EXPLORING FEED-IN TARIFFS FOR CALIFORNIA

Feed-In Tariff Design and Implementation Issues and Options

Prepared For:
CALIFORNIA ENERGY COMMISSION

Prepared By:
KEMA, Inc.

DRAFT CONSULTANT REPORT

June 2008
CEC-300-2008-003-D

Prepared By:
KEMA, Inc.
Robert Grace, Sustainable Energy Advantage, LLC
Wilson Rickerson, Rickerson Energy Strategies, LLC
Kevin Porter and Jennifer DeCesaro, Exeter Associates
Karin Corfee, KEMA
Meredith Wingate, Center for Resource Solutions
Jonathan Lesser, Bates & White

KEMA Inc.
492 Ninth Street, Suite 220
Oakland, CA 94607
Contract No: 500-04-027

Prepared For:
California Energy Commission

Rachel Salazar
Contract Manager

Drake Johnson
Project Manager

Mark Hutchison
Office Manager
Renewable Energy Office

Valerie Hall
Deputy Director
Energy Efficiency and Renewables Division

Melissa Jones
Executive Director

Please cite this report as follows:

KEMA *Exploring Feed-in Tariffs for California*. California Energy Commission. Publication number: CEC-300-2008-003-D

Table of Contents

Table of Contents i

List of Tables iv

Abstract v

Executive Summary 1

CHAPTER 1: Introduction 3

Background 3

What Is a Feed-In Tariff? 4

Benefits and Limitations 6

Design Issues 6

Feed-In Tariff Objectives and Measures of Success 7

Purpose of This Paper 8

Approach and Organization of the Paper 11

CHAPTER 2: Generator/Technology Eligibility 13

Resource Type 13

Options 13

Pros and Cons 14

Vintage 14

Options 15

Generator Location: Tariff Access 16

Options, Pros and Cons 16

Publicly Owned Utilities and Investor-Owned Utilities 17

Pros and Cons 17

Project Size 18

CHAPTER 3 Setting the Price—Approach **21**
Value-Based Payments 21
Options 21
Pros and Cons 23
Generation Cost-Based Payments 23
Options 24
Pros and Cons 25
Competitive Benchmarks 25
Options 26
Pros and Cons 26
CHAPTER 4: Setting the Price—Tariff Structure **29**
Options 29
Pros and Cons 30
CHAPTER 5: Setting the Price—Contract Duration **33**
CHAPTER 6: Adjusting the Price **35**
Price Adjustment Approaches 35
Options, Pros and Cons 35
When to Adjust Price? 37
Options, Pros and Cons 38
How Much to Adjust Price? 39
Queuing Procedures—Minimizing Speculative Queuing 40
CHAPTER 7: Tariff Differentiation **41**
Technology Type 41
Project Size 41

Resource Quality 42
Commercial Operation Date 42
Ownership Structure 43
Transmission Access 43
Location—Transmission-Constrained Areas 44
CHAPTER 8: What Is Being Sold/Purchased? 45
Options 46
Pros and Cons 46
CHAPTER 9: Cost Distribution/Allocation 49
Who Buys? 49
Options 49
Pros and Cons 49
Who Pays? 49
Options 50
Pros and Cons 50
Cost-Recovery Mechanisms 51
Options 51
Pros and Cons 51
Management of Cost Distribution 52
CHAPTER 10: Integration Into Power Supply of Utilities and Others 53
Options 53
Pros and Cons 53
CHAPTER 11: Access 55
Options, Pros and Cons 55

CHAPTER 12: Credit and Performance Assurance **57**

Options, Pros and Cons 59

CHAPTER 13: Quantity and Cost Limits **61**

CHAPTER 14: Policy Interaction **63**

Integration of Feed-In Tariffs With Existing RPS Framework 63

Options, Pros and Cons 63

Interaction of Feed-In Tariffs With Assembly Bill 32 65

Interaction With Competitive Renewable Energy Zones 65

Options 66

Pros and Cons 66

CHAPTER 15: Conclusion and Next Steps **67**

List of Tables

Table 1: Generator/Technology Pros and Cons 16

Table 2: Size Limit Pros and Cons 18

Table 3: Tariff Structure Pros and Cons 30

Table 4: Contract Duration Pros and Cons 33

Table 5: Price Adjustment Pros and Cons 36

Table 6: Price Adjustment Timing Pros and Cons 38

Table 7: Price Adjustment Size Pros and Cons 39

Table 8: Queuing Procedures Pros and Cons 40

Table 9: Michigan Project Size Differentiation 42

Table 10: Credit or Security Options 58

Table 11: Quantity Cap Pros and Cons 61

Abstract

California has a Renewables Portfolio Standard for investor-owned utilities, energy service providers, and community choice aggregators to serve 20 percent of retail sales with renewable energy by 2010. In addition, state law requires each governing body of a local publicly owned electric utility to implement and enforce a renewables portfolio standard that recognizes the intent of the Legislature to encourage renewable resources, while considering the effect of the standard on rates, reliability, and financial resources and the goal of environmental improvement. As stated in the *2007 Integrated Energy Policy Report*, a long-term goal of achieving 33 percent by 2020 can greatly assist the state in reducing greenhouse gas emissions and achieving Assembly Bill 32 goals.

California is currently not on track to meet 20 percent renewables by 2010 and significant changes are needed to achieve 33 percent by 2020. A feed-in tariff, which offers fixed-price payments for energy from renewable sources, is one of the changes recommended in the *2007 Integrated Energy Policy Report* to help the state achieve 33 percent renewable electricity by 2020.

This report identifies the issues and options associated with designing a feed-in tariff for California and lays out alternative design decisions and their advantages and disadvantages. It is designed for informing and promoting discussion among stakeholders and policy makers. Some feed-in tariffs are more effective than others, depending on the price level and other design characteristics. To be effective, feed-in tariffs must be designed to reflect the state's policy priorities. Design variables discussed are generator and technology eligibility, including generator vintage, type, and location. This report also discusses possible approaches to setting tariff prices and structures, contract duration, price adjustments, and alternative products that can be purchased. Other important issues addressed in this report include cost allocation, interconnection and grid access, effects of cost maximums and minimums, and the interaction of feed-in tariffs with other California policies.

Keywords: Feed-in tariff, tariff design, energy policy, Renewables Portfolio Standard (RPS), renewable resources, interconnection, grid access, cost allocation, fixed-price-payments

Executive Summary

Feed-in tariffs have driven rapid expansion in renewable energy development in some markets and may provide California with a tool to increase the pace of renewables development, reduce the rate of renewable energy contract failure, address the discrepancies between the market price referent (MPR) and the cost of renewable project development, and promote renewable projects in areas that require new transmission.

A simple definition of a feed-in tariff is an offering of a fixed-price contract over a specified term with specified operating conditions to eligible renewable energy generators (although some feed-in tariffs step down in price over time) and can either be an all-inclusive rate or a fixed premium payment on top of the prevailing spot market price for power. The price paid represents estimates of either the cost or value of renewable generation. The tariff is generally offered by the interconnecting utility and sets a standing price for each category of eligible renewable generator; the price is available to all eligible generators.

There are a variety of design issues that may be applied differentially across different groups of generators to accomplish specific policy objectives or address fundamental differences in resource cost or quality. Examples of categories that could be used to establish different tariff prices include:

- Resources (for example, wind power or solar power).
- Application types (for example, roof-mounted versus building-integrated photovoltaics).
- Project sizes (to reflect scale economies).
- Resource quality (such as wind regimes).
- Commercial operation date (for example, new vs. existing vs. repowered).
- Ownership-structures (for example, community-owned).
- Location (for example, in a renewable energy zone).

Ultimately, this paper is to stimulate stakeholder input and feedback on appropriate feed-in tariff objectives, measures of success, and design features of feed-in tariffs for renewable energy in California. The California Energy Commission will hold a staff workshop to discuss this paper on June 30, 2008. Discussion at the workshop will inform development of a Feed-in Tariff Evaluation and Options Report and assist California's energy policy makers in exploring the use of feed-in tariffs to support development of Renewables Portfolio Standard-eligible generation larger than 20 megawatts.

CHAPTER 1: Introduction

Background

In 2007, the California Energy Commission's (Energy Commission) *Integrated Energy Policy Report* (IEPR) recommended that the Energy Commission, in collaboration with the California Public Utilities Commission (CPUC), draft a white paper that explores the use of feed-in tariffs for electricity generation projects over 20 megawatts (MW) in California. Feed-in tariffs are essentially standardized contracts to sell energy delivered to the grid.

California has a Renewables Portfolio Standard (RPS) that requires the state's investor-owned utilities, energy service providers, and community choice aggregators to serve 20 percent of retail sales with renewable resources by 2010; publicly owned utilities are required to develop RPS programs as well.[1] As indicated in the *2007 IEPR*, California is not currently on track to meet the 20 percent by 2010 requirement. California has also set a renewable energy goal of 33 percent by 2020, and it is clear that renewable energy must play a significant role in meeting the state's aggressive carbon-reduction goals.

Feed-in tariffs have driven rapid expansion in renewable energy development in some markets and may provide California with a tool to increase the pace of renewables development, reduce the rate of renewable energy contract failure, address the discrepancies between the market price referent (MPR) and the cost of renewable project development, and promote renewable projects in areas that require new transmission.

California is already experimenting with feed-in tariffs through several different mechanisms.

- Assembly Bill 1969[2] requires that each electrical corporation develop a tariff for public water and wastewater facilities up to 1.5 megawatts in size, priced at the MPR, up to a statewide cap of 250 MW.
- Additionally, CPUC Decision 07-07-027 requires that Pacific Gas and Electric Company (PG&E) and Southern California Edison Company (SCE) implement feed-in tariffs priced at the MPR for up to about 230 MW of renewable facilities, each up to 1.5 MW in size and owned by customers other than public water and wastewater agencies.
- SCE offers standard contracts for biogas and biomass generators less than 20 MW priced at the 2006 MPR of approximately $0.08/kilowatt hour (kWh).[3]

---

[1] See Public Utilities Code Section 387, Subdivision (a)

[2] Assembly Bill 1969 (Statutes of 2006, Chapter 731), codified in Public Utilities Code Section 399.20.

What Is a Feed-In Tariff?

A simple definition of a feed-in tariff is an offering of a fixed-price contract over a specified term with specified operating conditions to eligible renewable energy generators (although some feed-in tariffs step down in price over time) and can be either an all-inclusive rate or a fixed premium payment on top of the prevailing spot market price for power. The price paid represents estimates of either the cost or value of renewable generation. The tariff is generally offered by the interconnecting utility and sets a standing price for each category of eligible renewable generator; the price is available to all eligible generators. Tariffs are often differentiated based on technology type, resource quality, or project size, and may decline on a set schedule over time.

Feed-in tariffs have been adopted widely around the globe, particularly in Europe. Outside the United States, 37 countries have adopted feed-in tariffs as of 2007, including 18 in the European Union, making it the most prevalent renewable energy policy globally.[4] In North America, two Canadian provinces – Ontario and Prince Edward Island – have adopted feed-in tariffs. The earliest experience with fixed-price payment policies in the United States was the Public Utilities Regulatory Policy Act (PURPA), which passed Congress in 1978 and required utilities to purchase electricity from independent renewable energy and cogeneration plants. Two well-known state-based PURPA programs were the California Standard Offer No. 4 contracts and the New York Six-Cent Rule. While there are no comprehensive feed-in tariff policies currently in place in the United States, there are a number of more-limited fixed-price payment policies that differ significantly from the European policies in terms of scope, size, and design. Fixed-price policies outside California include:

- Green pricing programs: For example, in Wisconsin several utilities have adopted fixed-price tariffs for small biomass, wind, and solar photovoltaic (PV) generators used to provide supply for their green pricing programs. Similar approaches have been taken by Central Vermont Public Service and Tennessee Valley Authority.

---

[3] The expiration date for SCE's Standard Contract for Biomass is 12/31/2008 or 250 MW, whichever comes first. As of early June 2008, SCE has 11 MW under contract, 23 MW in negotiation, and 22 MW of inquiries. If SCE does not reach 250 MW by 12/31/2008, SCE may consider continuing to offer the contracts in 2009. The SCE "Protocol" document is available at http://www.sce.com/NR/rdonlyres/F0F1759B-8D9B-4DD9-B249-6879680DD531/0/080314_BSC_Protocol.pdf

[4] Martinot, E. (2008). *Renewables 2007 Global Status Report* (Paris: REN21 Secretariat and Washington, DC:Worldwatch Institute).

- RPS compliance: In New Mexico, PNM Resources offers standard offer contracts for the purchase of renewable energy certificates (RECs, the renewable attributes of electricity generated from a renewable facility) from PV systems less than 10 kW for meeting its RPS. Colorado also has a program that falls into this category.

- Washington state utilities offer performance-based incentive payments capped at $2000 per system per year for electricity production from on-site, net-metered small renewables (solar, wind, and anaerobic digestion) without the transfer of RECs or the purchase of electricity.

- Ongoing PURPA implementation: Idaho and Oregon are examples of states with continuing PURPA implementation programs. Also, California has some continuing PURPA contracts based on previous requirements. For new contracts, California has a PURPA-based "must-take" requirement for existing and new qualifying facility generation less than 20 MW.[5]

- California is in the process of considering feed-in tariffs for RPS-eligible and combined heat and power generation up to 20 MW.[6]

---

[5] "Many RPS projects are eligible for status as Qualifying Facilities (QFs) under the Public Utilities Regulatory Policies Act (PURPA). California has a 'must purchase' obligation for electricity generated by QFs up to 20 MW under PURPA. (D.07-09-040, p. 20, citing Federal Energy Regulatory Commission Order 688, 71 Fed. Reg. 64352.) The Commission has established certain contract provisions for small QFs (under 20 MW) 'because a small QF is unable to bid in a utility RFO [and] generally does not have the resources or expertise required to negotiate and enter into a bilateral contract with a utility …' (D.07-09-040, pp. 118-9.) D.07-09-040 establishes the new contract price terms and conditions for both existing and new qualifying facilities." (CPUC, June 5, 2008, Amended Scoping Memo and Ruling of Assigned Commissioner Regarding Phase 2 of Tariff and Standard Contract Implementation for RPS Generators, in Rulemaking 06-05-027, p. A2-3).

