**Notes regarding submitting comments on this Draft Work Product:**

**Comments are Due November 30th, 2017.**

**Comments shall be no longer than 5 pages.**

**Comments should be submitted to LDBPcomments@ebce.org**

Clean Coalition
Making Clean Local Energy Accessible Now

# East Bay Community Energy
## *Feed-in Tariff Design Recommendations*

Prepared for
East Bay Community Energy

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## About the Clean Coalition

The Clean Coalition is a nonprofit organization whose mission is to accelerate the transition to renewable energy and a modern grid through technical, policy, and project development expertise.

The Clean Coalition drives policy innovation to remove barriers to procurement and interconnection of distributed energy resources (DER) — such as local renewables, advanced inverters, demand response, and energy storage — and we establish market mechanisms that realize the full potential of integrating these solutions. The Clean Coalition also collaborates with utilities and municipalities to create near-term deployment opportunities that prove the technical and financial viability of local renewables and other DER.

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# List of acronyms

Below is a list of acronyms used in this document:

BOS = balance of system
CAISO = California Independent System Operator
CCA = Community Choice Aggregation
COD = commercial online date
CPUC = California Public Utilities Commission
DSCR = Debt Service Coverage Ratio
FIT = feed-in tariff
GHI = global horizontal irradiance
GWh = gigawatt-hours
ITC = investment tax credit
kW = kilowatt
kWh = kilowatt-hour
LADWP = Los Angeles Department of Water and Power
$m^2$ = meters squared
MRP = market responsive pricing
MW = megawatt
MWh = megawatt-hour
NEM = net energy metering
O&M = operations and maintenance
PG&E = Pacific Gas & Electric
PPA = power purchase agreement
PV = photovoltaic
RPS = Renewables Portfolio Standard
W = watt
$X_{AC}$ = capacity (in alternating current)[1]
$X_{DC}$ = capacity (in direct current)

[1] All capacity references in this document are in alternating current (AC) unless noted otherwise.

## Executive Summary

The document details the Clean Coalition's recommendation for the design of East Bay Community Energy's Feed-in Tariff (FIT) program. Our recommendations are based upon relevant market analysis, solar insolation for Alameda County, and best practices associated with existing FIT programs nationwide.

This guide is divided into six sections. The first section, titled *Project eligibility*, details the criteria for projects to participate in the East Bay Community Energy FIT. We recommend that any new Renewable Portfolio Standard (RPS)-compliant generating facility, sited within East Bay Community Energy territory, and sized up to 3 megawatts (MW) be eligible to participate in the program.

Section two, titled *Program size and timing*, offers recommendations on how to best initiate and then expand the FIT program. Capacity for the FIT program will be limited by available budget, which is tied to the expansion of East Bay Community Energy's customer base and revenues. In summary, we believe East Bay Community Energy should open a 5 $MW_{AC}$[2] program in Spring 2018, with a plan to open an additional 5 MW of new program capacity quarterly until reaching 50 MW of allocated capacity by yearend 2021. A 50 MW FIT program would supply roughly 1.29% of East Bay Community Energy's total annual energy sales from local renewable energy sources.

Section three, titled *Pricing*, provides insights and recommendations for initial FIT program pricing and overall pricing design. We recommend an initiating the FIT with a 20-year fixed price contract and suggest an initial price of 9¢ per kilowatt-hour (kWh). We also recommend four pricing adders: 1) a built environment adder to guide FIT projects to be sited on rooftops, parking lots, parking structures, and other built environments; 2) a small project adder to support a greater diversity of FIT projects; 3) a community benefit adder to guide siting of FIT projects in disadvantaged communities and on tax-exempt built environments; and 4) a dispatchability adder to support the development of storage projects paired with FIT projects. These pricing recommendations are based upon recent solar pricing data, solar insolation for Alameda County, relevant FIT program pricing design, and relevant site lease costs data.

We also recommend the use of market responsive pricing, which is a best practice in FIT program design. Pricing is critical to successful procurement under the FIT. The optimum fixed price contract offer is defined as the price that will attract the desired amount of new local renewable energy capacity within the defined timeframe and at the lowest cost to customers. Prices set too high will ensure rapid development of local renewable energy capacity but will result in *less clean energy produced* for a given budget or cause unnecessary upward impact on electricity rates. Prices set too low will not attract the market to develop desired amount of local renewable energy capacity. Through market responsive pricing design, the price paid under the FIT will adjust based on market response to ensure East Bay Community Energy is paying the optimal price for local renewable energy.

[2] All capacity references in this document are in alternating current (AC) unless noted otherwise.

Section four, titled *Program budget*, details the financial requirements to establish and maintain the FIT program. The budget required will depend on the amount of capacity procured, as well as the price paid for power. Ultimately, the ability to finance expansion of the FIT will depend on the CCA's revenues.

Section five, titled *Policies and procedures*, details how East Bay Community Energy can manage its FIT program to be efficient and effective. Our recommendations, which are based upon lessons learned from the design of FIT programs nationwide, address how to structure the application process, how to guide projects into and through the program queue, and how to develop effective contracts for wholesale procurement.

Section six, titled *Anticipated challenges*, details potential hurdles East Bay Community Energy may face when implementing a FIT program.

# I. Project Eligibility

This section contains recommendations for determining project eligibility for participation in East Bay Community Energy's FIT program.

**New resource**

The generating resource should be new, meaning that is has not produced or delivered electric energy prior to the date in which East Bay Community Energy receives its application.

**Location**

The project should be located entirely within the service territory of East Bay Community Energy, which is comprised of Alameda County.

**Technologies**

All technologies that are compliant with California's RPS requirements should be eligible to participate in the FIT. Eligible fuel sources may include, but are not limited to, the following:

- Solar photovoltaic (PV)
- Solar thermal
- Wind
- Digester gas
- Landfill gas
- Geothermal

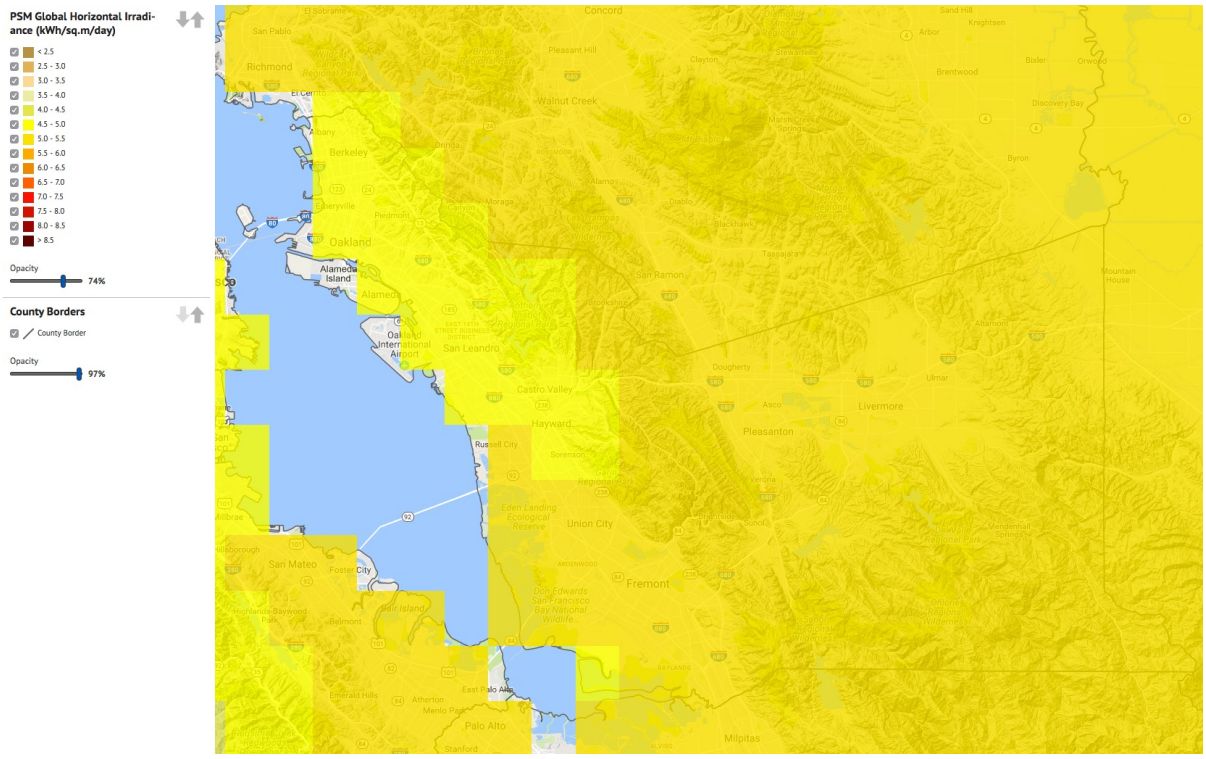
The development of local renewable energy projects will be determined by physical limitations and resource opportunities in the FIT region, as well as the pricing requirements of the program.

**Renewable resource quality in Alameda County**

The Clean Coalition analyzed the potential for renewable electricity generation in Alameda County. We found the most widely applicable local renewable electricity generation potential for the area is solar PV. Alameda County has ample solar siting opportunities, as more than 600 MW of technical potential within urban areas was identified in the Clean Coalition's Solar Siting Survey of viable sites for large solar installations on warehouses, commercial buildings, parking lots and other potential dual-use spaces, across the entire county. This is in addition to hundreds of acres of viable large, open field opportunities in eastern Alameda County.

Alameda County boasts a strong solar resource, with a 10% differential between western and eastern county. Figure 1, below, shows the solar resource quality — based on global horizontal irradiance (GHI) — across the entire county.

***Figure 1: Alameda County solar resource quality***




There is a daily insolation of 4.5-5.0 kWh/m$^2$/day for the western edge of Alameda County, where Berkeley, Oakland, San Leandro and Hayward are located. The rest of the county has a slightly higher solar resource quality of 5.0-5.5 kWh/m$^2$/day. This data comes from the National Renewable Energy Laboratory's National Solar Radiation Database.[3]

Solar energy production depends on two primary factors. The first is the solar resource quality, and the second is whether the solar PV system is fixed or if it follows the sun's arc using a tracking system. As shown in Figure 2 below, solar PV systems located in eastern Alameda County (i.e. Livermore) will produce slightly more energy than similar systems in western Alameda County (i.e. Oakland Airport). Solar installations that utilize a ground-mounted, single-axis tracking system will see even greater annual energy production.

