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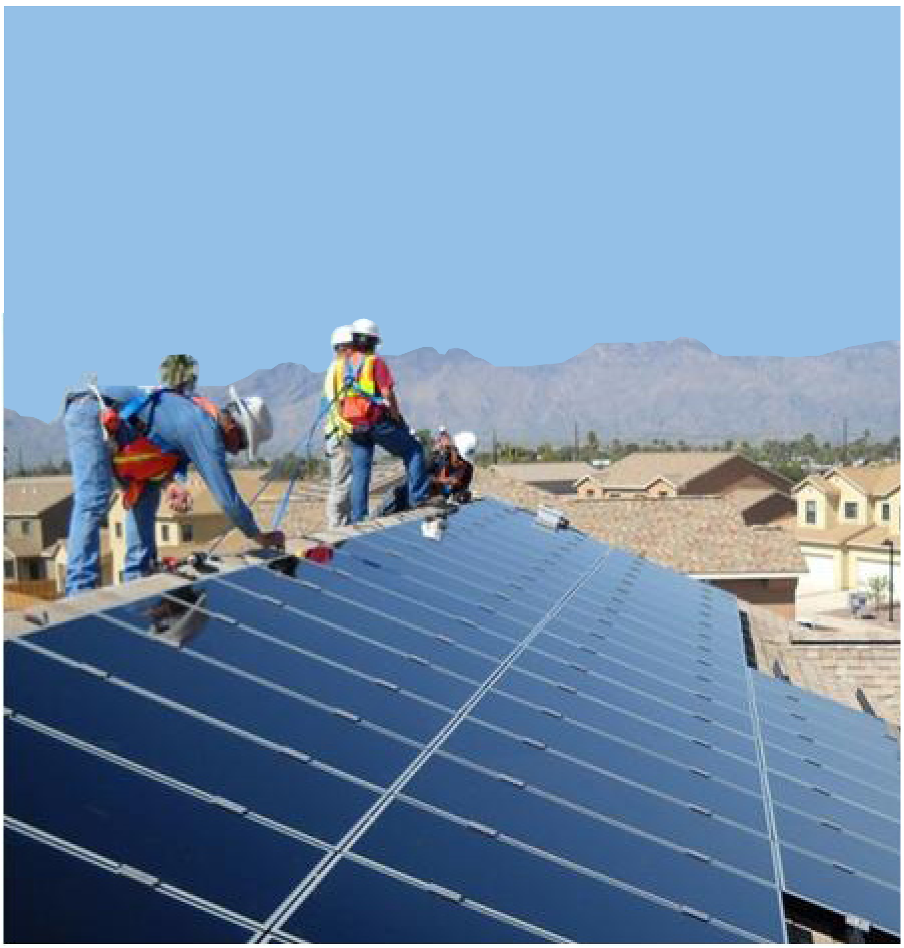
DESIGNING AN EFFECTIVE FEED-IN TARIFF FOR GREATER LOS ANGELES



Los Angeles Business Council Study

in partnership with the

UCLA Luskin Center for Innovation
School of Public Affairs

PURPOSE OF THE STUDY

In the search for clean energy solutions, new public policies are creating incentives for solar energy throughout California. Governor Schwarzenegger's executive order mandates a 33 percent renewable standard by the year 2020. The California Solar Initiative provides incentives to producers of solar energy, while SB1 extended these incentives to customers of public utilities. Last year in Los Angeles, Mayor Villaraigosa released a long-term, comprehensive solar plan intended to help meet the future clean energy needs of the city. This plan includes a proposal for a solar Feed-in Tariff program administered by the Los Angeles Department of Water and Power. As demonstrated in other cities throughout the world, Feed-in Tariffs can incentivize investment in solar infrastructure, stimulate local economies and create prevailing-wage jobs. However, implementation in other jurisdictions has also demonstrated how Feed-in Tariffs can create market barriers that inhibit solar technology and its associated economic benefits.

In September 2009, the Los Angeles Business Council created a Solar Working Group consisting of Los Angeles County leaders in the private, environmental and educational sectors to investigate the promise of a local Feed-in Tariff program. The LABC commissioned the UCLA Luskin Center for Innovation to conduct this study, which offers guidelines for Feed-in Tariff design. As part of its investigation, the Solar Working Group will issue a follow-up study that evaluates alternative program designs and tariff rate structures, estimating the participation rates and the amount of solar energy generated by different FiT programs.

The final results will be used by policymakers to design a Feed-in Tariff policy that spurs lasting economic development and significantly increases the solar energy generated in Los Angeles to meet regional renewable energy goals.

Solar Working Group Members:

Los Angeles County
Los Angeles Unified School District
Trammell Crow Company
CB Richard Ellis
Watt
Arden Realty, Inc.
Tuner Construction
Cedar Sinai
Kyocera Solar, Inc.
Parsons Brinckerhoff
Macerich
AECOM
Parsons
Westfield
Psomas
PsomasFMG
Latham & Watkins
JP Morgan
Energy Choice, Inc.
Kahn Solar
Union Roofing Contractors Association
Suncal Companies
G & C Equipment Corporation
Global Green
Sierra Club
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ACKNOWLEDGEMENTS

We would like to thank the following individuals and organizations for their contributions to this project. Sean Hecht and Cara Horowitz from the Emmett Center on Climate Change and the Environment arranged this project and assisted in developing the scope. Karlynn Cory of the National Renewable Energy Laboratory graciously reviewed this report and provided valuable insights into the issues presented here. Mark Greninger and the GIS team from Los Angeles County provided image analysis and data. Nurit Katz, Juan Matute, Dave Castle, Andrew Hunt, Dave Lewry, Brent Peterson, Daidipya Patwa, and Adam Green provided a valuable review of the content for clarity and accuracy. Any errors, omissions or inaccuracies in this report are the sole responsibility of the primary authors.

The Los Angeles Business Council and the Solar Working Group commissioned the study and made this project possible.

PHOTO CREDITS

Many of the photos in this report were provided courtesy of Kyocera, PsomasFMG, Axio Power, Kahn Solar, National Renewable Energy Laboratory and the Wayne National Forest Solar Project.

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EXECUTIVE SUMMARY

The Los Angeles Department of Water and Power (LADWP) has set ambitious renewable energy goals that it is currently falling far short of achieving. Recently Los Angeles Mayor Antonio Villaraigosa set the goal of producing 150 mega-watts of local solar power as part of a broader set of renewable strategies. In response, LADWP proposed a local solar program—known as a feed-in tariff. This report shows that neither LADWP's proposed feed-in tariff nor Southern California Edison's existing feed-in tariff will effectively contribute to these ambitious renewable energy goals. The purpose of this report is to provide guidance on how to design an effective feed-in tariff that is tailored to the needs of Greater Los Angeles.

A feed-in tariff is a policy that requires a utility to buy solar power that residents, businesses and public organizations produce by installing solar on their roof-tops, parking lots and vacant land. Based on the proven success of feed-in tariffs in other jurisdictions, the benefits of an effectively designed program are:

1. Produces significant number of in-basin high-wage jobs,
2. Quickly generates energy to meet renewable energy goals,
3. Taps the unused solar generation capacity of homes, businesses and parking lots,
4. Reduces utilities' out-of-basin transmission costs and peaking costs,
5. Signals a commitment to developing a local green-technology sector.

While a well-designed feed-in tariff policy can be a powerful tool for economic development that also yields a co-benefit of renewable power, the solar power that it produces is an expensive type of renewable energy to generate. So in the many places around the U.S. and world where feed-in tariff policies are adopted, policy makers place a priority on creating local high-wage jobs, supporting local green businesses and expeditiously meeting their renewable energy goals.

Section 1 of this report explains how a feed-in tariff works and describes the current challenges to owning solar power in Los Angeles. Although Los Angeles has abundant sunshine, there are many barriers to solar ownership including economic, regulatory and technical barriers. The current solar policy in Los Angeles is based on net metering programs. Net metering seeks to reduce the amount of power each building consumes from the grid (by encouraging the owner to install only enough solar to off-set their own energy needs). These policies often cause solar owners to undersize their installations, leaving much usable roof and parking space without solar panels. In contrast, a well-designed feed-in tariff will create incentives for people to maximize the solar capacity of their roofs and parking lots by transforming them into solar power plants that supply Los Angeles with clean, green power.

Section 2 reviews the lessons learned from jurisdictions in the U.S. and around the world that have implemented feed-in tariffs. Cases reviewed here include programs implemented in the Sacramento Municipal Utilities District, Gainesville Regional Utilities, the State of Vermont, the Province of Ontario, Germany and Spain. Some programs have been very successful in generating renewable energy and creating green jobs while others have not. Those places that have successful programs have set their tariffs based on the actual cost of installing and operating solar plus a reasonable rate of return. A second feature of larger successful programs is that the feed-in tariff policy is used to achieve the dual goals of renewable energy generation and economic development.

Section 3 assesses whether the feed-in tariff of Southern California Edison and the policies proposed by the LADWP will generate renewable energy and local green jobs. The likely effects of these policies on small scale residential rooftops, medium size commercial rooftops and parking lots, and large scale commercial rooftops are analyzed. Three findings stand out. First, neither LADWP's nor Edison's feed-in tariff policies will induce significant additional in-basin solar power as currently designed and at current prices for energy and solar technologies. Second, large-scale public (e.g., LAUSD, LACCD) and commercial solar sites are likely to produce the most cost-effective in-basin solar—which will minimize the burden placed on rate-payers. Third, effectively designed policies would enable the region to take advantage of tax benefits and subsidies from state and federal solar programs which would result in a significant flow of financial resources into the region. (In contrast, utility installed in-basin solar power is not eligible for these state and federal incentives and so it is probably more costly to install per unit.)

Section 4 presents the important design elements of feed-in tariffs and discusses how alternative designs for each element affect the performance of the policy. The speed with which feed-in tariffs will generate renewable power and jobs depend most importantly upon a) the basis for calculating the tariff and b) the administrative requirements for participating. Cost-based tariffs and simple, cost-less application and grid inter-connection procedures will generate the most renewable power and jobs in the shortest time period. The size of the program cap determines how much power will be generated, how many jobs will be created and the amount of investment attracted. The other design elements of feed-in tariffs, such as customer or project caps and differentiated tariffs, simply determine which segments of the in-basin market (residential, medium and large scale public and commercial projects) will most benefit from the policy.

Section 5 concludes by discussing the follow-up study that will be released as part of this project. This study will estimate the quantity of solar power and jobs that will be produced within sub-regions of Los Angeles under alternative feed-in tariff designs and rates as well as the ratepayer burden associated with each type of policy.

SECTION 1 INTRODUCTION TO SOLAR ECONOMICS AND POLICY

Los Angeles maintains some of the most ambitious regional clean energy goals of any jurisdiction in the world. Regional leaders have articulated goals relating to renewable energy targets and economic development. Clean Tech Los Angeles, a multi-institutional collaboration between Los Angeles' major research universities, businesses, and public agencies, aspires to "establish Los Angeles as the global leader in research, commercialization, and deployment of clean technologies." [1]

Los Angeles' municipally-owned utility plans to eliminate coal and meet 40% of its electricity demand from renewable and sustainable sources by 2020.[2] In 2008, the Mayor of Los Angeles proposed a plan to procure 1,280 mega-watts of solar generation by 2020.[3] Each one of these goals, taken individually, is among the most ambitious of any jurisdiction in North America. Taken collectively, the realization of this broad vision could transform Los Angeles into a leading center of clean technology.

Solar energy generation has the potential to contribute to these goals, but it has yet to make a significant contribution to the Los Angeles economy. Not only does solar generation produce clean, emission-free energy, but also it creates local opportunities for employment and entrepreneurship. Solar companies employ people to find suitable sites, sell systems, install equipment, and monitor each installation. These opportunities originate from the site and the system itself, and therefore create local employment benefits.

California's share of the world-wide installed solar is declining.[4] Driven by economic development strategies expressed through energy policy, other countries are claiming solar market share faster than California. Germany has led the world in annual solar installations with sustained growth between 2004 and 2008. Germany's steady growth was due to a national feed-in tariff (FiT) law that stimulated their domestic

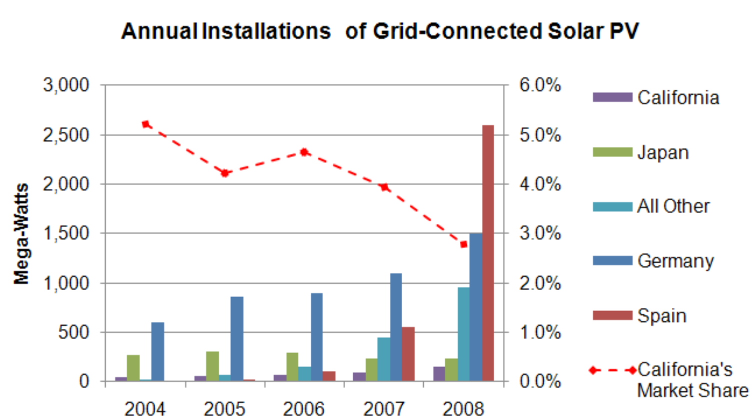


FIGURE 1: Annual Installations of Grid-Connected Solar PV
Data Source: Renewable Energy Policy Network for the 21st Century

solar industry. In 2008, Spain experienced explosive growth and overtook Germany in annual installations due to an aggressive national FiT policy. In 2009, the policy was changed and Spain's annual installations plummeted. Germany is poised for steady growth and will retake the annual leadership position during 2009. During 2009, 45 countries had FiT policies.[5]

The influence of FiT policies is evident as the rest of the world makes significant annual contributions to the total installed solar capacity. Despite strong absolute growth, California's share of the world's annual installations fell from 5.2% to 2.8% between 2004 and 2008. Driven by aggressive FiT policies, other jurisdictions around the world are increasing their use of solar energy, developing their local economies, and capturing the world's solar market at a faster rate than California.

PURPOSE AND METHODOLOGY

The purpose of this report is to provide a useful guide for policy makers interested in designing a FiT policy for Los Angeles. The design guidelines in this report provide a general framework highlighting the important considerations policy makers must identify and confront when addressing this type of solar policy. The framework focuses on design alternatives and their associated trade-offs.

This framework is the product of several sources of information. First, we researched FiT programs that have been implemented in the United States and around the world. We gathered information about the specific program design and the actual results of each program. Second, we interviewed important stakeholders in the solar industry. This included leading organizations in the commercial, educational, and non-profit sectors within the Los Angeles region. From these interviews we gained a general frame for the important issues. Third, we developed a solar project model using industry best-practices. We applied this model to California's proposed and existing FiT programs using realistic assumptions and examples. Based on the observations from these individual research tasks, we propose the framework in this report as a guide for policy makers in the Los Angeles region interested in understanding FiT policies.

SOLAR PHOTOVOLTAIC INDUSTRY 101

SOLAR TECHNOLOGY

Solar photovoltaic ("solar PV" or simply "solar" in this report) systems are energy conversion devices that transform sunlight into electricity. In areas where the sun is intense, solar systems are more productive. A typical 4 kilo-watt system on a single family home in Los Angeles can produce about 5,400 kilo-watt hours per year.[6] This is enough electricity to offset most of the annual requirements of this typical residence. In cities where solar systems are very productive, the cost of the energy is lower. Los Angeles is among the most productive cities in the United States for solar.

Solar technology is not new, but innovation within the solar industry is driving new applications and achieving greater conversion efficiencies. Originally solar was used in

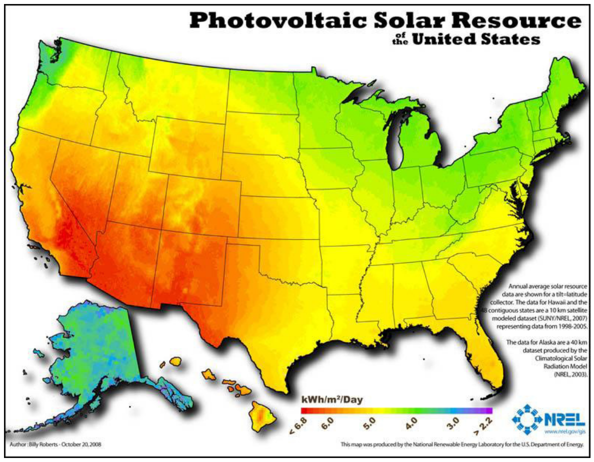


FIGURE 2: U.S. Solar Resource Map
Source: National Renewable Energy Laboratory [7]

space-based applications, but the early market adopters used the technology to meet the electricity needs of remote buildings or "off-grid" applications. Later, solar was integrated into the existing electrical grid. Today solar is most frequently used to offset the electrical loads of homes and businesses. Any excess power can be delivered to the electrical grid and made available to other electricity consumers. Some solar projects are designed to provide all their power to the grid.

Solar systems can be placed virtually anyplace that receives direct sunlight. Modern applications of solar are diverse. Rooftops are the most common grid-connected ap-

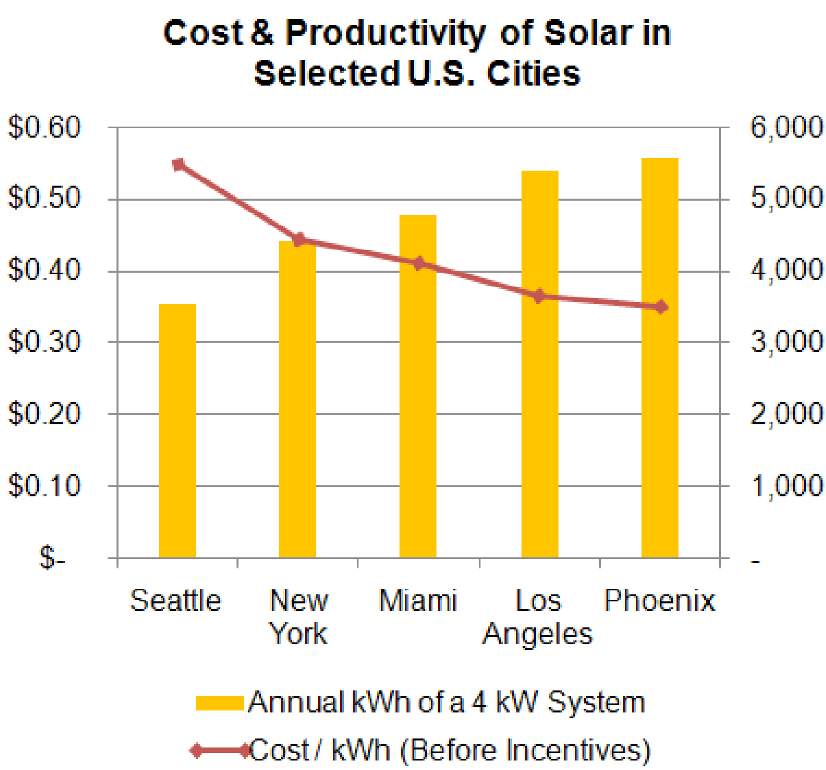


FIGURE 3: Cost and Productivity of Solar in Selected Cities

A 7 kilo-watt residential solar system

plication, but panels can also be mounted over parking lots, integrated into building structures (BIPV), or constructed in large ground-mounted arrays known as "solar farms."

