Gipe Sierra Club California Key FIT Criteria

October 19, 2010

**Key Elements Necessary for a Successful**
**California Renewable Energy Sources Act**[1]

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in cooperation with the
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Much has been written about the painfully slow pace of renewable energy development in California and how feed-in tariffs can be used to create a robust market for renewable energy in the Golden State.

This paper summarizes best practices used elsewhere and how California can incorporate these key elements in designing a world-class system of feed-in tariffs. By doing so, California can reclaim its leadership in renewable energy development that it held in the 1980s.

The key elements of successful programs are

- Priority access and efficient project connection
- Program size caps
- Project size caps
- Contract term
- Technologies included
- Tariffs based on cost of generation
- Tariffs differentiated by technology
- Tariffs differentiated by size or application for each technology
- Tariffs differentiated by resource intensity
- Inflation indexing
- Program review
- Degression of solar photovoltaic (PV) tariffs

In addition there are some provisions that are uniquely American that need to be considered.

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[1] The modern system of feed-in tariffs now used in Germany was introduced in the year 2000. In English the law is called the Renewable Energy Sources Act (Erneurebaren Energiengesetz).
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- Multiple tariff tracks for generators with or without access to federal subsidies
- Bonus payments or adders for social benefits such as community development

While the importance of some criteria may be obvious others may be more obscure.

**Priority Access and Connection**

Fundamentally, all successful programs require access to the grid and the certainty that the electricity produced by renewable generators will be purchased. The law creating the German system of Advanced Renewable Tariffs, the Renewable Energy Sources Act, is subtitled, the “law on granting renewable energy priority on the grid” for this reason.

The situation in France illustrates how important access to the grid and connection policy is in determining the pace of renewable energy development. France has one of the best systems of feed-in tariffs in the world, but development has lagged well behind that of Germany and Spain.[4] This is partly due to more restrictive siting policies in France than in Germany and Spain but more is predominantly due to a huge backlog of connection requests. The connection backlog has slowed growth significantly.

Unlike the dense transmission and distribution network in Europe, the grid in North America is more dispersed. As a consequence, the process for assigning grid capacity in North America—who gets to connect and who doesn’t—will be more complex than that in Europe and will vary by jurisdiction.

The connection application process is critical to the pace of renewable energy development and to the success of many of the ancillary program goals, such as job creation, community economic development, and equity among all participants.

Connection policies must be transparent and insure timely resolution of applications. It may be necessary to separate microgenerators, such as residential solar PV, from larger generators.[5]

<u>Ontario’s feed-in tariff connection policy is a North American model that can be followed in California. Ontario has, in general, four classes of possible connections.</u>[6]

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[4] Installed wind capacity in France at the end of 2009 was 4,500 MW; well behind Germany at 26,000 MW and Spain at ~19,000 MW. There is 4,700 MW of wind and 3,700 MW of solar PV awaiting connection in France.

[5] Existing policy in the US differentiates potentially four categories: less than 1 MW, 1 MW to 20 MW, 20 MW to 80 MW, and greater than 80 MW.

- MicroFIT: Systems less than 10 kW are guaranteed a connection and expedited application processing,
- Distributed Generation: Systems <250 kW connecting <15 kV; and <500 kW connecting >15 kV are all guaranteed a connection,
- Large Systems with possible connection: >500 kW at >15 kV; >250 kW at <15 kV must go through a queuing process where a connection is possible, and
- Large Systems without current connection: Applicants are placed in a reserve pool until sufficient capacity becomes available or new transmission capacity is added.

**Program Size Caps**

Policymakers have sometimes used program size caps as a means to control the pace of development and program costs. Program size caps is only one method for controlling program costs, another is the degression of tariffs for new projects.

Programs without administrative caps are invariably more successful than those programs with capacity or generation caps. Industry, investors, and the financial community can scale up their operations when it is clear that the market is large and will expand rapidly. If there are caps and especially if there are low caps, businesses will essentially take a pass on making the long-term investments necessary to drive rapid development and the cost reductions needed to make programs successful.