[6] In addition to feed-in tariffs offered by SCE for biomass and biogas and CPUC implementation of AB 1969, "[e]lectrical corporations are required to have a tariff/standard contract for the purchase of electricity from certain customers up to 20 MW (Public Utilities Code § 2840 et seq.; Assembly Bill 1613, effective January 1, 2008, requiring an electrical corporation to file a tariff/standard contract for the purchase of electricity delivered by a combined heat and power system up to 20 MW). The Commission has not yet acted on this new section of code." (CPUC, June 5, 2008, Amended Scoping Memo and Ruling of Assigned Commissioner Regarding Phase 2 of Tariff and Standard Contract Implementation for RPS Generators, in Rulemaking 06-05-027, p. A3).

Benefits and Limitations

As with other policies, there are characteristics of feed-in tariffs that provide both benefits and limitations, a number of which depend upon the design of the tariff. From the generator's perspective, the benefits of a feed-in tariff include the availability of a guaranteed price, buyer, and long-term revenue stream. Market access is enhanced, as project timing is not constrained by rigidly scheduled periodic solicitations, completion dates may not be constrained by contractual requirements, quantities are often uncapped, and interconnection is typically guaranteed. Together, these characteristics can help to reduce or alleviate generator revenue uncertainty and associated financing concerns. Because standing tariffs are less costly and less complex than competitive solicitations, they increase the ability of smaller projects or developers to help the state meet its RPS and greenhouse gas emission reduction goals. Feed-in tariffs reduce transaction costs for both buyer and seller and are more transparent to administer than the current system. Policy makers can use feed-in tariffs in a targeted fashion to encourage specific types of projects and technologies, if so desired.

However, there are limitations to how a feed-in tariff might function in California. Feed-in tariff costs cannot be predicted accurately because, despite the predetermined payments, the quantity of generation responding to a feed-in tariff is not typically predetermined (though it can be, and sometimes is, capped). One key question is how the tariff fits in a deregulated market structure; the majority of early feed-in tariff experience has been in vertically integrated electricity markets. This leaves open questions of who pays, how payments are distributed, through what portion of rates the tariff costs are recovered, and how the purchased electric production is integrated into utility power supplies. Another question specific to California is whether feed-in tariffs would work in concert with California's existing RPS law or would require changes in that law.

Of course, getting the price "right" can be challenging. If the price is set too high, the tariff introduces the risk of overpaying and overstimulating the market. This risk may be exacerbated when the tariff is open to large projects in regions with ample resource potential. On the other hand, if the tariff is set too low to provide adequate returns to eligible projects, it may have little effect on stimulating development of new renewable energy generation.

Design Issues

As noted earlier, proper design is critical to the success of a feed-in tariff. If the tariff rates are fixed and are unable to be adjusted, for example, they will not have the necessary flexibility to respond to market conditions. Moreover, some feed-in tariffs intentionally or unintentionally favor less efficient plants. As renewable energy resource potential is not uniformly distributed across California, unequal costs are likely to be incurred by interconnecting utilities, raising the issue of cost allocation. Finally, tariff quantity limitations or declining tariff price blocks will tend to encourage a scramble for projects to assure their place in line. This may result in speculative queuing, in which projects with no real commercial prospects detract from the success of a feed-in tariff by reserving funds that are ultimately not disbursed or are later released at a lower incentive level. Policy makers should strive to minimize such negative, unintended outcomes with careful feed-in tariff design.

Many feed-in tariff design issues are structural in nature and apply across all generators. REC ownership is one example. However, there are a variety of design issues that may be applied differentially across different groups of generators to accomplish specific policy objectives or address fundamental differences in resource cost or quality such that resources that may fail to be successful under a single feed-in price approach (for example, based on the value of the production) could be encouraged, resulting in a more diversified resource mix and generation profile. Such tariff differentiation options are discussed in Chapter 7; examples of categories that could be used to establish different tariff prices include:

- Resources (for example, wind power or solar power).
- Application types (for example, roof-mounted versus building-integrated PV).
- Project sizes (to reflect scale economies).
- Resource quality (such as wind regimes).
- Commercial operation date (for example, new vs. existing vs. repowered).
- Ownership-structures (for example, community-owned).
- Location (for example, in a renewable energy zone).

Feed-In Tariff Objectives and Measures of Success

Since any feed-in tariff program is likely to have multiple objectives, policy makers must first determine the specific set of objectives they wish to achieve and consider how they will prioritize or weigh those objectives against one another. Only then can a feed-in tariff program be designed that achieves those objectives at the lowest possible cost.

Potential goals for a feed-in tariff mechanism may include:

- Maximizing renewable generation development (with metrics such as MW of capacity or kilowatt-hours as a percentage of retail sales).
- Minimizing the overall retail electric ratepayer impact of renewables development.

- Developing a known quantity of renewable generation in a specified period.
- Promoting more-rapid technological advances for specific renewable generation technologies (technological diversity).
- Minimizing incremental transmission costs.
- Supporting smaller renewable projects or businesses that may not otherwise be able to bid under a solicitation process.
- Promoting renewable energy development in specific geographic locations.
- Minimizing contract regulatory oversight costs.

There are well-established "multi-attribute decision making" techniques that can be employed to select and weigh the desired set of objectives.[7] Under multi-attribute decision-making, the goal is to identify the smallest set of attributes that fully reflect the objectives. Every objective will be characterized by one or more attributes. For example, suppose policy makers wish to develop a diverse set of renewable resources, and that objective precedes all others. In that case, policy makers need to develop the measures of "diversity" they wish to use. If policy makers wish to promote greater diversity than would result under a single tariff price, policy makers would need to develop a feed-in tariff mechanism with various payment levels, with more expensive renewable resources qualifying for higher payments. With that in mind, the issue then becomes one of identifying the best design to incorporate different prices that will obtain the desired quantities of resources.

Purpose of This Paper

The *2007 IEPR* recommended that a paper be developed to investigate the advantages and drawbacks of adopting feed-in tariffs in California. The guiding purpose of this paper, therefore, is to:

- Explore the implications of the possible use of feed-in tariffs as a policy tool in the California context.
- Inform policy makers and stakeholders on design issues and options available for feed-in tariffs.
- Identify the advantages, disadvantages, and tradeoffs of alternative design approaches.

---

[7] For instance, methods to do this are described in Keeney R. and Raiffa, H. (1993). *Decisions with multiple objectives: Preferences and value trade-offs.* New York: Cambridge University Press.

As noted earlier, California is not on track to meet its current RPS target of 20 percent by 2010, absent the liberal use of flexible compliance rules, and is expected to need new policy tools to meet the renewable energy target of 33 percent by 2020. A number of market barriers exist to meeting the current RPS, including:

- Permitting and siting challenges.
- Transmission availability, timing, and cost allocation.
- Development risks, including securing site control and obtaining financing.
- Complexity of the RPS solicitation processes (including suitability of RPS solicitation processes for smaller projects).
- Lack of transparency.
- Contract failure, which may be caused by a wide variety of reasons, including over-aggressive bidding in solicitation processes.[8]
- Cost changes during the project development process, which may cause some projects to become infeasible; such cost changes are often caused by external factors, ranging from whether federal tax credits will be extended, to rising costs of equipment.
- Potential limitations on the availability of funds for any above-MPR contract costs.

Feed-in tariffs can address a number of these issues and help California meet its 33 percent by 2020 renewable energy target. Feed-in tariffs can:

- Reduce project developer costs, risks, and complexity without increasing ratepayer cost (relative to the cost of viable projects, as opposed to speculative bids, which result in contract failure).
- Reduce utility and regulator administrative burdens.
- Reduce transaction costs. Current complexity hampers the ability for small businesses and small projects to participate.
- Increase the willingness of developers to take on risk in addressing siting, permitting, or other barriers because the reward has a higher degree of certainty than under the current regime.

---

[8] Wiser, R., O'Connell, R., Bolinger, M., Grace, R., and Pletka, R. (2006). *Building a "margin of safety" into renewable energy procurements: A review of experience with contract failure* (CEC-300-2006-004). Sacramento, CA: California Energy Commission.

- Add the possibility of lower overall costs. Currently, low-cost viable projects are allowed to bid up to the MPR, which may act as a price floor, contrary to legislative intent.

- Shift competitive pressure from generators to manufacturers and suppliers of renewable energy generation equipment.

- Reduce the rate of contract failure. Many cost factors can change between a solicitation response and a project's resolution of permitting, siting, interconnection, and equipment procurement.[9] Once projects have progressed to the point where costs become certain, previously signed contracts may become infeasible. Under the current approach, such contracts would fail (or their proponents would seek to renegotiate with the purchasing utility, a practice that would tend to encourage more speculative bidding). For comparable feed-in tariff prices to that of RPS contracts that do succeed, it is possible that a greater number of projects could move forward because the potential for reduced costs under a feed-in tariff regime could leave a project more headroom to absorb costs increases related to potential project delays.

Ultimately, this paper is to stimulate stakeholder input and feedback on appropriate feed-in tariff objectives, measures of success, and design features of feed-in tariffs for renewable energy in California. The Energy Commission will hold a staff workshop to discuss this paper on June 30, 2008. Discussion at the workshop will inform development of a Feed-in Tariff Evaluation and Options Report and assist California's energy policy makers in exploring the use of feed-in tariffs to support development of RPS-eligible generation larger than 20 MW.

[9] In response to solicitations, projects often bid before having cost certainty. Fixing a project's costs requires substantial progress through permitting, interconnection, commitment to equipment orders, construction contracts, and financing. Obtaining cost certainty requires commitment of substantial funds, something many developers are unable to do without the certainty of a contract. In addition, a competitive solicitation without substantial bid security requirements encourages bidders to price aggressively, with little to lose if the price becomes infeasible.

Approach and Organization of the Paper

This paper analyzes feed-in tariff design by:

- Identifying and describing each major design issue and its importance.
- Identifying the range of conceptual design options, noting common practices used elsewhere and any apparent best practices (where applicable).
- Summarizing the advantages and disadvantages of each design option in relation to its potential for application in California.

This discussion will provide the basis for posing questions to stakeholders for feedback and comment at the June 30, 2008, stakeholder workshop.

The remainder of this paper is organized as follows:

- Chapter 2 discusses design issues related to generator and technology eligibility, including issues such as generator vintage, type, location, interconnecting utility, and project size.
- Chapters 3 through 7 treat issues associated with feed-in tariff pricing. Chapters 3 and 4 explore alternative approaches to setting the tariff price and designing the tariff structure, respectively. Chapter 5 explores approaches to setting the contract duration, while Chapter 6 considers approaches to adjusting tariff prices over time. Chapter 7 discusses the various approaches to tariff differentiation that might be used to accelerate development of a diversified mix of renewable energy resources in California.
- Chapter 8 explores the alternative products that may be sold and purchased under a feed-in tariff.
- Chapter 9 highlights the variety of options for allocating the costs of a feed-in tariff among utilities, and possible cost recovery mechanisms.
- Chapter 10 considers the alternatives for integrating purchased products into a purchaser's (or other party's) power supply.
- Chapter 11 deals with the critically important issues of interconnection and grid access.
- Chapter 12 discusses other contractual elements of a feed-in tariff.
- Chapter 13 addresses the potential imposition of quantity or cost limits on various segments of eligible generation under a feed-in tariff.
- Chapter 14 discusses the potential interaction of feed-in tariffs with other California policies.

- Conclusions are offered in Chapter 15.

Additional issues pertinent to California's consideration of feed-in tariffs will be deferred to the Feed-in Tariff Evaluation and Options Report.

CHAPTER 2: Generator/Technology Eligibility

One of the threshold issues for feed-in tariff design is defining which resources are eligible to receive the feed-in tariff rates. In this section the authors briefly review several key eligibility considerations, including resource type, vintage, location, interconnecting utility, and project size.

Resource Type

A feed-in tariff is open only to resources and technologies meeting defined eligibility standards. RPS-eligible renewable energy sources are defined in the California law[10] and in Energy Commission Renewable Energy Program guidelines.[11] The primary design question is not which technologies should be targeted by the state for policy support, but which technologies should specifically be targeted with a feed-in tariff.

Options

Resource eligibility design options include:

- Create a set of feed-in tariffs that are applicable to all RPS-eligible renewables. A set of feed-in tariffs under which all technologies are targeted is the most straightforward design option, and is similar to most European feed-in tariff policies.
- Use a feed-in tariff only for certain subsets of eligible resources. Several analysts have recommended the use of different mechanisms to support renewable resources at different levels of maturity. Mechanisms that emphasize generation price competition could be used for more mature technologies, for example, whereas generation cost-based tariffs could be used to target emerging resources.[12] Italy has taken this approach and has used feed-in tariffs for PV, and

---

[10] Section 399.12 of the Public Utilities Code defines an "eligible renewable energy resource" as an electric generating facility meeting the definition of an "in-state renewable electricity generation facility" as defined in Section 25741 of the Public Resources Code.

[11] California Energy Commission (2008) Overall Program Guidebook (2nd Ed., CEC-300-2007-003-ED2-CMF); California Energy Commission (2008) *Renewables Portfolio Standard Eligibility* (3rd Ed., CEC-300-2007-006-ED3-CMF).

[12] Midttun, A., and Gautesen, K. (2007). "Feed in or certificates, competition or complementarity? Combining a static efficiency and a dynamic innovation perspective on the greening of the energy industry." *Energy Policy, 35*(3), 1419-1422; see also Rowlands, I. H. (2005). "Envisaging

REC trading for "main tier" resources.[13] Hawaii legislators took a similar approach: in the four feed-in tariff bills[14] that the state considered during the past two years, the feed-in tariff applied only to PV, and not to any other resources.

