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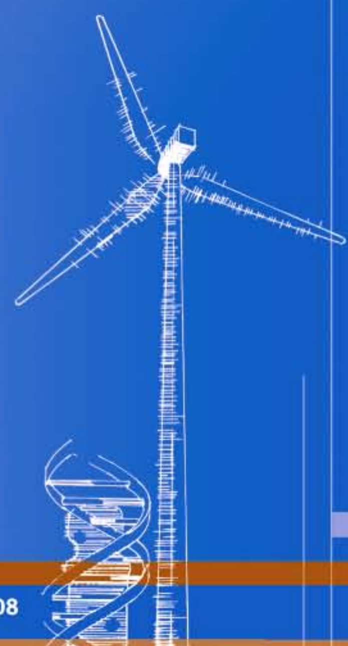
Feed-in Tariff Policy: Design, Implementation, and RPS Policy Interactions

Technical Report
NREL/TP-6A2-45549
March 2009

Karlynn Cory, Toby Couture, and Claire Kreycik



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National Renewable Energy Laboratory
1617 Cole Boulevard, Golden, Colorado 80401-3393
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Introduction

Feed-in tariff (FIT) policies are implemented in more than 40 countries around the world and are cited as the primary reason for the success of the German and Spanish renewable energy markets (Grace 2008, Stern 2006). As a result of that success, FIT policy proposals are starting to gain traction in several U.S. states and municipalities. A number of states have considered FIT legislation or regulation, including Florida, Hawaii, Illinois, Indiana, Maine, Massachusetts, Michigan, Minnesota, New Jersey, New York, Oregon, Rhode Island, Virginia, Washington and Wisconsin; and a federal FIT proposal has also been developed (Gipe 2009, Rickerson et. al. 2008b). Three other municipal utilities have also proposed FIT policies, including Los Angeles, California (Los Angeles 2008); Palm Desert, California; and Santa Monica, California (Ferguson 2009).

Experience from Europe is also beginning to demonstrate that properly designed FITs may be more cost-effective than renewable portfolio standards (RPS), which make use of competitive solicitations. This article explores the design and operation of feed-in tariff policies, including a FIT policy definition, payment-structure options, and payment differentiation. The article also touches on the potential interactions between FIT policies and RPS policies at the state level.

FIT Policy Definition

A feed-in tariff (FIT) is an energy-supply policy focused on supporting the development of new renewable power generation. In the United States, FIT policies may require utilities to purchase either electricity, or both electricity and the renewable energy (RE) attributes from eligible renewable energy generators.[1] The FIT contract provides a guarantee of payments in dollars per kilowatt hour ($/kWh) for the full output of the system[2] for a guaranteed period of time (typically 15-20 years). A separate meter is required to track the actual total system output.[3] This payment guarantee is often coupled with the assurance of access to the grid (Rickerson et. al. 2008b), and the actual payment amount is usually differentiated based on technology type, project size, quality of the resource and/or other project-specific variables (Klein et. al. 2008). Feed-in tariffs are also generally structured according to a standard power purchase contract.

There are two main methodologies for setting the overall return that RE developers receive through FIT policies. The first is to base the FIT payments **on the levelized cost of RE generation**; the second is to base the FIT payments **on the value of that generation to the utility and/or society**.[4] In the first approach, the payment level is based on the levelized cost of RE generation, plus a stipulated return (set by the policy makers, regulators, or program administrators). The advantage of this approach is that the FIT payments can be specifically designed to ensure that project investors obtain a reasonable rate of return, while creating conditions more conducive to market growth.