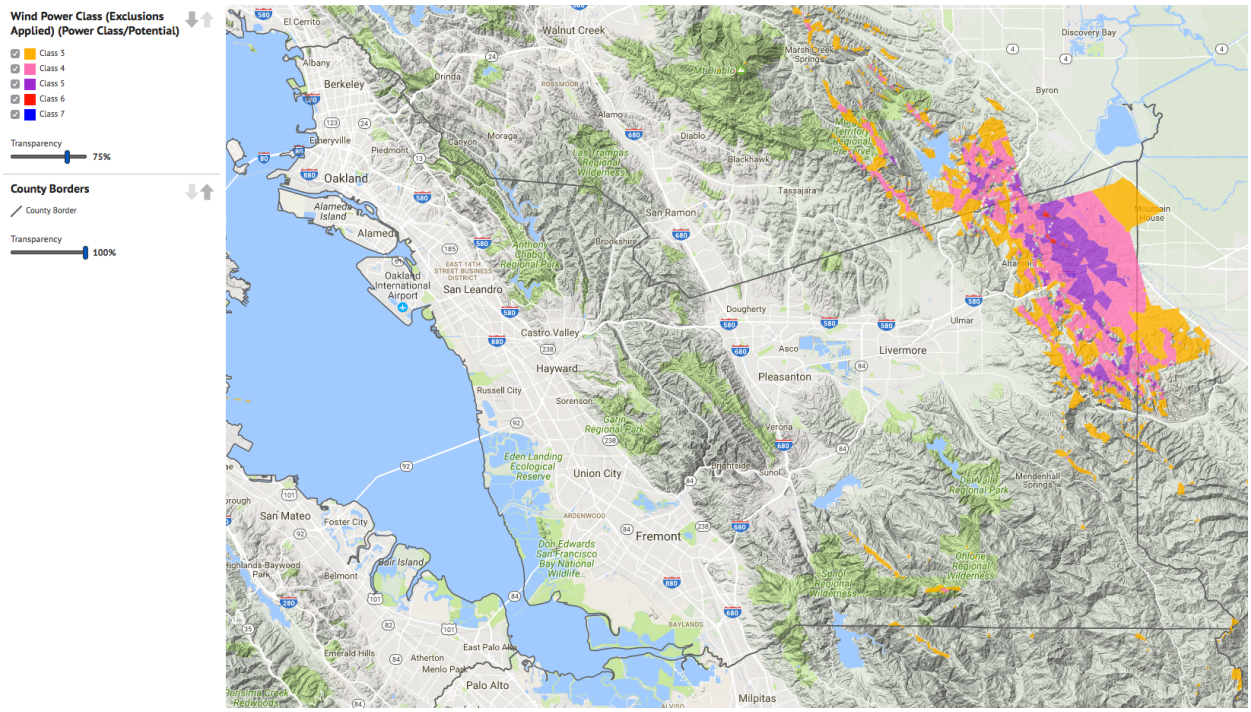
***Figure 2: Solar energy production by locale and system type***

| Location | Solar resource quality (kWh/m$^2$/day) | System type | Annual energy production (kWh/kW/year) |
|---|---|---|---|
| Oakland Airport | 4.63 | Fixed rooftop installation | 1521 |
| Livermore | 5.00 | Fixed rooftop installation | 1605 |
| Livermore | 5.00 | Single-axis tracking installation | 2024 |

[3] "National Solar Radiation Database," National Renewable Energy Laboratory, available at http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/, last visited May 18, 2017.

There is also significant wind potential in eastern Alameda County around Altamont Pass, as shown in Figure 3 below. Wind, by nature, is a less evenly distributed resource than solar. Most wind projects are large-scale installations comprised of many turbines connected directly to the transmission system, and the average size of wind turbines installed in the U.S. is 2 MW.[4] Because FITs are geared towards supporting individual installations sized to be sited near loads and connect directly to the distribution grid, Alameda County's wind resource may be most applicable for procurement through a large, non-size constrained, competitive solicitation.

***Figure 3: Alameda County wind resource quality[5]***




Based on our assessment of local renewable energy resource potential, solar PV and wind hold the greatest promise for renewable energy generation in Alameda County. However, it is unnecessary to prohibit other renewable technologies that are able to produce clean local energy at the established program price. Therefore, we recommend a FIT program that is open to all RPS-compliant technologies and allows the market to deliver local renewable electricity generation at the offered price. East Bay Community Energy may wish to limit eligibility of local sources to zero emission or net emission reduction facilities however.

[4] "Utility-Scale Wind," U.S. Department of Energy, available at http://apps2.eere.energy.gov/wind/windexchange/utility-scale-wind.asp, last visited May 30, 2017.
[5] "Wind Prospector," National Renewable Energy Laboratory, available at https://maps.nrel.gov/wind-prospector, last visited May 30, 2017.

### Project sizing

The maximum allowable project size for East Bay Community Energy's FIT should be 3 MW. This is slightly larger than nearby Community Choice Aggregation (CCA) FIT programs, including Marin Clean Energy and Sonoma Clean Power, whose FIT programs have a maximum project size of 1 MW. However, Alameda County offers plenty of large project siting opportunities, and a larger project cap of 3 MW will enable East Bay Community Energy to secure lower pricing for local renewable energy through increased economies of scale.

It is worth noting that current California Independent System Operator (CAISO) metering and scheduling requirements impact the cost effectiveness of larger projects once they reach the 1 MW threshold.[6] Therefore, a 3 MW project cap provides enough room for larger projects to handle these additional requirements.

While a smaller maximum project size would ensure a greater number of projects come online through the FIT given a fixed program capacity, it would also require higher pricing to make projects economically viable. If East Bay Community Energy wants to ensure a greater number or diversity of FIT projects, then the CCA should offer a small project adder, as Sonoma Clean Power does in its ProFIT program. More details about adders and required pricing based on project size are discussed in detail in *Section III. Pricing*.

## II. Program size and timing

This section contains recommendations for the initial size of the East Bay Community Energy FIT program, as well as an expansion plan that aligns with the projected growth of the CCA and makes strong use of the federal investment tax credit (ITC).

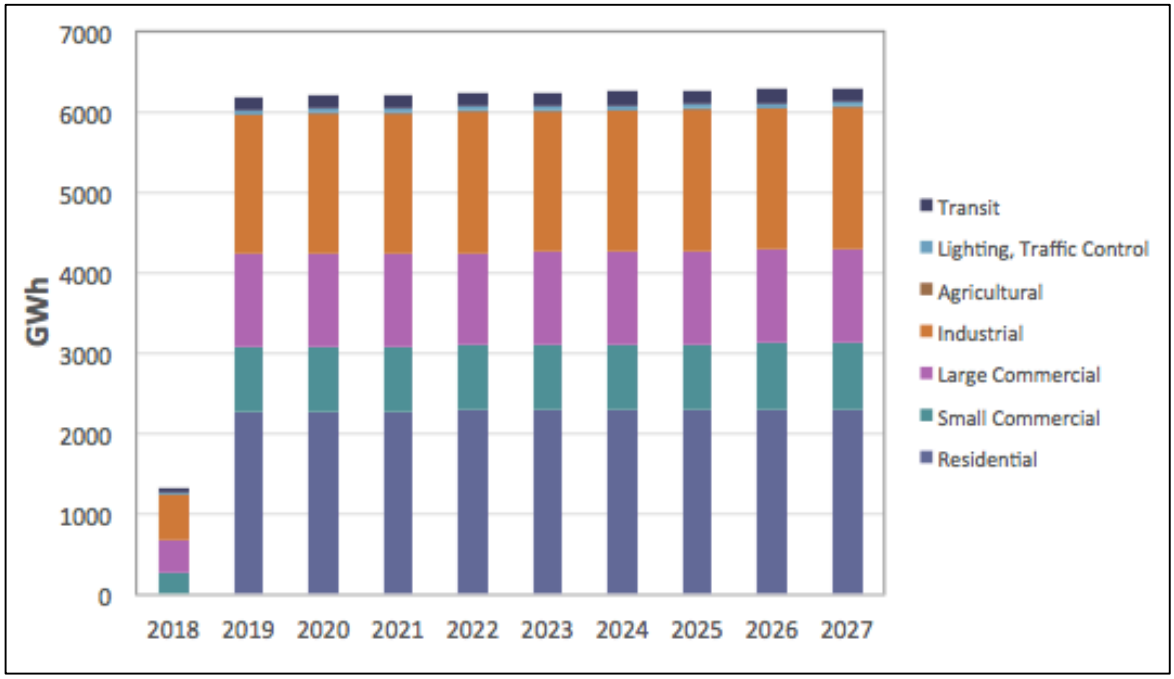
### Initial program size

The Clean Coalition recommends that East Bay Community Energy launch a FIT program of 5 MW, which will meet roughly 0.13% of the CCA's total annual load through this first capacity allocation.

It is projected that East Bay Community Energy will serve an annual load of 6,200 GWh from 2019 through at least 2027. This load data comes from EES Consulting and R2S Energy's presentation to the East Bay Community Energy board on July 19, 2017, which is shown below in Figure 4.

[6] Pacific Gas & Electric, Rule 21 Tariff, Advice Letter # 4565-E, Filed January 20, 2015, Decision No. 14-12-035, pg. 183, available at http://www.pge.com/tariffs/tm2/pdf/ELEC_RULES_21.pdf, last visited April 17, 2016.

***Figure 4: Annual load forecast for East Bay Community Energy***




An annual load of 6,200 GWh translates to 6,200,000 MWh. 0.129% of this annual load is roughly 8,000 MWh, which translates to 8,000,000 kWh per year. Using a fixed-tilt solar PV system in eastern Alameda County as the standard FIT project, each kW of FIT capacity will produce roughly 1,600 kWh/kW/year. This means that a FIT program with a capacity of 5 MW will serve 0.129% of East Bay Community Energy's annual load, as illustrated in Figure 5 below.

***Figure 5: Initial East Bay Community Energy FIT program sizing***

| Initial FIT capacity | Annual energy production from each kW of FIT capacity | Annual energy deliveries through FIT | Annual CCA energy sales | Percent of total CCA retail sales |
|---|---|---|---|---|
| 5 MW | 1,600 kWh | 8,000,000 kWh | 6,200,000 MWh | 0.129% |

## Program expansion and timing

The Clean Coalition recommends that East Bay Community Energy plan to increase its total FIT program procurement to 50 MW, equal to 1.29% of its total annual load, by the CCA's third year of operation, as shown in Figure 6 below.

***Figure 6: A 50 MW FIT program for East Bay Community Energy***

| FIT capacity | Annual energy production from each kW of FIT capacity | Annual energy deliveries through FIT | Annual CCA energy sales | Percent of total CCA retail sales |
|---|---|---|---|---|
| 50 MW | 1,600 kW | 80,000,000 kWh | 6,200,000 MWh | 1.29% |

We recommend that East Bay Community Energy allocate 20 MW of program capacity each year, released in quarterly increments of 5 MW. Figure 7, below, offers a program expansion plan that scales the FIT to 50 MW of online capacity by yearend 2021, which will provide 1.29% of the CCA's total annual load by its third year of operation. It is worth noting that through offering capacity in predictable, quarterly allocations, East Bay Community Energy will drive a sustainable and increasingly efficient renewable energy market in Alameda, as well as learning from market response to reduce FIT pricing over time. Market responsive pricing design is discussed in detail in *Section III. Pricing*.