- Use a feed-in tariff to target only certain ownership models. In Minnesota, for example, the feed-in tariff bill[15] would limit eligibility to renewable energy generators that are community-owned by Minnesota citizens or cooperatives. In California, Assembly Bill 1969 (Yee, Chapter 731, Statutes of 2006) limited the state feed-in tariffs to 1.5 MW resources owned by wastewater or water treatment facilities. Additionally, the CPUC allowed feed-in tariffs priced at the MPR for facilities owned by other customers. In Rhode Island, bill sponsors were considering limiting feed-in tariffs only to resources located on state or local government property.

Pros and Cons

The decision about whether and how to target a feed-in tariff is closely related to other design considerations, such as the state's policy objectives, and feed-in tariff's interaction with other policies (see Chapter 14). As a result, there are few inherent pros and cons with the choice of resource eligibility.

Vintage

Vintage refers to the age of the generator, and some states have crafted policies that both incent new renewable generation and maintain existing generation.

---

feed-in tariffs for solar photovoltaic electricity: European lessons for Canada." *Renewable and Sustainable Energy Reviews, 9*(1), 51-68.

[13] See Ölz, S. (2007, June 29). "Renewable energy policy approaches in IEA countries." Proceedings of the International Energy Agency Global Best Practice in Renewable Energy Policy Making Expert Meeting, Paris, France. It should also be noted that, although Italy uses a system of tradable RECs for non-PV resources, wind REC prices were fixed in 2008 to provide investor security. See also Gipe, P. (2008). Tables of renewable tariffs or feed-in tariffs worldwide. Retrieved on June 11, 2008, from: http://www.wind-works.org/FeedLaws/TableofRenewableTariffsorFeed-InTariffsWorldwide.html

[14] HB 1748 (Saiki), SB 1223 (Menor) and SB 1609 (Hanabusa) in 2006-2007; HB 3237 (Thielen) in 2008.

[15] HF 3537 (Bly)

Options

There are several options that could be used for setting vintage:

- Apply RPS definitions to feed-in tariffs. The Energy Commission's current RPS Eligibility Guidebook defines eligibility. This is the most straightforward option. Any generator that qualifies as eligible under the RPS could also qualify to sell power under the feed-in tariff contract. The current feed-in tariff in California under Section 399.20 is open to RPS-eligible generators less than 1.5 MW.

- Only new generators are eligible. Under this option, only new generators are eligible for the feed-in tariff, starting in the year in which they come on-line. This is how most of the European feed-in tariffs are structured.

- Qualification life. Under this option, generators are eligible for a contract with a length of a given duration (for example, 20 years). Older generators may take advantage of the feed-in tariff, but they must subtract the number of years that they have already been in operation from the contract date. For example, a generator that had been in operation for 10 years before the feed-in tariff policy was passed could only sell power under the feed-in tariff for 10 years total. This concept of "qualification life" is similar to what is contained in the Proposed Rule for the New Jersey solar renewable energy credit market.[16]

- Generators after a certain date are eligible. A final option is to allow only generators that came on-line after a certain date to qualify. Some states' RPS rules define new generators as those installed after a certain date. In Ontario, only generators that came on-line after electricity restructuring in May 2002 are eligible.[17]

Adopting the same vintage eligibility definition as the RPS builds from the administrative infrastructure already in place and sends clear signals to the marketplace. The current California feed-in tariff is technology-neutral and based on the MPR. This grounds feed-in payments in avoided cost and theoretically limits ratepayer impacts, although the Energy Commission has recommended changes in the way the MPR is calculated to better account for fuel price risk associated with natural gas.

---

[16] New Jersey Board of Public Utilities (2008). "Renewable Energy Portfolio Standard proposed amendments: N.J.A.C. 14:8-2.2, 2.3, 2.8, 2.9, 2.10" (Internal Discussion Draft 2/5/2008 – Pre-Stakeholder Review). Available at:
http://njcleanenergy.com/files/file/Solar%20transition%20rule%20proposal%20stakeholders%2020508.pdf

[17] Ontario Power Authority. (2007). *Standard Offer Program - Renewable energy for small electricity generators: An introductory guide*. Toronto, ON.

Generator Location: Tariff Access

To date, feed-in tariffs typically have tied eligible generation to their host utility. However, California has several other options for implementing feed-in tariffs in addition to limiting eligible generation to host utilities. Table 1 discusses pros and cons of a number of options regarding generator location and tariff access.

Options, Pros and Cons

Table 1: Generator/Technology Pros and Cons[18]

Option	Description	Pros	Cons	Notes
Access Interconnecting Utility Tariff Only	Generation within a local utility's service area is eligible only for that local utility's feed-in tariff.	Consistent with other feed-in tariff policies that are known to work.	Could restrict supply of available eligible renewable energy resources.	
California Generator May Access Any Feed-in Tariff	Permit eligible generators in California to choose from utility feed-in tariffs outside of the service area the generator is located in.	Would allow generators in locations without feed-in tariffs (for example, POUs) to access guaranteed revenue stream.	If each utility is allowed to set its own feed-in tariff, it could lead to renewable energy generators chasing the best available feed-in tariff rate and perhaps lead to obligated entities seeking to raise feed-in tariff rates.	Raises question of whether generation must be transmitted to the receiving utility, or whether delivery accomplished via RECs.
Tariff Access with Delivery to Feed-in Tariff Utility in California, Unrestricted	Permit eligible generators regardless of location (inside and outside of California) to receive the feed-in tariff rate of any California utility upon delivering energy.	Would expand supply of eligible renewable energy resources.	If each utility is allowed to set its own feed-in tariff, it could lead to renewable energy generators chasing the best available feed-in tariff rate and perhaps lead to obligated entities seeking to raise feed-in tariff rates. Could minimize the local environmental and economic benefits California ratepayers could receive if obligated entities only contract with renewable resources outside California.	Raises question of whether generation must be transmitted to the receiving utility, or whether delivery accomplished via RECs.

Source: KEMA

[18] Multi-jurisdictional utilities will have distinct issues in all three scenarios.

Publicly Owned Utilities and Investor-Owned Utilities

The *2007 IEPR* recommended that the CPUC require investor-owned utilities (IOUs) to implement a feed-in tariff for renewable energy generators under 20 MW. The CPUC's jurisdiction includes California's IOUs and does not extend to publicly owned utilities (POUs).

POUs, including both municipal utilities and electric cooperatives, serve roughly 25 percent of the state's electricity load and are provided flexibility in meeting the state's renewable energy targets. As specified in Public Utilities Code Section 387(a), "Each governing body of a local publicly owned electric utility, as defined in Section 9604, shall be responsible for implementing and enforcing a Renewables Portfolio Standard that recognizes the intent of the Legislature to encourage renewable resources, while taking into consideration the effect of the standard on rates, reliability, and financial resources and the goal of environmental improvement."

The *2007 IEPR* notes that POUs have contracted for about 1,600 MW of renewable energy capacity since 2003, with 1,300 MW of that being new. In comparison, IOUs have signed contracts for 4,598 MW to 6,230 MW of new, repowered, or restarted renewable energy projects as of August 6, 2007.[19]

While requiring IOUs to implement a feed-in tariff may not require legislation, requiring POUs to establish and implement a feed-in tariff would most likely require legislation.

Options:

- Require POUs and IOUs to establish a feed-in tariff.
- Only apply feed-in tariffs to IOUs; allow POUs to continue current approaches to acquiring renewables.

Pros and Cons

- Requiring POUs as well as IOUs to institute a feed-in tariff makes it a statewide requirement and (presuming a generator can only access the tariff of the utility to which it interconnects) would provide access for all eligible generators in the state regardless of which utility service territory they are located within.
- POUs have made progress toward meeting their designated RPS targets; still, additional incentives may be helpful in achieving long-term renewable goals.
- For small POUs, adopting a feed-in tariff may pose too great a burden.

[19] California Energy Commission. *2007 Annual Report to the Legislature*, p. 18.

Project Size

The ability for smaller renewable energy generators to bear the overhead costs of participating and competing in RPS solicitations has been cited as a reason for considering feed-in tariffs,[20] and was cited as a rationale for SCE's setting a 20 MW eligibility cap on its biogas/biomass feed-in tariff.[21] The *2007 IEPR* recommends that the state immediately establish feed-in tariffs for systems under 20 MW, and that the Energy Commission collaborate with the CPUC to explore feed-in tariffs for systems larger than 20 MW to "incorporate the value of a diverse mix of renewables as well as features of the most successful European feed-in tariffs," as stated in the *2007 IEPR*.

Table 2: Size Limit Pros and Cons

Option	Description	Pros	Cons	Notes
No Project Size Limit	Eligibility not limited by size.	Smaller projects that might not be competitive in RPS solicitations can take advantage of feed-in tariff programs. Could create the conditions for more rapid progress toward California's renewables goals.	Potential for large projects to dominate if there is an overall program capacity cap. This raises the concern that the program may be capped such that one large-scale project could satisfy the requirement, excluding other market participants.	Consistent with the current RPS generator rules.[22] In Europe, there generally are no size caps on generators,[23] but the incentive rates are sometimes differentiated by project size.

[20] Rickerson, W., and Grace, R. C. (2007). *The Debate over Fixed Price Incentives for Renewable Electricity in Europe and the United States: Fallout and Future Directions.* Washington, DC: Heinrich Böll Foundation North America.

[21] California Energy Commission. (2007). *2007 Integrated Energy Policy Report* (CEC-100-2007-008-CMF). Sacramento, CA, p. 143.

[22] For the California RPS, hydropower is capped at 30 MW.

[23] Feed-in tariffs generally do not have size caps in Europe. There have been exceptions, however. Prior to July 2005, France had a 12 MW cap in place for wind farms. *See* Jones, C. (2006). "French revolutions: Could new policies boost France's wind industry?" *Renewable Energy World 9*(2) 56-65.

Option	Description	Pros	Cons	Notes
Capacity Based Project Size Caps	Eligible generators may not exceed a specified maximum nameplate capacity.	Ability to target systems that might "fall through the cracks" of the RPS. Ability to encourage distributed generation. Potential to act as a mechanism for controlling market growth and policy costs.	Possible for large projects to fragment into multiple smaller "projects" that match the cap.	Examples include: Current California feed-in tariff caps generators at 1.5 MW. Ontario's feed-in tariff is available only to projects up to 10 MW.[24]
Capacity Based Program Size Floors	Eligible generators must exceed minimum system capacity.			In Prince Edward Island, the feed-in tariff is only available to systems larger than 100 kW.
Energy Based Program Size Limits	Eligibility is limited to generators below a specified resource intensity or capacity factor.	Encourages project development in areas with marginal renewable resources.	May provide support for less efficient projects or for projects that do not generate a lot of energy (if not policy objective).	Feed-in tariff legislation introduced in Michigan, Illinois and Minnesota limited wind turbine tariffs by energy output. This approach is a tariff differentiation strategy designed to encourage development in areas with marginal wind resources.

Source: KEMA

[24] The cap was chosen because it is easy to administer, it facilitates participation by small suppliers, and it fits with the Independent Electricity System Operator's registration rules. Ontario Power Authority. (2006). Joint report to the Minister of Energy: Recommendations on a standard offer program for small generators connected to a distribution system. Toronto, ON.

CHAPTER 3
Setting the Price—Approach

One of the central design issues for feed-in tariffs is the approach used to establish the price level offered in the tariffs. Each approach has its own underlying philosophies, benefits, and risks. There are a wide range of methods for setting feed-in tariff rates, but they can be grouped into three broad categories: value-based, cost-based, and prices based on competitive benchmarks.

Value-Based Payments

One approach to setting feed-in tariff levels is to base the payments on the value of the energy delivered. The philosophy behind such an approach is one of technology-neutrality; a generator is paid based on the value it contributes to the system, which can be measured in a variety of ways.

One of the most basic value-based methods derives feed-in tariff payments tied to the "avoided cost" of energy. California has taken several approaches to this in its history, using different definitions of avoided cost. In the 1980s, for example, the Standard Offer No. 4 contract defined avoided cost as a 10-year escalating rate schedule based on projected oil prices. Both the state's RPS and the current feed-in tariff employ a version of avoided cost known as the market price referent, or MPR. The MPR is a proxy price for a long-term contract with a new, baseload natural gas facility, including capital costs and long-term natural gas costs.[25]

Options

If California were to rely on avoided cost methods in future rounds of feed-in tariff policy development, there are several ways that avoided cost can be modified to take additional value into account. Examples include incorporating time-of-delivery, environmental externalities, and grid benefits into the feed-in tariff rate.

- Time: The current California feed-in tariff is based on time-of-delivery rates, such that electricity sold into the grid during peak times (for example, on-peak and during week days) reflects peak prices. The tariff is different for each utility territory; in SCE territory, for example, the feed-in tariff could be up to

[25] Assembly Bill 1969 sets the current feed-in tariff rate at the MPR. For more information on the MPR, see CPUC, February 8, 2008, Administrative Law Judge's Ruling Requesting Pre-Workshop Comments on 2008 Market Price Referent for the Renewables Portfolio Standard Program.

$0.31/kWh, and as little as $0.06/kWh.[26] In Ontario, there is an adder for generators that can reliably produce power on-peak. In the Czech Republic and Hungary, the feed-in tariff is differentiated by season.

- Environmental externalities: Value can also be set to include environmental externalities. Under integrated resource planning (IRP) regimes in the 1990s, 15 states incorporated environmental externality value into their comparisons of least cost resources[27] and IRP externality valuation methods[28] could be adapted to enhance feed-in tariffs. Portugal's feed-in tariff, for example, is based on a formula that includes a carbon dioxide reduction adder. For California renewable energy contracts based on the 2007 MPR, the amount paid will increase in 2012 due to a greenhouse gas (GHG) adder.