Germany has no administrative cap on its program. France and Spain have such high caps that they act effectively as no cap in the short term. Germany, France, and Spain all use some form of tariff degression to control program costs.

Ontario's new program also has no regulatory cap; capacity is limited by available transmission.

California currently has a 20% by 2020 renewable target and the Sierra Club supports increasing the target to 33% by 2020.

In early 2010, Germany increased its target to 38.6% by 2020.[7]

<u>For California to take a leadership role in renewable energy development worldwide it must at least formally acknowledge the 33% by 2020 target, and set new more aggressive targets of 40% by 2025 and 50% by 2030. Such</u>

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[6] See http://fit.powerauthority.on.ca/Storage/29/10120_Session_2_Presentation_-_March_24_2009.pdf, page 12.
[7] See Germany Ups Renewable Target--Again. Note that Germany has a target, but no cap on program size.

aggressive targets would put California on a path to match the German target 40% of supply by 2020.

**Project Size Caps**

Similarly, programs with no project size limitations are more successful than those that try to limit project size. Germany has no limit on project size, nor does France on wind energy.[8] Spain limits project size to 50 MW under its fixed tariff program.[9]

Ontario's Standard Offer Contract (SOC) program limited contracts to 10 MW. This was an artifact of Ontario's interconnection policy and was found to be unduly restrictive to wind energy and hydro development. Ontario's SOC program was the forerunner of the current feed-in tariff policy.

On December 1, 2008, the California Energy Commission (CEC) recommended that the Public Utility Commission (PUC) "immediately implement a feed-in tariff program for all RPS-eligible generating facilities up to 20 MW in size".[10] The CEC went further and recommended that the CEC and PUC jointly "evaluate feed-in tariffs for renewable projects larger than 20MW.

The CEC's recommendation for projects less than 20 MW should be the minimum acceptable in California.

**Contract Term**

The length of contracts offered under feed-in tariff policies influence the tariff that must be paid for profitable operation. Shorter contracts require higher prices than longer contracts to achieve the same level of profitability. Higher prices will have a greater effect on the immediate costs to ratepayers in the short term. Thus, it's better to pay for long-lived renewable energy projects, such as solar or wind plants, over 20 years or more to minimize the impact on ratepayers.

Contracts are typically 20 years or more in length.

- Germany: 20 years
- Spain: wind, 20 years; solar PV, 25 years
- France: wind, 15 years; solar PV 20 years
- Ontario: 20 years except hydro, 40 years

Best practice is to offer contracts for a minimum of 20 years.

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[8] France limits solar PV to 12 MW at any one site. This is an artifact of French post-war electricity policy and not an integral part of its system of Advanced Renewable Tariffs.

[9] Spain has two programs, one with fixed tariffs, and another with a premium payment on top of the wholesale price. Only the program with fixed tariffs is considered here.

[10] See CEC Recommends Cost-Based Feed-in Tariff.

## Technologies Included

True renewable energy policies go beyond tariffs only for popular technologies such as wind and solar energy. They should include all or nearly all renewable energy technologies. Feed-in tariffs and especially systems of Advanced Renewable Tariffs include as many technologies as reasonable. For example, there's no need to include a tariff for wave energy in land-locked Iowa. However, a program for Iowa should include at least wind, solar PV, hydro, biogas, and biomass. Policies for such a geographically diverse country as Spain also include CSP (Concentrating Solar Power), and geothermal power generation.

California is the most geographically diverse state in the Union. As such California can develop a robust mix of various technologies, from variable generating resources such as wind and solar to firm sources such as run-of-the-river hydro and biogas plants.