Grid-connected solar projects come in many sizes. At the smallest, a one kilowatt system on a residential home requires just 100 square feet of rooftop space and offsets only a small portion of the home's electricity use. A larger one mega-watt project requires several acres. The largest solar projects can occupy hundreds or thousands of acres in less developed areas of the southwest.

SOLAR IN LOS ANGELES

Within the Los Angeles basin, there are fewer opportunities for larger solar projects. The Los Angeles basin is land supply-constrained. There are many competing uses for land that prevent free-standing, ground-mounted "in-basin" projects. Gaining entitlements is more difficult in densely developed areas. These factors present challenges to larger solar projects within the Los Angeles basin. However, rooftops, uncovered parking lots and buffer areas around transportation facilities lack alternative uses. In-basin solar energy generation may be the highest and best use for these areas.

A 2 mega-watt solar farm on 16 acres.

Land-intensive, utility-scale projects are only feasible "out-of-basin." These projects provide solar power more cheaply than in-basin projects, but there are significant challenges to importing power into Los Angeles. High-voltage transmission lines are either congested or reserved for other renewable energy projects. The time required to plan, permit, and develop new transmission capacity far exceeds the time required to develop energy generation. This mismatch creates a transmission bottleneck that limits the amount of solar power Los Angeles can import.

Each type of solar project has specific advantages and disadvantages, cost structures, and energy conversion efficiencies. Because the costs of the system and the electrical output vary according to many factors, the economic profile of every type of project is unique. Solar economics are driven by technology, project size, application, and location. Due to this variation, unique market segments have emerged that focus on delivering solar energy in specialized ways. Appendix 1 illustrates this diversity and highlights the difference between in-basin and out-of-basin solar projects.

THE SOLAR VALUE CHAIN

The solar value chain delivers solar products and services to the market. It is a diverse collection of companies. The upstream players in the value chain manufacture equipment. The downstream players produce energy and provide services. Most solar public policies and incentives are targeted towards the downstream end of the solar value chain consisting of owners and electricity consumers.

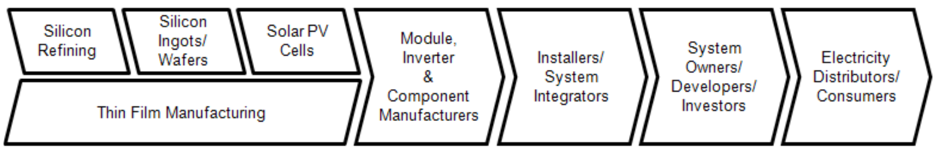


FIGURE 4: The Solar Value Chain

UPSTREAM

The upstream participants in the value chain are the manufacturers. These entities collect raw materials, manufacture solar cells, and assemble solar modules. Because the inverter is a major component of the solar system, inverter manufacturers are important players in the upstream solar value chain. The remaining balance-of-system (BOS) components of the solar system consist of electrical connections, wires, insulators, mounting and tracking hardware, system monitoring software, and other components. These manufacturers are a diverse set of companies that also participate in other industries such as the consumer electronics industry.

DOWNSTREAM

The downstream participants in the solar value chain are the installers, system owners, and users of electricity. These participants are primarily focused on providing services. Installers, also called system integrators, are the solar industry's construction managers. The industry supports many types of business models at the system integrator role in the value chain. In general, these companies sell solar systems to owners. They also oversee the installation process. This involves procuring equipment, managing construction crews, engineering the systems, and interacting with municipal permitting authorities.

There are several distinct business functions at the system owner position in the value chain. Some owners are professional solar developers who find promising sites, hire installers, arrange financing, and sell the electricity. Professional developers rely on capital provided by investors to cover the high initial installation costs. Other owners are non-professional players. They purchase solar systems for the energy benefits, but solar ownership is not their core business activity. Homeowners are non-professional owners. Most commercial owners also fall into this category. The purchase of a solar system represents a serious financial commitment for the non-professional owner. Although solar systems are reliable and relatively simple to operate and maintain, many potential commercial owners perceive direct ownership to be a distraction from their core business activity.

The furthest downstream players in the value chain are the distributors and consumers of electricity. Traditionally, utilities have been the monopoly distributors of electricity to households and businesses. In some instances, solar owners can act as wholesale electricity providers and sell their electricity to a utility, which then distributes the power to retail end-users. Utilities have complex procurement processes making it difficult or impossible for many solar owners to participate. In many parts of the country, an alternative model has emerged. Professional developers build systems on a customer's site and sell the electricity directly to the customer under a long-term contract. This model, called a Power Purchase Agreement (PPA), has been the most successful business model to date in the U.S. for large, commercially-owned solar systems.[8]

BARRIERS TO SOLAR OWNERSHIP

BARRIERS TO SOLAR OWNERSHIP:

- High Installed Costs
- Increased Business Risk
- Tax Incentives Limitations
- Lack of Access to Capital
- No Grid Access
- Competing Uses for Space
- Non-optimal Placement

ECONOMIC BARRIERS

The most significant barriers to solar ownership are economic. Although some potential owners are interested in the positive social and environmental benefits of solar energy, the economics of the investment are weighted most heavily in any decision to purchase a system. Relative to the long-term recurring benefits, the installed costs of the system are very high. To facilitate ownership, the recurring benefits must be sufficient to pay back the system costs and to provide a reasonable return on investment.

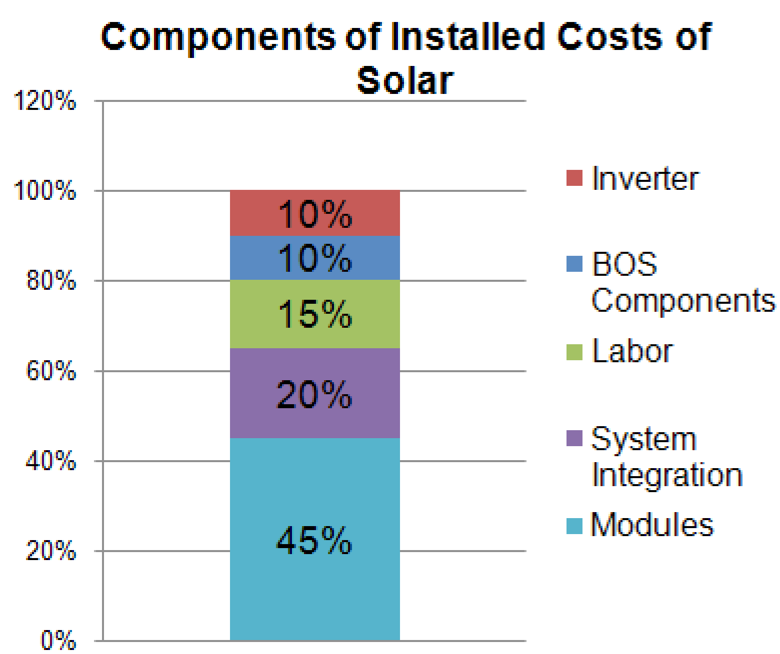


FIGURE 5: Components of Installed Costs of Solar

The high installed costs of solar are a barrier for most owners. The installed costs of a solar system are a product of business contract negotiations throughout the value chain. For this reason, installed costs are highly variable. The solar modules represent the largest single component (about 45%) of the installed costs in most projects.[9] Module costs, subject to global supply and demand, are also the most volatile component of installed costs. Inverter and the BOS costs cover the remaining hardware. System integration and labor costs reflect the administrative and construction labor costs of installation. In December 2009, installed cost indexes ranged from $4.63 per watt for a large industrial system to $8.44 per watt for a small residential system.[10] These indexes trended downward during 2009, primarily because of decreases in module costs.[11] Because of the volatility of the installed cost of solar, public incentives must be well-designed in order to consistently and positively influence the economics of a solar project.

Many building owners are not able to accept significant business risk to accommodate solar generation on the buildings they own. To own a solar system, landlords must pay the initial installed costs, but cannot accrue the utility savings benefits under most lease structures. The tenant benefits exclusively from the decreased utility charges. This split incentive dilemma prevents solar adoption on many commercial buildings that are not owner-occupied. Furthermore, many rooftop solar installations on commercial buildings can invalidate the roof warranty and introduce additional business risks. Although many landlords are interested in adding value to their properties with solar energy, the current structure of the real estate market prevents them from owning systems and providing solar energy to their tenants.

Many owners cannot use tax-based incentives. Many public and non-profit agencies are mandated to meet a portion of their energy consumption with renewables. Others are motivated by the social benefits of clean energy or the potential for operational cost savings. Many incentives designed to reduce the cost of an installation are implemented through tax-based policies. If the entity does not pay taxes, they cannot take advantage of these cost reduction policies. The lack of access to tax-based incentives is a barrier to ownership for public and non-profit agencies.

A 106 kilo-watt rooftop solar system. Under current market conditions, this system costs over $600,000.

Lack of access to capital is a major barrier to ownership for businesses. The initial installation costs are out of reach for many businesses. Many cash-constrained owners cannot provide the up-front capital without external financing. The benefits from solar ownership must not only be sufficient to cover the installation costs, but also predictable in order to facilitate external financing.

The economic barriers to ownership make it difficult for many organizations to own solar systems. These entities are interested in solar energy benefits but are unable to bear the business risks in many cases. In other jurisdictions outside of Los Angeles, professional solar owners take the business risk of ownership and sell solar energy to the site under a PPA contract. This arrangement allows the site hosts to focus on their core activities while simultaneously benefiting from solar energy.

REGULATORY BARRIERS

The most significant regulatory barrier to solar adoption in Los Angeles is the protection of LADWP's legal monopoly status by the City's Charter. This regulatory barrier prevents professional solar developers from owning systems and selling solar energy to those entities that cannot otherwise bear the business risk associated with solar. Other jurisdictions have experienced similar regulatory barriers and have experimented with potential workarounds. Under solar lease structures, electricity customers pay professional solar owners to lease solar equipment rather than to buy electricity. Alternatively, a utility could become a contractual intermediary between a solar owner and an electricity consumer. If determined to be legal, these structures could bypass this major obstacle. This regulatory barrier prevents the City of Los Angeles from accommodating the most successful rooftop solar business model in the United States so far.

Access to the electricity grid is fundamental to solar economics. Because solar production does not match electricity consumption at every site, the system must be interconnected to the grid so the owner can be compensated for every kilo-watt hour of electricity the system produces. Without this guarantee, most owners cannot recover their costs of installation. However, access to the grid is often not guaranteed. Furthermore, many suitable solar sites are not near a feasible grid interconnection point. The infrastructure to transmit and distribute electricity is planned and constructed through a separate, but parallel process to solar generation planning. At many locations, grid availability and solar potential are not aligned. This condition creates a barrier to the potential solar owner.

TECHNICAL BARRIERS

Not every site is appropriate for solar. Regardless of the incentives offered, some sites cannot accommodate the equipment, have too much shading, or have competing land uses that prohibit installations. Some sites receive excellent sun, but use little electricity or cannot deliver the surplus energy to the grid. Solar modules are most productive when tilted skyward and oriented to the south. If the site cannot accommodate the installation at these specifications, the modules' performance can be degraded by as much as 50%.[12] The decreased output caused by less than optimal placement can alter the economics so the project is no longer feasible. Regardless of the economic or regulatory barriers, some sites will never accommodate solar economically.

SOLAR PUBLIC POLICIES IN CALIFORNIA

Public incentives are necessary to reduce the barriers to ownership. Potential solar owners are currently incentivized by an array of programs. These programs provide the subsidy to participants through different delivery methods, each addressing the economic barriers to ownership differently. The goal of California's incentive frameworks is to allow an owner to recover some or all of the costs of ownership.

Under the current conditions of the retail electricity market, most solar energy systems cannot pay for themselves without public incentives. With sufficient incentives, a system owner can achieve a payback of the initial costs within 6-10 years. Most owners expect a reasonable return on the solar investment over the entire life of the system, which can exceed 25 years. The long-term nature of a solar investment creates an economic risk profile that many potential owners are unable to bear. Most solar public policies are aimed at incentivizing ownership by improving the economic profile of a solar investment.

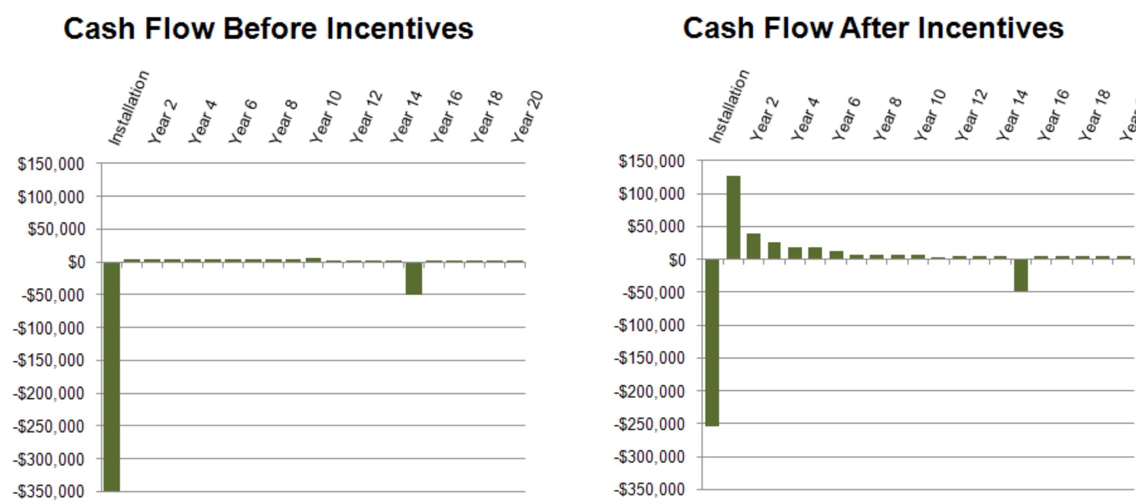


FIGURE 6: Impact of Incentives on a Typical 50 kW Commercial Solar Project

RATEPAYER FUNDED INCENTIVES

In many jurisdictions, utility customers (ratepayers) subsidize solar ownership in the form of direct incentives. SB1 authorized ratepayer subsidies for California solar owners. Direct incentives can be disbursed to owners in one of two forms, cash rebates which offset the high initial system cost, or production incentives which pay system owners periodically based on the amount of energy produced by the system. The California Solar Initiative (CSI) offers both types of incentives for customers of the Investor Owned Utilities (IOUs). In either form, the total value of the CSI subsidy helps make the economics of solar more attractive for system owners. The program has incentivized over 480 mega-watts of solar for California.[13] LADWP administers a similar program which has incentivized 35 mega-watts of solar for Los Angeles.[14]

IMPACT OF INCENTIVES

BEFORE	AFTER*
RETURN ON INVESTMENT:	
1.2%	7.4%
YEARS TO PAYBACK:	
No Payback	7 Years

*After the 30% ITC, MACRS Depreciation, and a $2.50 per watt rebate

These incentive programs are intended to work in conjunction with net metering policies. Solar systems produce electricity during the hours of direct sunlight. Many sites cannot use all the solar electricity during these hours. Since the excess generally cannot be stored economically, net metering policies allow the owner to deliver the excess energy to the grid for a retail credit. Two provisions to this policy dissuade owners from building systems that will produce more energy than they can use on-site. First, the owner's energy bill can only go to zero. This two-way net metering system increases the owner's utility bill savings, but does not allow the owner to be credited for surplus energy beyond what can be used on-site. Second, California's net metering policy will only credit owners for production by systems up to one mega-watt in size. Beyond each of these inherent caps, the economic benefits of larger systems decrease dramatically.

LIMITS TO CALIFORNIA'S CURRENT SOLAR INCENTIVE FRAMEWORK

1. First limitation:
   On-site power requirements
2. Second limitation:
   One mega-watt incentive caps. Beyond these caps, the economic benefits of larger systems decline quickly.

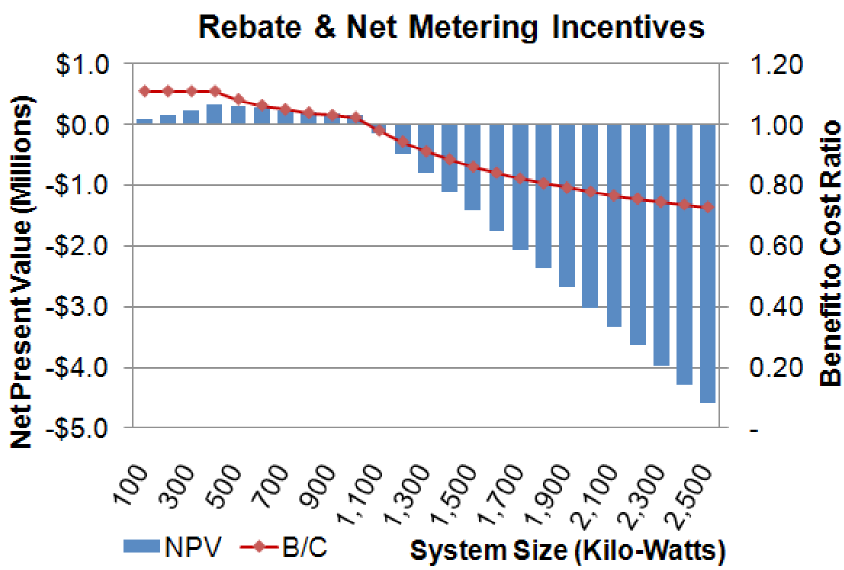


FIGURE 7: Limitations of Current Incentive Framework

Because of these implicit caps, owners are discouraged from building the largest system their site will accommodate. Commercial or public entities with abundant unused rooftop space, large uncovered parking lots, or low on-site power requirements are most affected

A 743 kilo-watt Solar System in City of Industry.
Using only a portion of the available roof, this system brought the owner's electricity bill to zero.

by these inherent restrictions in the existing incentive policies. These types of sites are examples of untapped solar market segments.

Large multi-family residential developments are another untapped market segment. An apartment complex with a rooftop solar system could avoid the complexity of crediting each individual resident's electricity bill for their portion of the solar energy by simply selling all the energy to the grid. This model could expand the potential solar market by incentivizing professional solar developers towards Los Angeles' multi-family residential market. Other untapped market segments include unused space along transportation corridors, transmission and communication rights-of-way, and buffer zones around airports or industrial facilities. Because of these implicit caps, net metering policies limit the potential size of the solar market in Los Angeles.