The second method of setting FIT payments is by estimating the value of the renewable energy (Grace 2008). This value can be defined in a number of ways, either according to the utility's avoided costs, or by attempting to internalize the "externality" costs of conventional generation. Externality costs can include things such as the value of climate mitigation, health and air quality impacts, and/or effects on the energy security (Klein et. al. 2008). This can be considered the "value-based" approach, which contrasts with the first, "RE project cost-based" approach. Value-based FIT payments require quantification of these numerous benefits (either to the utility, society, and/or the environment) to establish the total compensation, potentially leading to a high degree of administrative complexity. The challenge is that value-based approaches may not match the actual RE generation costs, and may provide insufficient payments to stimulate rapid market growth. Alternatively, they may provide payments that are higher than generation costs, leading to cost-inefficiency.

Most successful European FIT policies, which resulted in quick and substantial RE capacity expansion (often at both distributed and utility-scale levels), have FIT payments structured to

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[1] In Europe, FIT policies may or may not include the attributes. It is presumed that under current U.S. law, payment for the power would be made under Federal Energy Regulatory Commission (FERC) wholesale power rules, and payment for the RECs could be made under state law. However, this is an assumption, and these issues will need to be clarified using a proper legal review in due course.

[2] The payment guarantee is usually designed to cover the all-in cost of project development, which includes a specified target return on equity investment (determined by the policy makers). However, the payment guarantee may be at a fixed or variable price.

[3] FIT policies pay for the entire output of the system and are different from net metering, because net- metered generation only receives credit for the excess generation sent to the grid.

[4] The Chabot Profitability Index is not explored here, but is a third, less frequently used option.

cover the RE project cost, plus an estimated profit (Klein et. al. 2008). Many U.S. states currently use value-based cost methodologies to support renewable projects. However, value-based FIT policies, whether tied to avoided costs or to external social and environmental costs, have so far been unsuccessful at driving rapid growth in renewable energy (Grace 2008, Jacobsson and Lauber 2005).

FIT Payment Structure

Given that they have proved to be the most effective, only FIT policy designs that are based on the levelized cost of RE generation are included here. Accordingly, this section provides an overview of the two most common FIT payment designs: the fixed-price and the premium-price FIT options. One variation of the premium-price FIT design is the "spot-market gap" model, currently implemented in the Netherlands (van Erck 2008). A spot market is one where energy can be sold for cash and delivered immediately. It may be of particular interest to policy makers in the United States, because it represents a novel FIT design that may be found to be more compatible with the current U.S. regulatory policy environment.

Fundamental FIT Payment Options

One primary FIT payment-structure choice is whether the project owner's compensation is tied to fluctuations in the actual market price of electricity. These two different policy options are often characterized as either fixed-price or premium-price policies (the premium being a FIT payment above spot-market prices) (Held et al. 2007, Klein et. al. 2008). These two models dominate FIT policy design;[5] however, most countries with FIT policies choose the fixed-price approach (Klein et al. 2008, Mendonca 2007).

Figure 1 illustrates a fixed-price FIT policy. In this policy design, the total FIT payment to the project remains independent from the market price, and is a predetermined payment for a guaranteed period of time. Because fixed-price FIT policies offer market-independent payments, they create stable conditions for investors. This risk reduction can lead to lower project-financing costs (de Jager and Rathmann 2008).