- Grid-side benefits: There have been many studies enumerating the grid-related benefits of distributed energy systems,[29] and these benefits have often been used to justify renewable energy incentives. Value-based feed-in tariffs can be designed to capture grid-side benefits through the use of adders or other mechanisms. Again referring to Portugal, part of the feed-in tariff formula includes a factor representing the avoided transmission and distribution (T&D) losses to the grid attributed to the renewable generators.

- Retail: An alternative method for defining value-based feed-in tariffs is to reference the retail price of electricity, rather than wholesale price or avoided cost. In the 1990s, both Denmark and Germany relied on feed-in tariffs pegged to retail price. In Denmark, renewables were guaranteed a price of 85 percent of the local, average retail price, whereas in Germany, wind and solar producers were

---

[26] Rickerson, W., Baker, S. E., and Wheeler, M. (2008). "Is California the next Germany? Renewable gas and California's new feed-in tariff." *BioCycle, 49*(3), 56-61.

[27] Mitchell, C. (1992). "Integrated resource planning survey: Where the states stand." *The Electricity Journal, 5*(4), 10-15.

[28] Swisher, J. N., Jannuzzi, G. d. M., and Redlinger, R. Y. (1997). *Tools and methods for integrated resource planning: Improving energy efficiency and protecting the environment*. Roskilde, Denmark: UNEP Collaborating Centre on Energy and Environment, Risø National Laboratory.

[29] *See* Duke, R., Williams, R., and Payne, A. (2005). "Accelerating residential PV expansion: Demand analysis for competitive electricity markets." *Energy Policy, 33*(15), 1912-1929; see also Lovins, A., Datta, E. K., Feiler, T., Rábago, K. R., Swisher, J. N., Lehmann, A., et al. (2002). *Small is profitable: The hidden economi cbenefits of making electrical resources the right size*. Snowmass, CO: Rocky Mountain Institute; See also Iannucci, J., Cibulka, L., Eyer, J., and Pupp, R. (2003). *DER benefits analysis studies: Final report* (NREL/SR-620 34636). Golden, CO: National Renewable Energy Laboratory.

guaranteed at least 90 percent of the retail rate.[30] Although both systems drove rapid wind growth through the mid-1990s, development tapered off when retail prices sagged; Germany switched to a technology-differentiated feed-in tariff based on generation cost in 2000.[31]

Pros and Cons

To date, value-based feed-in tariff policies in California have been technology-neutral, meaning that the same rate applies to different technologies. Value-based approaches can create rapid market growth (for example, Standard Offer No. 4), and, when based on time-of-use (for example, the current feed-in tariff), they can send positive market signals to generators that can dispatch on peak. However, as pointed out in the *2007 IEPR*, technology-neutral approaches do not address the state's desire to incorporate the value of a diverse mix of renewables. The state could attempt to differentiate between technologies under a value-based system through the selective use of adders, but most of the time, technology-differentiation through feed-in tariffs has gone hand-in-hand with generation cost-based mechanisms.

Generation Cost-Based Payments

An alternative approach to setting feed-in tariff prices is to base the payment level on the generation cost of each technology type. The theory behind generation cost-based feed-in tariffs is that each type of renewable energy technology should receive incentives designed to ensure its sufficient profitability, in turn leading to either a diverse mix of resources, or alternatively, targeting certain more expensive resources.

Cost-based feed-in tariffs are typically based on calculated estimates of the per-unit energy payment necessary to cover fuel (if applicable) and operation and maintenance costs, amortize up-front capital and development costs, and provide an estimate of reasonable return on investment to project investors consistent with a contract with a credit-worthy utility over a specified contract duration. Two closely related issues are how the feed-in tariff level is set and/or adjusted based on its interaction with other federal and state policies, including tax incentives or grants (Chapter 14), and how the

---

[30] Krohn, S. (1998). *Creating a local wind industry: Experience from four European countries*. Montreal: Helios Centre.Testimony on behalf of the Regroupement national des Conseils Régionaux de l'environnement du Québec before the Régie de l'énergie du Québec

[31] Rickerson, W., and Twele, J. (2002). *An overview of German wind energy policy*. Berlin, Germany: Bundesverband WindEnergie e.V. Prepared for Comité de Liaison Energies Renouvelables (CLER) Promotion of Renewable Energy and Development of Actions at a European Level (PREDAC).

tariff is differentiated within each resource type (Chapter 7). There are several standard methodologies for how generation cost and profit are calculated.

Options

- Setting the profit level. In determining the profit, there are a number of different benchmarks that could be referenced, such as the return on investment historically given to utilities. Different states and countries have defined profit in different ways in their feed-in tariff legislation. In the proposed federal feed-in tariff bill, for example, the feed-in tariff rates would be structured to "provide a nominal, post-tax project internal rate of return of not less than 10 percent after recovery of all operating and maintenance costs." In Rhode Island, the proposed feed-in tariff legislation[32] defines "reasonable profit" as "not less than ten percent (10 percent) but not more than thirty percent (30 percent)." The definition of profit also needs to consider the typical debt leverage.
- Defining a generator cost level. One of the key assumptions in generation cost methodology is determining a reasonable representation of generation cost. This determination can be political as well as technical, and this is particularly true when policy makers adopt a single tariff for a given technology.[33] Depending on the policy, a tariff can be set aggressively or conservatively.
    - Under a conservative tariff, generation costs are defined to target only the most competitive developers, or most competitive project scale or resource quality, within each technology type. In Ontario, for example, the PV tariff is set at levels too low (roughly equivalent to $0.41/kWh) for all but the largest systems,[34] and this effectively excludes small- and mid-size projects.
    - Under a more aggressive tariff, the incentive level is set high enough to allow a broad range of systems of different sizes, types, resources, and so forth. to

---

32 Rhode Island General Assembly, H 7616 of 2008. *An Act Relating to Public Utilities and Carriers* (would require certain providers of electric service to purchase electricity from eligible electric generators). State Representative Raymond Sullivan, February 26, 2008.

33 The use of tariff differentiation (Chapter 7) requires a finer-grained definition of generation cost for each technology type. Even here, however, a determination still needs to be made as to what an "average" generator requires for profitability.

34 Blackwell, R. (January 22, 2008). Solar power heats up with new Ontario projects: A huge increase in contracts to supply the grid means the province may soon be home to some of the planet's biggest arrays. *ReportonBusiness.com*.

take advantage of the tariff. In Austria and Germany, for example, the feed-in tariffs for biogas are set relatively high to encourage small farm digesters.[35]

Pros and Cons

There has been vigorous debate in Europe about setting the price based on generation cost.[36] Most European countries have shifted away from value-based policies, and the debate has shifted instead to one between generation cost-based feed-in tariffs and tradable credit systems. The European Commission's preliminary conclusions are that regulators have been able to set prices more accurately and effectively, rather than trying to accurately set quantity targets (which include assumptions about future supply and demand) and allowing tradable credit systems to determine price.[37] According to some analysts, creating incentives for all technologies simultaneously moves each technology down its experience curve more rapidly and may be a more cost-effective approach in the long term than exhausting the cheapest technologies first (as with inter-technology competition), and only then shifting to the next most expensive.[38] On the other hand, to the extent that cost-based tariffs are set more aggressively to entice less mature or more costly technologies, or less efficient project sites or scales, the ratepayer cost may be higher than the alternative. Whether this is a drawback depends on the objectives.

Competitive Benchmarks

The philosophy behind using a competitive benchmark, which is a variation on the cost-based approach, is a desire for the most cost-effective renewables, paying not what the output is worth or what the generation costs, but rather the least cost to secure the

---

[35] Klein, A., Held, A., Ragwitz, M., Resch, G., and Faber, T. (2007). *Evaluation of different feed-in tariff design options: Best practice paper for the International Feed-in Cooperation*. Karlsruhe, Germany and Laxenburg, Austria: Fraunhofer Institut für Systemtechnik und Innovationsforschung and Vienna University of Technology Energy Economics Group.

[36] Rickerson, W., Sawin, J., and Grace, R.C. (2007). "If the shoe FITs: Using feed-in tariffs to meet U.S. renewable electricity targets." *The Electricity Journal* 20(4) 73-86.

[37] Commission of the European Communities. (2005). *The support of electricity from renewable energy sources*. Brussels, Belgium.

[38] Huber, C., Faber, T., Haas, R., Resch, G., Green, J., Ölz, S., et al. (2004). *Green-X: Deriving optimal promotion strategies for increasing the share of RES-E in a dynamic European electricity market*. Vienna, Austria: Vienna University of Technology Energy Economics Group; Huber, C., Ryan, L., Ó Gallachóir, B., Resch, G., Polaski, K., and Bazilian, M. D. (2007). "Economic modeling of price support mechanisms for renewable energy: Case study on Ireland." *Energy Policy, 35*(2), 1172-1185

desired resources. It also acknowledges the inherent difficulty in making accurate administrative determinations of cost or sufficient return to motivate investors. The authors are unaware of the use of this approach in a feed-in tariff to date.

Options

- What is eligible?
  - All eligible source competition
  - Differentiation by type
- Mechanism and frequency for determining competitive benchmark
  - All prices determined through periodic auctions[39] or competitive solicitations, in which policy makers determine the types and quantities of renewable energy capacity or energy desired each year.
  - Recent/representative competitive benchmark. This approach will use a recent comparable competitive price, for instance, the last utility solicitation result could be used to set the feed-in tariff price.
- Adjustment factor. This would generally apply to the representative competitive benchmark and is a multiplier used to adjust the benchmark for purposes of setting the feed-in tariff price. For example, a price might be set at 95 percent of a recent auction clearing price, or 105 percent of the average price of projects selected in an as-bid solicitation.

Pros and Cons

- This approach can reduce the risk of setting the feed-in tariff price too high, which as noted above, is particularly acute in regions with the potential for very large projects. It can be challenging and risky to rely on the cost-based approach to setting feed-in tariff prices in some circumstances, particularly when dealing with regions with the potential for very large projects where the risk of setting a price too high can end up increasing ratepayer costs.

---

[39] See, for example, Lesser, J. A., and Su, X. (2008). "Design of an economically efficient feed-in tariff structure for renewable energy development." *Energy Policy, 36*(3), 981–990. This approach to feed-in tariff structure and price setting uses market auctions to establish feed-in tariff levels. This design is similar to existing generation capacity markets in PJM, ISO-NE, and the NYISO. Under this approach, renewable generation developers would receive a fixed per-MW capacity payment for a preset number of years, based on separate auctions for each desired renewable technology, and be paid for the energy they generate at the market price.

- The alternative requiring all prices to be determined through a competitive solicitation can be administratively cumbersome. If there is a solicitation each time, one could argue that it fails the definition of a feed-in tariff. In any event, success with this approach depends on ensuring solicitations or auctions are competitive.

CHAPTER 4:
Setting the Price—Tariff Structure

Another important design consideration is how the incentive should be structured. Although the 20-year fixed-price structure in Germany is the most familiar feed-in tariff, there are a number of current and proposed feed-in tariff structures that vary in terms of their present risk profile, degree of revenue certainty to generators, and interaction with the electricity markets.

Options

The following list represents a range of options that may be used for structuring a feed-in tariff:

- Fixed-price: Under a fixed-price contract, the purchasing entity offers a multi-year contract that does not vary over time. This contract structure is used in Germany, where non-wind generators receive a 20-year fixed-price payment for PV, biomass, and other resources. As will be discussed in Chapter 6, the German tariff declines at a predetermined rate over time such that a generator locking into a price in 2007 would get a higher price than a generator who locks into a price in 2008. It is important to note that the tariff rate, once locked into, remains the same for the full 20-year contract.
- Stepped fixed-price tariff: The stepped fixed-price tariff is a variant of the fixed-price tariff in which the generator receives a fixed-price payment, which then "steps down" to a lower payment level after a specified length of time. In Germany, and elsewhere, the wind energy tariff is stepped and is used as a mechanism to differentiate payments by wind resource (see Chapter 6 below).
- Fixed premium: Under a fixed premium contract, the generator sells power at the market rate and receives a fixed-price adder that floats on top of the market price. Spain has had the most rapid growth in Europe under a fixed premium system. The premiums are differentiated by technology and range from approximately $0.02/kWh for small hydropower, to $0.045/kWh for wind, to $0.39/kWh for solar thermal electric.[40]
- Hybrid approach: Under a hybrid approach, the purchasing entity is only responsible for buying certain commodities or attributes from the generator. This

[40] Held, A., Ragwitz, M., Huber, C., Resch, G., Faber, T., and Vertin, K. (2007). *Feed-in systems in Germany, Spain and Slovenia: A comparison*. Karlsruhe, Germany: Fraunhofer Institut für Systemtechnik und Innovationsforschung. Euros converted to U.S. dollars using exchange rates effective June 2008.

is discussed in greater detail in Chapter 8. During the recent New Jersey solar market transition regulatory proceedings, for example, stakeholders coined the term *hybrid tariff*. Under the hybrid tariff, generators would be able to combine a long-term, fixed-price incentive provided by the electric distribution companies (for example, $0.10/kWh), with the ability to sell RECs into the market.[41]

- Contract-for-differences.[42] This approach, also referred to as a *fixed-for-floating swap*, combines two inversely-floating revenue streams to yield a stable and certain revenue stream. In this approach, a *strike price* would be set at the level of revenue necessary to attract investment. The payment is determined as the difference between the strike price and the spot energy market price, so if the spot market price is less than the strike price, there is a payment to the generator of the difference. If the spot market price is above the strike price, however, then generators pay the difference between the two. This approach is consistent with selling RECs under the feed-in tariff and selling energy into the spot market.

Pros and Cons

The pros and cons of these different structures are summarized in Table 3.