AB920 was passed into law in California during 2009.[16] This law will allow solar owners who supply surplus power to the grid to be credited beyond their utility bill charges at a wholesale rate yet to be determined. This bill could expand the solar market by allowing owners to build systems to provide more power than they can use. Because the credits are likely to be based on the prevailing value of electricity and not on the cost of solar generation, this bill will not fundamentally change the nature of net metering incentives.

TAX-BASED INCENTIVES

Federal tax authorities offer the Investment Tax Credit (ITC) for investment in solar energy equipment. These tax credits are intended to offset the high initial costs of solar by giving the system owner a dollar-for-dollar reduction in income taxes. The value of the ITC is 30% of eligible initial costs, reducing the initial burden. The disadvantage of this type of incentive program is that the system owners must owe taxes in order to realize the benefits. Public agencies and non-profit entities cannot directly receive this benefit. With the onset of the financial crisis, fewer commercial entities owed enough income taxes to monetize this credit. The American Recovery and Reinvestment Act (ARRA) of 2009 created a short-term option for cash grants from the Treasury in lieu of tax credits, effectively bypassing the temporary obstacle to tax-based incentives.

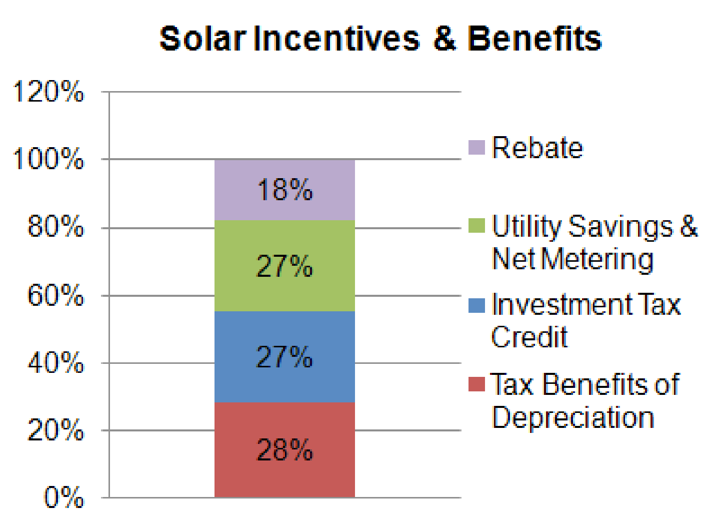


FIGURE 8: Relative Contribution of Solar Incentives (Present Value Basis)

Solar energy equipment can be depreciated under an accelerated schedule. This allows a commercial owner to accelerate their tax deductions from twenty to five years. This timing difference significantly increases the overall value of the depreciation tax benefits. Although depreciation benefits are realized over the first six years, their total value amounts to a significant portion of the initial system cost. As with the ITC, businesses must have the tax liability to take advantage of this benefit. Residential and public owners are not eligible. This restriction increases the cost of solar for these types of owners.

Tax-based incentives are funded by all tax-payers. Because of this, these programs are more politically vulnerable through budgetary processes. Commercial owners can receive both forms of tax-based incentives, so commercially-owned systems are more cost-effective than comparable residential or publically-owned solar.

SUBSIDIZED FINANCING

An innovative method to overcome the high initial costs of solar is Property Assessed Clean Energy (PACE) bonds.[17] These bonds allow a property owner to finance energy efficiency and solar through municipally-issued bonds. The owner then repays the principle and interest on the bond over twenty years through an additional property tax assessment. AB811, the enabling legislation in California, was passed in 2008 and the first bond was issued in Berkeley during 2009. Although this program does not reduce the cost of solar, it can address the capital constraints faced by many potential owners. The program could expand the solar market by making it easier for capital-constrained homes and businesses to purchase a system to offset their on-site power requirements.

RENEWABLE PORTFOLIO STANDARDS & RENEWABLE ENERGY CERTIFICATES

The Renewable Portfolio Standard (RPS) requires the state's IOUs to meet a minimum portion of their electricity sales with renewable energy.[18] Although this regulatory mechanism does not directly affect a private producer of in-basin solar energy such as a solar-equipped home or factory, the mechanism has several indirect effects on the broader market. First, the RPS incentivizes market participation by creating certainty that there will be a statewide market for at least a minimum quantity of clean energy. This facilitates long-term investment. The RPS system allows renewable producers to compete for supply contracts with utilities. The competitive process creates downward pressure on the prices bid by developers. A disadvantage of this process is that bidders often underbid just to win the renewable supply contract. With low contract prices that often do not cover the project's costs, the winning projects often fail to get built.

The second way in which an RPS can influence solar adoption is through the creation of Renewable Energy Credits (RECs). A REC is a certification that a unit of energy was produced through renewable generation. This potential value could be realized over the life of the project as power is produced and RECs are generated. RECs can be sold independently of the solar energy itself. Incentive programs normally require that participants transfer their RECs to the utility. California's state RPS program has helped create opportunities for professional developers to sell solar power to the utilities, but it has not significantly expanded the opportunities for in-basin solar.

FEED-IN TARIFFS

BASIC QUALITIES OF FEED-IN TARIFFS

QUALITIES COMMON OF ALL FEED-IN TARIFFS:

- Price Certainty
- Simplicity
- Accessibility

A FiT is a contract for electricity sales between a solar owner and a utility. FiT contracts have standardized prices, terms and conditions, simplifying the electricity procurement process and creating opportunities for homeowners, businesses, and public entities to enter the electricity supply market. The price paid for the electricity fed into the grid is called the "tariff."

Many variations of FiT programs have been implemented around the world, but there are three general qualities of solar FiTs.[19] They are price certainty, simplicity, and accessibility. Other solar incentives can have similar attributes, but FiT programs intentionally shape market response by maximizing these qualities. These three programmatic qualities make it possible for smaller systems, non-professional owners, and less cost-effective solar sites to contribute solar energy to the grid.

First, the tariff must create price certainty. Potential owners and capital providers must clearly understand how the tariff is set and how it is likely to change over time. The contract must be designed in a way to assure the owner of the timing and magnitude of the benefits provided by the tariff structure. The FiT contract must provide certainty for a period roughly equivalent to the economic life of the solar system, generally at least 20 years. A FiT contract is a long-term financial asset that can balance the long-term liabilities created by a solar investment. Without this price certainty, owners and capital providers are less likely to invest in solar.

Simplicity is an essential quality for residential customers.

Second, the contracts must be simple. Non-professional solar owners do not have the expertise or resources to participate in a complex utility procurement process. Power generation equipment is not familiar to most non-professional owners. A simple contract is a requirement for widespread solar participation in a FiT.

Third, owners must be guaranteed access to the grid. The utility must be required to offer the tariff (and grid access) to any eligible solar provider without a competitive negotiation process. Small, non-professional solar owners cannot compete with professional energy generators. Negotiations will favor certain parties over others, inherently favoring lower cost fossil-fuel generation or professional market players. Without this purchase obligation from the utility, some generators will be excluded from the utility's procurement process. Guaranteed grid access and a utility purchase obligation create market accessibility.

FiTs are generally considered a distinct alternative to California's current incentive framework designed to incentivize solar systems which offset on-site power use.[20] Under most FiT programs, a system owner would not be eligible for ratepayer-funded rebates, other production-based incentives, or net metering benefits. Tax-based incentives will apply to FiT projects, however.

ARGUMENTS FOR AND AGAINST FEED-IN TARIFFS

FiTs programs are controversial. There are valid arguments both for and against them.

Critics of FiT policies highlight the risks of setting the tariff through an administrative process rather than a market-based process.[21] If the tariff is too high, owners will be excessively compensated, the market will overreact, and the program can exhaust its resources, creating a policy-driven industry "boom and bust" cycle. If the program continues for a long-time, the industry will come to rely on subsidized tariffs. Downward pressure on costs will not be passed through the value chain and there could be reduced incentives to be efficient. The tariffs are normally passed directly on to ratepayers. With an expensive technology such as solar energy, this effect can be pronounced. FiTs do not directly address the high installed cost of solar. And at the high penetration levels caused by FiTs, renewable energy can introduce grid integration challenges.[22]

Advocates say FiT programs are the fastest way to bring clean energy online, creating environmental and economic benefits. They say FiT programs can expand the solar market by creating accessibility for new market segments. The programs can reduce the regulatory and economic barriers to ownership. Research suggests that FiTs are also the most cost-effective way to bring renewable energy online.[23] Because the guaranteed tariff reduces revenue risk, it also reduces the risk premiums required by equity investors, thereby lowering the costs of this financing mechanism. The tariff predictability and price certainty also can facilitate the greater use of more cost-effective debt financing, further reducing project costs.[24]

CONCLUSIONS

Economics drive solar energy development. Innovation within this nascent industry is creating specialized ways of delivering solar. There are many significant barriers to solar ownership and public policies are addressing these challenges. Although California has a strong solar market, other jurisdictions around the world are capturing the solar industry at a faster rate. California's current policies help some owners offset their electricity use with solar, but the policies do not maximize the opportunities for solar energy generation within the state and the Los Angeles region. FiTs are a promising alternative which can increase the opportunities for solar within Los Angeles.

SECTION 2 REVIEW OF FEED-IN TARIFFS PROGRAMS WORLDWIDE

FiT policies have several decades of history from which to draw lessons. Los Angeles can learn from implementation both in the U.S. and abroad. This section of the report describes the design, implementation, and results of six FiT program worldwide.

In 2009, 45 countries and 18 states, provinces, or territories had FiT policies.[25] We selected six jurisdictions that not only represent diverse program design, but also illustrate the policy trade-offs faced by Los Angeles. We selected Germany, Spain, Ontario, Canada, Gainesville (Florida), Vermont, and the Sacramento Municipal Utilities District (SMUD) to investigate more thoroughly.

Because of the diversity of the jurisdictions, these six FiT programs and their results demonstrate many of the commonly experienced trade-offs policy makers face when making design decisions. Spain and Germany are national jurisdictions, both with over one decade of FiT-related policy experience, while the domestic programs are all very new. SMUD and Gainesville are municipal utility-based programs, while Vermont and Ontario are state/provincial programs. The national programs are large, driven by renewable energy goals measured in giga-watts, while Gainesville's total goal for the program is just a few dozen mega-watts. Each program is designed differently. The different program designs demonstrate how program design can influence the program results.

GERMANY

Germany is the world's leading solar market primarily because of its FiT law. Although Germany receives only about one-half the sunlight of Los Angeles, the German FiT has created an economic environment that is supportive of the nascent solar industry. The German model is often looked to as the epitome of an effective FiT.

Germany created its first FiT law in 1990. This law, Stromeinspeisungsgesetz (StrEG), was initially aimed at helping the hydropower industry, but wind producers soon became involved. The StrEG assisted renewable energy generators by requiring utilities to purchase the renewable power at wholesale prices without negotiated contracts or complex administrative procedures.[26] The program achieved some uptake of wind power, but the benefits to solar providers did not provide enough incentive to substantially move this market.

The StrEG offered a tariff based on the value of retail electricity. Under this value-based structure, tariffs paid to renewable generators were proportional to the retail market price of electricity. Market prices of electricity are primarily determined by conventional energy generation which has greater market share and a lower cost structure than renewable generation. This structure made it challenging for even the most cost-effective renewable projects to recoup their higher initial costs. Although the StrEG achieved some participation from the least expensive renewable producers, wind and small hydropower, it did not incentivize widespread renewable energy or solar adoption. During 2000, the last year the StrEG was in effect, the German market only installed 40 mega-watts of solar.[27]

GERMAN FEED-IN TARIFF LAW EVOLUTION

In 2000, a new national FiT law replaced this initial attempt to level the playing field for renewable energy. The Renewable Energy Sources Act of 2000, Erneuerbare-Energien-Gesetz (EEG), and its 2004 amendments provided the incentive necessary to stimulate the solar market in Germany.[28] Based on experience gained from the 1990 law, administrators designed the EEG to allow the tariffs to move with market conditions, minimize cost to the ratepayers, and maximize energy production.

German policy makers have articulated a goal of meeting 30% of national electricity consumption through renewables by 2020 and 50% by 2050.[29] These ambitious renewable energy goals are driven by a clear intent to reduce greenhouse gases and create economic development.

Among the most important changes were differentiated tariffs based on the renewable producer's costs, market-responsive incentive levels, and increased accessibility of the program. Solar PV systems benefited from these amendments, making solar more attractive and accessible to entities which did not specialize in energy production. The EEG was the biggest factor contributing to Germany's solar market explosion after 2004.

The EEG changed the tariff basis to consider the specific cost structures of renewable technologies. Administrators set tariffs based on detailed predictions of project costs plus a reasonable profit. Solar energy benefited from this new tariff structure. Tariffs were high enough to cover solar installation and ensure a reasonable profit.

The EEG does not cap the total participation. Also, the eligible system size is not capped, creating opportunities for many types of market participants. Individuals with large rooftops or open spaces can convert these under used resources into energy generators and sources of income.

Since 2004, the major design elements of the EEG have remained constant. The EEG requires utilities to buy renewable energy from those able to supply it, even individuals or entities which do not specialize in energy production. The solar tariffs are designed to create access to five distinct segments of the solar market: residential rooftops, medium-sized agriculturally-owned and community rooftops, large commercial rooftops, and open-space projects. Because the cost of solar varies by market segment, so do the tariffs. This allows each type of owner to recoup their up-front costs and make a reasonable return on investment. During 2009, these tariffs ranged from $0.37 USD for open space projects to $0.64 USD for small rooftops. Tariffs decline 8-10% annually based on the market's response. This structure is intended to maximize market participation while consistently providing 4-5% after-tax rates of return to participants.

RESULTS

The cost of the EEG law is distributed equally among all ratepayers. To achieve a 15.1% renewable contribution to the electricity supply, the Federal Ministry for the Environment estimates that the cost to an average household in 2008 was about $4.64 USD per month.[30] Solar energy consists of 6% of this total renewable contribution.[31] The Ministry estimates Germany's renewable industry revenue at 28.7 billion euros during 2008 and that 117,000 jobs were created in renewable energy since 2004.[32]

In 2009, despite Germany's marginal sunlight, its solar industry is among the world's largest. During 2008, Germany installed 1,500 mega-watts of solar and claimed the largest national share of the existing worldwide solar PV installations.[33] Germany's 2009 installations are estimated to be 2,500 mega-watts despite the global recession, bringing its cumulative solar to 7,800 mega-watts.[34] Germany achieved this leading position by clearly articulating its national energy goals and designing a FiT policy that achieves these goals over the long-term.

SPAIN

Spain's experience with FiT-related policies dates to 1997.[35] Spain's early FiT policies were primarily motivated by energy diversification concerns. The 1997 Electric Power Act set a 12% renewable goal by 2010. These early policies established the legal basis of paying a premium above market rates for renewable power. Royal Decree 2818/1998 entitled owners of renewable systems to be paid a wholesale price plus a guaranteed premium. Although Spain's wind industry boomed under these initial policies, its solar industry did not experience a similar growth trajectory until 2007.

FROM VALUE-BASED TO COST-BASED TARIFF STRUCTURES

Royal Decree 661/2007 introduced a FiT program designed to achieve 371 mega-watts of solar. This cap was achieved quickly and increased to 1,200 mega-watts. Single projects up to 50 mega-watts were eligible for a fixed tariff for 25 years. Tariffs differentiated only by project size. Administrators increased tariffs annually for inflation, but did not reduce the tariffs based on market response. They ranged from $0.35 USD for large projects greater than 10 mega-watts to $0.68 USD for projects under 100 kilo-watts. Although Spain receives about twice the sun of Germany, these tariffs were nearly equivalent to those of Germany, creating opportunities for windfall profits. Multiple solar systems could participate under the umbrella of one project.

The 2007 FiT program created an explosive bubble which propelled Spain to install 2,600 mega-watts during 2008.[36] Both global and Spanish investors, seeking shelter from the real estate crisis, were attracted to the long-term certainty and double-digit returns offered by the 2007 FiT. This dramatic increase in market activity represented a 400% increase over the previous year's installations. Spain overtook Germany, the incumbent solar market leader, in annual installations during 2008.

The tariffs were established during a silicon shortage, which kept solar module prices high. When the shortage eased, module prices fell while tariffs remained at their original levels. This divergence created large profit margins for participants. No degression or periodic review was built into the tariff design in this version of Spain's FiT program.

Spain did not differentiate the 2007 tariffs in a precise manner. For example, projects between 10 and 50 mega-watts received $0.35 USD, while projects under 10 mega-watts received $0.64 USD. There was no limit on the number of systems per application. Project developers connected many small solar systems in series to capture the higher tariffs for smaller projects while benefiting from the economics of scale associated with the larger projects. The result was large open-space installations accounting for 95% of the country's total solar installed capacity.

This run-away market growth and the imminent economic crisis prompted Spain to revise its program. The new program, Royal Decree 1578/2008, cut tariffs by 25%, capped the program at 500 mega-watts per year, and established a burdensome registration process. The Decree reduced the system cap to 10 mega-watts and tariffs were differentiated according to the type of system: small rooftops, large rooftops, or ground-mounted. An annual degression scheme was applied to the tariff.

The 2008 program attempts to control market growth by creating a registration process that requires considerable effort from the program applicants. Applicants must submit administrative authorization, acquire building permits, and post a substantial security deposit. The projects are selected by the program registrar according to the strict quarterly cap allowances and on a 'first come, first served' basis. The program grants licenses to applicants who then have one year to connect projects to the grid.

RESULTS

While the new program seeks to balance participation more effectively than the 2007 program, the complex application procedures remain a barrier to the owners of rooftop projects. Many rooftop participants are non-professional solar market participants and cannot easily navigate the administrative procedures. As a result, the number of applications for open space installations has exceeded the allowed cap by a factor of 8 to 10 while rooftop applications have not reached the quarterly caps.[37]

After 2,661 mega-watts were installed during 2008, only 5 mega-watts were installed during the first eight months of 2009.[38] The solar sector accounted for more than 26,000 employees in 2007 and 50,000 employees in 2008. But in 2009, between 15,000 and 20,000 jobs were reportedly lost with countless companies exiting the market.

After 2008, Spain had 3,354 mega-watts of installed solar. This met 1.5% of Spain's electricity needs. The design of the Spanish FiT programs created a boom and bust cycle in Spain's solar industry. Although the FiT significantly increased solar's penetration into the Spanish market, the potential of the FiT to create the conditions for solar to further contribute to Spain's energy goals is uncertain.

A large solar thermal power plant in Spain.

ONTARIO, CANADA

Ontario implemented the Renewable Energy Standard Offer Program (RESOP) during 2006. The program did not have a strict capacity cap. The program offered a single, undifferentiated tariff to all solar projects. The $0.40 USD tariff was available to solar projects up to 10 mega-watts. The program was intended to procure 1,000 mega-watts of all types of renewable energy over 10 years in order to meet a provincial mandate for renewable energy procurement.