***Figure 7: East Bay Community Energy FIT program expansion and timing***

| Allocation date | Capacity allocation | Total FIT program size | Estimated commercial online date (COD)[7] | Approximate annual energy deliveries through FIT[8] | FIT as a percent of total CCA estimated retail sales[9] |
|---|---|---|---|---|---|
| Spring 2018 | 5 MW | 5 MW | Fall 2019 | 8,000,000 kWh | 0.129% |
| Summer 2018 | 5 MW | 10 MW | Winter 2019 | 16,000,000 kWh | 0.26% |
| Fall 2018 | 5 MW | 15 MW | Spring 2020 | 24,000,000 kWh | 0.39% |
| Winter 2018 | 5 MW | 20 MW | Summer 2020 | 32,000,000 kWh | 0.52% |
| Spring 2019 | 5 MW | 25 MW | Fall 2020 | 40,000,000 kWh | 0.64% |
| Summer 2019 | 5 MW | 30 MW | Winter 2020 | 48,000,000 kWh | 0.77% |
| Fall 2019 | 5 MW | 35 MW | Spring 2021 | 56,000,000 kWh | 0.90% |
| Winter 2019 | 5 MW | 40 MW | Summer 2021 | 64,000,000 kWh | 1.03% |
| Spring 2020 | 5 MW | 45 MW | Fall 2021 | 72,000,000 kWh | 1.12% |
| Summer 2020 | 5 MW | 50 MW | Winter 2021 | 80,000,000 kWh | 1.29% |

## Timing of contracted capacity

Importantly, there will be a time lag between when East Bay Community Energy offers FIT program capacity and when projects come online and begin delivering energy to the CCA. We would expect, and recommend requiring, a commercial online date (COD) 12-18 months after the Power Purchase Agreement (PPA) is signed with East Bay Community Energy. For reference, the Los Angeles Department of Water and Power (LADWP) now requires 12 months to COD, with a possible six-month extension, in its FIT program. However, it can take a project 6 months or longer to complete the application review process and have a signed PPA after the application is submitted. And applications will not start to come in until after the capacity is released to the market. Therefore, we assume a

[7] Assuming a total lag time of 18 months from capacity release to FIT projects delivering energy to the CCA — 6 months for the application process and PPA execution, and then 12 months to bring the project online.
[8] This energy will be delivered to the CCA based on the commercial online date of FIT projects — not the capacity allocation date.
[9] Using the commercial online date of FIT projects — not the capacity allocation date.

total lag time of 18 months — 6 months for the application process and PPA execution, and then 12 months to bring the project online.

**Capacity management**

If any capacity remains unclaimed within 30 days of the next upcoming allocation, then that excess capacity should be rolled into the next allocation. For example, if a 5 MW allocation in Spring 2018 receives only 3 MW worth of applications, then the Summer 2018 capacity allocation should total 7 MW — the originally planned 5 MW plus the 2 MW of unclaimed capacity from Spring 2018. This will ensure that the program remains on track to deliver the desired capacity in line with the program timeline. Ultimately, budgetary constraints may cap the release of new FIT program capacity. If a higher price must be paid to procure local renewable energy, then the amount of capacity procured may decrease. As East Bay Community Energy makes this financial determination, it is key to remember to that it will begin paying for power not when FIT capacity is released, but when the projects actually come online — around 18 months later.

Lastly, through a transparent and continual offering of new program capacity, as shown above in Figure 7, the CCA can effectively utilize market responsive pricing in its FIT. A market response pricing approach will ensure that East Bay Community Energy is offering to pay neither more nor less than is necessary to procure local renewable energy. More details on market responsive pricing are provided in the following section on pricing.

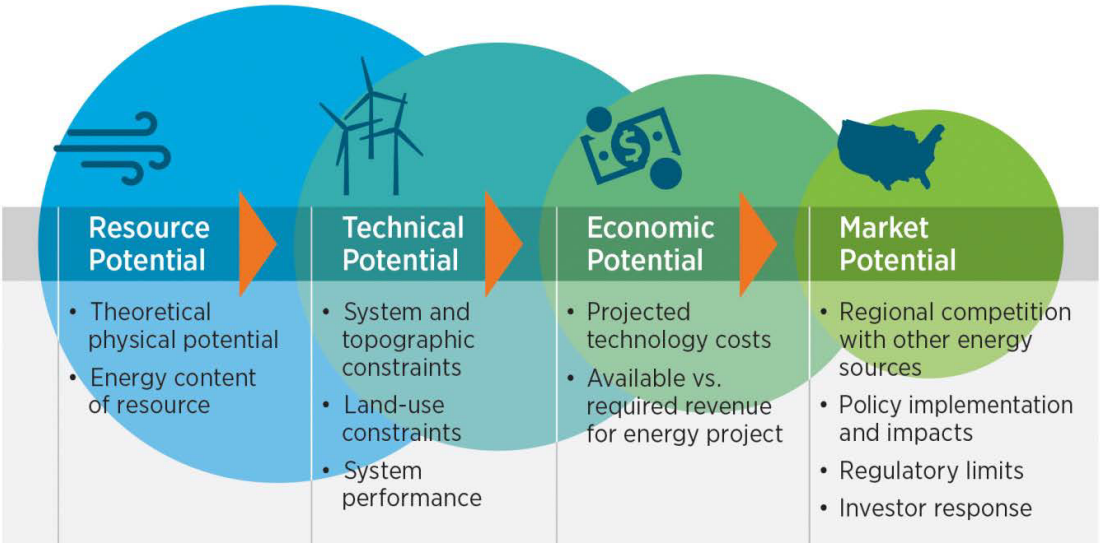
# III. Pricing

Given that solar PV is expected to be the primary technology responding to the FIT, this pricing analysis evaluates the market pricing required to spur development of wholesale local solar PV installations in East Bay Community Energy's territory.

Pricing is critical to successful procurement under the FIT. The optimal fixed price is defined as the price that will attract the desired amount of new local renewable energy capacity within the defined timeframe and at the lowest cost to customers. Prices set too high will ensure rapid development of local renewable energy capacity but will result in *less clean energy produced* for a given budget or cause unnecessary upward impact on electricity rates. Prices set too low will not attract the market to develop the desired amount of local renewable energy capacity. It is worth noting that a FIT contract price high enough to trigger a strong market response can drive down renewable energy prices more rapidly over time. This is because as more system installers participate in the local market, increased experience, competition, and economies of scale will support lower FIT prices after the program's initial targets have been reached. However, price declines will be offset to the degree that prime solar siting opportunities are limited in the FIT area, as the best sites will likely be developed early on.

In developing pricing recommendations, the energy resource potential for Alameda County is first modeled against standard system performance to establish the technical potential of installations in the county. Full development and operational costs are then modeled for

system owners — based on survey data and cost trends to determine the revenue required for the modeled project to be financially viable. Market potential is estimated based on observed market penetration distribution in regional markets in comparison to Alameda County cost factors and relative siting potential, as illustrated in the following diagram.




**Initial 20-year fixed pricing**

Based on our analysis, the Clean Coalition recommends that East Bay Community Energy utilize a fixed, non-escalating FIT PPA price initially set at 9¢/kWh for a term of 20 years — recognizing that this will primarily be viable pricing to support larger, ground-mounted projects. Pricing in this range may also support development of solar installations on buildings where property owners are the owner of the FIT system, which would eliminate the site lease cost component.

As Figure 8 below illustrates, the Clean Coalition expects that a price of 9¢/kWh is a conservative starting point to incent market development of larger solar PV projects around 3 MW in the eastern half of East Bay Community Energy's service territory. Smaller projects will require a higher price as these are assumed to be fixed installations in built environments, producing roughly 20% less energy per watt of capacity. Solar PV projects sized around 500 kW will require a PPA rate around 13.5-14.2¢/kWh, while projects around 100 kW will require an even higher PPA rate between 14.8-15.6¢/kWh.

Projects sited in eastern Alameda County are likely to be more cost-effective, as there is a slightly higher solar resource, larger PV siting opportunities, and a lower cost of land compared to western Alameda County.

***Figure 8: Required FIT pricing by solar PV project size in Alameda County[10]***

| Type of system | Size of solar PV system ($W_{AC}$) | Installed cost ($/$W_{DC}$) | 20-year fixed PPA price (¢/kWh) Oakland | 20-year fixed PPA price (¢/kWh) Livermore |
|---|---|---|---|---|
| Built environment | 100 kW roof | $2.30 | 15.6¢ | 14.8¢ |
| Built environment | 350 kW roof | $2.12 | 14.5¢ | 13.8¢ |
| Built environment | 500 kW roof | $2.06 | 14.2¢ | 13.5¢ |
| Built environment | 1 MW roof | $1.90 | 13.5¢ | 12.8¢ |
| Ground-mount | 1 MW tracking | $1.86 | n/a[11] | 10.0¢ |
| Ground-mount | 3 MW tracking | $1.78 | n/a | 9.74¢ |

Pricing at 9¢/kWh is slightly lower than the projected PPA rates shown in Figure 8 above. However, this conservative initial FIT pricing is designed to protect East Bay Community Energy from overpaying for its first 5 MW tranche. Given than the CCA won't begin purchasing energy from this first tranche until mid-2019, starting the FIT PPA price at 9¢/kWh accounts for continued reductions in renewable energy costs over the next 2 years, as well the recent passage of Assembly Bill 398, which includes a sales tax exemption for electricity generating facilities (defined as the generation or production, or storage and distribution, of electric power from sources other than a conventional or nuclear power source). The sales tax exemption is anticipated to reduce PPA market rates by roughly 3%. East Bay Community Energy will only set the initial price, and the future PPA price offered through the FIT will be guided by market response, which is discussed in more detail below.

Taking the 3 MW ground-mount project as the standard for East Bay Community Energy's FIT, since developers will likely make use of these cost-effective project sites first, Figure 9 illustrates how costs are expected to change with respect to the year of installation and the role of site lease rates in determining a financially viable FIT price.

[10] The assumptions for this pricing are:
- Pricing is based on site lease cost at 20% of revenue ($43,000/MW/year).
- Observed site lease rates for rooftops have been higher than this 20% revenue-share, adding about 1¢/kWh to the PPA rate. However, the modeled PPA rate is achievable with the CCA's education and outreach to commercial building owners, in conjunction with pro forma Model Lease Agreements.
- Prevailing union wage adds between $0.25-0.5¢ to these figures.

[11] There is unlikely to be land available in Oakland to support ground-mounted solar PV projects 1 MW and larger.