Table 3: Tariff Structure Pros and Cons

Alternative	Example	Pros	Cons	Countries
Fixed price over fixed duration	$/MWh for 20 years.	Revenue certainty for generator over a fixed duration.	No incentive to operate at system peak.	Germany (non-wind) Ontario France (non-wind)
Fixed price stepped down over time	$/MWh for yrs 1-10, different $/MWh years 11-20.	Revenue certainty for generator, while transitioning off over-market support. Can be used to differentiate between resources.	No incentive to operate at system peak. Administratively more complicated to set.	Germany (wind) France (wind) Cyprus (wind)

[41] This structure was ultimately not adopted. See Kling, C. (2006). "Tariff model outline." *White paper series: New Jersey's solar program* (pp. 54-63). Trenton, NJ: New Jersey Clean Energy Program

[42] Bolinger, M., Grace, R., Smith, D., and Wiser, R. (2003). *Using wind power to hedge volatile electricity prices for commercial and industrial customers in New York*. Albany, NY: New York State Energy Research and Development Authority.

Alternative	Example	Pros	Cons	Countries
Fixed Premium	$/MWh over spot market (or sell energy to spot, plus receive premium).	Generators receive electricity market signals.	If electricity market prices rise, more costly for customers and more profitable for generators than under alternatives. Forgoes opportunity for near market feed-in contracts to serve as hedge.	Spain Czech Republic Slovenia
Hybrid Tariff	Fixed contract for energy only, generator can sell RECs independently.	Shares policy risk between ratepayer and developer.	Investors partially exposed to volatility in REC market.	Proposed in New Jersey, along with fixed-price tariff.
Premium as Contract-for-differences	REC payment set as $/MWh less spot price.	Revenue certainty for generator.	No incentive to operate at system peak.	Considered, but not implemented, for NY central procurement RPS. Consistent with RECs sold under feed-in tariff with energy sold to spot market

Source: KEMA

CHAPTER 5:
Setting the Price—Contract Duration

Setting the price and the length of the contract that the generator receives are closely linked, and under certain scenarios, there is a direct trade-off. If the policy goal is to assure developers a specific rate of return, for example, then a shorter contract will require higher $/kWh payments to deliver the same return as a longer-term contract. For the most capital-intensive renewable energy technologies, longer-term contracts will yield lower required payments to meet attractive returns on investment. As discussed in Chapter 1, however, not all feed-in tariffs are structured to target a specific developer return. Several approaches to contract duration are summarized in Table 4.

Table 4: Contract Duration Pros and Cons

Option	Pros	Cons	Notes
Short-term (3 to 7 years)	Potentially less risk for investors, if they can pull out quickly with their investments intact. Potentially lower ratepayer impact for high-cost technologies like PV.[43]	Upfront rate shock due to higher rates if a specific return for investors is targeted. Investors that pull out early do not have an incentive to maintain the technology for its lifecycle. Lose potential for near-market technologies to serve as a hedge to market prices over long term.	Currently no feed-in tariffs are based on short term contracts.
Medium-term (10 to 14 years)	Lowers investor risk due to longer contract terms. Balances out the risks of both the short-term and long-term contract durations.		Many of the European feed-in tariffs currently rely on a 10-14-year contract length, including Austria, Greece, Luxembourg and Slovenia.
Long-term (15 -20 years or longer)	By creating sufficiently long duration over which to spread high up-front costs, creates the opportunity for near-market technologies to serve as a hedge.	Creates a potential risk for technologies with fuel costs (biomass) due to the difficulty of ensuring a fuel supply over the long-term.	The majority of the recently proposed U.S. feed-in tariffs and many of the European feed-in tariffs (for example, Cyprus, Czech Republic, France, Germany, Ireland, and Portugal) specify a contract term of 15-20 years.

[43] Wilson Rickerson, personal communication with Jon Abe and Jim Christo from Massachusetts Technology Collaborative (MTC), based on MTC modeling of rebate and feed-in tariff ratepayer impacts.

Option	Pros	Cons	Notes
Optional Contract Terms, for example, Offers developers a range of contract lengths—typically 10, 15, or 20-years—to choose from.	Provides the developers with the flexibility to determine the appropriate contract length for financing a specific project.	Creates administrative uncertainties with regards to total life of the program.	The current California state feed-in tariff and the SCE biomass standard offer allow for 10-, 15-, or 20-year contracts.
Indefinite (pays the tariff for the entire life of a project)	Provides developers with a guaranteed revenue stream for the life of the project.		The Spanish feed-in tariff is open ended and currently has no official limit.

Source: KEMA

CHAPTER 6: Adjusting the Price

In general, tariffs are set such that price, price approach, and structure are known and set for any given renewable energy project availing itself of the feed-in tariff. Experience in Spain, Germany and Denmark suggests that such a stable policy framework may lead to high investment security and encourage substantial penetration.[44] The level at which the tariff is set has significant bearing on how successful it will be in encouraging new renewable generation. If the tariff is set too low, it will not drive new renewable energy development. However, if the tariff is set too high, the program will be using ratepayer dollars inefficiently, supporting fewer projects than if it were set at the "right" level. Adopting a mechanism that provides flexibility to periodically adjust tariff prices for new projects toward the right level for future projects is therefore desirable. Ultimately, the incentive level should be tailored to achieve specific policy goals defined by the state. This section addresses how the available price to new projects may be adjusted over time.

Price Adjustment Approaches

Options, Pros and Cons

There are a number of different approaches that can be used to address how the feed-in tariff price is changed over time. Each option, including examples, pros and cons, is summarized in Table 5 below.

---

[44] Klein, A., Held, A., Ragwitz, M., Resch, G., and Faber, T. (2007). *Evaluation of different feed-in tariff design options: Best practice paper for the International Feed-in Cooperation*. Karlsruhe, Germany and Laxenburg, Austria: Fraunhofer Institut für Systemtechnik und Innovationsforschung and Vienna University of Technology Energy Economics Group, p. 21.

Table 5: Price Adjustment Pros and Cons

Approach	Description	Example	Pros	Cons	Notes
No Adjustment	Tariff set and left at specified level indefinitely.	Under the 2000 German feed-in tariff law, hydropower, geothermal, and landfill gas did not adjust; they were assigned digression rates in the 2004 amendment.[45]	Stable framework.	Fails to account for changes or to push cost reductions.	Tariff may be one rate over full duration, or have multiple 'steps', for example, $/MWh for first 10 years, different $/MWh for remainder of contract.
Fixed with Inflation Adjustment	Tariff level is periodically adjusted for new and operating plants.	Greece, Ireland, and Brazil correct 100% for inflation. Portugal corrects for existing plants annually. France corrects for inflation by 60%-100%, depending on the resource type[46]. Ontario corrects by 20%.	Provides for increases in operating costs.	Fails to account for changes, or push cost reductions.	

[45] Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (2007). *EEG – The Renewable Energy Sources Act: The success story of sustainable policies for Germany.* Berlin, Germany.

[46] Ibid. Klein et al., p. 20; see also ibid. Gipe (2008).

Approach	Description	Example	Pros	Cons	Notes
Tariff Digression	Level of the incentive payment available to new plants reduced over time.	Germany – 1% to 6.5% digression, depending on resource.[47] France, 2% digression for wind power only. Italy 2% digression for PV only.	Ensures that, as conditions change, incentive payments remain at the appropriate level to achieve policy objectives. Provides incentives for technology improvement, investment in and expansion of manufacturing capabilities to capture scale economies, encourage cost reductions, minimizes risk of over-compensation.	Administratively complex and could increase administrative costs. Projected tariff digression rate may not match actual changes in costs over time.	Generally associated with cost-based pricing. Level of support for plants once operating is maintained over specified duration of support.
Indexed to change in measure of "value"	Tariff price for new plants periodically reset based on then-current projections of value.	California MPR.	Keeps prices in line with the current value of long-term contracts.	Administratively complex, could increase administrative costs. Could diverge with costs necessary for generator to earn adequate returns.	

Source: KEMA

When to Adjust Price?

Once it is determined how, or even if, the tariff level will be adjusted, the next step is to determine when the adjustments should be made.

[47] German digression figures are through 2008. A recent German law changed the PV digression schedule such that feed-in tariffs for rooftop systems 100 kW and below will decline 8 percent in 2009 and 2010, and 9 percent in 2011. For ground-mounted systems, and rooftop systems over 100 kW, the feed-in tariff will decline by 10 percent in 2009 and 2010, and 9 percent in 2011; see also Wang, U. (June 6, 2008). Solar prices set in Germany. *Greentech Media*. Retrieved June 11, 2008 from http://www.greentechmedia.com/articles/solar-prices-set-in-germany-980.html; see also ibid. Gipe (2008) for digression rates in France and Italy.

Options, Pros and Cons

There are three general approaches to determining when to make these adjustments, summarized in Table 6. The first two approaches, periodic revision and capacity-dependent revision, generally adjust to account for improved efficiencies from economies of scale and to encourage cost reductions over time. The periodic review option is intended to consider a wider range of outcomes to best tune the price to policy objectives. For any of the options, technology specific tariffs may provide varying incentive payments to different technologies or project sizes, as discussed further in Chapter 7.

Table 6: Price Adjustment Timing Pros and Cons

Approach	Description	Example	Pros	Cons	Notes
Periodic Revisions	Scheduled price decreases (a schedule of annual % price declines is established).	Czech Republic and Netherlands, each revised annually (for example, Netherlands tariffs were set in 2004 for new installations in 2006 and 2007[48]).	Most predictable, encourages stable market. Administratively straightforward.	If market transformation does not occur at the predicted rates, then the payment streams may decline at a pace that is detrimental to increasing generation.	
Capacity-Dependent Revisions	Quantity blocks. Price declines when a block is fully subscribed.	Portugal revises the price downward when a specified capacity level has been reached, varying by technology.[49] California Solar Initiative.	Moderately predictable, can encourages stable market. if steps are small, good at making viable prices visible over time. More likely to track market transformation progress than periodic revisions.	May create speculative queuing to capture the higher rate. If price decline lags behind market transformation rate, the tariff may rapidly dry up.	Cons can be mitigated through queuing procedures.

[48] Ibid. Klein et al., p. 20

[49] Ibid. Klein et al., p. 20

Approach	Description	Example	Pros	Cons	Notes
Periodic Review	No scheduled decline; instead, regulator reviews prices and/or digression rates according to set schedule, or upon petition, to reconsider tariff price for new projects.	Several proposed U.S. state feed-in tariff bills (Illinois, Michigan, Minnesota, Rhode Island) contain 2-year periodic review by regulators.[50]	Best able to adjust to changing circumstances.	Least predictable.	

Source: KEMA

How Much to Adjust Price?

If prices are to be adjusted downward via either periodic or capacity-dependent revision approaches, the next question is how to establish the lower price. The two approaches that have been used are experience curves and uniform steps.

Table 7: Price Adjustment Size Pros and Cons

Approach	Description	Example	Pros	Cons	Notes
Experience Curves	Apply a calculated rate of annual cost decline based on past empirical and/or projected data on technology cost and efficiency.	Germany, France, and Italy.	Highly transparent; Predictable; In theory matches achievable cost decreases; Incentives to build early; incentives for technological improvement.[51]	If digression rate set for many years, system is inflexible (rising prices may alter the trajectory). Difficult to administratively determine correct rate.[52]	Ideally based on empirical data.
Uniform Steps	Price periodically reduced in often uniform steps (automatically, once trigger MW level is reached, or periodically).	California Solar Initiative.	Automatically respond to improved efficiencies from economies of scale; Modest steps increase likelihood that tariff is still financially feasible.	Administratively straightforward.	Often associated with capacity-dependent revisions.

Source: KEMA

[50] Ibid. Rickerson, Bennhold and Bradbury (2008), p. 17

[51] Ibid. Klein et al., p. 42

[52] Ibid. Klein et al., p. 42

Queuing Procedures—Minimizing Speculative Queuing

When a feed-in tariff involves either prices that decline as a function of quantity, or have quantity limits (caps), the issue of application order, reservation, or queuing arises. Under a capacity-dependent revision approach, where the quantity of feed-in tariff contracts that is available at a higher price level expires and is then followed by lower prices, there is a general incentive for projects to rush to get in line to lock in the higher price. This situation can clog the project development pipeline with immature projects with a wide range of probabilities of success.[53] It is possible for projects to receive tariff approval yet never reach fruition. Such speculative queuing ties up access to funds that could be used on viable projects. While the available capacity will eventually be returned to the tariff pool, this would likely be at the then-current quantity block. This could result in eligible projects missing out on higher tariff payments that could have helped drive project development in the early stages of the program. The risk of such speculative queuing can be mitigated or minimized if the tariff is specifically designed to address it. Some mitigation options are summarized in Table 8 below.

Table 8: Queuing Procedures Pros and Cons

Option	Description	Examples	Pros	Cons	Notes
Application fee	Non-refundable fee to get in line.	RPS solicitation. Offer Deposit.	Administratively straightforward.	If fee is modest, does little to discourage speculation.	
Security accompanied with project milestones	Up-front fee, refundable if project reaches fruition by milestone date, forfeited if project fails.	Project Development Security in IOU 2008 RFO for renewables.	Encourages viable projects if security is sufficiently high. Somewhat more administrative burden than application fee.	Inflexible – if a viable project hits a delay, it can be kicked out of line.	The challenge is to find the right balance. Security is more effective as it is made higher, but higher security becomes a barrier to some projects.
Security increases in exchange for time extensions	Similar to previous option, but allows project to “buy an extension” by placing more security at risk.	NYSERDA RPS contracts.	Strong incentive to encourage projects that are real and discourage those that are not viable while acknowledging timing risks in development.	May fail to discourage deep-pocketed developers from rushing into the tariff queue if a time extension would expose the generator to lower revenue under tariff digression.	

Source: KEMA

[53] For example, California Solar Initiative projects are counted toward the MW trigger once they are deemed eligible, have paid an application fee (if applicable), and have received notice their reservation has been approved. The payment of a fee is an example of financial measures that can reduce speculative queuing.