The program had a goal of 1,000 mega-watts over 10 years but in a year and a half, the program had already received 530 mega-watts worth of solar applications.[39] The Ontario Power Authority (OPA) did not expect the significant market response to the RESOP. However, most of the demand came from a small pool of developers submitting applications for 10 mega-watt projects, the maximum allowable project size.[40] The development of residential rooftop solar lagged behind due to the prohibitively costly interconnection and RESOP contracting processes.

The $0.40 USD tariff did not reflect any specific overarching policy goals or specific economic analysis. Instead it was intended as a "price discovery" mechanism. The initial tariff would test the market and incentivize early adopters. CanSIA suggested this tariff level was the minimum tariff required to stimulate any solar PV in Ontario.[41] They suggested that $0.79 USD would be more appropriate for rooftop installations based on system cost analyses. The RESOP program did not take this suggestion, and instead offered the single solar PV tariff of $0.40 USD, regardless of the specific costs incurred by a participant.

A solar farm in Perth, Ontario

Ontario's administrative and regulatory environment was not conducive to solar participation under the RESOP. Many local ordinances did not allow rooftop solar. Interconnection to the distribution grid was overwhelmed by the market response.[42] Furthermore, the procedures and fees associated with the interconnection process were too onerous for many small system owners to successfully navigate. Because there were no qualification requirements to apply for a RESOP contract, many developers entered into multiple contracts while lacking the organizational capabilities and capital necessary to complete even one project. In February, 2009 very few of the contracts had been successfully converted into operational projects.[43] At that time, of the initial contracts executed by the OPA, only 9% of the wind projects and 0.3% of the solar PV projects were in operation. By the end of 2009 only 58 mega-watts of solar will be installed in Ontario under the RESOP program.[44] Virtually all of this solar will be from three large solar farms.

REVISED FEED-IN TARIFF PROGRAM FACILITATES RESIDENTIAL SOLAR

The RESOP program was suspended in 2009 and replaced with the Renewable Energy Feed-in Tariff (REFiT). The REFiT Program launched on October 1, 2009. The REFiT program differentiates between system sizes. A separate, simplified program targets all renewable projects under 10 kilo-watts, while a different program targets projects over 10 kilo-watts.

The REFiT addresses many of the RESOP's issues and added new requirements for applicants. The most significant new feature is a requirement that at least 60% of the manufacturing content for solar PV must be sourced from Ontario. There is no overall program cap. There is a system cap of 10 mega-watts for ground-mounted systems. Tariffs vary from $0.44 USD for large open-space projects to $0.76 USD for small solar projects under 10 kilo-watts. The tariffs are designed to cover the project's costs, plus a consistent return.

The domestic content requirement is a very significant feature of the REFiT program. This domestic requirement could act as a de-facto program cap, constraining market response based on limited domestic solar manufacturing capacity.

Developers were caught off guard by stringent requirements to participate in the new FiT program. The application fees, environmental impact assessments, and the domestic content requirements significantly increase the organizational resources required to participate. These factors can make it challenging for smaller, non-professional solar owners to participate.

RESULTS

The official press release of December 16, 2009 states that the OPA received over 2,200 applications during the first application round.[45] About 1,200 of these applications were for projects under 10 kilo-watts. These smaller projects, mostly residential rooftop solar, account for only 8.6 mega-watts of 2,500 mega-watts available during the first round. The total applications are for 8,000 mega-watts of capacity. The OPA is prioritizing "shovel-ready" projects to handle the oversubscription.[46]

The RESOP program may have implicitly favored large projects and professional developers because of the challenging permitting and interconnection conditions. The REFiT was designed to accommodate the concerns of smaller owners, especially solar PV owners. Although the REFiT received over half of its applications for small solar projects, the 8.6 mega-watts of capacity offered by these projects is only a minute fraction of the overall first round target of 2,500 mega-watts. Based on the fact that the RESOP executed about 250 mega-watts of solar contracts during both 2007 and 2008 with a less valuable tariff, it is likely that solar participation in the REFiT was constrained by the domestic content requirements.

The OPA estimates that the first round of FiT projects will generate "$5 billion in investments in manufacturing, design, construction, and engineering and lead to the creation of thousands of new jobs."[47]

The difference between the RESOP and the REFiT program highlights how important it is to address the concerns of smaller owners if widespread participation is a program goal. Furthermore, it also illustrates how special provisions, such as domestic content requirements, can impact participation.

GAINESVILLE, FLORIDA

In March of 2009, Gainesville Regional Utilities (GRU) became the first U.S. utility to adopt a cost-based solar FiT.[48] The program plans to procure 4 mega-watts of solar PV per year from 2009 until 2016. This helps to meet municipal greenhouse gas reduction targets of 7% by 2012. Although only mentioned in one program information briefing and not in the utility's stated goals, an additional benefit of the program is economic development for Gainesville. The utility identified that the current value of Florida's utility and net metering incentive programs are not attractive to larger solar systems. By implementing a FiT, GRU is expanding the solar market in Gainesville by incentivizing participation from previously unreached market segments.

A TARGETED SOLAR FEED-IN TARIFF PROGRAM

GRU's program offers a fixed tariff to participants for 20 years. The tariff differentiates free-standing or building-mounted solar PV with $0.26 or $0.32 respectively, primarily targeted towards commercial installations.[49] These tariffs were based on the estimated cost of free-standing and commercial rooftop solar plus a targeted 4-5% return on investment. In determining the tariffs, the utility used an investment model and anticipated realistic project costs. The tariffs fall about 5% annually based on expected declines in solar installation and module costs. The goal of the tariff degression is to maintain a 4-5% return on investment as market conditions change.

RESULTS

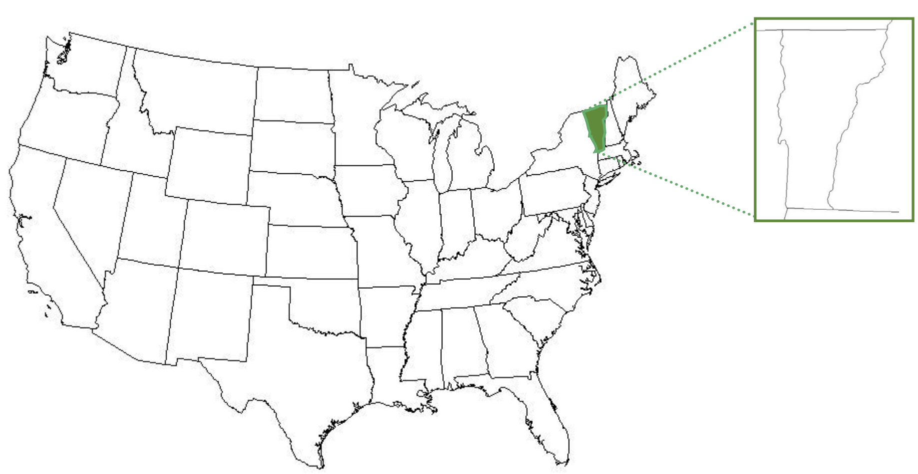
GRU's FiT program proved hugely popular. The 4 mega-watt annual cap was fully subscribed in one week after the application was available. Five months later the utility had received enough applications to fill the entire program cap by 2016 (32 mega-watts). The GRU calculated the expected rate of return assuming FiT projects would not receive the $4.00 per watt state rebate, which had recently run out of funding. When funds for the rebate program were reauthorized, projects could benefit from both incentives, creating high rates of return for those enrolled in both programs.

The program was successful in achieving its goal of incentivizing commercial applications. Most of the rooftop contracts, 75% of the first year's cap, are for systems ranging from 100-500 kilo-watts, many on commercial shopping centers. The remaining 25% of the program comes from two free-standing system applications, while residential rooftop applications amounting to "a blip on the screen."[50]

GRU anticipates the cost of the program for the first year of installations at $1.5 million. They estimate the first year impact on GRU ratepayers to be about $0.75 per month on a typical residential bill, a 0.6% increase. GRU expects annual increases of the same magnitude for the duration of the program. While the job creation potential has not been formally released by the utility, John Crider, a strategic planner for the utility, estimated the program could generate about 170 full-time positions for 7 years.

GRU's program demonstrates how a differentiated tariff can target specific market segments to achieve the program's stated goals.

VERMONT



Vermont opened the Sustainably Priced Energy Enterprise Development (SPEED) program in September, 2009. This program is aimed at achieving ambitious economic development and renewable energy goals.[51] These goals include meeting 20% of Vermont's electricity load with renewables by 2017 and ensuring that the economic benefits flow to the Vermont economy and the state's rate-paying citizens.

UNDIFFERENTIATED COST-BASED TARIFFS

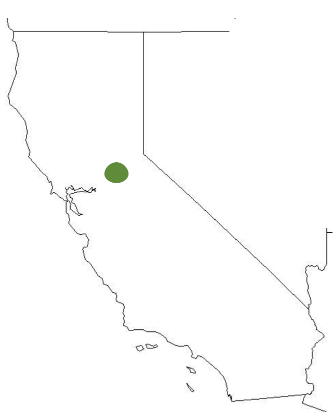
The SPEED program is capped at 50 total mega-watts with 14.5 mega-watts for solar technology. Single systems are capped at 2.2 mega-watts. A single tariff of $0.30 is available to all system owners for 25 year contracts. This tariff is intended to meet the costs of the owner and offer a 12.13% rate of return. These tariffs are subject to biannual reviews by the Vermont Public Service Board.

RESULTS

The program was fully subscribed on its first day. Administrators received 161 mega-watts of solar applications. A lottery process selected 13.7 mega-watts of projects ranging in size from 32 kilo-watts up to 2 mega-watts. Some applicants for the FiT incentive could also receive the 30% Vermont Business Investment Tax Credit for projects installed before 2010. The program does not differentiate tariffs based on system size or project type. The Board is examining the possibility of including tariff differentiation provisions in the January 2010 final contract offer.

Vermont's SPEED program demonstrates how effectively a tariff designed to recover the costs of a project and provide a return can move the market.

SACRAMENTO MUNICIPAL UTILITIES DISTRICT



In January of 2010 the Sacramento Municipal Utilities District (SMUD) will begin a FiT program designed to procure renewable energy and contribute to the utility's goals. They intend to use this program as a model to streamline their small-scale renewable power procurement process.[53] The energy will help SMUD meet its RPS goal of 20% by 2010. Economic development is not mentioned in the utility's stated goals.

LEAST COST PROCUREMENT

The program cap is set at 100 mega-watts with a 5 mega-watt project cap. The tariffs are based on the value of electricity to SMUD.[54] Tariffs are only differentiated by time-of-delivery. All customers, regardless of the cost of their system, will receive payment in accordance with this value-based tariff schedule.

The tariffs structures were calculated by accounting for the utility's avoided cost of generation, inflation, rising gas electricity prices, and avoided greenhouse gas cost. The tariffs vary from $0.08 to $0.29 based on when the energy is delivered to the grid. SMUD estimates that the expected tariff for a typical flat plate, south-facing solar PV system will average $0.16 annually.[55] Customers are not eligible for other state or utility solar rebates. Contracts can be 10, 15, or 20 years. Contracts for longer terms are given slightly increased tariffs.

RESULTS

Applications will open in January of 2010. SMUD reported that the utility has received many promising inquiries for solar PV projects, most of which approach the 5 mega-watt cap on individual projects.[56]

SMUD's FiT is a least cost utility supply strategy aimed at distributed renewable energy. The tariff structure is not designed to reach market segments for small solar systems or residential customers. Simply calculating the economics of a project with a time-of-delivery tariff schedule is a daunting task for a non-professional participant, those most likely to install small solar systems. Figuring out whether this program will provide any return on investment is only within the reach of more sophisticated players, such as those most likely to install larger 5 mega-watt systems. Furthermore, tariffs are unlikely to cover the higher costs of small systems and non-professional solar suppliers.

With tariffs based on the value of the electricity, this program is likely to have minimal impact on the electricity bills of SMUD's customers. This utility-based program does not mention economic development in its program goals.

SMUD's program is an example of a targeted FiT program intended to procure energy at least cost from small renewable energy facilities located at or near the customer's site. The SMUD program is not intended to support an industry, incentivize widespread adoption of solar, or create access to the electricity supply markets.

A commercial rooftop solar project.

LESSONS LEARNED

FiTs are increasingly used around the world to bring renewable energy online quickly and drive economic development. These two benefits are the most commonly cited goals for FiT programs. But FiT programs can contribute to these broad goals in different ways. Different jurisdictions can have different preferences about how these goals are achieved. SMUD is aiming to procure least cost renewable energy from small generators of many types of renewable energy while GRU is very specifically targeting mid-sized commercial solar projects. These two utilities have similar renewable procurement goals, but are approaching the challenge in different ways; presumably each approach is best-suited to their stakeholders. The choice of overarching policy goals is the first policy decision that must be made. All other decisions about FiT program design must follow from these policy goals in ways that are acceptable to the sponsoring jurisdiction.

FiTs are not blunt policy instruments. In order to achieve their stated goals, not only must they be informed by over arching policy goals, but also they must be carefully crafted through expert judgment and learned adaptation. Nearly every example above demonstrates an evolution of policy design. Even Germany, the world's solar industry leader, experimented with FiT designs that did not initially meet its ambitious goals. The current EEG represents two decades of policy refinement. A well-designed FiT program can create a sustained, long-term contribution to the policy goals, while a poorly-crafted FiT program can be detrimental to the jurisdiction's policy goals.

Every design choice introduces trade-offs that must be consciously managed by policy makers. For example, cost-based tariffs are the only proven tariff structure to incentivize solar energy. However, the increased costs of the solar technology will impact ratepayers more profoundly than other, less costly renewable technologies. Conversely, the cost-based tariff structure may incentivize many small solar projects and create greater opportunities for local employment. Each trade-off shifts the costs and benefits of the program between stakeholders. Ultimately, the tension created by the design trade-offs must be solved primarily through the political process. FiT program administrators must be prepared to quantify the program results and impacts in a way that is useful for the stakeholders in the debate.

LESSONS LEARNED

- FiTs are used worldwide to incentivize solar and drive economic development
- FiTs must be informed by policy goals and carefully designed to achieve the goals
- Every design element contains trade-offs

SECTION 3 ASSESSMENT OF CALIFORNIA'S FEED-IN TARIFF PROGRAMS & PROPOSALS

Los Angeles maintains ambitious renewable energy targets and economic development goals. Clean Tech Los Angeles, a multi-institutional collaboration between Los Angeles' major research universities, businesses, and public agencies, aspires to create jobs and deploy clean technology. This organization's ambitious goal is to "establish Los Angeles as the global leader in research, commercialization, and deployment of clean technologies."

Los Angeles' municipally-owned utility, LADWP, plans to eliminate coal and meet 40% of its electricity demand from renewable and sustainable sources by 2020. In 2008, the Mayor of Los Angeles proposed a plan to procure 1,280 mega-watts solar generation by 2020. Each one of these goals, taken individually, is among the most ambitious of any jurisdiction in North America. Taken collectively, the realization of this broad vision could transform Los Angeles into a leading center of clean technology.

There are three major FiT programs that, if designed appropriately, could induce the solar industry to significantly contribute to the vision that the leaders of Los Angeles have described. Two programs are proposed and one is active. The two proposals are the Los Angeles Department of Water and Power's (LADWP) FiT proposal and the California Public Utilities Commission (CPUC) staff proposal for a Renewable Auction Mechanism. The existing program is the California state-wide FiT as directed under AB1969. This section of the report assesses the potential of California's existing and proposed FiT programs to contribute to the policy goals of the Los Angeles area.

METHODOLOGY

We constructed a model to analyze the project-level economics of the three programs from the perspective of a program participant. This modeling process is representative of the best-practices of the solar industry. It takes a series of inputs, performs a cash-flow investment analysis, and produces several commonly-used indicators of economic worth. The indicators of economic worth are net present value (NPV), the ratio of the project's benefits to costs (B/C), years to payback, and annual rate of return. We used these indicators to evaluate the attractiveness of each program from a participant's perspective. Our basic assumption is that if a program is economically attractive, then owners will participate. Appendix 3 contains a more detailed definition of these indicators.

To assess the attractiveness of each program from the participant's perspective, we developed four case study examples. These examples are representative of potential solar sites within the Los Angeles basin. The first, a 5 kilo-watt residential project, is typical of the potential solar sites found on single-family homes within the Los Angeles basin. Second, a 500 kilo-watt rooftop project owned by a public agency, is typical of potential solar projects found on public schools, government administration buildings, or non-profit agencies. Third, a 500 kilo-watt commercially-owned parking lot solar project, is typical of the vast numbers of potential parking facility solar sites found in Los Angeles. Finally, a 1,500 kilo-watt rooftop system on a commercially-owned warehouse is typical of the large areas of commercial-industrial zoned sites within the region. These four examples represent the variety of potential in-basin solar projects in Los Angeles.

The model's inputs are representative of the market and policy conditions at the time of analysis. We developed the model's assumptions based on industry research and interaction with market participants. There are many inputs, each with considerable variability. We used a guiding principle of financial conservatism to develop appropriate values for the inputs. Commercial banks and investors use this general principle to evaluate the feasibility of loans and investments. From this, one important assumption to this assessment is that if a solar project is not economically attractive under conservative assumptions, no bank or investor will be willing to help a solar owner finance the high up-front costs. Because financing is such an important issue with solar, conservative assumptions are necessary when evaluating solar projects.

Appendix 3 contains a comprehensive list of these assumptions. The input values we used to analyze the case studies will not be true for every project. Instead there is a high degree of variability. Two factors influence the program economics more than others. The installed cost of solar is the most important factor. As module prices fall, solar will become more attractive over time if the incentives remain constant. The target rate of return for participants is the other important factor. If a FiT program intends for a participant to simply meet its costs, the tariff can be lower. A higher program target rate of return requires a higher tariff. The sensitivity analysis in Appendix 6 illustrates how significantly these two factors influence the economics of a FiT program.

We validated the results of our model with those of the Solar Advisor Model, a publically available solar project model developed and maintained by the National Renewable Energy Laboratory.[57] These are consistent with our results and can be found in Appendix 7.

LOS ANGELES DEPARTMENT OF WATER AND POWER: FEED-IN TARIFF PROGRAM PROPOSAL

On November 20, 2009 the LADWP proposed a FiT program to its Board of Commissioners.[58] According to the proposal, the solar energy purchased under the program will contribute to the utility's aggressive RPS goals. The proposal adds that the tariff should recognize the environmental attributes of renewable energy, the demand reduction characteristics of solar projects, and the avoided transmission costs. Furthermore, the proposal indicates that the tariff "should be set in a manner that accelerates the deployment of renewable energy resources." The program intends to procure no more than 25 mega-watts and limits the customer's system size to 5 mega-watts. Each customer must sign a 20 year contract and pay a monthly service charge to administer the account.