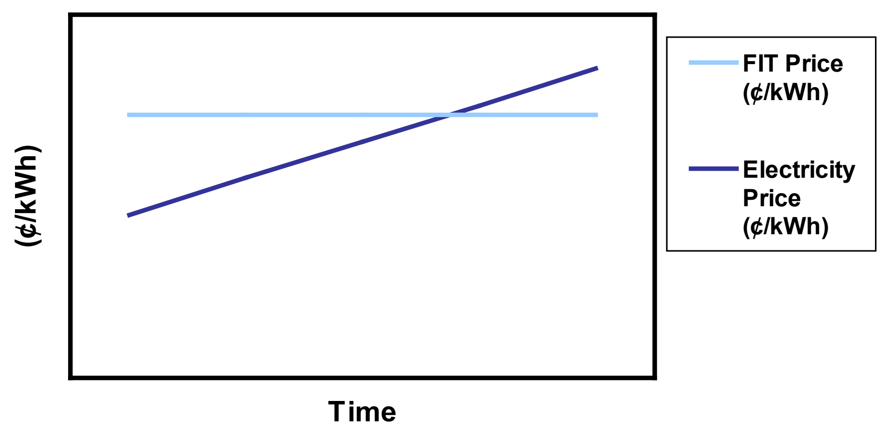

Figure 1. Fixed-price FIT model

[5] Another design is the percentage of retail price methodology, where the FIT payment is based on a percentage of the retail rate (which could be lower or higher than 100%). This structure was abandoned by Germany and Denmark in 2000 (Jacobsson and Lauber 2005, Nielsen 2005) and by Spain in 2006 (Held et al. 2007); today, both Spain and Germany use the renewable energy cost-based methodology.

FIT payments can also be offered as a premium on top of the spot-market electricity price. One variation is shown in Figure 2. Under a premium-level FIT policy, the project owner receives payment for the total electricity generated (at market prices), as well as a FIT payment.

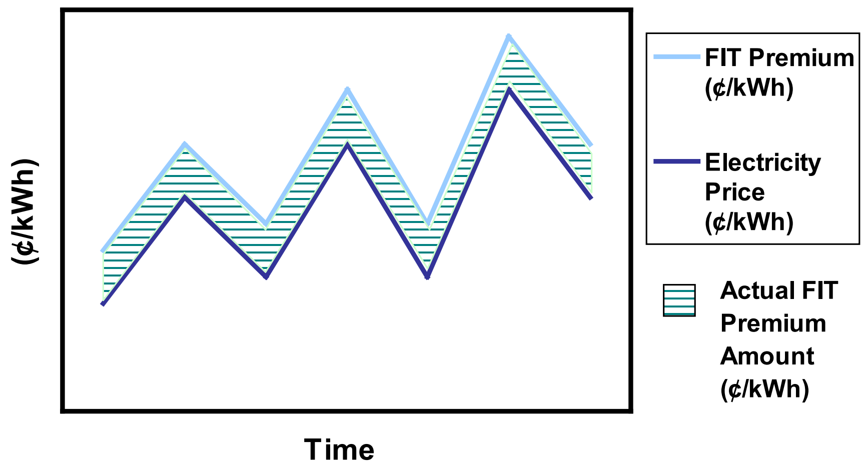

Figure 2. Non-variable premium-price FIT model

The premium FIT payments can be either non-variable (as a fixed, predetermined adder), or variable (where the premium varies as a function of the spot-market electricity price). Although a non-variable premium is a simpler design (shown in Figure 2), it risks resulting in windfall profits for developers if spot-market prices for electricity increase significantly. Similarly, if electricity prices fall, the investor return would be at risk, which would tend to put upward pressure on project-financing costs. This risk premium method would require proportionally higher payments to obtain the same amount of renewable energy development (Mendonca 2007, Klein et. al. 2008).

Two premium-price FIT designs attempt to address the challenges of over- or under-compensation by more closely targeting compensation based on renewable energy project costs. Spain introduced a variable premium-price FIT design with both a price cap and a price floor as part of its Royal Decree 661/2007 (Held et al. 2007). On an hourly basis, it ensures that the FIT premium payment declines as electricity prices increase, and vice versa (Klein et. al. 2008). This strategy provides more stable revenues for developers by introducing a minimum compensation level, and limits the exposure of the ratepayers by reducing the FIT payment level if electricity prices increase.

The other variable-premium FIT payment structure based on RE project costs is the "spot-market gap" model currently implemented in the Netherlands (Figure 3). It represents a hybrid approach between the fixed-price and the premium-price models. In this approach, the government guarantees that projects will receive a predetermined, minimum total payment. From a developer's standpoint, this makes it virtually indistinguishable from a fixed-price FIT. However, instead of paying projects the total amount through a FIT payment (as the fixed-price FIT policy in Figure 1), the project receives this payment through two separate revenue streams. The first is the prevailing spot-market price of electricity. The second is a variable FIT payment that covers the real-time difference between a minimum total payment guarantee and the spot-market price (van Erck 2008). Because the FIT payment covers the difference between the spot-market price and the required FIT price, the actual FIT payment fluctuates over time, covering the "gap" between the two. And because the actual FIT payment only includes the fluctuating premium, the FIT program costs could be more easily calculated. The incremental burden of the FIT policy on utilities may also be minimized.