CHAPTER 7:
Tariff Differentiation

This section discusses payment differentiation by technology type, project size, resource quality, initial operation date, ownership structure, and location. Independent of other structural choices is whether a tariff would be targeted in a manner designed to achieve specific policy purposes through tariff differentiation (for example, different prices available to subsets of eligible generators). Such choices come into play primarily when the policy is based on generation cost, rather than value. For example, wind is clearly less expensive than PV, but wind generation costs vary widely by factors such as turbine size and wind resource. So to what extent should feed-in tariff levels be subdivided and in what way? This is largely a question of policy objectives and has been approached in different ways by different countries.

Technology Type

The most basic type of differentiation is by resource type, and most of the existing European and proposed U.S. feed-in tariffs specify different rates for different resources (for example, wind power or solar power). Within each technology, however, some policies further differentiate by fuel or application type. In Germany, for example, there are adders within the biomass feed-in tariff for systems that use agricultural waste products, that are combined heat and power (CHP) systems, or that use advanced technologies such as fuel cells, Stirling engines, or organic Rankine cycles. Similarly, the German feed-in tariff provides higher payments for building-integrated photovoltaic systems than it does for roof-mounted PV.

Project Size

As a general rule, small projects cost more to develop on a per-megawatt basis than do large projects of the same technology. As a result, feed-in tariffs that do not differentiate by size tend to exclude small- to mid-size generators if they are set too low, or over-compensate large generators if they are set too high. To address this, the European feed-in tariffs and many of the proposed U.S. feed-in tariffs set different payment levels for different project sizes, with the policy objective of encouraging installations over a wide range of size and cost. The table below contains the proposed feed-in tariff rates for wind, biomass, and PV in Michigan (HB 5218 of 2007). As can be seen in the table, the Michigan bill would differentiate biomass and PV by capacity but would differentiate wind by output.

Table 9: Michigan Project Size Differentiation

Wind ($/kWh)	Biomass ($/kWh)	PV ($/kWh)
• $0.105 (less than 700 kWh/m²/year) • Linear in between 700 to 1,100 kWh/m2/year) • $0.08 (greater than 1,100 kWh/m²/year) • $0.25 (1000 sq. ft. swept area)	• $0.145 (less than 150 kW) • $0.125 (150 kW to 500 kW) • $0.115 (500 MW to 5 MW) • $0.105 (5 MW to 20 MW)	• $0.71 (façade cladding less than 30 kW) • $0.68 (façade cladding 30 kW to 100 kW) • $0.67 (façade cladding greater than 100 kW) • $0.65 (rooftop less than 30 kW) • $0.62 (rooftop 30 kW to 100 kW) • $0.61 (rooftop greater than 100 kW) • $0.50 (ground mounted)

Source: KEMA

Resource Quality

Another consideration for tariff differentiation is resource quality, particularly for technologies with widely varying or weather-dependent fuels such as wind. A tariff for wind that is set too low might only support projects in the windiest regions, which could lead to large, concentrated projects in a few windy areas rather than geographically distributed projects. In Europe, Portugal, France, Cyprus, and Germany each differentiate their wind tariffs by resource but take different approaches to doing so. In France and Cyprus, for example, each wind generator receives the same tariff rate for an initial period. After the initial period, the tariff is adjusted downward based on historical project performance. In Germany, each project's output is compared to that of a "reference turbine" representing output under average wind conditions in the country. All generators receive the same tariff initially, but then drop down to a lower tariff after a certain length of time. Turbines in lower wind regimes receive a higher incentive such that the rate is prolonged by two months for every 0.75 percent that the projected annual output is under 150 percent of the reference turbine output. In Germany, this tariff structure has led to wind development across the country, rather than just at the limited windy areas on the country's northern coastlines.

Commercial Operation Date

Although most generation cost-based tariffs are exclusively for new generation, tariffs can also be used to target existing or repowered generators. The early history of California's wind energy market was characterized by small turbines clustered in the state's windiest areas (for example, Tehachapi, Altamont Pass, and San Gorgonio Pass).[54] Since the 1980s, turbine size has increased dramatically, and there are opportunities to repower crowded windy sites with fewer, larger turbines. The current California RPS allows repowered resources to participate, but feed-in tariffs could be used to provide

[54] Gipe, P. (1995). *Wind Energy Comes of Age*. New York: John Wiley and Sons, Inc.

further (or more effectively targeted) incentive for repowering. Germany's development history is similar to that of California in that the windiest sites (for example, the coasts) were developed first using comparatively small-scale turbines. To encourage repowering, Germany's wind feed-in tariff allows generators to extend the higher wind rate by two months for each 0.6 percent that the output is below 150 percent of the reference turbine output.

Ownership Structure

Several U.S. states are beginning to explore policies to promote different ownership models for renewables, such as community-owned wind. Minnesota, for example, enacted a Community-Based Energy Development tariff that requires utilities to develop and offer 20-year contracts for renewable energy systems that are majority-owned by Minnesota residents or entities. The state is also currently exploring whether to turn the Community-Based Energy Development policy into a feed-in tariff. A recent Lawrence Berkeley National Laboratory study noted that feed-in tariffs have been successful in promoting community-owned projects in Europe,[55] but European feed-in tariffs generally do not include bonuses or adders for community ownership. As an alternative to limiting feed-in tariffs only to community-owned projects like in Minnesota, states could consider differentiating generation cost-based feed-in tariffs based on ownership. Although there is no precedent for community-owned feed-in tariff bonuses to date, community projects in Denmark were eligible for a $0.024/kWh[56] energy tax credit in addition to the feed-in tariffs during the 1990s,[57] and a similar mechanism could be integrated into feed-in tariffs in the future.

Transmission Access

To encourage generation closer to existing transmission and load centers, the tariff could be structured to provide higher payments to facilities that do not require significant transmission investments. Another alternative to encourage generation closer to existing transmission and load centers might be to rank tariff applications according to a project's proximity to available transmission and proximity to load.[58] Encouraging new generation close to existing transmission could delay significant near-term investments in expanding transmission infrastructure. It could be difficult to site significant new

[55] Bolinger, M. (2001). *Community wind power ownership schemes in Europe and their relevance to the United States* (LBNL-48357). Berkeley, CA: Lawrence Berkeley National Laboratory.

[56] In 1998 dollars.

[57] Ibid. Krohn (1998).

[58] Ranking would only be applicable in a situation in which a quantity or rate cap was in effect.

generation close to load centers due to “not in my backyard” issues. The renewable resource potential at sites close to existing transmission and load may be marginal compared to other locations in the state. Alternatively, a higher feed-in tariff could be set to assure usage of transmission built to access renewable energy zones.

Location—Transmission-Constrained Areas

Feed-in tariffs can be designed to target transmission constrained areas. Placing a priority on transmission constrained areas through a higher tariff rate could help alleviate transmission scarcity without significant short-term investments in new transmission (for example, in a load pocket). Alternatively, a feed-in tariff in a renewables-rich location with insufficient transmission access to the grid might be set at a lower rate to discourage over-investment in that location if transmission built to other renewable rich areas is not yet fully subscribed.

CHAPTER 8: What Is Being Sold/Purchased?

California and other states have had to tackle how to address renewable attributes associated with energy delivered under pre-existing contracts that do not specify the existence of renewable or environmental attributes, such as qualifying facility contracts under PURPA.[59] To avoid uncertainty over what is being sold and purchased, California policy makers should decide up front what is and what is not included in a feed-in tariff. Put another way, does a contract under feed-in tariff include all bundled renewable and environmental attributes and energy or not, and what happens once a feed-in tariff contract expires?

California law[60] defines a *renewable energy certificate* (also termed "renewable energy credits" or RECs) for California RPS purposes to mean a certificate of proof, issued through the accounting system established by the Energy Commission, that one unit of electricity was generated and delivered by an eligible renewable energy resource. RECs represent renewable and environmental attributes associated with renewable energy production.

It will be important to synchronize policy regarding what attributes are procured through feed-in tariffs with implementation of greenhouse gas reduction programs as also mentioned in Chapter 14. California policy makers should also recognize that the feed-in tariff price would need to be adjusted downward should some of the individual attributes be allowed to be disaggregated, as a result of the supplemental revenue stream(s) available to generators. Whether the CPUC allows the use of RECs for RPS compliance is also relevant. Finally, California policy makers should consider what happens to the attributes upon expiration of a feed-in tariff contract, that is, are the

---

[59] SB 107 (Sher, Statutes of 2006, Chapter 464) clarified that RECs would not be created for contracts with Qualifying Facilities under the federal PURPA executed after January 1, 2005, but that the deliveries of energy under these contracts would be tracked through the Energy Commission's accounting system and would count towards a retail seller's RPS procurement requirement. For contracts executed before January 1, 2005, the law specified that no tradable RECs shall be created unless the contract contains explicit terms and conditions specifying the ownership and disposition of those RECs. Deliveries from such pre-existing contracts will be counted towards the retail seller's RPS requirements. These provisions are now codified in Public Utilities Code Section 399.16, Subdivision (a) (5) and (6).

[60] Public Utilities Code Section 399.12, Subdivision (g)(1). In addition, Section 399.12, Subdivision (h) (2) defines a "renewable energy credit" to include all renewable and environmental attributes associated with production of electricity from the eligible renewable resource, except for an emission reduction credit issued pursuant to Section 40709 of the Health and Safety Code and any credits or payments associated with the reduction of solid waste and treatment benefits created by utilization of biomass or biogas fuels.

attributes being purchased in perpetuity or just through the term of the contract (see discussion of post-contract terms in Chapter 5).

Options

- Require that any contract entered into under a feed-in tariff be a bundled contract with energy, capacity, and ancillary services (if applicable),[61] plus all RECs.
- Allow feed-in tariff contracts to include only energy (or energy plus capacity and ancillary services if applicable) and allow unbundling of RECs and capacity attributes.
- Have feed-in tariff contracts include only RECs and allow energy (plus capacity and ancillary services if applicable) to be sold separately.
- Allow capacity rights and/or ancillary services (if applicable) to be unbundled from a feed-in tariff contract but not energy and RECs.
- Allow energy (plus capacity and ancillary services if applicable) and RECs to be transferred under a feed-in tariff but allow other attributes such as tradable emission rights to be sold independently.[62]

Pros and Cons

- Requiring that all contracts under a feed-in tariff be bundled would ensure that California ratepayers receive the energy and environmental benefits that they are paying for but may be inconsistent with the California RPS should the CPUC adopt the use of RECs, either partially or fully, for California RPS compliance.

---

[61] At present California does not have a capacity market, although that may change in the future. However, California contracts include the ability of load-serving entities to count the capacity for local resource adequacy purposes, which might also be applied in the case of feed-in tariffs.

[62] As defined by Public Utilities Code Section 399.12(g)(2): "Renewable energy credit" includes all renewable and environmental attributes associated with the production of electricity from the eligible renewable energy resource, except for an emissions reduction credit issued pursuant to Section 40709 of the Health and Safety Code and any credits or payments associated with the reduction of solid waste and treatment benefits created by the utilization of biomass or biogas fuels. As noted in the *2007 IEPR* (p. 103), any expected greenhouse gas emissions reductions from achieving the state's renewable energy goals should reduce the pool of available greenhouse gas allowances. Therefore, under current California policy, sales of tradable emission rights by California renewable energy generators could occur under only very narrow circumstances.

- Allowing RECs or other attributes to be unbundled from feed-in tariff contracts allows generators to access a supplemental revenue stream but also raises questions of what can be claimed as "renewable energy," what can be counted for RPS compliance, or what can be counted toward complying with the feed-in tariff if RECs or other attributes are unbundled from the feed-in tariff contract. The tariff price would be adjusted downwards to account for the supplemental revenue stream.
- Having feed-in tariff contracts only include RECs is compatible with a RPS or a renewables market that is characterized by unbundling RECs from energy. Currently, though, California does not allow RECs for RPS compliance, although the CPUC is considering allowing the use of RECs. The tariff price would be adjusted downwards to account for the supplemental revenue stream.

CHAPTER 9: Cost Distribution/Allocation

In considering feed-in tariffs, one must consider who first purchases the products conveyed by a generator under the tariff, whether these costs are reallocated among buyers, and how costs are recovered from customers. These considerations are discussed in sequence below.

Who Buys?

Options

In a vertically integrated market structure, there is no question which entity would maintain a tariff and purchase the products covered under the tariff: the utility. In California's market structure, the question has two potential answers:

- Retail generation sellers (investor-owned utilities, publicly owned utilities, energy service providers, and community choice aggregators).
- The provider of transmission and distribution services to retail customers (investor-owned utilities, and, if applicable, publicly owned utilities).

Pros and Cons

The choice will dictate how the costs of a feed-in tariff are carried and reflected in rates, who must administer the tariff and payments, and who must dispose of the products purchased. While the energy service providers and community choice aggregators serve a modest proportion of load in investor-owned utility territory, ultimately placing the obligation to purchase under a feed-in tariff on the provider of generation services could add a great deal of complexity in managing the power supply implications (see Chapter 10) unless all of the supply were to be sold into the spot markets.

Who Pays?

Several options exist for allocating costs from feed-in tariffs. A central question is whether costs should be allocated across the state, regardless of where the renewable energy generation is interconnected, or whether the interconnecting utility is responsible for the costs of the feed-in tariff. Further, if costs are recovered from all loads in the state, what are the mechanics of how those costs are collected and allocated? In the *2007 IEPR*, the Energy Commission suggested that the California Independent System Operator (California ISO) should consider performing this function, adding that "...several options should be evaluated as part of an Energy Commission white paper on feed-in tariffs prepared in collaboration with the CPUC to determine how best to allocate these costs. One option would be to allocate the costs through CPUC distribution rates. Another option would be to put in generation rates that allow stranded cost recovery from retail providers, as is currently done for qualifying facility renewable contracts."[63]

Another consideration is whether certain customer classes should be exempt from paying for a share of the costs of the feed-in tariff altogether, such as industrial customers.