The program offers two tariff options to the customers. Both tariff options are value-based tariff structures. The tariffs are based on the prevailing retail price of electricity rather than the producer's costs. This market-determined price is overwhelmingly influenced by cheaper, but more plentiful fossil-fuel generated energy. The tariff structures in LADWP's solar FiT proposals do not account for the higher cost of solar generation, nor do they differentiate by project type, size or type of customer.

FLOATING TARIFFS

The first tariff option is a Floating tariff based on the time-of-use electricity rate schedules and a highly variable component called the Standard Energy Credit.[60] Both components of the tariff vary by hour, day of the week, and season. The tariff is higher during summer afternoons when electricity is more expensive and lower at nights and during the winter when electricity is less expensive. As the solar system delivers energy into the grid, the customer receives these tariffs depending on the time-of-delivery. A typical FiT customer can expect to receive an annual average tariff of between $0.09 and $0.11 under this option. See Appendix 5 for a more detailed discussion of the expected tariff of the Floating option.

FIXED TARIFFS

The second tariff option available to customers is a Fixed tariff. The Fixed option offers a tariff that does not change over the 20 year contract. It is based on the "market price of solar" and "avoided transmission" costs. The market price is a tariff equivalent to what the utility could buy a long-term solar contract for from a professional solar developer. The avoided transmission is the component of the tariff paid to the customer to compensate for the utility's reduced need for high-voltage transmission lines. Since in-basin solar produces electricity near the point of use, it lessens the burden of importing power from a distant power plant.

In all of the examples, neither tariff option is attractive enough to induce in-basin solar participation in this program. The results indicate that in-basin solar will be a poor investment under LADWP's FiT program. In all cases, the tariffs will not provide enough benefit to a solar owner to either payback the initial system costs or provide a reasonable rate of return. For the Floating option, tariffs must escalate between 7% and 17% annually to be attractive. In the Fixed option, the tariff must be increase by a factor of two to four in order to be attractive. This proposal will not induce any additional in-basin solar for Los Angeles.

CALIFORNIA'S FEED-IN TARIFF UNDER AB1969 AND SB32

California has had a state-wide FiT program since 2008.[61] State law, AB1969, requires the IOUs to purchase renewable power from eligible on-site generators.[62] The bill capped the program at 500 mega-watts and the individual system size at 1.5 mega-watts. Previously, only very large projects could participate in the utilities' RPS process. The program's simplified contracts allow small generators (up to 1.5 mega-watts) to enter the RPS-driven renewable energy market. The bill requires the IOUs to pay a renewable generator a tariff no more than the market price of natural gas fired generation. It does not require the utilities to offer a differentiated tariff that would cover the higher costs of solar generation. The value-based tariff structure under AB1969 is not high enough to incentivize widespread solar participation. The CPUC indicated that solar developers have not participated in the program for this reason.[63]

CREST PROGRAM

SCE implemented the Crest program in order to comply with AB1969. The tariffs offered under this program are based on the value of natural gas fired generation. The tariffs vary by hour, day of the week, and season, but not by generator type or system size. Because the tariff is highly variable, evaluating the program economics is a sophisticated task that is beyond the reach of many small, non-professional solar owners.

For each of the four case study examples, the Crest program tariffs are not attractive enough to payback the solar system's costs or to provide a return on investment. Appendix 4 shows these results in greater detail. The Crest program is not attractive to in-basin solar owners. Therefore no solar owners have participated in the Crest program.

SB32

State law, SB32, amends the original FiT program to address some of these concerns.[64] The changes will become law in 2010. These changes require that in addition to the value-based tariff, IOUs must make additional payments to account for the valuable attributes of renewable and solar energy, including avoided environmental compliance and transmission costs. The value of these additional payments will be determined in future CPUC proceedings, but many in the solar industry expect that it will be no more than $0.02 to $0.04.[65] SB32 also increased the state-wide cap to 750 mega-watts and amended the current program to include individual projects up to 3 mega-watts. The actual effects of the SB32 amendments will not be known until after the CPUC's rule-making proceedings.

CALIFORNIA'S PUBLIC UTILITIES COMMISSION: RENEWABLE AUCTION MECHANISM

On August 27, 2009 the CPUC staff filed a proposal for a Renewable Auction Mechanism (RAM). The proposal would require the state's IOUs to hold an auction twice per year to procure a mandated quantity of renewable energy, including solar.[66] The current RAM proposal targets projects from one to twenty mega-watts in size. Developers would submit non-negotiable bids for long-term contracts with the regulated utilities. The lowest cost projects that meet the viability criteria would win the contracts. These contracts would be largely based on the state's existing FiT, as mandated by AB1969. The energy would contribute to the state's RPS goals. This regulated program would apply only to the IOUs, so LADWP would not offer this auction process. The program rules have not been developed and proposal is being debated through the CPUC's administrative process.

If implemented, the program could quickly stimulate renewable energy generation throughout the IOU's territories at cost-minimizing, market-clearing prices. The competitive pricing ensures that players in the solar value chain are incentivized to be efficient. It also should ensure the winning bid covers the winner's costs. This structure could keep prices low while simultaneously spurring innovation within the value chain. The quantity mandate would send a signal to the solar industry about the size of the solar market and help facilitate long-term investment. The targeted projects, one to twenty mega-watts, could be located near, but not within the densely developed areas, keeping land use competition low and reducing the need to build additional long-distance transmission lines.

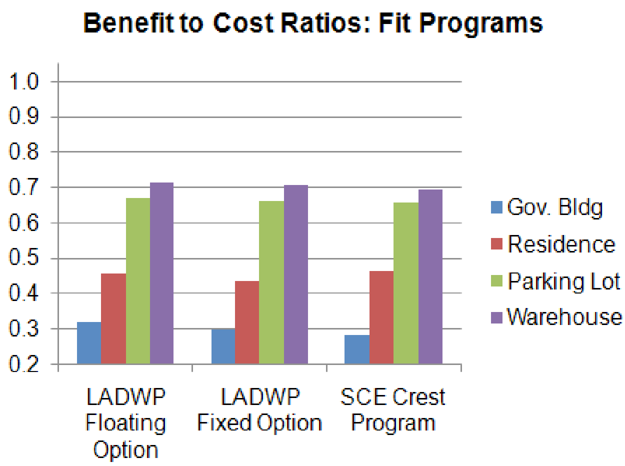
There are some valid criticisms of this proposal as well. Smaller market players who specialize in rooftop systems might be disadvantaged in a competitive process against more sophisticated and better capitalized developers. Gaming of the auction could produce unpredictable results over time. Industry collusion is a possibility. Underbidding could occur, leading to high levels of contract failure. Regardless of the overall outcome of the RAM, Los Angeles would only benefit as far as the program could induce solar projects within SCE's territory close to the City.

The RAM, as currently proposed, could shape the competitive environment to disadvantage in-basin solar bidders. Urban rooftop or parking lot projects (1-2 mega-watts) would have to compete with larger and more cost-effective out-of-basin solar projects (2-20 mega-watts). Also, the program does not differentiate between solar PV and solar thermal. Solar thermal is lower cost so it has advantages in a competitive auction process.[67] In-basin solar is not likely to win contracts under the RAM mechanism. For these reasons, many industry professionals support a fixed price FiT for smaller, in-basin projects and a competitive pricing process for larger projects.[68] Although the RAM could be very beneficial for the state, it will not directly contribute to Los Angeles' goals.

IMPLICATIONS FOR LOS ANGELES

These three programs will not significantly contribute to Los Angeles' renewable energy or economic development goals. The tariff structures are not high enough to cover the costs of in-basin solar projects or to provide any return on investment. In the case of the RAM, competitive forces will favor larger projects sponsored by professional developers. None of these programs or proposals will induce any significant in-basin solar.

All of the tariff structures are value-based structures. Value-based structures have not supported widespread adoptions of solar energy in other jurisdictions around the world and will not support solar within the Los Angeles basin. In all of the case study examples, the total benefits do not cover the total costs of the solar project. The tariffs are based on the prevailing market price of electricity, set by fossil-fuel based generation. Value-based tariffs alone cannot properly account for the higher cost structure and valuable attributes of in-basin solar, avoided environmental costs, and reduced need for transmission. Under a value-based structure, additional payments would be required to compensate the owner for their additional costs.



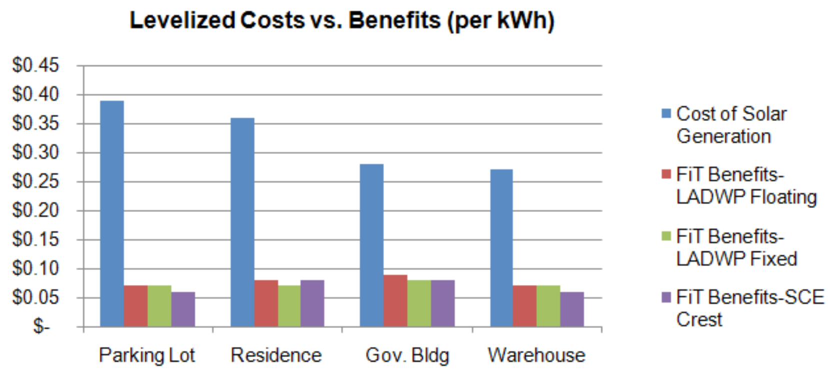


FIGURE 9: Project Owner Costs and Benefits of California's Feed-in Tariffs

Despite their inability to incentivize small, in-basin solar under the current market conditions in Los Angeles, value-based tariff structures have some positive attributes. Value-based tariffs can minimize ratepayer impact by procuring energy at the prevailing market price. Over time, as the solar industry matures, a value-based tariff can facilitate the positive effects of competition, including cost minimization and innovation. Value-based structures can contribute to the long-term sustainability of the solar industry within a free-market economy.

These three value-based programs and proposals could be attractive to certain market segments under certain conditions. The RAM proposal will likely be attractive to professional solar developers focused on larger projects. The LADWP proposal and SCE programs could possibly be attractive to a professional solar developer with a very low cost structure seeking to build a large system (3-5 mega-watts) just under the allowable project caps. The installed cost of solar would have to drop more dramatically than the current trend (below $3.00 per watt) and the developer must be willing to accept a very low rate of return as compensation for the project's risks. Many developers compete fiercely for contracts with utilities, accepting low tariffs in order to win contracts and establish them-

selves as experienced industry players. Under these conditions, a professional developer could possibly build a large system to participate in these programs.

These three programs could potentially procure solar energy to help meet RPS goals. However, they are unlikely to directly contribute to Los Angeles' clean energy or economic development goals under the current program design.

Each of these programs can coexist. Each program could be attractive to certain market segments. But none will achieve significant in-basin solar participation under their current design. To incentivize in-basin solar a cost-based tariff could be implemented. Alternatively, these value-based programs could be modified to meet the needs of solar. Tariffs can be differentiated through additional payments for small systems. The tariffs structures can be reviewed and modified periodically as market conditions shift. Policy makers can implement a targeted rate of return for solar providers as a program guiding principle and make the periodic tariff adjustments to keep this return consistent over time and by market segment. In addition to these modifications, LADWP can increase the total program cap to better take advantage of the solar opportunities within Los Angeles. Each of these programs could prove beneficial in specific ways, but many changes are required in order to extend these benefits to the in-basin solar market in Los Angeles.

SECTION 4 DESIGN GUIDELINES FOR FEED-IN TARIFF POLICIES

This section of the report provides a useful framework for FiT policy design. This framework is based on the review of other FiT programs and the assessment of California's FiTs. This section introduces some of the most important issues administrators must confront and the trade-offs associated with each of these choices.

REGIONAL GOALS

Before a FiT program can be designed effectively, political consensus on the over arching goals of the program must be achieved. FiTs around the world have been driven by two interrelated objectives, to stimulate renewable energy generation and to capture the associated economic benefits. Los Angeles has achieved a general consensus on the goals, but it lacks effective methods to bridge these goals with implementation.

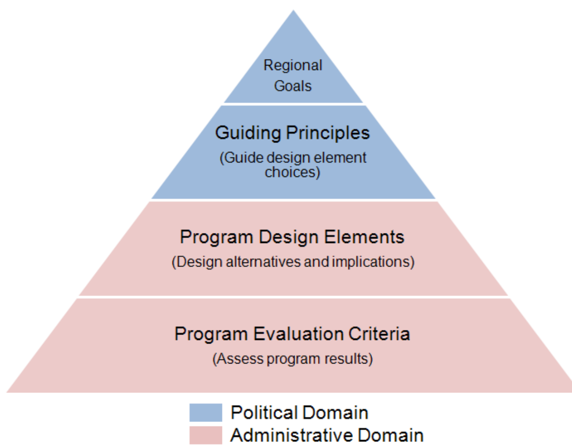


FIGURE 10: Feed-in Tariff Program Design Hierarchy

GUIDING PRINCIPLES

Guiding principles are decisions made by political leaders in support of regional goals and political consensus. These principles provide direction to the overall program and guide how the design elements are implemented. The guiding principles provide a shared vision of the results desired by political leaders and their constituencies to the public, the program administrators, and the solar industry. These principles must be concise statements that illuminate which alternatives will navigate the program design trade-offs in a politically acceptable way. Many combinations of design elements can achieve equivalent results. By focusing on goals and guiding principles, the political debate can remain oriented on the expected impacts and desired results of the program rather than the details of implementation. The guiding principles act as a bridge between the goals and the implementation of the FiT program.

DESIGN ELEMENTS

CATEGORIES OF FiT DESIGN ELEMENTS:

- Administration
- Eligibility
- Tariff Design
- Market Controls
- Special Provisions

Every FiT program has three qualities in common, price certainty, simplicity, and accessibility. However, program administrators can choose alternative designs that will either maximize or minimize these qualities. The specific design element choices will influence how the market responds to the program. There is no formulaic list of design choices that are appropriate for every conceivable program goal. Administrators must shape participation through conscientious program design.

The FiT program design elements are the functional components of the program. These elements are the aspects of the program that will most influence the actual results. They are the elements that will interface with the public. And they are the program administrator's most valuable tools to achieve the policy goals. The program administrator's responsibility is to arrange the design elements in such a way as to optimize the expected results to best achieve the policy goals.[69] It is not necessary to maximize each design element in support of the general qualities of FiT programs. Nor is it necessary to mimic the design of other FiT programs. There are five categories of design elements for FiT programs: administration, eligibility, tariff design, market control, and special provisions.

Within each program design element there is an opportunity to select alternative structures. Each alternative has distinctive implications not only for the overall program results but also for the other design elements. The program administrators must carefully select these design elements along a continuum.

ADMINISTRATION

The administrative design elements pertain to the program application and the execution of the program rules. These elements of a FiT program can influence its simplicity and accessibility.

The simpler, faster, and cheaper it is to participate, the broader the participation is likely to be. Solar technology and energy planning are not familiar topics to most non-professional solar owners. Extensive application procedures will present a barrier to participation for these owners. Professional solar developers are more accustomed to energy procurement processes and can handle more extensive applications. Spain's 2008 FiT maintains a rigorous registration process that shapes participation towards larger, ground-mounted projects developed by professionals. Ontario's REFiT program implicitly capped its participation from small solar PV owners in the short-term by requiring domestic manufacturing content.

Transparent and predictable queue procedures can increase the certainty associated with the program. When Vermont was oversubscribed, it resorted to a lottery system to randomly select projects for contracts. Ontario used the oversubscription opportunity to select projects based on "shovel-ready" criteria to speed deployment. Clearly delineated procedures increase certainty and simplicity.

The type of sponsor and resources allocated to the program can affect how the program is implemented. Each of the FiT programs sponsored by political jurisdictions explicitly state economic development as a top priority. While GRU briefly states economic impacts as a benefit for Gainesville in one informational briefing, both of the utility-sponsored programs are clearly supply-side programs, primarily intended to procure renewable energy. This goal is well aligned with the utilities' domain of expertise, procuring and distributing energy. Economic development goals are better aligned with the responsibilities of political jurisdictions.

ELEMENT	DESIGN ALTERNATIVES & IMPLICATIONS	
Participant Application Procedures	*EXTENSIVE* • Can impose transaction costs with lengthy processes, complex applications, or security deposits • May exclude non-professional solar owners • May implicitly favor experienced, professional solar developers	*SIMPLE* • Minimizes transaction costs of all kinds • Facilitates broad participation by more market segments • Could decrease the quality of projects • Could lead to higher degrees of contract failure
Permitting Support	*NO ADDITIONAL PERMITTING SUPPORT* • Permitting bottlenecks could become a de-facto program cap • Could exclude certain market segments that cannot manage the permitting process	*STREAMLINED PERMITTING* • Simplifies project development process • Reduces transaction costs • Can accelerate deployment of projects • Expands the potential market
Queue Procedures	*RANDOM SELECTION PROCESS* • Unregulated markets for queue positions can develop • Random selection processes such as lotteries can erode confidence	*CLEARLY DELINEATED SELECTION CRITERIA* • Increases confidence in program • Opportunity for administrators to select projects based on project viability criteria • Incentivizes project viability • "First come, first served" can create a rush, overwhelming grid interconnection
Resource Commitment	*LOW* • Can support a program with limited goals • More difficult to achieve broad goals without sufficient resource commitment	*HIGH* • Necessary for administering a cost-based tariff targeting a broad market • Minimizes program application burden • Customer service a consideration
Organiza-tional Sponsorship	*UTILITY* • Strong expertise with interconnection & energy procurement at "least cost" • Experience at managing ratepayer impacts • Not an economic development organization	*POLITICAL JURISDICTION* • Requires political leadership • Can orchestrate interagency will • Interested in economic development

FIGURE 11: Implications of Administration Design Elements

ELIGIBILITY

The choices of eligibility design elements either create broad access to the program for many market segments, or they limit access to a deliberately targeted segment of the solar market. These choices can explicitly shape participation by delineating which projects can participate and which cannot. Expanding project eligibility will increase program accessibility. These design elements can create conditions which inherently favor one market segment over the other. This targeted design strategy could be criticized as "picking winners" in technology development or solar applications. This strategy could also be very effective at achieving very specific, limited program goals. For example, if a policy goal was to create a local BIPV industry, administrators could include this segment while excluding other potential participants.

A specific application of solar technology

The more strict the eligibility requirements, the smaller the potential solar market created by the FiT. Although it is possible to shape participation through program eligibility requirements, most jurisdictions have used other design elements to shape participation, especially tariff design.