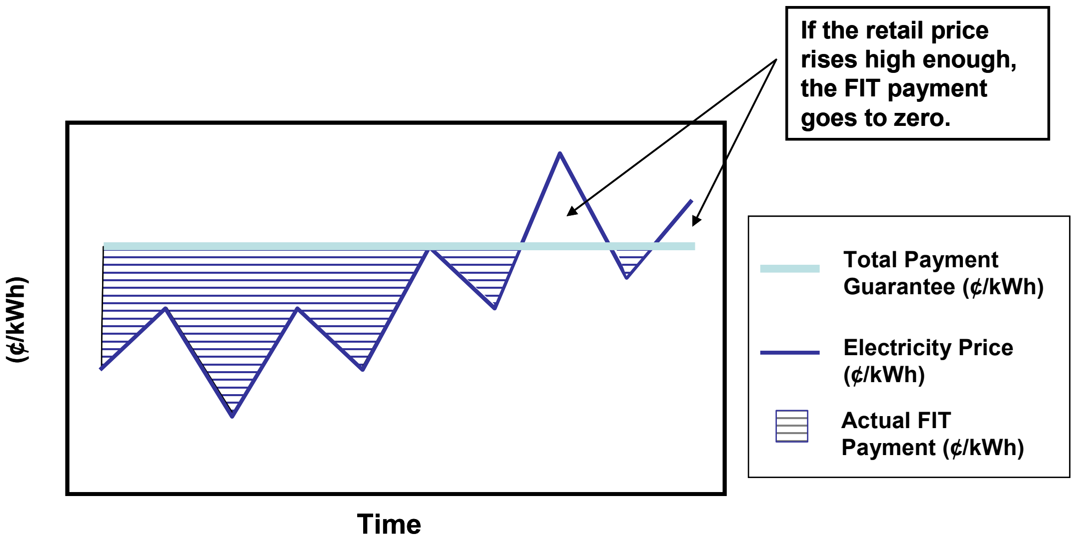

Figure 3. The Netherlands' premium-price FIT (Spot-Market Gap Model)

For both the Spanish and the Dutch premium-FIT models, if the market price rises above the guaranteed payment, then the FIT premium drops to zero (Held et al. 2007, Klein et. al. 2008). By providing limits on premium-price FIT payments, Spain and the Netherlands have provided developers the necessary revenues to secure investment while limiting the total costs of their FIT programs.

There are a few reasons why the spot-market gap model may be suitable to the U.S. political and regulatory context. First, the incremental cost of the policy can be transparently derived from the sum of the "spot-market gap" payments. Second, if electricity prices increase over time, the FIT payment eventually converges to zero, as the spot price rises above the required FIT price. This also provides a concrete means of quantifying the hedge benefit of fixed-price FIT payments. Finally, the spot-market gap could be designed to represent the fluctuating REC value, which could be contracted in conjunction with wholesale electricity purchases.[6] However, there would remain two main challenges to using this model in the United States: The first is that the spot-market price of electricity is not transparent everywhere in the United States, although it could be represented using the utility's avoided cost of generation or another similar cost estimation. Second, this model is much more complex to administer than a fixed-price model, which could add to the overall policy cost.

[6] This may be important if there are legal questions surrounding a state's ability to regulate power costs above wholesale rates, (which are under the jurisdiction of the Federal Energy Regulatory Commission).

