, with the rest being consumed onsite.

Landfill gas plants are eligible to receive the same payments as wastewater treatment gas, but market growth in this sector has been stagnant, with installations holding steady at approximately 250 MW. Not only has the landfill gas resource been largely developed, but Germany banned the landfilling of biodegradable organic waste in 2005, eliminating a source of methane-producing feedstock.

Although the German wastewater digester and landfill gas markets are comparatively dormant, the feed-in tariff's impact on the biogas market has been significant. ("Biogas" references in this article do not include wastewater digester gas and landfill gas.) In 2005, there were 2,680 biogas systems installed throughout Germany totaling 650 MW. By the end of 2007, installed capacity had nearly doubled to 1,271 MW (Figure 1).

Figure 1. Development of biogas in Germany, 1992-2007



SOURCE: Fachverband Biogas e.V. (based on a survey of state government records; September 2007)

The reasons for this comparatively rapid growth include the fact that the biogas feed-in tariff specifically targets a broader range of system sizes than do the wastewater tariffs (Table 2), and that the agricultural biogas resource is significantly larger than the developable wastewater treatment plant gas resource. It is important to note that the German biogas market relies heavily on energy crops as a feedstock. According to the German Renewable Resources Agency, approximately 22 percent of the 1.8 billion hectares of energy crops planted in Germany were harvested as biogas fuel in 2007. Of the currently installed capacity, the German Biogas Association estimates that 85 percent are fueled by energy crops blended with manure, while 15 percent are fueled by organic wastes from households and industry.

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While these two factors have moved the market forward, the primary reason for the recent market explosion has been the biogas payment adders established in 2004. Biogas generated from manure, or from energy crops such as corn silage, is eligible for an additional $0.088/kWh on top of the feed-in tariff rate. Another $0.029/kWh is available for biogas that generates both heat and power — and for biogas plants that employ emerging technologies such as fuel cells or Stirling engines, there is an additional $0.029/kWh available. These adders — especially the energy crop adder — have significantly improved the economics for biogas.

The experience in Germany demonstrates, on the one hand, that renewable gas sources can be supported with targeted feed-in tariffs, and, on the other hand, that feed-in tariffs can have their limitations when resources are constrained or more attractive power sales options exist (e.g. offsetting retail electricity). The section below reviews California's experience with feed-in tariffs to date, compares the proposed incentive structure with that in Germany, and discusses potential implications of the current policy for future market development.

CALIFORNIA LANDSCAPE

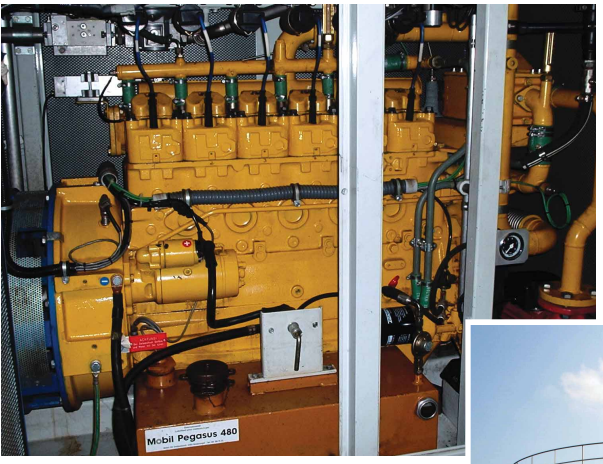
California is well known for championing alternative energy sources. Wastewater digester gas, landfill gas and biogas all qualify for a range of state incentives. Renewable gas is eligible to participate in California's RPS, which requires 20 percent of electricity sold in the state to be generated from renewables by 2010, and sets a goal of 33 percent by 2020. A few large biogas plants have signed agreements with utili-

Table 2. German feed-in tariff rates for biogas

Resources	2004 Rate ($)	2008 Rate ($)
Biogas (≤ 150 kW)	0.169	0.159
Biogas (≤ 500 kW)	0.145	0.137
Biogas (≤ 5 MW)	0.131	0.123
Biogas (> 5 MW)	0.123	0.116
Energy crop and manure adder	+0.088	+0.088
Combined heat and power adder	+0.029	+0.029
Emerging technology adder	+0.029	+0.029

ties to supply renewable gas under the RPS, but the transaction costs associated with RPS participation generally make it difficult for smaller digesters to compete.