Feed-in tariffs can also be applied to technologies that create heat instead of electricity. For example, Great Britain has proposed a feed-in tariff for solar domestic hot water and other forms of renewable heat.[11]

At a minimum, tariffs should be offered for wind, solar PV, concentrating solar, run-of-the-river hydro, biogas, biomass, and geothermal. In addition, the Sierra Club should give consideration to both on and offshore wind as well as tariffs for small wind turbines.[12] Britain recently introduced tariffs for microgenerators up to 5 MW that includes distinct tariffs for both small and large wind turbines.[13]

To summarize, tariffs can be created for

Wind turbines
- Large: On land,
- Large: Offshore,
- Small,

Solar
- PV,
- Domestic Hot Water,
- Concentrating PV,
- Thermal Generation

Biogenic
- Biogas,
- Biomass,

Geothermal, and
Hydro

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[11] See Britain Proposes Feed-in Tariffs for Renewable Heat.
[12] Ontario offers tariffs for wind turbines on land and offshore.
[13] See Britain Launches Comprehensive System of Feed-in Rates.

Run-of-the-river,
Wave, Tidal, and Current.

**Tariffs Based on Cost of Generation**

In traditional regulated markets, electric utilities are paid for their cost of generation plus a reasonable profit. Successful feed-in tariff policies use the same principal. The difference is that unlike in the traditional system, where a regulatory commission negotiates with an electric utility after the plant has been built to determine a fair payment, the feed-in tariff policy sets a fair and equitable tariff before a project is built. The feed-in tariff policy says, effectively, if you can build your project at this price and operate it, then we will pay you this amount. Therefore, a legislature or a regulatory authority determines a tariff that is fair and equitable to all parties before a project is undertaken through a transparent public process.

The tariff must be sufficient to cover all costs as well as include a reasonable profit for a particular technology in a particular application. The degree of profit determines the rate of growth. When the profit is too low, development will lag.

Successful feed-in tariff polices, such as those in Germany, France, and Spain, calculate the tariffs based on the cost of generation plus a reasonable profit.

Other approaches have been used to set feed-in tariff prices. One is to set the tariff based on the value of the electricity to the system. This is an awkward attempt to find a tariff that will work for solar PV, a technology that is more expensive than most other technologies. In all cases to date, calculating a tariff based on its value has been insufficient to pay for the development of solar PV.

The least effective method is to base the tariff on the cost of a conventional fossil-fueled power plant that would be "avoided" by installing renewable energy. Unlike successful programs where the tariffs are determined by the specific characteristics of each renewable energy technology, "avoided cost" tariffs are determined by the characteristics of a conventional technology.[14] Tariffs based on avoided cost are not renewable energy policy; they are fossil-fuel policy with a provision for "allowing" renewable energy to participate.

Policies in Germany, France, and Spain calculate tariffs that are specific to each technology based on costs specific to each technology in each country. And each country determines what it considers a reasonable profit for each technology.

<u>Best practice worldwide is to base all tariffs on the cost of generation plus a reasonable profit.</u>

[14] In California "avoided cost" is called "market-price referent".

### Tariffs Differentiated by Technology

Successful programs differentiate tariffs by technology. There's one price for wind energy and another for solar PV, and so on. The least successful programs are those that post only one price for all technologies under all conditions.

Some programs vary the tariff by the time of day to reflect the value of the electricity to the system. These programs require a sophisticated analysis to estimate how much a generator will be paid over time. Worse, the generator will not know beforehand how much they will actually be paid. They will know only after the fact. Projects using these tariffs are difficult to finance because the revenue stream is unknown.

When tariffs are based on the "cost of generation plus a reasonable profit", tariffs vary by technology, and often by application as well.

### Tariffs Differentiated by Size and Application

Renewable energy projects have many different applications and come in many different sizes. Programs designed to encourage development in many different categories differentiate tariffs within each technology into several tranches determined by size, ownership, location, or some other distinguishing factor.

It follows naturally that if tariffs are based on the cost of generation plus a reasonable profit, then tariffs will vary among different classes of installations within a technology. For example, rooftop solar PV is more expensive than groundmounted solar PV and therefore the tariff for rooftop PV will be higher than that for a groundmounted system. Similarly, small systems don't have the economies-of-scale of larger systems and their tariffs will be higher than those of large projects.

Germany differentiates tariffs for solar PV generators based on whether the system is installed on a rooftop or on the ground. Tariffs for rooftop solar PV are further differentiated by size into four classes with systems less than 30 kW receiving the highest tariff and systems greater than 1,000 kW receiving the lowest.