Options

- Adopt a feed-in tariff without any statewide reallocation among all customer classes.
- Reallocate the aggregate annual costs (or, above-market costs) of the feed-in tariff to equalize the costs among utilities with feed-in tariffs. Each utility would thereby bear a share of costs in proportion to load, and their ratepayers would be subject to comparable impacts. This would be accomplished via each utility collecting a comparable amount per kilowatt-hour sold from their ratepayers, and those utilities collecting amounts in excess of their outlays would transfer a share of the overcollections to those utilities whose outlays to generators exceeded their collections.[64]
- Reallocate costs to equalize the rate impact among utilities offering feed-in tariffs through an agent such as the California ISO could perform the reallocation on behalf of the utilities.

Pros and Cons

- Adopting a feed-in tariff without some form of state redistribution of either costs or the power may raise costs significantly for utilities in renewable-rich areas.
- Adopting a feed-in tariff with some form of state redistribution could resolve some of the equity and imposing more costs on some load-serving entities (LSEs) than others but could also raise complexity.
- Public support for a feed-in tariff may waver if costs are disproportionally incurred by some load-serving entities as compared to others, particularly if renewable energy resources are concentrated in parts of the state compared to others.

---

[63] Energy Commission, *2007 IEPR*, p. 113

[64] Note: Equalization could also be accomplished through reallocating the purchased electricity products themselves, as discussed in Chapter 10.

- Conversely, support for a feed-in tariff may decrease if LSEs are paying surcharges while receiving little or no renewable generation.
- Exempting customer classes will ultimately result in higher costs borne by those customers not exempted.
- The California ISO is an independent entity that manages the statewide transmission grid. It is not involved in generation, and assigning this responsibility to the California ISO is perhaps at odds with its mission. FERC approval would likely be needed for the California ISO to extend its scope of control to performing cost or energy redistribution functions associated with a feed-in tariff.

A significant portion of the statewide renewable resource base is in SCE service territory. Therefore, adopting a feed-in tariff without some reallocation method may cause some rate impacts to SCE. Germany faced a similar issue, where a majority of the wind capacity was installed in E.On-Netz's service territory in northern Germany. A change to Germany's feed-in tariff was made where the costs of the feed-in tariff was allocated to Germany's transmission system operators on a statewide load-ratio basis. Allocation could be done through trading energy in "make-up" transactions or through cost allocation.

Cost-Recovery Mechanisms

Should California adopt a feed-in tariff for generators exceeding 20 MW, a suitable cost-recovery mechanism must be found. Two options California could choose from include recovery through generation rates and through a surcharge on distribution rates. Cost-recovery will be crucial to the success or failure of a feed-in tariff policy.

Options

- Recover feed-in tariff costs through generation rates.
- Recover feed-in tariff costs through a separate charge on distribution rates.

Pros and Cons

California utilities file general rate cases before the CPUC for recovering distribution, generation, power purchase, and administrative costs. The costs related to a feed-in tariff could be made part of those cases. An advantage is that the costs of feed-in tariffs could be rolled into the larger cost recovery proceedings. A disadvantage is that these cases are large and complex and will not provide much opportunity for the CPUC to provide much oversight on the effectiveness (or lack thereof) of feed-in tariffs, absent opening a separate proceeding to consider the issue.

Another possibility is to institute a separate charge on distribution rates, similar to a public goods charge that provides funds for renewable energy, energy efficiency, and electricity and natural gas research and development in California. This offers the advantage of providing transparency to how much a feed-in tariff costs California ratepayers. However, several administrative and oversight issues must be addressed that may serve as potential disadvantages for this option. These include 1) whether the Energy Commission or the CPUC should be the fund administrator; 2) at what amount the distribution charge should be set; 3) how often the distribution charge should be adjusted; 4) how funds should be allocated; and 5) how true-ups should be implemented.

Management of Cost Distribution

There are several different options for managing cost allocation. It is assumed that the state would be responsible for managing the cost distribution mechanisms, similar to its management of the public goods charge and California Solar Initiative. Other options include utility or third-party management.[65] In Germany, feed-in tariff costs are managed by the utility industry. The country's four transmission system operators calculate the national renewable portfolio on an annual basis, and the average price paid for renewables. Once the national averages are calculated, each distribution utility collects a surcharge on each kWh sold (for example, a public goods charge that recovers the incremental feed-in tariff costs. In Vermont, New Jersey, and Delaware, state public goods charge funds are being managed by third-parties under contract, and the federal feed-in tariff also proposes the creation of a third-party nonprofit corporation charged with managing cost distribution.

---

[65] See Blumstein, C., Goldman, C., and Barbose, G. (2005). "Who should administer energy-efficiency programs?" *Energy Policy, 33*(8), 1053-1067. See also Byrne, J., Kurdgelashvili, L., Partyka, E., and Rickerson, W. (2008). *Sustainable energy utility design: Options for the District of Columbia*. Newark, DE: Center for Energy and Environmental Policy. Prepared for the District Department of Environment. See also Eto, J., Goldman, C., and Nadel, S. (1998). *Ratepayer-funded energy efficiency programs in a restructured electricity industry: Issues and options for regulators and legislators* (LBNL-41479). Berkeley, CA: Lawrence Berkeley National Laboratory.

CHAPTER 10: Integration Into Power Supply of Utilities and Others

If California adopts a feed-in tariff, the resulting renewable energy generation will need to be incorporated into the market. As noted earlier in this paper, California does not presently allow California's tradable RECs to fulfill RPS requirements, although the CPUC is considering the issue. When enacted, the California RPS required energy delivery into the utility's service territory, but this has steadily been relaxed in recent years to allow flexible delivery anywhere within the California ISO. In addition, the California ISO will transition to a nodal spot market, known as the Market Redesign and Technology Upgrade (MRTU), later this year.

As an example of how this issue is addressed elsewhere, in Germany, the four transmission operators purchase the generation products under contracts, average the costs nationally, and require distribution operators to recover costs on their behalf.

Options

- All generation products sold into the spot markets.
- All generation products delivered to a utility's system are incorporated into the utility's own power supply. If reallocation is necessary, allocate dollars among utilities (or among retail generation sellers) instead of energy.
- All generation products allocated to and delivered to each utility (or, among retail generation sellers) in proportion to their respective load. In this case payments to the generators would come from each utility (or generation service provider) either directly or through an agent. Reallocation of funds between utilities (or generation service providers) would be unnecessary. This is similar to the approach taken in Vermont for distribution of PURPA contracts equally among Vermont's more than 20 utilities.

Pros and Cons

- Selling all generation into spot markets is perhaps the simplest option to implement. As noted, the California ISO will be launching the MRTU later this year, and the MRTU has the potential to enable robust day-ahead and hour-ahead markets that can help integrate levels of intermittent renewable, assisted by California ISO's Participating Intermittent Resource Program (PIRP).
- Having utilities incorporate energy and other products from generators connecting to their own systems into their own power supply may be reasonably straightforward if netted from the load to be served. This is similar to a situation

where the utility would sign RPS contracts with all such generators. However, it will leave planning to supply the remaining load obligations somewhat more difficult, as the quantity and timing of feed-in tariff generation is less predictable.

- Having generation service providers incorporate energy and other products from feed-in tariff generators would have similar impacts on utilities but may add considerable complexity for energy service providers and community choice aggregators by interfering with the manner in which they plan for and procure their electric supply.
- Allocating generation products among all utilities or generation service providers adds a level of complexity and cost (ISO costs associated with delivery to other utility service territories, as well as transaction costs). Allocating costs may therefore have a lower rate impact than allocating generation products.
- Having utilities incorporate energy from feed-in tariffs into their power supply may appear simple from a contracting and financing standpoint, but if utility delivery is strictly enforced, it would be somewhat inconsistent with the flexible delivery and shaping and firming currently allowed by the California RPS. Furthermore, strict utility delivery would be at odds with the California ISO's new nodal market design.
- Allocating feed-in tariff energy across all retail generation sellers in proportion to load is consistent with setting a statewide feed-in tariff target and is consistent with how Germany implements its feed-in tariff. Another entity such as the California ISO would need to allocate the energy and other products among retail generation sellers.

CHAPTER 11: Access

European feed-in tariff policies typically allow guaranteed grid interconnection and access, either to the distribution system or the transmission grid. Generators are generally required to pay the costs of physically interconnecting to the grid, while there are a variety of approaches used to allocate required system upgrade costs from interconnecting feed-in tariff generators, ranging from full cost allocation to the generator to full socialization.[66]

If California were to adopt a feed-in tariffs for generators greater than 20 MW, there would be no question of access: Feed-in tariff generators, like any other generator in California, have the guaranteed right to interconnect if they are willing and able to pay for their share of the costs of doing so. Access questions are largely handled via existing policy. Open access to the transmission grid is established policy under FERC Orders 888 and 890, and under CPUC Rule 21 for distributed generation for up to 10 MW. Rule 21 would have to be amended for feed-in tariffs for generation over 20 MW interconnecting to the distribution grid; however, technical questions on whether the distribution grid can incorporate such levels of generation would have to be addressed.

Throughout the United States, as a matter of FERC policy, generators are responsible for all direct costs of physically interconnecting to the system. Cost allocation for new "upstream" transmission upgrades to interconnect generation facilities is also under FERC jurisdiction. Current California ISO policy is to allocate transmission upgrades above 200 kV across all customers; upgrades below 200 kV are allocated to the transmission owner where the upgrades are located.[67] If the California ISO designates a renewable energy zone, then the ISO will pay for upgrade costs initially and subsequently spread a share of these costs to load until generation comes on-line; thereafter generators pay their pro-rata share of these costs. Allocation of the cost of distribution upgrades resulting from interconnection is a matter of state policy and therefore is within the control of the state to decide whether such distribution upgrades would be paid for by a feed-in tariff generator.

Options, Pros and Cons

As access is guaranteed, questions for California to consider related to this aspect of feed-in tariff design include:

---

[66] Ibid. Klein, et al, p. 62.

[67] If the California ISO designates a renewable energy zone, then the ISO will pay for upgrade costs initially and subsequently spread a share of these costs to load until generation comes on-lineon-line; thereafter, generators pay their pro-rata share of these costs.

- Should feed-in tariff generators pay for the direct costs of interconnecting to the grid (current policy) or should such costs be socialized? A change in the current policy to socialize such interconnection costs would lower barriers to renewable generation and improve the internal economics of individual generators, perhaps leading to greater penetration of renewables at any given tariff level. While the authors are unaware of an example of a feed-in tariff being designed in this manner, one example of this treatment is a law directing Germany's four transmission utilities to pay for the costs of interconnecting to off-shore wind projects. However, socializing interconnection costs would be a major departure from current policy, which would remove an important price signal for locating plants. This would not encourage careful siting of the renewable energy generator to minimize interconnection and transmission costs, thereby potentially increasing overall costs of meeting renewable energy targets.
- Should upstream improvement cost allocation be socialized more broadly than to just the interconnecting utility for upgrades under 200 kV or distribution upgrades? The choice here may be tied to the broader choice of whether feed-in tariff costs are allocated among utilities to equalize their ratepayer impact. If so, socializing these costs would appear to be consistent with such a choice.
- Should greater standardization of interconnection tariffs be pursued? Updating Rule 21 to allow standardization of interconnection of facilities over 10 MW on the distribution grid, if the facilities meet the eligibility requirements of a feed-in tariff, could simplify access and remove a potential barrier to feed-in tariff generators. Updating Rule 21 to allow systems larger than 10 MW to interconnect to the distribution grid will take careful study to ensure there are not reliability impacts; however, it is not clear whether there will be significant numbers of large renewable generators interconnecting to the distribution grid.

CHAPTER 12: Credit and Performance Assurance

When renewable energy is solicited or procured by utilities or other market participants that plan to rely on the energy and other products to serve load requirements or comply with RPS obligations, various forms of credit or security requirements can be imposed to protect against the risk of a new project not going forward or for non-performance once a project is operating. Such requirements are a common feature of solicitations and contracts for generation and encompass all aspects of project development, from early stage development to financing and construction to operation. Here the authors consider the role of:

- Up-front credit or security requirements used to secure timely performance and protect the buyer against the repercussions of a relied-upon resource failing to materialize when expected, or at all. Such security takes a variety of forms in industry practice and has a variety of labels, such as completion security, project development collateral, performance bonds, bid, or deposits. They can take the form of cash or equivalent deposits, letters of credit, or guarantees from a credit-worthy developer, parent company, or financier.
- Operating security. Operating security protects the buyer against the cost of replacement energy, RECs, or other products in the event a seller fails to meet its obligations, fails to properly maintain a generator, or seeks to get out of a contractual obligation to seek a more lucrative market. Such security takes a variety of forms in industry practice and has a variety of labels, such as performance bonds or operating collateral, and may be in the form of a letter of credit, corporate guarantee, performance bond, or similar document.

Some or all of these requirements may be worth considering in designing a feed-in tariff. The credit or security requirements can be adjusted to reflect such elements as requiring greater credit or security requirements if payments under a feed-in tariff are front-loaded in the early years, or in reducing credit or security requirements to facilitate emerging technologies. While these requirements can protect against default or non-performance by a generator, overly stringent requirements may restrict competition and increase the cost of power.

In utility solicitations, utilities typically use at least four types of credit or security requirements, as discussed below. These could be adapted for feed-in tariffs:

- *Advance deposits* due either at project application, short listing of a project, or when a project is selected.
- *Financial information* used during project evaluation and during project development, construction, and operation.
- *Development security* from when the contract is signed to when the project begins operation.

- *Operation collateral* for when the project is in operation.[68]

These credit and security options are discussed in more detail in Table 10 below.