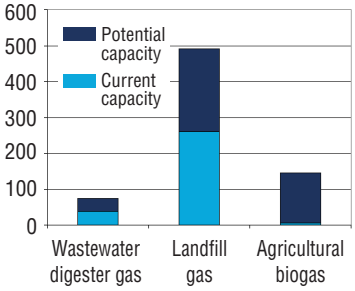
In years past, electricity from smaller onsite digesters has generally been governed through the state's net metering rules, adopted by the California Public Utilities Commission (CPUC) in 1996. Under net metering, a customer receives financial credit during times when more power is generated than consumed onsite. In other words, the electricity meter spins forwards when power is being purchased from the grid, but spins backwards when excess power is being exported onto the grid from the renewable energy system. Credit from any month can be applied to electricity bills through the end of the year, at which point, any surplus electricity is granted to the utility without compensation. While net metering for most renewable energy technologies is capped at 1 MW, an exception allows up to three biogas systems, each between 1MW and 10MW, to net meter statewide. Notwithstanding this exception, there remains a cap of 50 MW on the total digester capacity that can be net metered statewide.



Wastewater digester gas systems in Germany receive a fixed price payment that varies by system capacity. The annual rate of decline for payments is 1.5 percent.

According to the CEC, there are currently 260 MW of landfill gas, 36 MW of wastewater digester gas, and 5.7 MW of agricultural biogas installed in the state (Figure 2). The agricultural biogas systems are comprised of 22 dairy farm digesters that use dairy manure, or a mixture of dairy manure and dairy process wastewater, as feedstock. According to a report prepared for Western United Dairymen, the statewide agricultural biogas resource is 140 MW, which includes only waste and not energy crops. In addition to the agricultural biogas potential, the CEC estimates that both landfill gas and wastewater digester gas capacity could approximately double to 490 MW and 74 MW, respectively (Figure 2).

Figure 2. Current and potential biogas generation (in megawatts) in California



CALIFORNIA'S "FEED-IN TARIFF"

In 2005, a group of water and wastewater facilities petitioned California legislators for new laws to promote the generation of renewable electricity at their facilities. Their reasoning was that: 1) existing net metering laws do not compensate on-site generators for electricity left over at the end of the year; 2) net metering does not distinguish between the value of electricity generated during peak periods when power is more expensive, and off-peak periods; and 3) it was difficult for small systems, such as those typically sited at wastewater plants, to compete in the state's RPS program. In response to these arguments, the California legislature passed Assembly Bill (AB) 1969 in 2006.

AB 1969 required the CPUC, which regulates the state's investor-owned utilities (IOUs), to facilitate creation of a standard offer contract for IOUs to purchase electricity from up to 250 MW of renewable energy systems, including digesters, at water and wastewater facilities. A standard offer contract implies a fixed price payment similar to that offered through European feed-in tariffs, and the CPUC explicitly stated that the contracts were "a form of feed-in tariff" during its rulemaking. In 2007, the CPUC expanded the scope of the new agreement to include a broader range of renewable energy generation owners. The expansion allows for an additional 228.4 MW of renew-

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able energy capacity to be awarded contracts at sites other than water and wastewater facilities.

In the July 2007 decision, the CPUC directed Pacific Gas and Electric (PG&E), Southern California Edison (SCE) and San Diego Gas & Electric (SDG&E) to establish a feed-in tariff, priced at the market price referent (MPR). The MPR is a benchmark price representing the "avoided cost" of generation from a new natural gas fired plant. Avoided cost is a regulatory term for what utilities would otherwise pay if the resource in question, in this case a renewable gas plant, were not procured. By tying the feed-in tariff to the MPR, the Commission sought to minimize the rate impacts of the AB 1969 program as compared to the impacts of purchasing new nonrenewable electricity.

A second important feature of the California feed-in tariff is that the MPR varies according to time-of-day factors and reflects the time value of electricity. In other words, electricity produced during periods of peak demand is awarded higher peak prices. Table 3 summarizes the MPR price paid in different utility service territories for energy generated during specific time periods. It is noteworthy that SCE's peak retail rates are significantly higher than most other IOU rates, and higher than some of the German feed-in tariffs.

Under the feed-in tariff, generators can choose a contract term of 10-, 15-, or 20-years. For the three IOUs, participants can also choose between two compensation structures: full buy/sell, in which the participant buys 100 percent of its power at the retail rate, and sells 100 percent of its generation at the contract price; or net excess, in which the participant offsets its retail electricity consumption with self-generation and sells surplus energy at the contract price.