***Figure 9: 3 MW tracking PV system costs & solar prices for a FIT in Livermore***

| Solar PV system details | | | Necessary 20-year PPA pricing (¢/kWh) | | | |
|---|---|---|---|---|---|---|
| Commercial online date (year) | Applicable investment tax credit (ITC) rate | Installed PV system cost at 8% decline annually ($/$W_{DC}$) | With no site lease costs | With site lease cost at 10% of FIT project revenue (~$20/kW/yr)[12] | With site lease cost at 20% of FIT project revenue (~$40/kW/yr)[13] | With site lease costs at $50/kW |
| 2018 | 30% | $1.78 | 7.9¢ | 8.8¢ | 9.7¢ | 10.3¢ |
| 2019 | 30% | $1.64 | 7.4¢ | 8.3¢ | 9.2¢ | 9.8¢ |
| 2020 | 26% | $1.51 | 7.2¢ | 8.15¢ | 9.1¢ | 9.6¢ |
| 2021 | 22% | $1.39 | 7.1¢ | 8.0¢ | 8.9¢ | 9.5¢ |
| 2022 | 10% | $1.28 | 7.4¢ | 8.3¢ | 9.2¢ | 9.8¢ |

Some site owners may elect to own the FIT system, thereby eliminating site lease costs altogether. For the vast majority of projects, however, third-party ownership of the FIT system is expected and a site lease will be required. The Clean Coalition recommends that East Bay Community Energy promote a de facto standard site lease financial arrangement that is solely based on revenue-share between the third-party FIT owner and the site owner with 10% to 20% of the revenue being provided to the site owner. Generally, the revenue-share will be on the lower side for ground-based leases and on the higher side for rooftop leases. The provisioning of standardized, pro forma site lease terms, based on a 10-20% FIT project revenue-share, will save time and cost in the project development process, and the Clean Coalition believes this approach will be well-received by the market. If East Bay Community Energy were able to facilitate standard site lease arrangements at 10% revenue-share, then it would be able to secure local renewable energy at lower cost, as shown in Figure 9.

Also shown in Figure 9 is the impact of the federal ITC, which provides a significant incentive for the installation of renewable energy. The ITC begins to decline starting in year 2020 and declines markedly in 2022. More details on the ITC are discussed further below.

Like Figure 9, Figure 10 illustrates how costs for a 1 MW rooftop solar system in Oakland are expected to change with respect to the year of installation and the role of site lease rates in determining a financially viable FIT price.

[12] Site lease cost based on 10% of PPA gross revenue represents $20/kW/year averaged over the 20-year contract term.
[13] Site lease cost based on 20% of PPA gross revenue represents $40/kW/year averaged over the 20-year contract term.

***Figure 10: 1 MW roof mount PV system costs & solar prices for a FIT in Oakland[14]***

| Solar PV system details | | | Necessary 20-year PPA pricing (¢/kWh) | | | |
|---|---|---|---|---|---|---|
| Commercial online date (year) | Applicable investment tax credit (ITC) rate | Installed PV system cost at 8% decline annually ($/$W_{DC}$) | With no site lease costs | With site lease cost at 10% of FIT project revenue (~$20/kW/yr) | With site lease cost at 20% of FIT project revenue (~$40/kW/yr) | With site lease costs at $50/kW/yr |
| 2018 | 30% | $1.90 | 10.7¢ | 12.1¢ | 13.5¢ | 14.2¢ |
| 2019 | 30% | $1.75 | 10.0¢ | 11.4¢ | 12.8¢ | 13.5¢ |
| 2020 | 26% | $1.61 | 9.8¢ | 11.2¢ | 12.6¢ | 13.3¢ |
| 2021 | 22% | $1.48 | 9.5¢ | 10.9¢ | 12.3¢ | 13.0¢ |
| 2022 | 10% | $1.36 | 9.9¢ | 11.3¢ | 12.7¢ | 13.5¢ |

Because of a smaller system size and a slightly less strong solar resource quality in Oakland, as compared to the 3 MW PV project sited in Livermore shown in Figure 9, the required pricing is higher in Figure 10.

We based solar PV systems details for both Figure 9 and 10 on historical[15] and projected installed cost trends[16] and component prices,[17] reflecting average costs for similar PV installations in California. This base cost is adjusted to reflect pricing trends for subsequent years, calibrated to comparable metropolitan rooftop PV developments and site lease rates, and adjusted for differences in solar irradiance and sales tax in Alameda County.

Projected installed cost and component price trends have exhibited annual reductions of approximately 12% in recent years, but there is strong indication of slower cost decreases through the remainder of the decade. Therefore, the lower value of 8% annual cost decline is reflected in the modeled cost and PPA pricing projection results.

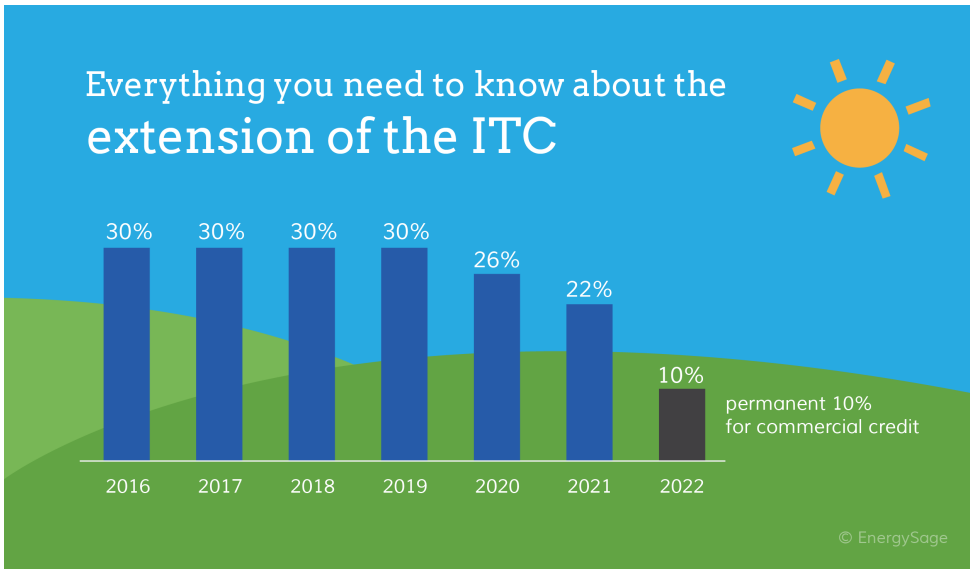
As the PV market further matures, price declines will continue to flatten — resulting in lower decreases in installed costs. This will be further compounded by the fact the ITC will also decrease in the coming years, as shown below.

[14] Required PPA rates are 6% lower if Eastern Alameda County solar resource values are used. 2018 base year installed costs of $1.90/$W_{DC}$ ($2.09/$W_{AC}$) for 1 MW rooftop, with applicable federal tax incentives and accelerated depreciation. With respect to site lease rates, we assume no cost if solar PV owned by property owner. For third party PV ownership, 20% of PPA revenue equals $40/kW/year. The average annual reported lease costs in urban regions of California are $30/kW for parking lots, and $50/kW for commercial rooftop. Individual costs will vary subject to normal distribution curves. All prices are shown in 2017 constant dollars.

[15] Tracking the Sun Report VII: An Historical Summary of the Installed Price of Photovoltaic in the United States from 1998 to 2013 (September 2014).

[16] Deconstructing Solar Photovoltaic Pricing: The Role of Market Structure, Technology, and Policy. (December 2014).

[17] "U.S. Solar Market Insight, Q3 2014," GTM Research and the Solar Energy Industries Association www.greentechmedia.com/research/ussmi, last visited April 19, 2016.




*Source:* Energy Sage, April 2016

Therefore, we do not expect cost reductions in the installed cost of solar PV systems to outpace the planned step-down of the ITC. Given this, there is benefit for East Bay Community Energy to bring as much capacity online, as possible given budgetary constraints, before the ITC benefit erodes significantly at yearend 2021. Our recommended FIT program timing will bring all 50 MW of local renewable generation online by yearend 2021 — ensuring East Bay Community Energy strongly leverages the financial benefits of the ITC.

**Pricing adders**

As stated above, the Clean Coalition recommends an initiating the FIT with a fixed, non-escalating PPA price set at 9¢/kWh for a term of 20 years. We also recommend that East Bay Community Energy offer four pricing adders on top of its FIT rate. The concept of pricing adders is simple. The CCA identifies what characteristics it would like to see in its FIT projects and then creates adders to its FIT price to incentivize these project characteristics. The Clean Coalition recommends East Bay Community Energy implement four pricing adders: a built environment adder, a small project adder, a community benefit adder, and a dispatchability adder.

*i. Built environment adder*

Developing local renewable energy projects within the built environment helps preserve pristine spaces and minimizes the environmental impacts of these projects. To drive the siting of FIT projects to within the built environment — which includes rooftops, parking lots, brownfields, and landfills — East Bay Community Energy should offer a 20% built environment adder for projects sited in these locations. The 20% built environment adder will be calculated based on the baseline 20-year FIT pricing. For example, if East Bay Community Energy is offering 9¢/kWh, then a 1 MW FIT project sited on a large, commercial rooftop would receive 10.8¢/kWh for the full 20-year contract, as illustrated below in Figure 11.

***Figure 11: Example pricing for a 1 $MW_{AC}$ rooftop solar project***

| FIT pricing | Built environment adder (20%) | Final pricing for the FIT project |
|---|---|---|
| 9¢/kWh | 1.8¢/kWh | 10.8¢/kWh |

*ii. Small project adder*

To encourage a greater number and diversity of projects to come online through the FIT, the Clean Coalition recommends that East Bay Community Energy offer a small project adder.

Any FIT project sized under 350 $kW_{AC}$ should receive a 10% adder on the baseline FIT pricing. Any FIT project sized under 100 $kW_{AC}$ should receive a 20% adder on the baseline FIT pricing. This is the Clean Coalition's estimate for what pricing adder would stimulate some development of smaller projects within the FIT program. East Bay Community Energy should regularly assess the effectiveness of the small project adder and adjust the adder percentage as necessary, either up or down, depending on the market's ability to develop smaller projects through the FIT program. Figure 12, below, illustrates the Clean Coalition's recommended initial small project adder.

***Figure 12: Small project adder***

| FIT project size | Small project adder (% based off current FIT price) |
|---|---|
| Less than or equal to 100 $kW_{AC}$ | 20% |
| Greater than 100 $kW_{AC}$ and less than or equal to 350 $kW_{AC}$ | 10% |
| Greater than 350 $kW_{AC}$ | 0% |

For example, a 350 $kW_{AC}$ FIT project sited on a large, commercial rooftop should receive the 20% built environment adder and a 10% small project adder, as illustrated in Figure 13 below.

***Figure 13: Example pricing for a 350 $kW_{AC}$ rooftop solar project***

| FIT pricing | Built environment adder (20%) | Small project adder for projects between 100 kW and 350 kW (10%) | Final pricing for the FIT project |
|---|---|---|---|
| 9¢/kWh | 1.8¢/kWh | 0.9¢/kWh | 11.7¢/kWh |

A 100 $kW_{AC}$ FIT project sited on a large, commercial rooftop should receive the 20% built environment adder and a 20% small project adder. This is illustrated in Figure 14 below, for baseline FIT pricing of 9¢/kWh.