Table 10: Credit or Security Options

Option	Description	Examples	Pros	Cons
Deposit requirements	Flat fee or amount based on capacity ($/kW) or energy ($/MWh), due either upon bid submission or being shortlisted.	All three California IOUs require bid deposits in 2008 Requests for Offers for renewable energy (generally $/kW deposit).	Helps to weed out speculative projects and to cover costs in reviewing bid.	Benefits larger, more financially established. Could keep viable projects of smaller developers from participating.
Financial information	Provision of company-specific and project-specific financial information.	Varied; could encompass historical financial statements, credit ratings, financing plan for the project, or pro forma budgets.	Helps evaluators determine whether company is viable enough to obtain financing and to verify whether financial assumptions are realistic.	Companies may object to providing sensitive financial information.
Development security	Collateral for period between contract execution and project operation.	All three IOUs have development security requirements for 2008 renewables RFO. Typically $/kW requirement, lowered for intermittent resources.	Provides protection if project or construction schedule is not met or in case project defaults.	May benefit larger companies at expense of smaller companies and limit submission of viable projects.

Source: KEMA

In the context of feed-in tariffs, the first three categories have generally not been used. For instance, under European feed-in tariffs, grid operators are required to interconnect the eligible generator and pay the tariff, regardless of the generator or its creditworthiness. There is no way not to pay, so credit guarantees are not asked for. It is generally understood that there is no need for credit or security requirements: if a generator goes bankrupt or otherwise fails to deliver, it does not get paid. On the other

[68] KEMA. *The Cost of Credit: A Review of Credit Requirements in Western Energy Procurement*. California Energy Commission consultants' report, June 2006, CEC-300-2006-014. Available at http://www.energy.ca.gov/2006publications/CEC-300-2006-014/CEC-300-2006-014.PDF.

hand, if payments are to be made by the grid operator in advance of generation (a practice sometimes used), then there may be reason for security to assure performance.[69]

Options, Pros and Cons

Within the context of a potential feed-in tariff in California, two categories of security might be considered: development security and operational security. Options for each, and their pros and cons, are as follows:

- Development security. Since, under a feed-in tariff, policy makers may be attempting to maximize renewable energy generation rather than meet a minimum standard, the risks associated with contract failure under a traditional power supply or RPS contract are substantially lessened. If the tariff price is above the replacement cost of "commodity" energy, then there is little risk exposure and therefore minimal rationale for requiring development security to assure completion. Furthermore, such a requirement may create a barrier to small generators or developers, and would likely increase the cost of power (or conversely, make it more difficult for a generator to be profitable at the tariff price offered). To date, none of the states other than California that have introduced feed-in tariff legislation in the United States require development security in the bill text, and none (beyond California) have proceeded to the rulemaking stage where such concerns might be more appropriately raised. That said, should a feed-in tariff be designed to facilitate meeting a 33 percent RPS in California, then policymakers should explore further whether development security would advance or impede policy objectives. If such security is required, one option is to reduce credit or security requirements to facilitate emerging technologies.
- Operation collateral or security. For the same reasons described above, it is not clear whether there is a strong impetus for operational security, as under a feed-in tariff there is less reliance upon delivery for power supply or compliance purposes and therefore the damages are less than under typical contracts. Credit or security requirements may protect ratepayers if payments under a feed-in tariff are front-loaded in the early years. However, while these requirements can protect against default or non-performance by a generator, overly stringent requirements may create a barrier to small generators or developers and may increase the cost of power. If such security is required, one option is to reduce credit or security requirements to facilitate emerging technologies.

[69] Personal communication by Wilson Rickerson with Uwe Büsgen, Bundesministerium für Umwelt, Naturschutz und Reaktosicherheit (the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety of Germany), May 31, 2008.

CHAPTER 13: Quantity and Cost Limits

Given California's history with rapid market growth under PURPA, which was characterized during recent feed-in tariff proceedings as an "overwhelming response with too much potential supply,"[70] the state may want to consider limiting the feed-in tariff beyond any limitations found in eligibility definitions (Chapter 2). The two primary mechanisms for limiting policy impact are by establishing capacity caps and establishing cost caps. It should be noted that quantity caps can also be paired with eligibility considerations, such as in Brazil where capacity caps are assigned by region to encourage geographic diversity.[71]

Table 11: Quantity Cap Pros and Cons

Option	Description	Examples	Pros	Cons	Notes
Quantity cap based on capacity	Cap feed-in tariffs at a specific capacity amount (typically by technology).	France caps wind at 17,000 MW, solar at 500 MW, hydro and biomass at 2000 MW. Italy caps solar at 1,200 MW. South Korea caps solar at 1,300 MW.[72] The California AB 1969 feed-in tariff is capped at 478.4 MW.	Limits uncontrolled growth and cost.	Can create market uncertainty, especially depending on queuing protocols (Chapter 6).	If cap is not technology specific, then "average" MW capacity may have to be defined, similar to Iowa RPS.
Quantity cap based on generation	Cap feed-in tariffs at a specific amount of electricity sold within the state.	Similar to RPS tiers in states specifying that specific resources must supply specific shares of final target.	Limits uncontrolled growth and cost.	Can create market uncertainty, especially depending on queuing protocols (Chapter 6).	

[70] California Public Utilities Commission. (2007). Opinion adopting tariffs and standard contracts for water, wastewater, and other customers to sell electricity generators from RPS-eligible renewable resources to electrical corporations (Order Instituting Rulemaking to Continue Implementation and Administration of California Renewables Portfolio Standard Program, Rulemaking 06-05-2007). San Francisco, CA.

[71] Kissel, J. M., and Krauter, S. C. W. (2006). "Adaptations of renewable energy policies to unstable macroeconomic situations - Case study: Wind power in Brazil." *Energy Policy, 34*(18), 3591-3598.

[72] Ibid. Gipe (2008).

Option	Description	Examples	Pros	Cons	Notes
Cost cap	Cap based on policy impact, such as % of annual electricity sales.	New Jersey solar RPS cost impact capped at 2% of annual sales. New Mexico RPS cost cap starts at 1% of annual sales and rises by 0.2% annually to 2% .	Cost limits independent of capacity and directly tied to ratepayer impact.	Can be less transparent for market participants.	Need to determine whether queuing takes place until costs subside or whether policy terminates.

Source: KEMA

CHAPTER 14:
Policy Interaction

California already has a number of policies in place aimed at increasing renewable energy generation and reducing greenhouse gas emissions. The structure and intent of these policies would need to be taken into consideration in designing a feed-in tariff so as not to duplicate existing efforts or inhibit forward progress.

Integration of Feed-In Tariffs With Existing RPS Framework

One of the central questions of feed-in tariff design in the United States is how feed-in tariffs can be integrated into existing RPS frameworks. California's RPS currently requires 20 percent of retail sales to be served with renewable energy by 2010. State policy has a goal of achieving 33 percent renewable energy by 2020. Unlike RPS regimes in the Northeast and Texas, California's RPS does not rely on a system of tradable RECs. Instead, the IOUs conduct annual RPS procurement solicitations to contract for energy and also may enter into bilateral contracts. If California were to design a feed-in tariff, there are several ways that feed-in tariffs could be integrated into the RPS framework.

Options, Pros and Cons

- Feed-in tariffs as a parallel to current contracting mechanism: A feed-in tariff in California could serve as a parallel mechanism to the current solicitation process. The current California feed-in tariff functions in this manner, and utilities can count any electricity purchased through a feed-in tariff toward the RPS goal. As discussed above, the amount of capacity that can take advantage of the feed-in tariffs is currently capped at 478.4 MW. One option would be to raise or remove the current caps on project size and cumulative MW eligible. Having a feed-in tariff available as a standardized, open-ended alternative to the current process could help create a diverse renewable resource mix. Or, depending on how the policy was structured, a feed-in tariff could serve as a safety net for projects that are unsuccessful in the bidding process and provide "between-cycle" opportunities, allowing projects to go to market when ready (which could reduce the rate of premature projects seeking utility contracts at prices that turn out to not be viable).[73] Feed-in tariffs might also alleviate some of the concerns

[73] This discussion assumes that the feed-in tariff price would be set at or below recent or anticipated auction prices.

associated with contract failure in California.[74] In 2007, however, the CPUC stated that feed-in tariffs should not be "open-ended" since California's Standard Offer No. 4 contracts resulted in an "overwhelming response with too much potential supply."[75]

- Feed-in tariffs as a limited alternative to current contracting mechanism: In light of concerns over "open-ended" contracting, a limited feed-in tariff could be adopted that only targeted certain types of resources or ownership models (see more on Technology Differentiation in Chapter 2 above). This is in part how the current feed-in tariff in California is structured. The current feed-in tariff is based on the MPR, however, another option would be to employ a generation cost-based feed-in tariff targeting certain policy goals in parallel with the RPS and the MPR-based feed-in tariff.

- Feed-in tariffs as a replacement for the current mechanism: Another option would be replace the existing structure entirely with a feed-in tariff. This could occur either in the near term, or once a specified milestone had been met. One option is for the RPS to be replaced immediately with an open-ended (that is, unlimited) feed-in tariff. Another option for the feed-in tariff transition for projects larger than 20 MW is to begin once the state meets a specific percentage target, or at a specified future date, after which utility solicitations might be discontinued. Full replacement of the RPS could streamline, simplify, and accelerate the renewable energy procurement process in California if structured properly. Also, the MPR has risen steadily during the past several years, and establishing a standardized, generation cost-based contract for near-market resources has the potential to lock-in long-term renewable energy prices below the MPR for the most cost-effective renewables. Full replacement with an open-ended feed-in tariff, however, would raise the risk of increased ratepayer costs if the tariff level is set too high and generation is developed and delivered faster than policy makers can respond to terminate or modify tariff offerings.

---

[74] Wiser, R., Bolinger, M., Porter, K., and Raitt, H. (2005*). Does it have to be this hard? Implementing the nation's most aggressive Renewables Portfolio Standard in California* (LBNL-58728). Berkeley, CA: Lawrence Berkeley National Laboratory.

[75]. California Public Utilities Commission. (2007). Opinion adopting tariffs and standard contracts for water, wastewater and other customers to sell electricity generators from RPS-eligible renewable resources to electrical corporations (Order Instituting Rulemaking to Continue Implementation and Administration of California Renewables Portfolio Standard Program, Rulemaking 06-05-2007). San Francisco, CA.

Interaction of Feed-In Tariffs With Assembly Bill 32

At the time of writing, many important details are not yet decided regarding how AB 32 will be implemented with regards to the electricity sector and how the RPS will be incorporated into AB 32. As a general rule, any energy generated from projects receiving a feed-in tariff **w**ould be anticipated to be treated in a similar manner as other renewables under AB 32.

Interaction With Competitive Renewable Energy Zones

The California ISO is implementing its location-constrained resource interconnection policy, and the statewide Renewable Energy Transmission Initiative (RETI) is underway[76]. The California ISO received approval from FERC in late 2007 for its location-constrained resource interconnection proposal and is in the midst of collecting information necessary to designate candidate areas as part of its annual transmission planning process. Costs of new transmission or transmission upgrades for location-constrained resources will be recovered through the California ISO's transmission access charge, subject to a 15 percent cap. Generators in a designated energy resource area that come on-line then pay a pro-rata share of transmission costs.

In addition, the Energy Commission, the CPUC and industry stakeholders are participating in RETI, a process that will:

- Identify and rank potential renewable energy zones.
- Identify conceptual transmission plans for high priority renewable energy zones, in coordination with the California ISO's and publicly owned utilities' transmission plans.
- Identify high-priority transmission plans for renewable energy zones and initiate the permitting process for such projects.

The Energy Commission also suggested in the *2007 IEPR* that feed-in tariffs can help control costs and provide price transparency within designated renewable energy zones.

The California ISO's location-constrained resource interconnection policy and RETI are proceeding forward, and implementing a feed-in tariff for generators over 20 MW could represent a significant policy change that will require careful coordination with both the California ISO and the RETI participants.

---

[76] See California Energy Commission, "Renewable Energy Transmission Initiative," http://www.energy.ca.gov/reti/

Options

- Determine appropriate tariff prices for individual technologies based on RETI calculations for each renewable energy zone.
- There may be a variety of other options, but prior experience with feed-in tariffs does not provide much in the way of real-world examples.

Pros and Cons

- Renewable energy technology cost estimates developed to date in Phase 1 of RETI are relatively wide-ranging and reflect renewable energy cost estimates not only from California but from other states as well. More detailed and site-specific cost estimates will be developed in Phase 2 of RETI. Additional cost information can be found in the Energy Commission Cost of Generation report and the E3 model prepared for the CPUC and the Energy Commission. The costs in the E3 GHG model vary by technology and "zone;" the zones in this model are based on state boundaries, with a few sub-state or interstate exceptions.[77]
- Administration determinations of appropriate feed-in tariff levels for each renewable energy zone will be, by nature, imprecise and may be complex and unwieldy to implement, depending on the method used to set the price levels.

---

[77] See California Energy Commission, *Comparative Costs of California Central Station Electricity Generation Technologies*, Final Staff Report. Publication # CEC-200-2007-011-SF. http://www.energy.ca.gov/2007_energypolicy/documents/index.html#061207. See also Energy and Environmental Economics, Inc., "CPUC GHG Modeling," http://www.ethree.com/cpuc_ghg_model.html.

CHAPTER 15:
Conclusion and Next Steps

Feed-in tariffs have garnered international attention for their success in countries such as Germany and Spain. Just as with most renewable energy policies, however, the success of feed-in tariffs is largely a function of their design. As has been outlined above, there are a broad range of choices to consider when structuring feed-in tariffs.

The purpose of this issues and options paper is to inform and facilitate discussion among stakeholders and policy makers regarding the use of feed-in-tariffs in California for RPS-eligible generation greater than 20 MW. A workshop will be held to discuss this paper on June 30, 2008.

The discussion and written comments from the June 30 workshop will be considered in development of a Feed-in Tariff Evaluation and Options Report. Additional workshops are planned in the fall to discuss drafts of the report. The Energy Commission plans to publish a final version of the Feed-in Tariff Evaluation and Options Report in December 2008.