Some have called this kind of detail within each technology band "granularity" and is a mark of a sophisticated program where great pains have been taken to calculate the tariffs needed for various kinds of projects. The intent is to create equitable opportunity for all size projects in as many different applications as possible while not paying too much for some and too little for others.

France, for example has two sets of tariffs for most technologies. One set applies to continental France and another set applies to its overseas territories where the cost of generation is considerably higher than on the continent. In France, as elsewhere, a “one size fits all” approach would have to choose between paying a high tariff to achieve fair participation in both continental France and its territories, and paying a lower tariff which would discriminate against entire sectors of the French economy.

Ontario’s new feed-in tariff program has two tariffs for wind energy (that for wind on land and that for offshore), six tranches for solar PV, and five tranches for biogas.

Gainesville Regional Utilities offers three tariffs for solar PV: two for rooftop applications, and one for groundmounted systems.

Vermont offers two tariffs for wind turbines on land: one tariff for large turbines and one tariff for small turbines.

To emulate best practice worldwide, California should consider at least four to five tranches each for solar PV, biogas, biomass, and hydro.

**Tariffs Differentiated by Resource Intensity**

Probably no part of modern feed-in tariff programs is as misunderstood as tariffs based on resource intensity. Tariffs differentiated by resource intensity have, until recently, only been applied to wind energy where it is critical to equitable programs.

The cost of wind energy in particular is determined by the strength of the wind resource where the wind turbines are located. Wind generation is proportional to the cube of the wind speed. Slight differences from one region to another can have significant impact on the amount of electricity produced. Thus, the cost of generation from wind turbines in windy areas is less than that in less windy locations.

If the goals of renewable energy policy are to create equal economic opportunity for all citizens, distribute renewable energy development geographically, and minimize costs to ratepayers, then wind tariffs must be differentiated by resource intensity. Often a further objective is the wish to avoid the massive concentration of wind turbines in the windiest areas like that in California’s windy passes, which poses a challenge to both the electric transmission system and to the environment.

Both France and Germany have been successful in spreading development opportunity across their geographically diverse countries by differentiated wind tariffs. Farmers in the less windy interior of each country have an equal opportunity to develop their wind resource as those on the windy coasts. At the same time both Germany and France have the ability through differentiated tariffs to limit overpayment to wind developers in the windy areas, and thus, limiting costs to ratepayers.

Germany and France differentiate tariffs by resource intensity for both onshore turbines and those offshore. China now also has a similar policy that varies the tariff for wind energy by geographic location.

In both Germany and France, wind turbines are paid a standardized reference price for a period of time, and then the tariffs are reset according to the productivity of the wind turbines at the site. The productivity of the wind turbines is a surrogate for the resource intensity of the site.

In Germany the reference period is five years, in France it is now ten years.

In Germany's system, the length of time that the base tariff is offered varies relative to a "reference turbine". A wind turbine at the "reference site" is paid the reference or base tariff for twenty years. Wind turbines at the windiest sites are paid the reference price for only five years after which the tariff drops to a significantly lower value. In this way, Germany can limit excessive profits at windy sites.

Wind tariffs in France vary by load factor, the European expression of capacity factor. The reference or base tariff is paid for 10 years, and then the tariff is reset. Turbines at low wind sites are paid the reference tariff for the full 15 years of the contract. For turbines at windier sites, the tariff drops to a pre-determined value based on the turbine's productivity in terms of load factor.

As in Germany, the French method controls the profits at windy sites, limiting costs to ratepayers.

Load factor and capacity factor can be gamed and this is the case in France. It is preferable to use a measure of productivity better suited to wind energy than capacity factor, such as annual specific yield in $kWh/m^2/year$. Such a system has been proposed by the author of the current French system. However, it has not been adopted in France, or elsewhere.

Similarly, varying wind tariffs with annual specific yield has been proposed in Ontario, Michigan, Indiana, and in California.[15] No jurisdiction in North America has adopted any of the several methods for varying wind tariffs with resource intensity.