FIT Payment Differentiation

Another important distinction in feed-in tariff design is how the payment levels will be differentiated, based on project-specific factors. These factors can include the **technology type** (whether solar, wind, geothermal, etc.; or the fuel type, in the case of biomass and biogas), the **size of the project** (to account for economies of scale), the **quality of the resource** at that particular site (to encourage broad deployment of wind and solar power, and limit windfall profits at high-quality sites), and/or the **specific location** of the project (e.g., building integrated, offshore wind) (Grace 2008, Klein et. al. 2008).

Because each renewable energy generation project is unique, differentiation of FIT payments to account for these differences can ensure that a variety of technologies and project sizes come online. Many European FITs provide an equal opportunity for both small (residential) and large (industrial) customers to own renewable energy generation. In most cases, the utility with whom the generator interconnects provides the FIT payment and is then allowed to pass on any incremental costs to its customers (Klein et. al. 2008). Also, in most jurisdictions, utilities are eligible to participate and are provided the same payment-level guarantee (Jacobsson and Lauber 2005, Held et al. 2007, Klein et al. 2008) (i.e., in the United States, this would mean that regulatory "prudency" issues are addressed in the program design[7]). The fact that FITs impose very few limits, if any, on who can participate in selling renewable power to the grid has made them a powerful vehicle for leveraging both local and global capital toward RE development.

[7] Regulators may question whether a utility investment was prudent or not; the utility is not allowed to recover any cost from their customers that is disallowed as "not prudent."

FIT–RPS Policy Interactions

The renewable portfolio standard[8] (RPS) is the most common state-level policy in the United States today. As such, one of the first questions when a FIT policy is considered in the United States is whether it would replace or conflict with existing RPS policies. While the design details of each policy will determine the answer, it is clear that the two policies can be structured to work together – and can even do so synergistically (Rickerson and Grace 2007, Grace 2008).

RPS Overview

RPS policies require electric utilities to provide renewable electricity to their customers, typically as a percentage of total energy use. Twenty-eight states and the District of Columbia have mandatory RPS policies, five states have voluntary RPS goals (DSIRE 2009c), and more states (as well as the federal government) are considering implementing similar policies.

RPS policies appear to have successfully motivated new renewable development in certain regions of the United States. From 1998-2007, an estimated 8,900 MW of new non-hydro renewable capacity (more than half of that constructed) was built in states with RPS policies (although it is difficult to demonstrate that RPS policies were the only factor driving RE development in these states).[9] In addition, most states have achieved compliance in the early years of their RPS requirements (Wiser and Barbose 2008). However, some RPS policies appear to have a number of challenges encouraging new and rapid RE development in the United States. These include uncertainties associated with project financing (Wiser and Barbose 2008), relatively high contract failure rates in states such as California (Wiser and Barbose 2008), a high level of market concentration due to the limited number of investors (Chadbourne and Parke 2008), and little local and community-scale involvement in renewable energy development (Bolinger 2004). The combination of these challenges has increased the interest in alternative approaches for RE procurement such as feed-in tariffs in the United States.

FIT and RPS Policy Distinctions

It is important to note the main differences between FIT and RPS policies to understand their potential relationship to each other. RPS mandates prescribe *how much customer demand* must be met with renewables, while properly structured FIT policies attempt to support *new supply development* by providing investor certainty. As mentioned earlier, FIT policies are typically designed to provide a renewable project with revenue streams sufficient to cover development costs, plus a reasonable return. They are focused on setting the right *price* to drive RE deployment. In contrast, most RPS policies are focused on the *quantity*, leaving the price up to competitive bidding.