***Figure 14: Example pricing for a 100 $kW_{AC}$ rooftop solar project***

| FIT pricing | Built environment adder (20%) | Small project adder for projects up to 100 kW (20%) | Final pricing for the FIT project |
|---|---|---|---|
| 9¢/kWh | 1.8¢/kWh | 1.8¢/kWh | 12.6¢/kWh |

*iii. Community benefit adder*

To encourage the siting of local renewable energy projects in disadvantaged communities and on tax-exempt facilities, such as municipal properties, non-profit facilities, public housing, and schools, the Clean Coalition recommends East Bay Community Energy offer a community benefit adder. The community benefit adder, of 5% on the baseline FIT pricing, will apply to any FIT project sited on a tax-exempt facility or located in a geographic area that is rated at 75% or above in the CalEPA's CalEnviroScreen 3.0 map, which is publicly available.[18]

For example, a 100 $kW_{AC}$ FIT project sited on a rooftop in an eligible CalEnviroScreen 3.0 community should receive the 20% built environment adder, a 20% small project adder, and a 5% community benefit adder. This is illustrated in Figure 15 below, for baseline FIT pricing of 9¢/kWh.

***Figure 15: Example pricing for a 100 $kW_{AC}$ rooftop solar project sited in a CalEnviroScreen 3.0 disadvantaged community***

| FIT pricing | Built environment adder (20%) | Small project adder for projects up to 100 kW (20%) | Community benefit adder (5%) | Final pricing for the FIT project |
|---|---|---|---|---|
| 9¢/kWh | 1.8¢/kWh | 1.8¢/kWh | 0.45¢/kWh | 13.05¢/kWh |

The community benefit adder should only apply to projects sized no larger than 1 MW and sited on built-environments.

*iv. Dispatchability adder*

To encourage the development of energy storage within Alameda County, the Clean Coalition recommends that East Bay Community Energy offer a dispatchability adder. This adder is a fixed ¢/kWh bonus, whereas the other adders (built environment, small project, and community benefit) are a percentage of the current baseline FIT PPA price.

Pairing local renewables with local energy storage can provide many benefits to the grid and associated value to the CCA. These benefits and values include:

[18] "CalEnviroScreen 3.0", California's Office of Environmental Health Hazard Assessment, available at https://oehha.maps.arcgis.com/apps/webappviewer/index.html?id=4560cfbce7c745c299b2d0cbb07044f5, last visited on August 25, 2017.

- Making renewable energy dispatchable to match grid requirements and potentially reaping energy arbitrage and capacity value.
- Reducing peak congestion on the transmission and distribution grids and potentially reaping associated congestion relief value.
- Matching the energy supply and demand for a given Load Serving Entity (LSE), including a CCA's forecasted versus real-time experience, and potentially reaping value from avoiding scheduling penalties, etc.

When an energy storage system is deployed in conjunction with an ITC-qualifying resource, the ITC can be applied to the cost of the entire system. This means that East Bay Community Energy can facilitate the ITC being leveraged and secure the benefits of energy storage at a lower cost than otherwise possible.

For an energy storage project to be eligible for the dispatchability adder, it must meet the following operational requirements:

- The energy storage power capacity must be rated at a minimum of 100 kW and a maximum of the nameplate capacity of the renewable energy project to which it is attached. For example, a 2 MW solar project can have a battery with a power capacity between 100 kW and 2 MW.
- The energy storage capacity must provide a minimum of 2 hours and a maximum of 4 hours of the nameplate power capacity. For example, a battery with a 1 MW power capacity can have the dispatchability adder apply to between 2 MWh and 4 MWh.
- The full amount of energy being paid the dispatchability adder must be available on a daily basis.
- The energy storage facility must follow the dispatch schedule provided by East Bay Community Energy, with as little as one hour advance scheduling; and the storage system eventually be able to allow direct dispatch control per future East Bay Community Energy specifications.

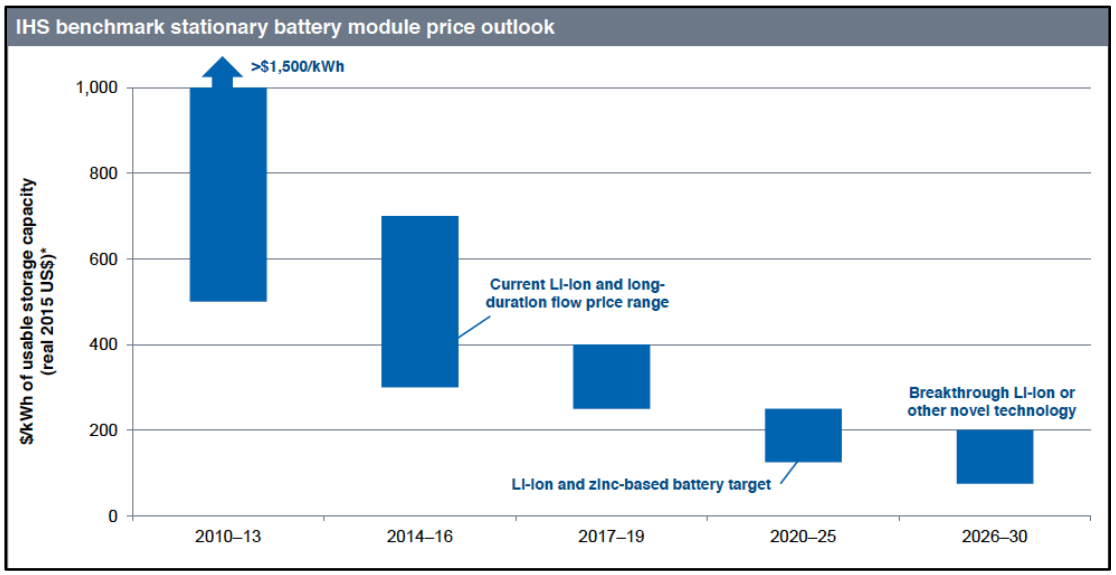
Dispatchable renewables facility owners will be compensated via a 15¢/kWh dispatchability adder for their full kWh deliverability rating daily, or if the total energy delivered on a given day is less than the kWh deliverability rating due to unfavorable weather or a poorly performing facility, then the deliverability adder will be applied on the total energy delivered. Any shortfalls from the contracted levels under the dispatchability adder must be justifiable weather-driven or planned maintenance reasons. Unjustified shortfalls will be penalized 100 times the value of shorted amounts, and three or more unjustified shortfalls within a rolling twelve-month period will result in potential termination of the dispatchability adder for the offending facility — solely at the discretion of East Bay Community Energy.

***Figure 16: Example pricing for a 3 $MW_{AC}$ solar project paired with a 3 MW / 6 MWh battery***

| Pricing component | Energy output (kWh/year)[19] | FIT pricing | Dispatchability adder | Final pricing for the delivered energy | Annual cost of energy for the CCA |
|---|---|---|---|---|---|
| Non-dispatchable | 2,610,000 | 9¢/kWh | 0¢/kWh | 9¢/kWh | $234,900 |
| Dispatchable energy | 2,190,000 | 9¢/kWh | 15¢/kWh | 24¢/kWh | $525,600 |
| **Total** | **4,800,000** | | | **15.84¢/kWh[20]** | **$760,500** |

Pricing for the dispatchability adder is based on detailed analysis of AES's solar+storage project with Kauai Island Utility Cooperative[21], as well as IHS's April 2016 report titled *Following the Grid Storage Current: Technology, cost, and economics*. As Figure 17 shows, IHS expects to see pricing in the 18-25¢/kWh range between 2020-2025 for lithium-ion energy storage. It is worth noting that this pricing does not take into account the ITC benefit, which can be secured by pairing storage with an ITC-qualifying resource. The Clean Coalition expects that an adder of 15¢ for each dispatchable kWh delivered to the CCA will drive deployment of some energy storage capacity within Alameda County.

***Figure 17: Pricing outlook for lithium-ion battery storage in the U.S.***




[19] This assumes 1,600 kWh/kW/year of energy production, which is in line with solar resource quality assessment for Alameda County and used consistency throughout this report. Round trip inefficiency of energy storage devices are not reflected in these figures, but could have an impact of 10% or more for energy that goes in and out of the battery.

[20] This is the average price, in cents per kilowatt-hour, paid by the CCA for energy from this project.

[21] "AES' New Kauai Solar-Storage 'Peaker' Shows How Fast Battery Costs Are Falling," *Greentech Media,* January 16, 2017, available at https://www.greentechmedia.com/articles/read/aes-puts-energy-heavy-battery-behind-new-kauai-solar-peaker, last visited August 17, 2017.

**Market responsive pricing structure**

The success of an energy procurement program often hinges upon determining the appropriate fixed price paid for energy. Determining the appropriate fixed price paid for energy is a major challenge in designing fixed-price, long-term contracts. Historically, the most widely used mechanisms to set a price for energy have been auctions or administrative price setting. Both of these mechanisms have been criticized on several fronts however.

The high cost for bid preparation and qualification for parties seeking to sell energy, combined with low certainty of success, discourages participation in auctions, while the development of a request for offers and management of the responses is a substantial burden for the purchasing agency. These factors create disproportionately high transaction costs when seeking to attract development of commercial-scale projects. Additionally, the auction approach does not send clear and consistent pricing signals to the market that assist developers in determining whether a potential project is financially viable and worth pursuing.

Administratively set fixed-prices are only optimal if the price matches actual market prices. If the price is set too low, there is insufficient participation in the program. If the price is set too high, then a "gold rush" may ensue and the buyer will overpay for energy. Administrative determination of appropriate pricing requires significant effort, and even the best effort cannot perfectly account for all market factors.

Market responsive pricing (MRP) is an effective and easy-to-implement mechanism that allows the price offered to automatically adjust as the market responds to the program. The essential feature of MRP is to adjust the initial FIT prices offered over time based on the market uptake. With high interest in a FIT, the offered price adjusts downward for future PPAs. With low market interest in a FIT, the offered price adjusts upward for future PPAs. MRP has emerged as a best practice for accurate price discovery, through ongoing polling of the market, over the duration of an energy procurement program.[22] When purchasing electricity from local renewable generators under a FIT, East Bay Community Energy should utilize the MRP approach to adjust the price for successive long-term PPA offers.

There are several advantages of MRP over competing pricing mechanisms and methods. By adjusting the contract price offered to developers as the market responds, East Bay Community Energy can efficiently meet its procurement target without administrative recalculation to estimate the correct price. Pricing with MRP is also fully transparent, resulting in market efficiency and a drive towards the lowest viable prices, while also limiting risky speculation through being forced to place bids at prices that are unreasonably low, as happens with auction programs. Competition between sellers for the available contracts maintains the lowest viable pricing while reducing project failure risk when compared to an auction mechanism, as generators are not trying to win a bid, and are far less likely to contract at a price that is too low for the project to be built. Finally, MRP

[22] "Market Responsive Pricing: Policy Mechanism Brief," Clean Coalition, May 2013, available at www.clean-coalition.org/site/wp-content/uploads/2013/07/Market-Responsive-Pricing-Brief-14_ssw-7-May-2013.pdf, last visited April 18, 2016.

offers visibility and control over program costs. Procurement planning limits the amount of energy/capacity contracted at the offered price, so policymakers are able to control the rate of uptake, the maximum price paid for energy, and total expenditures for purchased energy.