GERMANY AND CALIFORNIA TARIFF COMPARISON

In Germany, the biogas market has grown rapidly as a result of technology-specific premium payments and lucrative adders that target a broad range of system sizes. In California, policy-makers have opted for technology-neutral contracts tied to the time-value of electricity, and rooted in avoided cost methodology (i.e. the MPR). To date, no feed-in tariffs have been awarded in California, and it will take time and data to evaluate how effective the California feed-in ultimately is. It is safe to say, however, that the California feed-in tariff's unique structure could allow wastewater digester, landfill gas and biogas systems to pursue a range of different contractual approaches.

Generally speaking, average retail rates in California are higher than the feed-in tariff levels during all but peak periods. As a result, facilities with a large on-site load may opt not to pursue the feed-in tariff, unless they have large on-site resource potential. Most facilities would prefer the benefits achieved by switching to a net metering tariff that compensates parties for excess production based on either the full retail rate (in the case of solar) or based on the generation component of retail rates (in the case of biogas). However, one of the drawbacks of net metering is that it motivates the customer to size their generation facility to their load, not to their available fuel resource. Therefore, California facilities with resource potential roughly equal to the on-site load may benefit by sizing their system to zero out their retail consumption and sell any small remainder to the grid, under the net excess option.

For facilities with large resource potential, the feed-in tariff may also create opportunities for more strategic uses of gas resources, sized to the fuel resource in excess of the onsite load, under the full buy/sell option. For example, facilities with a low load and a large gas resource could store excess fuel, and dispatch as much electricity as possible only during the peak feed-in tariff periods. Similarly, some high-load facilities that can shift their loads to off-peak periods may also be able to profitably dispatch power when the feed-in tariff is at its peak. In short, the California feed-in tariff will likely benefit customers having a very specific load/generation profile characterized by relatively high consumption during peak hours and low generation/high consumption during off-peak hours.

It will also be interesting to see what types of renewable generators apply for the feed-in tariff. The primary focus of this article is on renewable gas, but other resources such as solar power could benefit from the AB 1969 policy in the future. The current feed-in tariffs are far lower than German feed-in tariffs for solar, and large commercial solar systems would probably forego the CPUC feed-in in favor of net metering plus a performance-based incentive

Table 3. Time-dependent MPR for energy sold under AB 1969 feed-in tariffs ($/k Wh)

	Summer Weekday			Winter Weekday		
			($)			
Utility/Time-of-Day Period[1]	*Peak*	*Shoulder*	*Off-Peak*	*Peak*	*Shoulder*	*Off-Peak*
PG&E	0.18	0.08	0.06	0.14	0.10	0.07
SCE	0.31	0.12	0.06	0.10	0.08	0.06
SDG&E	0.15	0.10	0.08	0.11	0.10	0.07

[1]Defined periods vary by utility, but generally, peak hours are noon to early evening; shoulder hours are evening and morning; and off-peak hours are nighttime.

(paid up-front or over five years based on system size). The current five-year payment is approximately $0.22/kWh offered under the California Solar Initiative. As CSI incentives decline over time based on demand, it is conceivable that they may converge and adjust in favor of the time-varying feed-in price.

A final point of comparison between Germany and California is policy stability and certainty. The German feed-in tariff has been said to create market certainty because the schedule of payment decreases is known in advance — although the government revisits the rate at which the payment schedule decreases every two years. In California, the CPUC annually resets the MPR (rather than every two years), according to updated inputs such as construction cost trends. As a result, investors have one year to evaluate project economics and sign a contract with the utility. Although this annual change could create uncertainty for project developers, recent trends are encouraging: the MPR has climbed steadily at an average annual rate of 17 percent since its inception in 2004, largely due to recent construction cost increases in the power industry.

In summary, Germany's feed-in tariff has been highly effective in stimulating rapid biogas market growth. Although California's feed-in tariff shares its name with Germany's national renewable energy policy, it is unlikely that California's biogas market will erupt as Germany's market has. The German tariff is specifically tailored to biogas, and the tariffs pay premiums significant enough to create incentives for the cultivation of energy crops for biogas.

The California tariff does not pay premiums or target specific technologies, and is also capped. Even if California biogas generators were to cultivate energy crops to expand the potentially developable biogas resource, there could only be 478.4 MW of capacity installed under the program. Although California's feed-in tariff may not be the market maker that some expect, the policy does represent an innovation because of its recognition of the time value of electricity. Wastewater digester gas, landfill gas and biogas systems may be able to benefit from the California feed-in tariff because of its ability to dispatch electricity on peak. It will be interesting to see how this on-peak dispatch capability impacts the renewable gas markets, and how the time-differentiated feed-in tariff model informs other governments in the U.S. and abroad that are exploring feed-in as a policy option. ■

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