ELEMENT	DESIGN ALTERNATIVES & IMPLICATIONS	
Technology Application	*TARGET ONE APPLICATION* • Rooftop, parking lot, open-space, or BIPV, for example • Limits the FiT market size • Can incentivize a single segment • Supports a focused, limited policy goal	*INCLUDE MULTIPLE APPLICATIONS* • Expands the potential market size by including more potential solar sites • Increases scope of program • Necessary for broad policy goals • Requires a differentiated tariff as costs vary by solar application
Technology Types	*TARGET ONE TYPE OF TECHNOLOGY* • Crystalline-Silicon or Thin Film, for example • Limits the FiT market size • Can incentivize a single segment • Can support a focused, limited policy goal • Can "pick winners" by favoring one technology over another	*INCLUDE ALL SOLAR TECHNOLOGIES* • Expands the potential market size • Increases scope of program • Necessary for broad policy goals • Requires a differentiated tariff as technology costs vary
Ownership	*TARGET ONE SEGMENT OF OWNERS* • Residential, Commercial, or Publically-owned projects, for example • Limits the FiT market size • Appropriate for a targeting strategy • Could be controversial	*INCLUDE MULTIPLE SEGMENTS OF OWNERS* • Expands the potential market size by including more classes of ownership • Increases scope of program • Necessary for broad policy goals • Requires a differentiated tariff as tax-based incentives vary by ownership
Project Size	*TARGET A SMALL RANGE OF PROJECT SIZES* • Limits the FiT market size • Appropriate for a targeting strategy	*INCLUDE A LARGE RANGE OF PROJECT SIZES* • Expands the potential market size by including more potential solar sites • Increases scope of program • Necessary for broad policy goals • Requires a differentiated tariff with administrative support to be successful
New Construction	*TARGET NEW INSTALLATIONS ONLY* • A sufficient tariff incentivizes new, additional solar installations • Most common way to design a FiT	*INCLUDE EXISTING PROJECTS* • Could negatively interact with other solar incentive policies • Unclear how to set a cost-based tariff to account for installation costs retroactively • Value tariff, with shorter contracts could be more appropriate for existing projects

FIGURE 12: Implications of Eligibility Design Elements

TARIFF DESIGN

The design of the tariff relates to the price certainty and accessibility characteristics of FiT programs. Because an owner will receive a known tariff structure for the duration of the contract, it creates the price certainty necessary for financing and long-term economic planning at the project level.

The tariff basis is the most fundamental decision relating to tariff design. Value-based tariffs could be an appropriate procurement strategy for some types of renewable energy, but these structures are proven ineffective at inducing widespread participation from solar PV. Both Germany and Spain had versions of value-based tariffs before eventually adopting a cost-based tariff. Both countries saw significant participation from solar only after these changes. All the proposed and existing programs in California have value-based tariffs. Solar PV participation is zero in the SCE Crest Program, while LADWP's value-based tariffs do not cover the installation costs of solar ownership.

Cost-based tariffs that cover project costs and provide a specified rate of return are effective at inducing solar. The German EEG, Spain, Ontario's REFiT, Vermont and the GRU target an explicit rate of return for owners. Each of these programs has seen substantial participation from solar PV.

Tariff differentiation can expand the program to a broader market. While a broadly differentiated tariff can improve program accessibility, it can also be more challenging to administer effectively from the program sponsor's perspective. Tariff differentiation is essential in order to attain broad market participation.

Both value-based and cost-based tariffs can be differentiated. SMUD's single, undifferentiated value-based tariff structure is only attractive to a single market segment, those close to 5 mega-watts. While SMUD may be successful in achieving their program capacity goals, it will not induce broad participation from many segments of the solar market. The GRU differentiated their cost-based tariff to target commercial projects and free-standing projects. The results of GRU's first year's applications are consistent with these goals. The German EEG differentiates a cost-based tariff for five market segments. This model has facilitated broad market access and boasts the world's largest solar market.

California will attempt to differentiate value-based solar tariffs with the implementation of SB32. SB32 will differentiate value-based tariffs for renewable projects by providing additional payments for the valuable attributes of renewable energy such as time-of-delivery, avoided transmission costs, and avoided GHGs. The exact rules have not been released so it is unclear whether this value-based differentiation strategy can expand solar participation.

Most FiT programs include tariff adjustment procedures. Vermont incorporated a biannual tariff review process, while GRU has a published an annual degression schedule with the program rules. The GRU model provides more transparency about the benefits of the program because the tariff adjustments are published in advance. Spain revamped its 2007 program after uncontrolled market growth. Tariffs were reduced unexpectedly and other market controls were introduced, effectively bringing the over-stimulated Spanish solar industry to a halt. The German EEG is a successful compromise between market stimulation and tariff adjustment with a pre-programmed degression schedule. The German market has shown, steady, even growth even during the recent global economic downturn.

ELEMENT	DESIGN ALTERNATIVES & IMPLICATIONS	
Tariff Basis	*VALUE OF COMMODITY ELECTRICITY* • Minimizes ratepayer impacts • Does not support in-basin solar PV • Current market price can be observed, easier to develop tariff structure • Market value does not account for valuable renewable attributes	*COST RECOVERY PLUS A RATE OF RETURN* • Proven effective for solar PV • Maximizes participation • Ratepayers share burden equally • Setting the tariff could be challenging as actual projects costs are variable and difficult to observe
Cost-based Tariff Different-iation	*SINGLE COST-BASED TARIFF FOR ALL PARTICIPANTS* • Fewer resources necessary to administer a simpler tariff structure • May only move one segment of the market • May provide excess profits to one segment and zero profit to another	*TARIFF STRUCTURE DIFFERENTIATED BY MARKET SEGMENT* • Most common differentiation factors: project size, project type, technology • Necessary for broad market response • Can incentivize multiple market segments • Expands market, creates market access
Value-Based Tariff Different-iation	*SINGLE TARIFF EQUAL TO MARKET VALUE OF COMMODITY ELECTRICITY* • All projects get tariff equal to market value of commodity electricity • Proven ineffective to induce in-basin solar participation	*PREMIUM PAYMENTS FOR VALUABLE ATTRIBUTES OF SOLAR ELECTRICITY* • "Adder" payments for avoided GHG, avoided transmission costs, time-of-delivery, "peaking" attributes • Can index tariff to market value of electricity plus a fixed premium
Tariff Adjustment Procedure	*PERIODIC ADJUSTMENT DECISION* • Requires more administrative involvement but provides flexibility • Can ensure tariffs evolve with market • Creates policy uncertainty • Can be controversial decisions • Dramatic adjustments create market cycles	*PRE-PROGRAMMED ADJUSTMENTS* • Tariff adjustment is programmed up-front • Market conditions could evolve more dramatically than anticipated • Provides policy certainty • Tariff degression linked to market response is a commonly used adjustment procedure
Adjustment Trigger	*MARKET BASED TRIGGER* • Tariff adjusts based on the market's response • Creates uncertainty • Can create a rush for early participation • Puts downward pressure on solar prices	*TIME BASED TRIGGER* • Tariff adjusts based on elapsed program time • Market will anticipate changes • Could artificially boost solar prices until tariff adjustments
Program Life	*SHORT* • Market response is uncertain, could take longer than anticipated to achieve program goals • Total ratepayer impact is more certain • Could provide more policy flexibility as industry approaches "grid-parity"	*LONG* • Total ratepayer impact is less certain • Economic conditions can change over time, influencing program economics • Sends a long-term signal to the industry facili-tating industry investment
Contract Length	*SHORT* • 10 year contract or less increases uncertainty of project investment • Does not create price certainty for the life of the solar project	*LONG* • 20 year contract is more aligned with life of a solar project • Creates price certainty needed for long-term investments in solar projects

FIGURE 13: Implications of Tariff Design Elements

MARKET CONTROLS

While the tariff design elements relate to market stimulation, market control design elements are an attempt to prevent over-stimulation. If they are designed appropriately, they send a clear signal to the solar industry about the size and timing of the FiT induced market, creating a sense of certainty necessary for long-term investments in infrastructure. If they are designed poorly, they can be counter-productive towards the overall policy goals. Program administrators must deliberately balance explicit market controls with program accessibility concerns.

In Germany, the total participation in EEG is not capped. The market is controlled through tariff design, not explicit caps. This condition has facilitated the steady, long-term growth of the German solar industry by providing the right market signal. In Ontario's RESOP, the lack of a customer cap allowed a concentrated group of developers to dominate the initial program's participation. The GRU provided an attractive tariff, but controlled the market growth by designing annual caps on participation. This may prevent a policy-driven boom and bust cycle within Gainesville's local solar industry.

Between the 2007 and 2008 FiTs, Spain deliberately reduced the solar market size through the use of caps as market controls. The 2007 program did not have any effective market controls, while the 2008 program capped the annual market at 500 mega-watts and single projects at 10 mega-watts. The effect was a dramatic reduction in installations between 2008 and 2009.

Any implicit factor constraining market growth can act as a de-facto market cap. This appears to be the case in Ontario, where solar FiT contracts in REFiT were less than in RESOP, despite a more attractive tariff. Although Ontario is hoping for the development of local manufacturing capacity, the solar industry's long-term response is uncertain.

ELEMENT	DESIGN ALTERNATIVES & IMPLICATIONS	
Total Program Capacity Caps	*LOW* • Can support limited program goals • Minimizes ratepayer impacts • Less energy / economic development benefits • If tariff is attractive, a low program cap will create competition for program participation • Can constrain market growth	*HIGH* • Necessary to support ambitious goals • Ratepayer impact must be managed • Sends a strong policy support signal to the solar industry • Program can be constrained by other factors instead, e.g. site availability
Single Project Capacity Cap	*LOW* • Could be used to target smaller, in-basin solar projects	*HIGH* • Allows out-of-basin and in-basin solar projects
Cap on # of Projects Per Participant	*LOW* • Could limit the market size • Market response could take longer • Can become a de-factor program cap	*HIGH* • Professional developers could dominate the program participation
Periodic Caps	*YES* • Application "rounds" can manage program growth but are administratively burdensome • Could constrain market response below its potential • Could allow facilitate the development of a local in-dustrial base over time, rather than a local policy-driven business cycle • If tariff is attractive, a low periodic cap will create com-petition for program participation	*NO* • Sudden, dramatic market response can overwhelm administrative and grid interconnection processes • Outside labor will be brought in to meet a sudden, but temporary market response
De-Facto Market Control	*YES* • Any administrative process that cannot keep up with market response can impede market development • Owner administrative burden can increase the total transaction costs and reduce participation even with a sufficient tariff • De-facto caps can increase program uncertainty	*NO* • Explicit market controls increase confidence versus de-facto controls
Incentive Exclusivity	*NO* • Allow FiT projects to also receive rebates • Can be another method to differentiate between market segments • Complex interactions between policies are difficult to anticipate	*YES* • Most common structure: FiT programs are not eligible for rebates or net metering • FiT participants are eligible for tax-based incentives, depending on tax status • All other available incentives must be considered when setting the tariff

FIGURE 14: Implications of Market Control Design Elements

SPECIAL PROVISIONS

Special provisions are any features that are incorporated into the FiT program intended to shape the results to meet desirable criteria. For example, the REFiT's domestic content requirements are intended to capture upstream investment in the solar industry by incentivizing downstream transactions. Special provisions could take the form of labor requirements, specific quality standards above the industry best practices, or participant qualifications. In the RESOP, there were no stringent standards to enter a contract. Participation was dominated by speculative activity from developers that lacked strong credentials. Although special provisions can provide local, targeted benefits, they also make it more difficult to participate and reduce the accessibility and simplicity of the program. Smaller participants could have a harder time managing the requirements of the special provisions.

Special provisions can be structured in one of two forms, either with firm contract requirements or with additional incentives. In the case of contract requirements, all participants must meet the desired criteria in order to execute the FiT contract. Stipulating that a minimum portion of the equipment must originate from local sources is one example of a contract requirement. Additional incentives do not require the participants to meet the desired criteria, but instead encourage participants to meet them by providing additional bonus payments to those that do. For example, utilities can use bonus payments to incentivize solar in specific locations that enhance the reliability or operation of the electricity grid.

DESIGN ALTERNATIVES & IMPLICATIONS

	YES	NO
Local Hardware Require-ments	• FiT contracts stipulate a portion of hardware must be locally manufactured • Can create a local industry • Could take time to build up local manufacturing base • Industry may not make local investments • May exclude small participants which cannot man-age the contract requirements • Can become a de-facto program cap • Dramatically reduces simplicity and accessibility for participants • Can increase political acceptability	• FiT contract does not contain local hardware requirements • Does not require industry investments • Large industry investments in local solar man -ufacturing are uncertain • Gives more flexibility to solar value chain participants
Labor Provisions	• FiT program contains installation labor requirements • Can benefit labor interests • Make take time to build up a qualified labor force • Can increase installed costs of solar projects • Can increase political acceptability • May exclude small participants which cannot manage the contract requirements	• FiT contract does not have specific labor requirements • Allows more flexibility for solar value chain participants
Project Quality Controls	• Can increase the costs of solar projects • Local industry may take time to develop additional expertise • Provides a measure of assurance for the long-term performance of FiT solar systems • Can benefit specific stakeholders over others • Specific standards can be controversial	• FiT contract does not contain specific project-level quality controls • Allows the industry to develop and maintain project standards • Could provide less assurance of long-term performance of FiT solar systems
Participant Require-ments	• Can limit the available participants • Could increase the cost of participation	• May increase contract failure • Facilitates broader participation
Program Carve-outs	• Can ensure a desired effect by reserving a portion of the total program capacity for special types of projects • Can be controversial	• Less guarantee of the desired effects

FIGURE 15: Implications of Special Provision Design Elements

Beyond what is required to create price certainty, simplicity, and accessibility and meet the policy goals, there is no "right way" to design a FiT. Results that would be considered successful in one jurisdiction will not be considered successful in the next. Policy goals must inform FiT design. Program administrators have an assortment of design elements from which to craft a program that will be most beneficial to their jurisdiction.

EVALUATIVE CRITERIA

FEED-IN TARIFF PROGRAM EVALUATIVE CRITERIA

- Estimated Participation
- Contribution to Renewable Energy Goals
- Regional Economic Impact
- Distributional Impacts
- Cost-Effectiveness
- Policy Interactions

Evaluation of the anticipated and actual results is a critical aspect of FiT program administration. Because resources are limited, administrators will face a choice of which results they can effectively measure and evaluate. It is important to measure the results that matter most to the policy goals. The six program evaluation criteria can provide a general framework. Administrators must carefully devise specific performance criteria that follow directly from the program guiding principles and the policy goals. Performance criteria will fall under the broad categories of these evaluative criteria. This report does not recommend performance criteria. Many variations of performance criteria are possible and they are relevant only to specific program implementation schemes.

These evaluative criteria can be helpful in both the initial program design and the ongoing program evaluation. Policy makers can choose to weight the criteria at any time during the process. We do not suggest specific weights, but this can be a useful technique to assist decision making between design alternatives. FiT programs are often the subject of political debates. It is important for administrators and political leaders to be fully aware of the program's anticipated and actual impacts. The measurement of these criteria can be tailored to support decisions during any phase of implementation.

Although all six criteria are all important considerations, estimated participation must be the central consideration. All other program costs and benefits, such as job creation, energy production, and ratepayer impact, follow from the total participation in a FiT program.

ESTIMATED PARTICIPATION

There are two important perspectives from which administrators must estimate participation. First, administrators must evaluate the attractiveness of the program for the solar owner's perspective. A project cash flow model built to industry standards is the most effective way to accomplish this. This technique must be applied to each market segment. The program administrator must precisely organize the market in a useful manner that supports the program goals and facilitates program evaluation through market segment analysis. Second, administrators must evaluate the total regional participation in the program based on site availability, tariff attractiveness, land use patterns, and other available solar policies. An estimate of total regional participation will be required to estimate other evaluative criteria.

CONTRIBUTION TO RENEWABLE ENERGY GOALS

Solar energy contribution to renewable goals is the most often cited FiT program benefit. Both of these evaluative criteria follow from total participation. Energy contribution can be evaluated in terms of total energy contribution or expected contribution over time. If the regional goals call for rapid uptake of renewables to meet a time-based target, the FiT program design elements can be developed in manner to support these goals.

REGIONAL ECONOMIC IMPACT

Regional economic impacts are also frequently cited as a program benefit. Employment created by installing systems and increased regional output are the primary direct impacts. Because FiT programs incentivize transactions in the downstream solar value chain, the direct economic benefits can only be evaluated with respect to the downstream parties to the transaction. Regional economic input-output models can provide an estimate of the indirect effects from downstream transactions. It is more difficult to infer the local effects from a FiT on the upstream end of the solar value chain. Special provisions built into FiT contracts are a way to capture more of the upstream impacts within the FiT jurisdiction. Without these special provisions, local effects on the upstream value chain, manufacturing for example, are uncertain and difficult to estimate.

DISTRIBUTIONAL IMPACTS

FiT programs redistribute the costs and benefits of solar energy generation. Because of these distributional impacts, FiT programs can be politically controversial. Program administrators must be able to estimate these effects. Ratepayer impact is an important concern. Public input sessions are an important mechanism to gauge the public's willingness to accept these impacts. The California Standard Practice Manual offers a methodology to quantify the impact on ratepayers. If a FiT program targets specific market segments, the program is inherently favoring one over the other. Although this can be an effective way to achieve policy goals, it can also redistribute costs and benefits within the solar industry itself. Administrators must be prepared to evaluate and justify these impacts.

COST-EFFECTIVENESS

Not all solar energy is equally cost-effective. There are economies of scale, differing cost structures, and variable incentives available between market segments. The administrator must evaluate project sites, technologies, applications, and classes of ownership for cost-effectiveness. This can be accomplished with project-level economic analysis and the regional analysis. The California Standard Practice Manual illustrates a method to analyze the cost of energy on a per unit basis. This methodology can inform administrators about the most appropriate program design elements choices to support the policy goals.

POLICY INTERACTIONS

Solar owners have a host of policy incentives to choose from. Net metering and rebates can incentivize solar production for on-site consumption. These policies are a distinct alternative to FiT policies. Administrators must understand how solar owners might choose between these available alternatives in order to understand total regional participation. It is feasible that FiT program can reduce participation in other solar programs, rebate programs, for example. As with participation, it is important for administrators to evaluate these interactions at both the project level and at the regional level.