[15] On 13 July, 2010, the Kern-Kaweah Chapter of the Sierra Club sponsored a feed-in tariff pricing workshop in San Francisco by Bernard Chabot. This pricing workshop featured a proposal for calculating the tariffs for wind energy in California that varied with annual specific yield. See Report on the Bernard Chabot FIT Price-Setting Workshop in San Francisco.

The principal of varying tariffs with resource intensity can also be applied to solar energy. France now offers one tranche of solar PV tariffs that vary by geographical location. Projects in northern France are paid 20% more per kilowatt-hour than projects along the Riviera.[16]

Oregon's volumetric incentive rate for solar PV uses a similar principle: tariffs differ among four geographic regions of the state.

California's geographic and climatic diversity is likely more than that in any other state. Solar insolation varies up to 40% from the Northwest coastal zone to the hot interior of the Mojave Desert. Typical specific yields vary from 1,300 1,300 kWh/$kW_{DC}$/yr to nearly 1,900 1,300 kWh/$kW_{DC}$/yr.

Aracata-Eureka: 1,300 kWh/$kW_{DC}$/yr
Bakersfield: 1,600 kWh/$kW_{DC}$/yr
Daggett-Barstow: 1,850 kWh/$kW_{DC}$/yr

Best practice for wind energy is to vary tariffs by annual specific yield as proposed in Ontario, Indiana, and in a workshop held recently in San Francisco.

For California, best practice may require implementing tariffs for solar PV that vary not only by application and size, but also by solar intensity.

### Inflation Indexing

Most renewable energy technologies are long-lived and capital intensive. As a consequence, the returns or profits from investments in renewable energy for two or more decades are significantly affected by inflation. Calculations determining tariffs based on the cost of generation plus profit must either incorporate inflation in the initial tariff or compensate for the erosive effect inflation has on profitability by adjustment of the tariff after the project has been built.

Initial tariffs must be higher for the same level of profitability when there is no inflation adjustment as initial tariffs in programs that index the tariff with inflation. Some programs have fully indexed the tariff with inflation, others, such as Germany, have no inflation adjustment.[17]

France falls somewhere in between.  Some French tariffs are indexed to 60% of inflation, others indexed to 70% of inflation. In France, both the tariffs inside and outside the contract are indexed with inflation.

[16] See Conservative French Government Again Proposes Higher Solar PV Tariffs.
[17] Germany does not index tariffs with inflation once a project has been built, but all tariffs include assumptions about inflation when calculating the tariff necessary for profitable operation during the 20-year contract term.

France adjusts or indexes the tariffs with inflation for new projects every year. That is, during the interim between the four-year program reviews, the tariffs offered to new projects are indexed with inflation.

Inside the contracts for a project that is already built, the tariffs paid in France also increase with inflation.

Clearly, Germany has been successful without any inflation adjustment after a project has been built. Yet Spain has also been successful and for many years Spanish tariffs were fully adjusted for inflation. Currently, the Spanish program provides inflation indexing of 75% under the fixed tariff track.

Ontario indexes 20% of the tariff for inflation both inside and outside the contract.

Best practice for California is to establish an indexation for inflation inside the contract of from 40% to 60%. Higher indexation diminishes the hedging benefits of renewable energy development relative to dependence on fossil-fuel price volatility.

If the review period is two years or less, there is little need for indexation outside the contract as prices for new projects will revised frequently enough.

**Program Review**

Program reviews are necessary to insure that the programs are sufficiently robust to meet renewable energy development targets and to limit program costs to ratepayers. Most feed-in tariff programs are reviewed every four years. Ontario launched its feed-in tariff program in 2009 and has scheduled its first review in 2011.

Because of the rapid decrease in the cost of solar PV in particular, it is preferable to both include a program review after only two years as well as to weigh a programmed degression in solar PV tariffs.

Best practice for a new program in California is a full program review after two years. If the program is working satisfactorily, then California can move to a four-year review.