Under an RPS, the load-serving entities or central procurement agency must determine how they will comply with the mandate. Typically, a competitive solicitation is used to secure supply to meet RPS policies in the United States. Utilities issue a request for proposals and select the projects that offer the most promising package of siting, operational expertise, and cost. However, due to the high costs of developing a bid, the high risk of failing to obtain a contract,

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[8] In Europe, RPS policies are called quota-based mechanisms, quota obligations, or renewables obligations.
[9] Other factors include the voluntary green power market (which covers about half of new renewable projects) and favorable wind project economics compared to current electricity prices.

and the nature of the investors financing projects at this scale, the return on investment requirements in competitive solicitations are generally much higher than in jurisdictions employing feed-in tariffs (de Jager and Rathmann 2008, Ragwitz et. al. 2007, EREF 2007, Ernst & Young 2008, Fouquet and Johansson 2008). While the transaction costs may be only a small percentage of the total project cost, they increase the return on investment requirement, which ultimately increases the required payment price. These high transaction costs also make it difficult for smaller investors to participate. Also, the overall market structure that results from a competitive bidding framework limits the investor pool and can lead to a less-dynamic RE market (Dinica 2006, Grace 2008).

Experience in Europe is beginning to demonstrate that due to the stable investment environment created under well-designed FIT policies, renewable energy development and financing can happen more quickly and often more cost-effectively than under competitive solicitations (de Jager and Rathmann 2008, Ernst & Young 2008, Stern 2006, EREF 2007, Fouquet and Johansson 2008). In addition, the guaranteed contract terms enable project developers to finance a larger proportion of the project with debt financing, as opposed to equity, which puts further downward pressure on the cost of capital (de Jager and Rathmann 2008, Kahn 1996).

One of the most important elements of FIT design is the guarantee of reliable revenue streams (Klein et. al. 2008). This has helped catalyze renewable energy development in countries such as Germany, where both small and large developers can invest for a profit in renewable energy technology. And the fact that FIT policies are generally designed to cover the cost of the renewable energy project, plus a reasonable return, helps ensure that the costs to society of RE development are minimized.

FIT Application in the U.S.

As of early 2009, only a few U.S. jurisdictions have enacted FIT policies. The most notable example is the solar photovoltaic (PV) FIT passed by the municipal utility in Gainesville, Florida in February 2009 (RE World 2009). It is the first and only U.S. FIT policy structured the same way as many successful European FIT policies: It is based on the cost to develop the renewable generation project, plus a stipulated 5%-6% return. California has also created a statewide FIT program, but the payments are based on the utility's avoided cost and not on the actual cost of the RE project (DSIRE 2009a, Rickerson et al. 2008a). Several U.S. utilities have enacted fixed-price production-based incentive policies that can be considered FITs, including Green Mountain Power (Vermont) (GMP 2008), Eugene Water & Electric Board in Oregon (DSIRE 2009b), WE Energies in Wisconsin (WE Energies 2009), and Madison Gas and Electric in Wisconsin (MG&E 2009). Finally, Washington State passed voluntary FIT legislation, and all but one public utility district now has a FIT policy (Nelson 2008). These FIT programs are structured rather simply, were implemented in the past two or three years, and have enjoyed limited success.

How FITs Can Complement RPS Policies

Several challenges to new renewable project financing (not always addressed using RPS policies) may be addressed using FIT policies. In fact, FIT policies can be used to help meet RPS policy targets, as described below. It is important to note that considerable research is still required concerning these interactions, and that few actual designs have been tested.[10]

1. **Project-financing support.** Not all states have RPS design elements that support new project financing, such as a requirement for long-term contracts or centralized state procurement (Wiser and Barbose 2008). Without long-term support to secure investment, renewable projects will likely have difficulty securing financing (Cory et. al. 2004), which could result in a shortage of supply to meet RPS demand. FIT policies provide the revenues that project investors require and can ensure that enough supply will come online.

2. **Cost-effective procurement mechanism.** Due to the guaranteed contract terms and the stable investment environment created by FITs, these policies appear to be a cost-effective procurement mechanism for renewable energy development. They could be used alongside competitive solicitations; or, provided the FIT payments are differentiated to account for economies of scale, they could be used to replace competitive solicitations to meet government-established renewable goals, similar to what is done in countries such as Germany and Spain.