To implement MRP, program designers must first determine tranches for assessing market response, the magnitude of price adjustments (up and down), and the length of the waiting periods to gauge market response before the price is adjusted. For example, a FIT using a MRP will allow the first 5 MW of capacity to contract at a starting fixed price. If the first 5 MW tranche fills quickly with projects, then the price paid for the following 5 MW tranche is reduced by a predetermined adjustment. If, on the other hand, the first 5 MW of available capacity is not procured within the planned time frame, then the fixed price adjusts upward by a predetermined increment after a set period of time for the subsequent tranche.

The MRP mechanism continues to apply through the lifetime of the FIT, which means that only the initial fixed price was determined in another manner. The use of MRP limits the risk associated with a starting price that might not be optimal, and deliberations over the starting price can be minimized — further reducing administrative burden.

East Bay Community Energy should be aware that a small program will have proportionately fewer participants, which means fewer data points and limited opportunity for market response. A smaller program also needs time to garner market interest and establish a record of successful contracting and development.

With that in mind, we recommend East Bay Community Energy institute a MRP for its FIT. Pricing adjustments should be made quarterly when new FIT program capacity is allocated. Adjustments of ±0.25¢ are large enough to ensure program pricing is market responsive, while not so large enough that wild swings in pricing will create an unstable and ineffective program. However, this MRP design includes a price decrease of 0.5¢ if the CCA receives valid applications totaling more than 7.5 MW for any given tranche, which is 150% of the desired 5 MW quarterly capacity. This will minimize risk for the CCA by ensuring a larger price drop if the market shows very strong ability to deliver local renewable energy capacity at a set price.

The following guidelines detail our recommended MRP mechanism for East Bay Community Energy's FIT program:

*Downward price adjustment*

- If valid applications exceeding 7.5 MW (150% of 5 MW, the desired quarterly capacity) have been reserved as of 30 days prior to the next scheduled quarterly procurement, then there is a downward price adjustment of 0.5¢.
- If valid applications totaling between 5 MW and 7.5 MW (100-150% of desired quarterly capacity) have been reserved as of 30 days prior to the next scheduled quarterly procurement, then there is a downward price adjustment of 0.25¢.

*No price adjustment*

- If valid applications totaling between 3 MW and 5 MW (between 60% and 100 of desired quarterly capacity) have been reserved as of 30 days prior to the next scheduled quarterly procurement, no price adjustment is made.

*Upward price adjustment*

- If valid applications totaling less than 3 MW (less than 60% of desired quarterly capacity) have been reserved as of 30 days prior to the next scheduled quarterly procurement, then there is an upward price adjustment of 0.25¢.

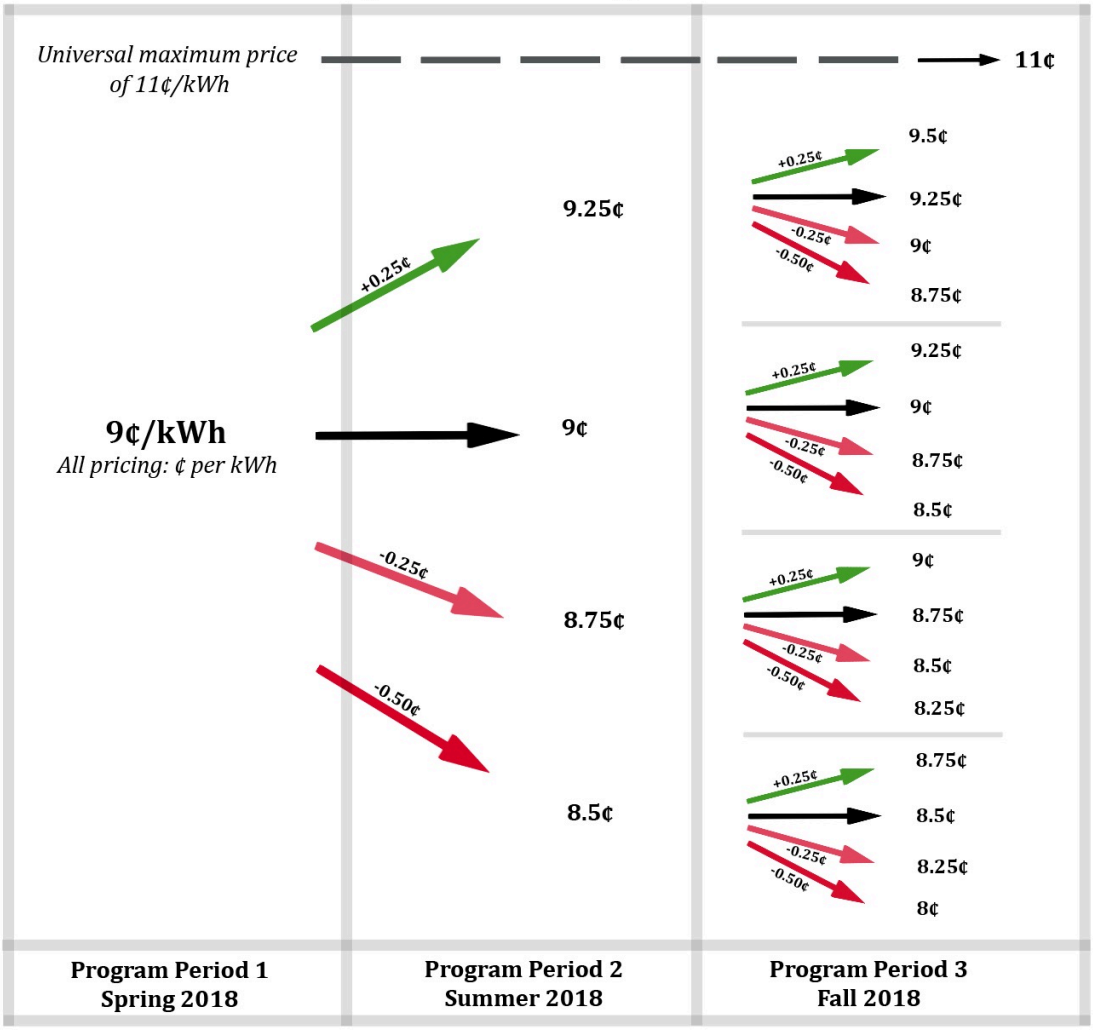
Note that quarterly pricing adjustments allow adequate time for potential providers to respond. And our recommended pricing adjustments are proportional to the level of market response, while providing increments sufficient to change market response in the next allocation.

The Clean Coalition recommends that East Bay Community Energy not drop the offered FIT price, via the MRP mechanism, if there is any rollover capacity remaining from previous unfulfilled tranches. This approach will help ensure that the program remains on track to bring the full 50 MW of capacity online by yearend 2021, which will make strong use of the ITC before it declines from 22% in 2021 to 10% in 2022.

The Clean Coalition also recommends that East Bay Community Energy create a universal maximum price, which is the maximum price the CCA will pay for energy through its FIT program. A clearly defined universal maximum price will send a signal to the market about the CCA's limit, and it will enable East Bay Community Energy to establish an upper limit for its FIT program budget. The Clean Coalition recommends that East Bay Community Energy establish 11¢/kWh as its universal maximum FIT price.

Figure 18 illustrates the potential MRP adjustments over the few first allocations of the East Bay Community Energy FIT, with the price adjustments based on market response.

***Figure 18: Market responsive pricing (MRP) base case for East Bay Community Energy***




Note that the pricing adders are tacked onto this FIT price. Figure 19 illustrates the PPA price for a solar FIT project that qualifies for the built environment, small project, and community benefit bonuses—on top of the universal maximum FIT pricing of 11¢/kWh. The all-in pricing for this project would be 15.95¢/kWh. It is worth noting that the Clean Coalition expects the majority of projects to be developed through the FIT will be larger, ground-mounted projects in the multiple megawatt range that don't qualify for any pricing adder.

***Figure 19: Universal maximum price, shown for a 100 $kW_{AC}$ rooftop solar project on a tax-exempt facility***

| Universal maximum FIT price | Built environment adder (20%) | Small project adder for projects up to 100 kW (20%) | Community benefit (5%) | FIT pricing for the project |
|---|---|---|---|---|
| 11¢/kWh | 2.2¢/kWh | 2.2¢/kWh | 0.55¢/kWh | 15.95¢/kWh |

Now, if this project includes a 100 kW / 200 kWh energy storage system, the pricing will increase, as the dispatchability adder of 15¢ is added onto all the energy delivered from the energy storage system. Figure 20, below, details the all-in pricing for energy from this solar+storage project, which is 22.79¢/kWh.

***Figure 20: Universal maximum price, shown for a 100 $kW_{AC}$ rooftop solar project on a tax-exempt facility with a 100 kW / 200 kWh energy storage system***

| Pricing component | Energy output (kWh/year)[23] | FIT price[24] | Dispatchability adder | Final pricing for the delivered energy | Annual cost of energy for the CCA |
|---|---|---|---|---|---|
| Non-dispatchable | 87,000 | 15.95¢/kWh | 0¢/kWh | 15.95¢/kWh | $13,876.50 |
| Dispatchable energy | 73,000 | 15.95¢/kWh | 15¢/kWh | 30.95¢/kWh | $22,593.50 |
| **Total** | **160,000** | | | **22.79¢/kWh[25]** | **$36,470** |

Again, the Clean Coalition believes the vast majority of capacity that will come online through this FIT will be in the form multiple megawatt, ground-mounted projects in eastern Alameda County that do not qualify for any of the pricing adders.

East Bay Community Energy will ultimately determine the level of local procurement based on the budget available to support a local procurement premium, and the associated procurement targets will limit the CCA's total contract cost commitments. Signaling an upper limit for pricing through a universal pricing maximum will help the CCA quantify the upper limit for FIT program budget requirement.

**Price components and sensitivity**

PV project development and operation costs have numerous components, as outlined below. Module and inverter costs, typically comprising 25% of the total installed project cost, reflect global and national markets and are not generally affected by local conditions. Balance of system (BOS) costs, installation, engineering, and permitting comprise roughly 20% of the total project costs and can increase for rooftops with special constraints. The range of variability within BOS costs is unlikely to exceed 10% of the total project cost. Labor costs, while significant, are a relatively small contributor to total costs. While prevailing wage standards may add 50-80% to the base labor cost component, this represents a 5% variable in the total energy costs, adding 0.25-0.5¢/kWh.