**Degression of Solar PV Tariffs**

The cost structure of most renewable technologies, especially wind, hydro, and biogas, are fairly stable. With these technologies, it is often sufficient to revisit the price or tariff every two to four years.

Not so with solar PV. Largely in response to feed-in tariffs, the market for solar PV is growing rapidly, leading to the rapid expansion of volume manufacturing. As a result, the costs of solar PV are dropping dramatically.

Solar PV is the most expensive of the new renewable technologies and where the growth of new solar PV installations is rapid, program costs can also increase quickly. To minimize the costs of solar PV to ratepayers, it is wise to include an annual degression in the tariffs for new contracts.

Degression can take several forms: a fixed percentage decrease per year or per quarter, a degression by capacity installed, or a variable degression dependent upon the rate of growth. Germany now uses a degression for solar PV that varies with the rate at which solar PV is installed relative to a target. Germany's current target for solar PV is 3,000 MW per year. The annual degression is -10% per year. For every 1,000 MW of growth that exceeds the target, the price is decreased an additional 1%. Similarly, if the target is missed, the degression is reduced by an equivalent amount. Thus, the variable degression is designed to modulate the growth of solar PV. Nevertheless, Germany, like all other jurisdictions, reserves the right to redress tariffs when necessary to protect ratepayers from excessive charges.

<u>California may want to include a variable degression for solar PV tariffs in new contracts, as in the German program, to reflect the rapidly decreasing cost of the technology.</u>

**Dual Tariff Tracks**

Current federal US policy provides an "incentive" of federal tax subsidies in the form of "tax credits". Obviously, a generator can only use these tax credits if they have sufficient taxes due. Wind and solar PV in particular are extremely capital intensive and most Americans of modest means don't pay enough federal taxes to use all the credits that would accrue. On the other hand, large multi-national companies, and electric utilities have sufficient profits to use all the tax credits available. These tax credits are inequitable and unfair to the majority of Americans.

In the US, renewable programs designed to encourage equal participation across all economic classes will provide two tariff tracks: one that uses federal tax credits, another that does not use federal tax credits. This situation is unique to the US and not found in any other country.

<u>A progressive and equitable renewable energy policy in California will include two tariff tracks: one for those who can use the federal subsidies, and one for those who cannot.</u>

**Social Adders**

Programs may also include payments or "adders" for various social objectives. Ontario, for example, wants to encourage local ownership of its renewable resources. While the Ontario feed-in tariff program is open to all, local residents and outsiders alike, the province wants to enable as much local ownership as possible by community groups, cooperatives, and aboriginal communities.[18]

Ontario pays a premium of $0.01 CAD/kWh for community-owned wind projects, and $0.015 CAD/kWh for wind projects owned by aboriginal communities. Farmers, because they own land in a "community", qualify for the community adder.

Comparable "adders" are offered for other technologies as well.

To encourage community ownership, California may want to include a social adder.

**Summary**

Below is a summary of best practice in designing a world-class program of Advanced Renewable Tariffs for the California Renewable Energy Sources Act.

| **California Renewable Energy Sources Act** | |
|---|---|
| Key Elements for a Successful Policy | |
| 12-Oct-11 | |
| Priority acces and connection | microFIT guaranteed connection, DisGen guaranteed connection |
| Program cap | 40% by 2025; 50% by 2030 |
| Project size cap | >20 MW |
| Contract term | 20 years |
| Technologies included | wind on land, wind offshore, solar PV, solar DHW, CSP, biogas, biomass, geothermal, run-of-river hydro |
| Tariffs based on cost of generation | |
| Tariffs differentiated by technology | |
| Tariffs differentiated by size and application | minimum of 4 to 5 tranches each |
| Tariffs differentiated by resource intensity | wind and solar |
| Inflation indexing | 40% to 60% inside contract |
| Program review | initial 2 years, 4 years thereafter |
| Degression of solar PV tariffs | following the German "growth corridor" model |
| Dual tariff tracks | with and without federal tax credits |
| Social adders for farmers & community groups | ? |
| | |
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[18] Aboriginal communities include both First Nations and Metis.