RELEVANCE	CRITERION	EVALUATIVE TECHNIQUES
• Project-level economics drive participation • Administrators can shape economics and thus participation • Target rate of return must be managed for cost-based tariffs • All other program results follow from participation	ESTIMATED PARTICIPATION	• Project-level cash flow model o Industry best practices o Realistic assumptions o Owner's perspective o Consider all available incentives • Market segment analysis • Public input and solar industry feedback • Participation Test from CA Standard Practice Manual • Analyze total regional participation based on local land use patterns, project economics
• Well-designed FiTs have demonstrated that they can quickly bring renewables online	CONTRIBUTION TO RENEWABLE ENERGY GOALS	• Total energy produced over life of the program, avoided pollution & GHG • Time analysis of participation
• Global competition for the clean-tech industry is increasing • Job creation is frequently cited as a FiT program benefit	REGIONAL ECONOMIC IMPACTS	• Estimate direct effects to target market segments • FiTs directly impact the downstream solar value chain • Regional indirect effects can be estimated using regional input/output models
• The most controversial aspects of FiTs • Ratepayer impact is a critical impact that must be managed • Impacts across segments of the solar market could be an important concern • A targeted FiT program could effectively "pick winners" by favoring one market segment	DISTRIBUTIONAL IMPACTS	• Impact on electricity rates on a per kWh basis or per customer basis • Utility avoided cost is a critical component of ratepayer impact • Ratepayer Impact Test from CA Standard Practice Manual • Public input process
• Different types of solar projects have different economic profiles • Some in-basin solar projects are more cost-effective than others per kWh	COST-EFFECTIVENESS	• Cost of Solar Energy comparison between potential market segments • Total Resource Cost Test from CA Standard Practice Manual
• Solar owners can be eligible for other solar incentive programs • FiT administrators must anticipate these interactions	POLICY INTERACTIONS	• Evaluate policy interactions in both project level model and regional impact assessment

FIGURE 16: Evaluative Criteria

SECTION 5 CONCLUSIONS

The purpose of this report is to propose design guidelines for a comprehensive solar FiT policy for Los Angeles. We accomplished this by reviewing worldwide FiT programs, assessing California's current FiT proposals, and proposing FiT design guidelines. These guidelines can serve as a useful guide to Los Angeles policy makers in the design of a comprehensive FiT policy for the region. These conclusions summarize the key findings of the review, assessment, and proposal.

CONCLUSIONS

There is a disconnection between Los Angeles' aggressive solar goals and its policies. Although the region maintains some of North America's most ambitious renewable energy and economic development goals, the current solar policy framework does not facilitate any significant in-basin solar contribution to these goals. California's SB1 solar incentives are effective at inducing small amounts of solar power to offset on-site electricity usage, but these incentives do not reach every segment of the potential solar market. It is difficult for public agencies and cash-constrained businesses to directly own solar facilities, but they cannot look to professional owners because of Los Angeles' prohibition on third-party power sales. Current policies do not maximize the opportunities for solar within Los Angeles. An effective FiT policy could help expand the Los Angeles solar market and also contribute to the regional goals.

California's existing and proposed FiT programs are not effective for inducing extensive in-basin solar for Los Angeles. These programs lack a cost-based tariff structure that facilitates participation from non-professional solar owners and owners of small projects. A tariff that covers the producer's costs and provides a reasonable rate of return is essential for inducing widespread solar participation in a FiT. Value-based tariffs can be useful tools to support some types of policy goals. Value-based tariffs could be effective at inducing more cost-effective projects, such as utility-scale solar. But without additional compensation, in-basin solar producers cannot compete with fossil fuel producers or even with more cost-effective renewable producers. In Europe, FiTs did not experience significant solar participation until cost-based tariffs were implemented. Under the near-term market conditions, neither California nor Los Angeles will experience widespread solar participation with value-based tariffs.

Effective FiT program design alternatives must be tailored for local conditions. The specific design choices of a local policy must support the jurisdiction's larger goals. Global market conditions influence solar economics, but also many of the factors that influence solar energy economics are local. Because of this, program design alternatives cannot easily be imported from other policies, nor can specific elements be compared between jurisdictions. A tariff in one locality may induce the desired market response, while the same tariff in another locality could over-stimulate the solar market. A serious commitment by administrators is required to calculate the program economics and estimate the market response. This commitment is essential, not only for program design, but also to evaluate the results and make appropriate adjustments.

The FiT debate in Los Angeles must involve a discussion of the specific trade-offs inherent in the policy alternatives. Angelenos clearly accept lofty renewable energy goals but their willingness to pay for an in-basin solar contribution has not been debated in a transparent manner. If the stakeholders agree that solar energy is an important goal, then a policy can be designed to achieve this goal. The feasible alternatives within the FiT design elements provide enough flexibility to achieve nearly any solar energy goal, both limited and broad. Debating tariff levels based on other jurisdictions' tariffs is not productive. Any functional debate must include a discussion of specific policy alternatives and their estimated local impacts. The policy goal will drive the specific choices of design elements. By focusing on redistributive costs and benefits of specific policy alternatives, political leaders can reframe the debate in terms of interests rather than positions, and the region can more easily reach a political consensus on how to achieve its ambitious goals. FiT policies can be designed to achieve nearly any solar goal.

The most influential design elements are the tariff basis, total program cap, and participant application procedures. Although the combination of all of the program design elements can shape the program results, these three elements are the biggest drivers of solar uptake under a FiT regime. Other FiT programs have proven that tariffs must be cost-based and differentiated for solar participation. When the tariff is attractive, many owners will apply for participation, so the total program cap is the most fundamental market control design element available to administrators. Simplicity of participation is essential. Most people who own favorable solar sites are not energy professionals. Extensive participation procedures will limit participation. These drivers of FiT policy results must be carefully managed.

FOLLOW-UP STUDY

The earlier sections of this report provided evidence for the effectiveness of solar FiTs around the world and demonstrated California's lack of an effective solar FiT. The proposed design guidelines can be used by policymakers and stakeholders to focus the solar debate on how the region can meet its goals in an acceptable way. The design guidelines highlighted the trade-offs inherent in the design alternatives and proposed methodologies to evaluate the results. This report, however, does not attempt to quantify the trade-offs of any specific policy alternatives for Los Angeles.

A follow-up study issued at a later date will address the specific impacts of a comprehensive policy in Los Angeles. Based on several policy alternatives, the follow-up study will estimate the program results in accordance with the evaluative criteria proposed in Section IV of this report.

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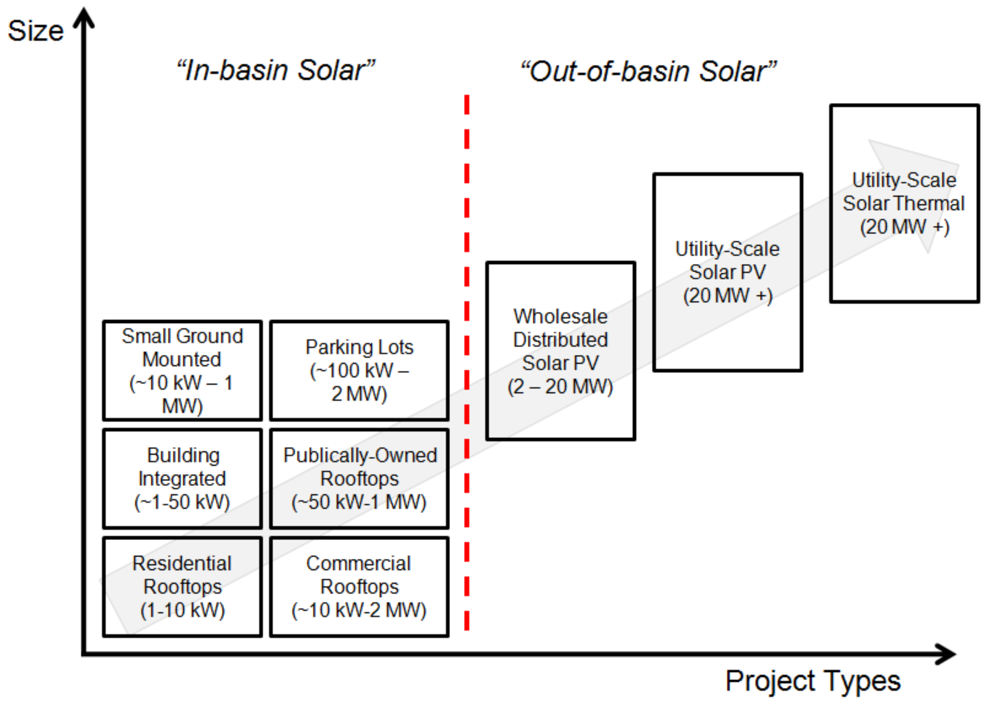
Appendix 1: Solar Market Structure

Solar Market Segments by Project Type



Market Segment Attributes

	In-basin	Out-of-basin
Land Use Patterns	Urban or Rural	Rural
Installed Cost	Higher ~$8.00 per watt	Lower ~$4.00 per watt
Ownership	Non-professional and Professional	Professional
Grid Inter-connection	Distribution lines On-site electricity use	High-Voltage Transmission Lines
Land Use Controls	Bldg. Codes Electrical Inspections	Conditional Use Permits, CEQA
Project Area	100 sq.ft. to 20 acres	200 + acres
Current Policy Framework	Net Metering SB1 Incentives	RPS Solicitations

Appendix 2: Summary of Worldwide Feed-in Tariff Design Elements

	Program Cap; System Cap	Contract Term	Tariff Basis	Tariff Differentiation	Solar Tariff (USD/kWh)	Tariff Adjustment	Other
German StrEG			Value		Wholesale electricity price		
German EEG	None	20 years	Cost + Return	Project size, type, technology	$0.48-0.64	Annual degression of 8-10% based on market response	
Spain			Value		Wholesale electricity price + premium		
Spain 2007	1.2 GW; 50 MW	25 years	Other	Project size, technology	$0.35-0.68	Annual Inflation	
Spain 2008	500 MW annual; 10 MW	25 years	Cost + Return	Project size, type, technology	$0.44-0.51	Annual degression	Extensive Registration Process
Ontario RESOP	1 GW goal	20 years	Other	Technology	$0.40		Transmission Constraints
Ontario REFiT	1 GW goal	20 years	Cost + Return	Project size, type, technology	$0.44-0.76		Domestic Content Requirements
Gainesville GRU	32 MW; 4 MW annual	20 years	Cost + Return	Project type	$0.26-0.32	Annual degression	
Vermont SPEED	14.5 MW (solar); 2.2 MW	25 years	Cost + Return	None	$0.30	Biannual review	
SMUD FiT	100 MW; 5 MW	10, 15, 20 years	Value	Time-of-delivery, Contract length	$0.08-0.29	None	

Appendix 3: Analytical Assumptions

These assumptions were used consistently throughout this report for all analytical modeling of solar projects. There is variability in the real-world values of each assumption. We selected reasonable values and demonstrated the variability inherent in the results of the analysis.

System and Cost Assumptions

1. Only quantifiable benefits and costs to the solar system owner are included in the model. Diffuse societal benefits such as avoided pollution benefits, for example, are not accounted for as a benefit to the owner by this model.
2. All system production is fed into the distribution grid and credited at the rates described in the program descriptions.
3. FiT customers are not eligible for net metering or SB1 incentives.
4. System installed costs will vary with the size of the system, type of project, and the customer class. The installed cost values used for this analysis are shown in Appendix 4. The ranges shown in Appendix 6 demonstrate how these costs can influence the results.
5. Annual operations and maintenance (O&M) costs are $20.00 per kW DC. Annual insurance cost is 0.5% of the total installed cost. Property taxes on the solar equipment are deferred for all customer classes.
6. The system's inverter must be replaced in year 15 at a cost of $0.70 per W DC.[1] Most inverters carry a 10 year warranty. Inverter refurbishment in year 15 at a cost of $0.20 to $0.40 per watt DC is also a reasonable assumption. Data on the expected life of inverters is not available. We used $0.70 for this analysis.
7. Annual inflation of all costs except insurance is 3%.
8. System life is 20 years based the standard warrantied life of the solar modules. Although the system may operate beyond this, an incentive program is not guaranteed. Residual value and disposal costs are assumed to be zero.
9. 20 year FiT contracts for both LADWP and SCE programs.
10. Solar Renewable Energy Credits (S-RECs) transfer to the utility with no additional value to the customer.
11. LADWP FiT benefits are calculated based on LADWP's proposal to the Board of Commissioners on November 20, 2009.
12. LADWP Floating option "Retail Price of Energy" is based on Small General Service A-1 Rate B (TOU) rate schedule. "Standard Energy Credit" is $0.06 during the high and low peak periods and $0.03 during the base period. The combined rate escalates at 3.0% annually.
13. LADWP Fixed option is based on "Market Price" of $0.12/kWh and "Transmission Credit" of $0.015/kWh. There is no annual tariff escalation under this option.
14. SCE Crest tariff is based on the 2009 Market Price Referent (MPR) with a 20 year Contract Start Date during 2010.[2]
15. DC to AC derating is the PVWatts V2 default of 0.77. PVWatts is a solar PV system performance estimator developed by the National Renewable Energy Laboratory.[3]

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PVWatts Performance Estimates for a 50 kW DC Solar PV System in 10 Zip Codes

Community	CSU Northridge	Sylmar	Van Nuys	Studio City	UCLA	West Los Angeles	Down-town	East Los Angeles	West Adams	Wilmington
Zip Code	91330	91342	91406	91604	90095	90025	90012	90023	90018	90744
Jan	5,321	5,255	5,321	5,321	5,321	5,321	5,166	5,166	5,133	5,133
Feb	5,317	5,367	5,317	5,317	5,317	5,317	5,203	5,203	5,179	5,179
Mar	6,603	6,525	6,603	6,603	6,603	6,603	6,374	6,374	6,363	6,363
Apr	6,703	6,659	6,703	6,703	6,703	6,703	6,488	6,488	6,541	6,541
May	7,155	7,243	7,155	7,155	7,155	7,155	6,966	6,966	7,032	7,032
Jun	6,797	7,248	6,797	6,797	6,797	6,797	6,997	6,997	6,687	6,687
Jul	6,907	7,339	6,907	6,907	6,907	6,907	7,131	7,131	6,853	6,853
Aug	7,090	7,448	7,090	7,090	7,090	7,090	7,249	7,249	6,997	6,997
Sep	6,438	6,701	6,438	6,438	6,438	6,438	6,444	6,444	6,366	6,366
Oct	5,964	6,365	5,964	5,964	5,964	5,964	6,020	6,020	5,858	5,858
Nov	5,522	5,684	5,522	5,522	5,522	5,522	5,451	5,451	5,411	5,411
Dec	5,040	5,024	5,040	5,040	5,040	5,040	4,895	4,895	4,914	4,914
Annual Prod (kWh)	74,857	76,858	74,857	74,857	74,857	74,857	74,384	74,384	73,334	73,334
Annual Prod Factor (kWh / kW AC)	1,944	1,996	1,944	1,944	1,944	1,944	1,932	1,932	1,905	1,905

Community	CSU Northridge	Sylmar	Van Nuys	Studio City	UCLA	West Los Angeles	Down-town	East Los Angeles	West Adams	Wilmington
% Production High Season (Jun-Sep)	36%	37%	36%	36%	36%	36%	37%	37%	37%	37%
% Production Low Season (Jan-May, Oct-Dec)	64%	63%	64%	64%	64%	64%	63%	63%	63%	63%

DC Rating	50.00	kW DC	Std Dev	26	Avg Annual Prod Factor	1,939	kWh/kW AC/yr
x DC to AC Derating	0.77		Min	1,905	x Orientation Derating	0.90	
AC Rating	38.50	kW AC	Max	1,996	Final Annual Prod Factor	1,745	kWh/kW AC/yr

Customer Assumptions

17. LADWP FiT service charge is $100.00 per month for commercial and public customers and $10.00 per month for residential. No service charge is specified in the SCE documentation.
18. FiT payments are taxable for commercial customers.
19. The benefits from both the Federal Investment Tax Credit/Grant (ITC) of 30% and MACRS depreciation can be monetized by commercial owners in the current tax period. Residential customers can monetize the ITC only. No bonus depreciation applies. State income tax depreciation benefits are calculated using the straight-line method over 10 years.
20. Future cash flows are discounted at the customer's weighted average cost of capital (WACC). The WACC is a blended cost of debt and equity financing for each customer class. Cost of equity financing is 5.0% for residential and public customers and 8.0% for commercial customers. No debt or external equity financing was considered for these projects.
21. FiT program target returns are intended to meet the each customer's WACC.

[3] PVWatts Version 2, "A Performance Calculator for Grid-Connected PV Systems," Accessed on November 20, 2009, Available at <http://rredc.nrel.gov/solar/codes_algs/PVWATTS/version2/>.

[4] California Energy Commission, "A Guide to PV Design," 9.

22. Federal tax rates are 28% for residential and 35% for commercial. State tax rates are 8% for residential and 9% for commercial.
23. Net Present Value (NPV) is the value of the project's cash flow in present dollars. The cash flow is discounted at the owner's WACC. A negative NPV indicates a poor investment from the owner's perspective.
24. Discounted Benefits/Costs is the ratio of the project benefits to the project costs, discounted at the owner's WACC. A ratio lower than 1.00 indicates a poor investment from the owner's perspective.
25. To estimate the rate of return for a solar owner, we selected the Modified Internal Rate of Return (MIRR) over the more commonly used Internal Rate of Return (IRR). The MIRR is a better representation of true annual equivalent yield of an investment.[5] In order to calculate Modified Internal Rate of Return from the bottom-line project cash flow, the customer's WACC was used for both the finance rates and the reinvestment rates. The project MIRR must be greater than the Program Target MIRR in order for a solar project to be attractive. The MIRR is expressed as "annual return, return, rate of return, or return on investment" within the body of this report.
26. We used two measures of the time required to recoup the owner's initial investment. Simple payback is the number of years it takes for the solar system to pay for its initial costs on an undiscounted basis. Discounted payback is the number of years it takes for the solar system to pay for itself when the cash flow is discounted at the owner's WACC.
27. Levelized Cost of Energy (LCOE) is the sum of the present value of the initial system costs, annual O&M costs, and insurance costs divided by the total kWh produced over the life of the system.
28. Levelized FiT Benefits are the sum of the present value of the total FiT benefits received during the entire contract divided by the kWh produced over the life of the system.

[5] John C. Kelleher & Justin J. MacCormack, "Internal Rate of Return: A Cautionary Tale," McKinsey on Finance, Number 12, (2004), 18.