The costs for interconnecting local renewable projects to Pacific Gas & Electric's (PG&E) grid can vary widely, and expensive grid upgrades can be triggered as the added capacity of

[23] This assumes 1,600 kWh/kW/year of energy production, which is in line with solar resource quality for Alameda County and used consistency throughout this report.
[24] Based on a universal maximum FIT price of 11¢/kWh, as well as the full built environment, small project, and community benefit adder, as shown in Figure 19.
[25] This is the average price, in cents per kilowatt-hour, paid by the CCA for energy from this project.

a proposed project crosses threshold constraints specific to each circuit or line section. Upgrades are more likely to be triggered as participation levels increase and available grid capacity and preferred siting opportunities are filled. Avoiding the most expensive 10% of interconnections, which represent non-viable proposals, both the mean and median interconnection cost has been approximately $150,000 per MW in the PG&E service area, with a standard deviation of $70,000. While significant, even a three-fold increase in interconnection costs will contribute less than 15% of the total 20-year costs to the system owner that must be recouped through energy sales, as reflected in the PPA price. It is important to note that very substantial commercial-scale PV can be developed without exceeding the available hosting capacity on any circuit or line section, as reflected in our Solar Siting Survey, thereby indicating that interconnection costs should be minimized to between $50,000 and $70,000 per MW.

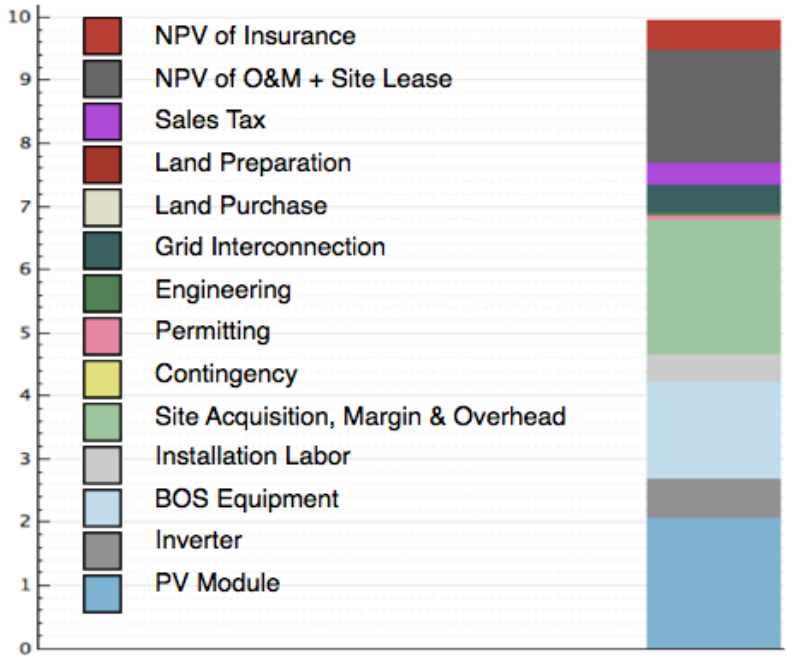
Our preliminary analysis indicates that much higher penetration levels of local solar PV will not trigger substantially higher costs on many circuits associated with commercial facilities, and these siting opportunities are widely available in Alameda County. Larger, ground-mounted systems face proportionately higher interconnection costs, but these projects are able offset these costs through higher energy production and other savings related to economies of scale.

If structural upgrades or early roof replacement are necessary before a solar PV project can be installed, this can be a substantial additional cost. Such upgrades are more commonly required on older, light-industrial sites where site lease rates are typically lowest. As increasing levels of FIT participation are sought, these costs are more likely to be encountered, and the total cost of a lease combined with these upgrades will be competing with higher lease costs demanded by other building or site owners. Parking lot installations already exemplify this trade-off. BOS costs for PV panel supports and labor are higher for parking lots than for PV-ready rooftops, and the lower reported site leasing costs for parking lots reflect both the added system owner costs and the site improvement value offered by the shade from a solar PV canopy.

The remaining major cost contributors are the developer margin and overhead, costs associated with locating and securing rights to a project site, and the cost of leasing that site. Developer margin and overhead costs, which include any associated development financing costs, contribute approximately 20% to the typical total project cost. While initial site acquisition requires increased effort as the supply becomes constrained, this is not a major cost contributor, and site availability is not expected to greatly influence significant developer costs and margins. While higher margins will certainly attract greater developer interest, these will remain subject to market competition, and the supply of developers is not likely to become constrained regardless of participation rates in the program.

Figure 21, below, illustrates the relative cost factors for a 1 MW fixed-tilt rooftop solar PV system.

***Figure 21: Relative project cost contributors for a 1 MW fixed-tilt rooftop PV system***




**Costs associated with participation rates**

As higher FIT participation rates are sought, overall costs and required PPA rates increase. Site lease value is highly correlated with participation, defining a classic supply-demand curve. Interconnection costs also increase with participation rates but are driven by technical rather than market factors. These costs may be mitigated by utility grid modernization and distributed energy hosting capacity enhancement policies currently under development and regulated by the California Public Utilities Commission (CPUC). Property owners will be increasingly motivated to make their rooftops available as the site lease payments increase. However, income from site leasing must be recognized as a minor component of the property value, representing 1-2% additional income.[26] As a result, very substantial increases in leasing rates may be required to attract site owner participation rates in excess of 20%. This may be mitigated by experience as the market matures, and by effective informational outreach efforts to commercial property owners by East Bay Community Energy and local governments to build awareness and set expectations. As noted above, sites burdened with necessary structural or interconnection upgrades become economically viable in light of increasing leasing costs associated with higher participation. These cost components are fully substitutable.

Installed solar PV requires roughly 200 square feet per kW. For example, a 100,000 square foot rooftop will accommodate approximately 500 kW of solar PV capacity. Therefore, site leasing at $50 per kW will yield $25,000 in annual lease revenues, or $0.25 per square foot.

[26] A 100,000 square foot rooftop will accommodate approximately 500 kW of solar PV capacity. Site leasing for solar PV at $50 per kW will yield $25,000 in annual lease revenues, or $0.25 per square foot. This contrasts with lease rates of $10 per square foot in 2012 for industrial space, $20 for office space, and $23 for retail.

Each $15/kW in annual lease costs contributes 1¢/kWh to the required PPA rate, as shown below in Figure 22.

***Figure 22: Projected lease rate relative to rooftop market participation & PPA price***

| Participation rate (% of local generation potential realized)[27] | Required PPA rate (¢/kWh) | Average site lease rate ($/kW/yr)[28] | Average site lease rate ($/square foot/yr)[29] | Site lease impact on base PPA rate (¢/kWh) | Site lease cost factor (% of PPA rate) |
|---|---|---|---|---|---|
| 1%* | 7¢* | * | * | * | * |
| 2% | 9¢ | * | * | * | * |
| 5% | 11¢ | $0** | $0 | 0¢ | 0% |
| 11% | 13¢ | $15 | $0.075 | 1¢ | 7% |
| 22% | 15¢ | $45 | $0.225 | 3¢ | 19% |
| 36% | 17¢ | $75 | $0.375 | 5¢ | 28% |
| 52% | 19¢ | $105 | $0.525 | 7¢ | 35% |
| 66% | 21¢ | $135 | $0.675 | 9¢ | 41% |
| 75% | 23¢ | $165 | $0.825 | 11¢ | 46% |
| 82% | 25¢ | $195 | $0.975 | 13¢ | 50% |
| 87% | 27¢ | * | * | * | >50% |
| 100.0% | Max | | | | |

* The margin of variability in this range exceeds predictive significance.
** A $0 site lease rate implies that the building owner is also the PV project owner and is utilizing existing property to derive income from the sale of energy.

In Palo Alto and San Francisco, reported and projected lease rates for their existing or planned FIT programs have been high due to price expectations by site owners and the limited availability of potential commercial sites. Alameda County has far greater large commercial scale siting capacity; however, price expectations are not well understood by building owners and managers. Adjusting for this difference, site leasing costs of $40/kW will be expected to constitute 20% of the total PPA pricing required to secure 100 MW of PV development in built environments, approaching a 20% realization rate of the available technical commercial rooftop potential that has been identified through the Clean Coalition's Solar Siting Survey.

[27] These numbers are derived from a UCLA *Luskin Center* study of Los Angeles solar potential and associated methodology, which assessed the economy potential and price elasticity of a feed-in tariff market response rate. Using the same price elasticity profiles, we applied this to Alameda solar irradiance and 2017 pricing data. The UCLA report is available at http://innovation.luskin.ucla.edu/content/bringing-solar-energy-los-angeles-assessment-feasibility-and-impacts-basin-solar-feed-tari-0, last visited on June 1, 2017.
[28] Average observed rooftop lease rates of $30-50/kW in major California metropolitan areas constitute a 12% contribution to the total wholesale price of energy reflected in the PPA rate. These observed lease rates are seen today in a market in which less than 5% of the potentially available commercial rooftops are participating.
[29] Installed solar PV requires roughly 200 square feet per kW.

Additionally, net energy metering (NEM) project development will compete for allocation of the remaining commercial siting opportunities and should be included in the participation rate totals. The LADWP experience with both commercial NEM and the wholesale FIT 100 commercial rooftop programs provides some indication, as 17 MW of commercial NEM projects were added during the initial two-year period in which the FIT 100 program was active. While comparison against wholesale procurement is highly dependent upon the FIT price offered, if we extrapolate the rate of NEM uptake in PG&E territory, we can anticipate the additional NEM participation rate during the 2017-2020 period to be on the order of 2%. This will marginally reduce the number of available siting opportunities and will offer full retail price value for the energy produced. NEM is generally only deployed on owner occupied buildings and limited to the on-site load. Therefore, while NEM will compete for participation, it is not expected to have a major impact on the PPA pricing required to reach participation rates necessary to significantly contribute to East Bay Community Energy's desired FIT procurement.

**Nearby CCA FIT pricing info**

For reference, below are details on pricing for FIT programs from nearby CCA programs.

Through its ProFIT program, Sonoma Clean Power offers a fixed price of 9.5¢/kWh for a term length of 20 years. There are a handful of bonus incentives, which are offered for the first five years of a project's contract:

- FIT projects of 250 kW or less receive an additional 0.5¢/kWh
- FIT projects sited on previously developed locations receive an additional 1¢/kWh
- FIT projects meeting local business criteria[30] receive an additional 1¢/kWh
- FIT projects meeting training criteria[31] receive an additional 1¢/kWh

Through its FIT program, Marin Clean Energy offers 20-year fixed pricing of between 9-11.5¢/kWh, depending on the technology's generation profile.[32]

[30] Local Business is defined as follows:
1. The developer and/or prime contractor has a place of business (i.e. possesses a business license) and headquartered in Sonoma County, and
2. At least 75% of the non-management project-specific labor resides in Sonoma County.

[31] To fulfill the "Training" requirement:
1. At least 20% of project-specific job hours are staffed by an apprentice who resides in Sonoma County and is participating in a State of California Division of Apprenticeship Standards approved program, and
2. A contractor licensed by the Contractors State License Board as a Class C- 10 electrical contractor for the placement, installation, erection and/or connection of all electrical work, as described in Title 16, California Code of Regulations, Section 832.10, will be part of any work involving an electrical system of 100 volt-amperes or more.