3. **Hedge against project delays and cancellations.** Among other things, project siting and access to transmission can challenge even the best and most economical renewable projects (Wiser et. al. 2005). If a utility's renewable procurement process does not consider the likelihood that a project will be developed (and just looks at lowest cost, for instance), then it is likely that not all of the projects under contract will be built – the utility, therefore, is less likely to meet its RPS. Rather than having the utility determine which projects go forward (i.e., with whom it will sign contracts), the government or utility can establish eligibility criteria as well as a payment level under a FIT – anyone who qualifies and is interested in investing in RE technology can do so and obtain a standardized utility supply contract (without the transaction costs or any potential gaming). This can help ensure that the best portfolio of projects moves forward.

4. **Focus on "reasonable-cost" renewables.** Similar to other power production, utilities must justify their costs for RPS compliance, whether through power purchase agreements or utility-owned projects. While the focus on "least-cost" principles attempts to minimize ratepayer costs, they may pressure utilities to negotiate contract prices for renewable projects that are inadequate to secure financing (and fail to adequately address investor risks). Instead of focusing on least cost, FIT policies focus on estimates of the actual costs required to build renewable projects based on technology and other project-specific considerations. If designed well, the FIT can ensure that a variety of projects receive just enough to cover their costs and a reasonable return.

[10] In an attempt to arrive at a European Union-wide RE policy, the European Commission conducted several comparisons of country-specific renewable energy policies. As a direct result, most European literature has focused on the benefits of FIT policies and RPS policies as alternatives to one another, rather than as complements to each other. Only recently (2008) did the commission decide that using a single policy across all of Europe may not be appropriate. In the United States, information comparing FITs and RPS policies can be found in regulatory dockets in both California and New Jersey.

5. **Assured support for emerging technologies.** New or emerging technologies[11] may not be able to secure financing, even with long-term utility contracts. The projected revenues need to be high enough to support the additional investment risk faced by investors. This higher risk requires higher-equity returns than commercially available renewable energy projects. Appropriately structured FIT policies will include this risk premium for emerging technologies (paid for by the ratepayers) and provide the long-term assurance that investors require.

6. **Provide ratepayer backing.** Regulated utility generation is sometimes subject to "prudence" reviews of investments and contracts after projects are built. If costs are deemed to not be prudent, the utility will have to cover the costs itself instead of relying on ratepayers, sometimes retroactively. Ultimately, this means that utilities may be uncertain as to whether they will be able to recover the costs from a contract or the ownership of new renewable projects. Overall, the FIT structure can provide more certainty, because the FIT payments are backed by the ratepayers and typically are not subject to retroactive regulatory prudency review. This certainty can help utilities become interested in FIT policies, particularly if the utilities are eligible to participate as project owners.

Overall, decision makers have several options to consider when considering FIT policies. They can be used in parallel and wholly separate from RPS policies, they can replace a part of the current mechanism (perhaps to support a solar carve-out, or distributed generation), or they can be used to entirely replace RPS mechanisms. Of course, they can also be used by states with voluntary renewable energy goals to advance renewable energy development.

FIT Policy Challenges

As with most policies, the FIT policy has some notable challenges. The first is the up-front administrative requirement: Detailed analysis is required to properly set the payment level at the outset. The payment level must ensure revenues will be adequate to cover project costs. If the FIT payments are set too low, then little new RE development will result. And if set too high, the FIT may provide unwarranted profits to developers. To achieve the right balance across a wide range of technologies and project sizes, many levels of differentiation are used. However, if the FIT policy is too complex with too many bonuses, exemptions, and qualifications, it may hinder program implementation. And as costs change and markets shift due to technological innovation and increasing market maturity, the FIT policy needs periodic revision to reflect evolving costs and market conditions.

Second, in contrast to other financial incentives for renewables, FITs do not decrease a developer's up-front costs. Policy makers enact investment tax credits, grants, and rebates to reduce the high, up-front capital costs of RE installations. As seen in the U.S. context, grants and rebates can be integral in increasing the market penetration of small, customer-sited projects.