Appendix 4: Results of Assessment of California's Feed-in Tariffs

LADWP's Floating FiT Option

Indicators of Economic Worth	Residential	Public	Commercial	
	Home	Gov Bldg	Parking Lot	Warehouse
	5 kW	500 kW	500 kW	1,500 kW
Installed Costs per Watt (DC)	$ 8.00	$ 6.00	$ 9.00	$ 6.00
Total System Cost	$ 40,000	$ 3,000,000	$ 4,500,000	$ 9,000,000
Program Target Rate of Return	5.0%	5.0%	8.0%	8.0%
Net Present Value ($)	-$25,396	-$2,447,773	-$1,736,181	-$3,168,364
Program Return	1.2%	-0.8%	6.0%	6.3%
Program Return meets Program Target	No	No	No	No
Discounted Benefits/Costs	0.46	0.32	0.67	0.71
Simple Payback (yrs)	No Payback	No Payback	No Payback	No Payback
Discounted Payback (yrs)	No Payback	No Payback	No Payback	No Payback

LADWP Fixed FiT Option

Indicators of Economic Worth	Residential	Public	Commercial	
	Home	Gov Bldg	Parking Lot	Warehouse
	5 kW	500 kW	500 kW	1,500 kW
Installed Costs per Watt (DC)	$ 8.00	$ 6.00	$ 9.00	$ 6.00
Total System Cost	$ 40,000	$ 3,000,000	$ 4,500,000	$ 9,000,000
Program Target Rate of Return	5.0%	5.0%	8.0%	8.0%
Net Present Value ($)	-$26,255	-$2,533,583	-$1,762,186	-$3,246,381
Program Return	1.0%	-1.3%	6.0%	6.2%
Program Return meets Program Target	No	No	No	No
Discounted Benefits/Costs	0.44	0.30	0.66	0.71
Simple Payback (yrs)	No Payback	No Payback	No Payback	No Payback
Discounted Payback (yrs)	No Payback	No Payback	No Payback	No Payback

SCE's Crest Program

Indicators of Economic Worth	Residential	Public	Commercial	
	Home	Gov Bldg	Parking Lot	Warehouse
	5 kW	500 kW	500 kW	1,500 kW
Installed Costs per Watt (DC)	$ 8.00	$ 6.00	$ 9.00	$ 6.00
Total System Cost	$ 40,000	$ 3,000,000	$ 4,500,000	$ 9,000,000
Program Target Rate of Return	5.0%	5.0%	8.0%	8.0%
Net Present Value ($)	-$25,040	-$2,584,564	-$1,786,318	-$3,336,165
Program Return	1.3%	-1.5%	5.9%	6.1%
Program Return meets Program Target	No	No	No	No
Discounted Benefits/Costs	0.46	0.28	0.66	0.70
Simple Payback (yrs)	No Payback	No Payback	No Payback	No Payback
Discounted Payback (yrs)	No Payback	No Payback	No Payback	No Payback

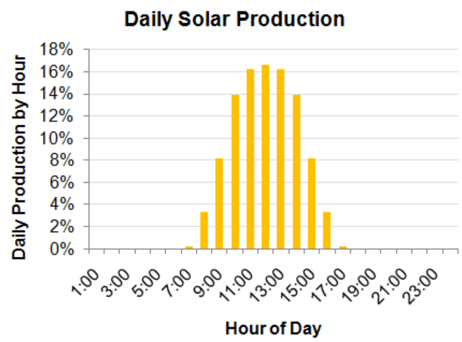
Appendix 5: LADWP Floating Option, Expected Tariff

Daily solar production is a function of location, panel type, panel orientation, tilt, and shading. We assumed a representative daily solar production function for this analysis.

Chart A: Daily and Weekly Solar Production

	Sun	Mon	Tues	Wed	Thur	Fri	Sat
1:00							
2:00							
3:00							
4:00							
5:00							
6:00							
7:00	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%
8:00	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%
9:00	1.16%	1.16%	1.16%	1.16%	1.16%	1.16%	1.16%
10:00	1.98%	1.98%	1.98%	1.98%	1.98%	1.98%	1.98%
11:00	2.32%	2.32%	2.32%	2.32%	2.32%	2.32%	2.32%
12:00	2.37%	2.37%	2.37%	2.37%	2.37%	2.37%	2.37%
13:00	2.32%	2.32%	2.32%	2.32%	2.32%	2.32%	2.32%
14:00	1.98%	1.98%	1.98%	1.98%	1.98%	1.98%	1.98%
15:00	1.16%	1.16%	1.16%	1.16%	1.16%	1.16%	1.16%
16:00	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%
17:00	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%
18:00							
19:00							
20:00							
21:00							
22:00							
23:00							
0:00							

Total Weekly Energy Production: 100%



The Floating tariff has two components. The first component is the Energy Credits which are based on the retail electricity rates under Rate Schedule A-1, Small General Service Rate B. The second component is the Standard Energy Credits. Both of these components vary hourly, daily, and seasonally.

Energy Credits
Energy Charge per kWh.[6]

	High Season	Low Season
High Peak Period	\$ 0.16385	\$ 0.05854
Low Peak Period	\$ 0.10256	\$ 0.05854
Base Period	\$ 0.03122	\$ 0.03122

High Season is Jun-Sep and Low Season is Oct-May.
High Peak Period: 1:00 PM to 4:59 PM – Weekdays (20 Hrs/Week)
Low Peak Period: 10:00 AM to 12:59 PM and 5:00 PM to 7:59 PM-Weekdays (30 Hrs/Week)
Base Period 8:00 PM to 9:59 PM - Weekdays and all day Saturday and Sunday (118 Hrs/Week)

Standard Energy Credits
Average Standard Energy Credits per kWh.[7]

	2008 Averages		2009 Averages	
	High Season	Low Season	High Season	Low Season
High Peak Period	\$0.07778	\$0.05866	\$0.02975	\$0.03293
Low Peak Period	\$0.07778	\$0.05866	\$0.02975	\$0.03293

[6] LADWP, "Schedule A-1 Small General Service," Accessed on November 15, 2009, Available at <http://www.ladwp.com/ladwp/cms/ladwp001751.jsp>.

[7] LADWP, "Standard Energy Credit," Accessed on November 23, 2009, Available at <http://www.ladwp.com/ladwp/cms/ladwp008917.jsp>.

Base Period	$0.04323	$0.03259	$0.01653	$0.01829

Expected Tariff Calculation

Chart B: High Season Tariffs = Energy Credits + Standard Energy Credits (2009)

	Sun	Mon	Tues	Wed	Thur	Fri	Sat
1:00							
2:00							
3:00							
4:00							
5:00							
6:00							
7:00	$0.0477	$0.0477	$0.0477	$0.0477	$0.0477	$0.0477	$0.0477
8:00	$0.0477	$0.0477	$0.0477	$0.0477	$0.0477	$0.0477	$0.0477
9:00	$0.0477	$0.0477	$0.0477	$0.0477	$0.0477	$0.0477	$0.0477
10:00	$0.0477	$0.0477	$0.0477	$0.0477	$0.0477	$0.0477	$0.0477
11:00	$0.0477	$0.1323	$0.1323	$0.1323	$0.1323	$0.1323	$0.0477
12:00	$0.0477	$0.1323	$0.1323	$0.1323	$0.1323	$0.1323	$0.0477
13:00	$0.0477	$0.1323	$0.1323	$0.1323	$0.1323	$0.1323	$0.0477
14:00	$0.0477	$0.1936	$0.1936	$0.1936	$0.1936	$0.1936	$0.0477
15:00	$0.0477	$0.1936	$0.1936	$0.1936	$0.1936	$0.1936	$0.0477
16:00	$0.0477	$0.1936	$0.1936	$0.1936	$0.1936	$0.1936	$0.0477
17:00	$0.0477	$0.1936	$0.1936	$0.1936	$0.1936	$0.1936	$0.0477
18:00							
19:00							
20:00							
21:00							
22:00							
23:00							
0:00							

Chart C: Low Season Tariffs = Energy Credits + Standard Energy Credits (2009)

	Sun	Mon	Tues	Wed	Thur	Fri	Sat
1:00							
2:00							
3:00							
4:00							
5:00							
6:00							
7:00	$0.0495	$0.0495	$0.0495	$0.0495	$0.0495	$0.0495	$0.0495
8:00	$0.0495	$0.0495	$0.0495	$0.0495	$0.0495	$0.0495	$0.0495
9:00	$0.0495	$0.0495	$0.0495	$0.0495	$0.0495	$0.0495	$0.0495
10:00	$0.0495	$0.0495	$0.0495	$0.0495	$0.0495	$0.0495	$0.0495
11:00	$0.0495	$0.0915	$0.0915	$0.0915	$0.0915	$0.0915	$0.0495
12:00	$0.0495	$0.0915	$0.0915	$0.0915	$0.0915	$0.0915	$0.0495
13:00	$0.0495	$0.0915	$0.0915	$0.0915	$0.0915	$0.0915	$0.0495
14:00	$0.0495	$0.0915	$0.0915	$0.0915	$0.0915	$0.0915	$0.0495
15:00	$0.0495	$0.0915	$0.0915	$0.0915	$0.0915	$0.0915	$0.0495
16:00	$0.0495	$0.0915	$0.0915	$0.0915	$0.0915	$0.0915	$0.0495
17:00	$0.0495	$0.0915	$0.0915	$0.0915	$0.0915	$0.0915	$0.0495
18:00							
19:00							
20:00							
21:00							
22:00							
23:00							
0:00							

High Peak Period	
Low Peak Period	
Base Period	
Hours of Solar Production	

Chart D: Seasonal Weighted Tariff = (37% x Chart B) + (63% x Chart C)

	Sun	Mon	Tues	Wed	Thur	Fri	Sat
1:00							
2:00							
3:00							
4:00							
5:00							
6:00							
7:00	$0.0489	$0.0489	$0.0489	$0.0489	$0.0489	$0.0489	$0.0489
8:00	$0.0489	$0.0489	$0.0489	$0.0489	$0.0489	$0.0489	$0.0489
9:00	$0.0489	$0.0489	$0.0489	$0.0489	$0.0489	$0.0489	$0.0489
10:00	$0.0489	$0.0489	$0.0489	$0.0489	$0.0489	$0.0489	$0.0489
11:00	$0.0489	$0.1066	$0.1066	$0.1066	$0.1066	$0.1066	$0.0489
12:00	$0.0489	$0.1066	$0.1066	$0.1066	$0.1066	$0.1066	$0.0489
13:00	$0.0489	$0.1066	$0.1066	$0.1066	$0.1066	$0.1066	$0.0489
14:00	$0.0489	$0.1293	$0.1293	$0.1293	$0.1293	$0.1293	$0.0489
15:00	$0.0489	$0.1293	$0.1293	$0.1293	$0.1293	$0.1293	$0.0489
16:00	$0.0489	$0.1293	$0.1293	$0.1293	$0.1293	$0.1293	$0.0489
17:00	$0.0489	$0.1293	$0.1293	$0.1293	$0.1293	$0.1293	$0.0489
18:00							
19:00							
20:00							
21:00							
22:00							
23:00							
0:00							

Chart E: Expected Tariff = Chart D x Chart A

	Sun	Mon	Tues	Wed	Thur	Fri	Sat
1:00							
2:00							
3:00							
4:00							
5:00							
6:00							
7:00	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000
8:00	$0.0002	$0.0002	$0.0002	$0.0002	$0.0002	$0.0002	$0.0002
9:00	$0.0006	$0.0006	$0.0006	$0.0006	$0.0006	$0.0006	$0.0006
10:00	$0.0010	$0.0010	$0.0010	$0.0010	$0.0010	$0.0010	$0.0010
11:00	$0.0011	$0.0025	$0.0025	$0.0025	$0.0025	$0.0025	$0.0011
12:00	$0.0012	$0.0025	$0.0025	$0.0025	$0.0025	$0.0025	$0.0012
13:00	$0.0011	$0.0025	$0.0025	$0.0025	$0.0025	$0.0025	$0.0011
14:00	$0.0010	$0.0026	$0.0026	$0.0026	$0.0026	$0.0026	$0.0010
15:00	$0.0006	$0.0015	$0.0015	$0.0015	$0.0015	$0.0015	$0.0006
16:00	$0.0002	$0.0006	$0.0006	$0.0006	$0.0006	$0.0006	$0.0002
17:00	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000
18:00							
19:00							
20:00							
21:00							
22:00							
23:00							
0:00							

Sum All Above = Expected Tariff: $ 0.084

The displayed result of $0.084 per kWh is the expected tariff a Floating Option customer can expect to receive based average values for the SEC during 2009. The expected tariff using 2008 SEC values is $0.111 per kWh.

Appendix 6: Sensitivity Analysis

The charts below demonstrate the requirements to meet a specified program target return under different conditions. These two key inputs are the installed cost of a solar system and the FiT program's target rate of return.

LADWP Fixed Fit Option, Required Tariff per kWh to Meet a Program Target Return

5 kW Residential Home

	1%	3%	5%	7%
$ 5.00	$ 0.25	$ 0.28	$ 0.31	$ 0.35
$ 6.00	$ 0.29	$ 0.32	$ 0.36	$ 0.40
$ 7.00	$ 0.32	$ 0.36	$ 0.41	$ 0.46
$ 8.00	$ 0.35	$ 0.40	$ 0.46	$ 0.51
$ 9.00	$ 0.39	$ 0.44	$ 0.51	$ 0.57

500 kW Commercial Parking Lot

	5%	6%	7%	8%
$ 6.00	$ 0.34	$ 0.37	$ 0.40	$ 0.43
$ 7.00	$ 0.39	$ 0.42	$ 0.45	$ 0.48
$ 8.00	$ 0.43	$ 0.47	$ 0.50	$ 0.54
$ 9.00	$ 0.47	$ 0.51	$ 0.56	$ 0.60
$10.00	$ 0.52	$ 0.57	$ 0.61	$ 0.66

500 kW Public Agency

	1%	3%	5%	7%
$ 3.00	$ 0.20	$ 0.23	$ 0.25	$ 0.28
$ 4.00	$ 0.25	$ 0.28	$ 0.32	$ 0.36
$ 5.00	$ 0.30	$ 0.34	$ 0.38	$ 0.43
$ 6.00	$ 0.35	$ 0.40	$ 0.45	$ 0.51
$ 7.00	$ 0.39	$ 0.45	$ 0.52	$ 0.59

1,500 kW Commercial Warehouse

	5%	6%	7%	8%
$ 3.00	$ 0.21	$ 0.22	$ 0.23	$ 0.24
$ 4.00	$ 0.25	$ 0.27	$ 0.29	$ 0.31
$ 5.00	$ 0.30	$ 0.32	$ 0.34	$ 0.36
$ 6.00	$ 0.34	$ 0.37	$ 0.39	$ 0.42
$ 7.00	$ 0.38	$ 0.42	$ 0.45	$ 0.48

LADWP Floating Fit Option, Required Annual Rate Escalation to Meet a Program Target Return

5 kW Residential Home

	1%	3%	5%	7%
$ 5.00	8.2%	9.6%	11.3%	13.0%
$ 6.00	9.3%	10.9%	12.8%	14.6%
$ 7.00	10.3%	12.0%	13.8%	15.8%
$ 8.00	11.2%	13.0%	14.9%	17.0%
$ 9.00	12.0%	13.9%	15.9%	17.9%

500 kW Commercial Parking Lot

	5%	6%	7%	8%
$ 6.00	12.0%	13.1%	14.2%	15.3%
$ 7.00	13.1%	14.2%	15.3%	16.5%
$ 8.00	14.3%	15.5%	16.6%	17.8%
$ 9.00	15.2%	16.4%	17.6%	18.8%
$10.00	16.0%	17.3%	18.5%	19.7%

500 kW Public Agency

	1%	3%	5%	7%
$ 3.00	5.9%	7.4%	9.0%	10.7%
$ 4.00	8.0%	9.6%	11.3%	13.2%
$ 5.00	9.5%	11.3%	13.2%	15.1%
$ 6.00	10.8%	12.7%	14.7%	16.7%
$ 7.00	12.0%	13.9%	16.0%	18.1%

1,500 kW Commercial Warehouse

	5%	6%	7%	8%
$ 3.00	7.0%	7.8%	8.6%	9.5%
$ 4.00	9.0%	10.0%	10.9%	11.9%
$ 5.00	10.6%	11.7%	12.7%	13.8%
$ 6.00	12.0%	13.1%	14.2%	15.3%
$ 7.00	13.2%	14.3%	15.5%	16.7%

SCE Crest Program, Required Multiple of MPR to Meet a Program Target Return

5 kW Residential Home

	1%	3%	5%	7%
$ 5.00	2.0x	2.2x	2.5x	2.8x
$ 6.00	2.3x	2.6x	2.9x	3.2x
$ 7.00	2.6x	2.9x	3.3x	3.7x
$ 8.00	2.8x	3.2x	3.6x	4.1x
$ 9.00	3.1x	3.5x	4.0x	4.5x

500 kW Commercial Parking Lot

	5%	6%	7%	8%
$ 6.00	2.6x	2.9x	3.1x	3.3x
$ 7.00	3.0x	3.3x	3.5x	3.8x
$ 8.00	3.4x	3.6x	3.9x	4.3x
$ 9.00	3.7x	4.0x	4.4x	4.7x
$10.00	4.1x	4.4x	4.8x	5.2x

500 kW Public Agency

	1%	3%	5%	7%
$ 3.00	1.6x	1.8x	2.0x	2.2x
$ 4.00	2.0x	2.2x	2.5x	2.8x
$ 5.00	2.3x	2.7x	3.1x	3.4x
$ 6.00	2.8x	3.1x	3.5x	4.0x
$ 7.00	3.1x	3.6x	4.1x	4.6x

1,500 kW Commercial Warehouse

	5%	6%	7%	8%
$ 3.00	1.6x	1.7x	1.8x	1.9x
$ 4.00	2.0x	2.1x	2.3x	2.4x
$ 5.00	2.3x	2.5x	2.7x	2.9x
$ 6.00	2.7x	2.9x	3.1x	3.3x
$ 7.00	3.0x	3.3x	3.5x	3.8x

Appendix 7: Solar Advisor Model Results

The Solar Advisor Model (SAM) is a publically available solar project model developed and maintained by the National Renewable Energy Laboratory.[8] We validated the results of our model with those of the SAM. To compare the Floating Fit Option, we used an expected tariff of $0.105. We input this value into the SAM as a 20 year utility PBI with 3% escalation. The SAM model does not use MIRR or annual return as a standard output. We exported the cash flows into excel and calculated MIRR from "after tax cash flow" using the WACC as both the finance and reinvestment rates. The SAM results are comparable to our model results.

LADWP Floating FiT Option, Solar Advisor Model Results

Economic Evaluation Criteria	Residential	Public	Commercial	
	Home	Gov Bldg	Parking Lot	Warehouse
	5 kW	500 kW	500 kW	1,500 kW
Installed Costs per Watt (DC)	$ 8.00	$ 6.00	$ 9.00	$ 6.00
Total System Cost	$ 40,000	$ 3,000,000	$ 4,500,000	$ 9,000,000
Program Target Rate of Return	5.0%	5.0%	8.0%	8.0%
Net Present Value ($)	-$27,553	-$2,582,256	-$1,995,215	-$3,694,894
Program Return	-0.1%	-2.9%	5.3%	5.6%
Program Return meets Program Target	No	No	No	No
Payback (yrs)	No Payback	No Payback	No Payback	No Payback

[8] National Renewable Energy Laboratory, "Solar Advisor Model (SAM)," Accessed on November 30, 2009, Available at <https://www.nrel.gov/analysis/sam/>.

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