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[11] Based on a series of conversations with the insurance industry (for another project), the insurance industry believes that any new product from any company (e.g., a specific PV module from company X) is still a prototype until it has reached 3,000–8,000 hours of operation (lower end for PV or other products without moving parts, and higher end for natural gas turbines and wind turbines).

Unlike production incentives or FITs, grants and rebates do not require a long-term policy and financial commitment to a specific project, allowing for flexible support based on changes in the market (Wiser and Pickle 1997). However, these mechanisms may not be effective at spurring broad market adoption, and they have often failed to provide stable conditions for market growth (Lantz and Doris 2009).

Another concern is the total cost of the program if it is designed to include tariffs for costlier emerging technologies. While FITs can be efficient at promoting these technologies, a decision must be made regarding the total acceptable cost burden, and how that impact is weighed related to the job creation and economic benefits that result. For instance, locking in large amounts of solar PV in long-term contracts could be considered cost-inefficient, and could put unwarranted upward pressure on rates in the near term. However, a capacity cap (either program-wise or annually) can limit this exposure.

Finally, frequent updates to the FIT program *structure* can lead to policy uncertainty. The more uncertain the policy structure – even a few years out – the riskier the RE investment is to the project financier. The result may be that either an additional risk premium is added to investor returns, or the investor may leave the RE market and choose to invest in something else with less exposure to policy risk (Chadbourne & Parke 2009).

Conclusions

Feed-in tariffs are intended to increase the adoption of renewable energy technologies, encourage the development of the RE industry, and provide significant economic development benefits. Experience from Europe suggests that a well-designed feed-in tariff can generate rapid growth for targeted RE technologies by creating conditions that attract capital to those particular sectors. By using a variety of design variables to incentivize production in different areas as well as projects of different sizes, FIT policies can help encourage a variety of RE technology types and different-sized RE projects.

Feed-in tariffs differ from one jurisdiction to another, reflecting a wide spectrum in the sophistication and refinement of the policy design. Supporters of FIT policies consider this ability to adapt to particular contexts, and to be finely tuned according to particular policy goals, a crucial element in their success and overall cost-efficiency. Further, the price guarantee and long-term policy certainty offered by FITs have propelled some countries to the forefront of the global RE industry, creating hundreds of thousands of jobs and countless economic opportunities in new and emerging sectors. Their success at driving rapid RE growth will continue to fuel interest in FIT policies as the demand for renewable energy technologies continues to grow both in the United States and around the world.

Overall, a FIT policy can be developed to work in concert with an RPS policy, which sets a goal or mandate of *how much* customer demand should be provided by renewables. A properly structured FIT policy attempts to provide investor certainty to help support new supply development. FIT policies generally provide preapproved guarantees of payments to the developer and investors, whereas RPS policies leave the compliance and investment up to the market. For states that want to provide assurance to investors, drive more capital to the market, and get more projects built, a FIT can be a useful, complementary policy to an RPS.

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14. ABSTRACT *(Maximum 200 Words)*
Feed-in tariff (FIT) policies are implemented in more than 40 countries around the world and are cited as the primary reason for the success of the German and Spanish renewable energy markets. As a result of that success, FIT policy proposals are starting to gain traction in several U.S. states and municipalities. Experience from Europe is also beginning to demonstrate that properly designed FITs may be more cost-effective than renewable portfolio standards (RPS), which make use of competitive solicitations. This article explores the design and operation of feed-in tariff policies, including a FIT policy definition, payment-structure options, and payment differentiation. The article also touches on the potential interactions between FIT policies and RPS policies at the state level.

15. SUBJECT TERMS
NREL; feed-in tariff; FIT; renewable portfolio standard; RPS; renewable energy certificate; REC; electricity; Europe; renewable energy markets; levelized cost; FIT policy; Toby Couture; Karlynn Cory; Claire Kreycik

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