[32] "Feed-in Tariff", Marin Clean Energy, available at https://www.mcecleanenergy.org/feed-in-tariff/, last visited June 30, 2017.

# IV. Program budget

The budget required for the East Bay Community Energy FIT program will depend on two factors: program size and program pricing.

### Minimum budget requirements

The minimum annual FIT budget requirement for our recommended initial program of 5 MW is $720,000, which is detailed in Figure 23 below. The program budget is determined by multiplying the FIT rate by the number of expected number of kWh procured annually through the FIT. This budget assumes all 5 MW of capacity are filled at a rate of 9¢/kWh and annual production of 1,600 kWh/kW/year of FIT capacity, which is the expected production from single-axis ground mounted solar PV systems in eastern Alameda County.

***Figure 23: Minimum budget required for initial 5 MW FIT program capacity***

| Program capacity | Expected annual FIT generation (kWh/year) | FIT PPA price (¢/kWh) | FIT program budget required |
|---|---|---|---|
| 5 MW | 8,000,000 kWh | 9¢ | $720,000 |

The required FIT budget will change if project developers design projects that qualify for any, or all, of the adders: built environment, small project, community benefit, and dispatchability. Figure 24, below, illustrates the required budget per 5 MW tranche, if 10% of allocated capacity receives an average of a 20% adder.

***Figure 24: Budget required for 5 MW of FIT capacity, with a baseline price of 9¢/kWh, and with 10% of capacity receiving an average adder of 20%***

| % of allocated capacity | Capacity | Expected annual FIT generation (kWh/year) | PPA price (¢/kWh) | Budget required |
|---|---|---|---|---|
| 90% | 4.5 MW | 7,200,000 kWh | 9¢ | $648,000 |
| 10% | 0.5 MW | 800,000 kWh | 10.8¢ | $86,400 |
| **Total** | **5 MW** | **8,000,000 kWh** | **9.18¢**[33] | **$734,400** |

An additional $14,400 is required in this scenario (compared to Figure 23), in which 0.5 MW of FIT program capacity is filled by projects that receive an average adder of 20%. The average price per kWh paid by the CCA in this scenario is 9.18¢/kWh.

[33] This is the average price, in cents per kilowatt-hour, paid by the CCA for energy in this 5 MW tranche.

Figure 25, below, illustrates the required budget per 5 MW tranche, if 50% of allocated capacity receives an average of a 20% adder.

***Figure 25: Budget required for 5 MW of FIT capacity, with a baseline price of 9¢/kWh, and with 50% of capacity receiving an average adder of 20%***

| % of allocated capacity | Capacity | Expected annual FIT generation (kWh/year) | PPA price (¢/kWh) | Budget required |
|---|---|---|---|---|
| 50% | 2.5 MW | 4,000,000 kWh | 9¢ | $360,000 |
| 50% | 2.5 MW | 4,000,000 kWh | 10.8¢ | $432,000 |
| **Total** | **5 MW** | **8,000,000 kWh** | **9.9¢**[34] | **$792,000** |

An additional $72,000 is required in this scenario (compared to Figure 23), in which 2.5 MW of FIT program capacity is filled by projects that receive an average adder of 20%. The average price per kWh paid by the CCA in this scenario is 9.9¢/kWh.

Figure 26, below, illustrates the required budget per 5 MW tranche, if 50% of allocated capacity receives an average of a 50% adder.

***Figure 26: Budget required for 5 MW of FIT capacity, with a baseline price of 9¢/kWh, and with 50% of capacity receiving an average adder of 50%***

| % of allocated capacity | Capacity | Expected annual FIT generation (kWh/year) | PPA price (¢/kWh) | Budget required |
|---|---|---|---|---|
| 50% | 2.5 MW | 4,000,000 kWh | 9¢ | $360,000 |
| 50% | 2.5 MW | 4,000,000 kWh | 13.5¢ | $540,000 |
| **Total** | **5 MW** | **8,000,000 kWh** | **11.25¢**[35] | **$900,000** |

An additional $180,000 is required in this scenario (compared to Figure 23), in which 2.5 MW of FIT program capacity is filled by projects that receive an average adder of 50%. The average price per kWh paid by the CCA in this scenario is 11.25¢/kWh.

**Budget sensitivity**

East Bay Community Energy's FIT budget will vary depending on program size and pricing. Figure 27, below, illustrates the required budget for a suite of tranche sizes with average pricing ranging from 7¢/kWh to 13¢/kWh.

[34] This is the average price, in cents per kilowatt-hour, paid by the CCA for energy in this 5 MW tranche.
[35] This is the average price, in cents per kilowatt-hour, paid by the CCA for energy in this 5 MW tranche.

***Figure 27: Budget required for FIT capacity at various tranche sizes and pricing levels***

| Tranche size (MW) | Expected annual FIT generation (kWh/year) | Average Fit PPA price (¢/kWh) | Annual budget required |
|---|---|---|---|
| 2.5 MW | 4,000,000 kWh | 7¢ | $280,000 |
| 2.5 MW | 4,000,000 kWh | 8¢ | $320,000 |
| 2.5 MW | 4,000,000 kWh | 9¢ | $360,000 |
| 2.5 MW | 4,000,000 kWh | 10¢ | $400,000 |
| 2.5 MW | 4,000,000 kWh | 11¢ | $440,000 |
| 2.5 MW | 4,000,000 kWh | 12¢ | $480,000 |
| 2.5 MW | 4,000,000 kWh | 13¢ | $520,000 |

| Tranche size (MW) | Expected annual FIT generation (kWh/year) | Average Fit PPA price (¢/kWh) | Annual budget required |
|---|---|---|---|
| 5 MW | 8,000,000 kWh | 7¢ | $560,000 |
| 5 MW | 8,000,000 kWh | 8¢ | $640,000 |
| 5 MW | 8,000,000 kWh | 9¢ | $720,000 |
| 5 MW | 8,000,000 kWh | 10¢ | $800,000 |
| 5 MW | 8,000,000 kWh | 11¢ | $880,000 |
| 5 MW | 8,000,000 kWh | 12¢ | $960,000 |
| 5 MW | 8,000,000 kWh | 13¢ | $1,040,000 |

| Tranche size (MW) | Expected annual FIT generation (kWh/year) | Average Fit PPA price (¢/kWh) | Annual budget required |
|---|---|---|---|
| 10 MW | 16,000,000 kWh | 7¢ | $1,120,000 |
| 10 MW | 16,000,000 kWh | 8¢ | $1,280,000 |
| 10 MW | 16,000,000 kWh | 9¢ | $1,440,000 |
| 10 MW | 16,000,000 kWh | 10¢ | $1,600,000 |
| 10 MW | 16,000,000 kWh | 11¢ | $1,760,000 |
| 10 MW | 16,000,000 kWh | 12¢ | $1,920,000 |
| 10 MW | 16,000,000 kWh | 13¢ | $2,080,000 |

## Program budget over time

As the FIT expands over time, the annual budget required to pay for additional capacity will grow. The exact budget will depend on how much new program capacity is established, as well as the pricing offered for the new capacity, and the percentage of FIT projects that qualify for adders. Figure 28, below, shows the required budget for a 50 MW FIT program at an average price of 9¢/kWh. Note that the annual program budget requirements trail behind capacity allocation. This is because, as previously discussed, there is a roughly 18 month lag time between when the CCA releases capacity to the market and when that capacity begins delivering power to East Bay Community Energy.

***Figure 28: Estimated budget requirements as FIT program capacity expands, with an average FIT PPA price of 9¢/kWh***

| Capacity allocation date | Capacity allocation (MW) | Estimated commercial online date (COD)[36] | Annual incremental budget required for allocation[37] | Total annual incremental program budget retail sales[38] |
|---|---|---|---|---|
| Spring 2018 | 5 MW | Fall 2019 | $0 | $0 |
| Summer 2018 | 5 MW | Winter 2019 | $0 | $0 |
| Fall 2018 | 5 MW | Spring 2020 | $0 | $0 |
| Winter 2018 | 5 MW | Summer 2020 | $0 | $0 |
| Spring 2019 | 5 MW | Fall 2020 | $0 | $0 |
| Summer 2019 | 5 MW | Winter 2020 | $0 | $0 |
| Fall 2019 | 5 MW | Spring 2021 | $720,000 | $720,000 |
| Winter 2019 | 5 MW | Summer 2022 | $720,000 | $1,440,000 |
| Spring 2020 | 5 MW | Fall 2021 | $720,000 | $2,160,000 |
| Summer 2020 | 5 MW | Winter 2021 | $720,000 | $2,880,000 |
| Fall 2020 | 0 MW | n/a | $720,000 | $3,600,000 |
| Winter 2020 | 0 MW | n/a | $720,000 | $4,320,000 |
| Spring 2021 | 0 MW | n/a | $720,000 | $5,040,000 |
| Summer 2021 | 0 MW | n/a | $720,000 | $5,760,000 |
| Fall 2021 | 0 MW | n/a | $720,000 | $6,480,000 |
| Winter 2021 | 0 MW | n/a | $720,000 | $7,200,000 |
| Spring 2022 | 0 MW | n/a | $0 | $7,200,000 |
| **Total** | **50 MW** | | | **$7,200,000** |

[36] Assuming a total lag time of 18 months from capacity release to built FIT projects — 6 months for the application process and PPA execution, and then 12 months to bring the project online.
[37] This budget assumes an average FIT rate of 9¢ and annual production of 1,600 $kWh_{AC}$/kW/year of FIT capacity. The increase in FIT program budget is based on the capacity allocation date.
[38] Based on the commercial online date of FIT projects — not the capacity allocation date.

In this instance, the annual FIT budget would remain at $7,200,000 until Spring 2041, when the first projects reach the end of their 20-year contract term. At this point, the budget would decrease by $720,000 each quarter, as 5 MW of FIT contracts expire quarterly.

Of course, the expansion of the East Bay Community Energy's FIT will depend on the rate at which the CCA grows its customer base and has budget available to support local renewable generation.

# V. Policies and procedures

This section offers high-level recommendations on FIT program policies and procedures. Lessons learned and pro formas from existing FIT programs are referenced.

**Program application**

The application process should require enough information to enable East Bay Community Energy staff to thoroughly evaluate the viability of a proposed project without being unnecessarily onerous on program participants. Key details include:

- Evidence of emerging site control, which can come in the form of a standardized letter of intent signed by the project developer and property owner
- Proof of the ability to develop, finance, and construct within 24 months[39]
- Technical and engineering aspects
- A history of successful renewable energy project management and development

The Clean Coalition recommends that East Bay Community Energy require a non-refundable application fee and a refundable "per kW performance deposit". This will ensure a more efficient program by deterring non-viable bids from clogging the lottery and project queue. Sonoma Clean Power, under its ProFIT program, requires a non-refundable application fee of $500 and a performance deposit, which is fully refundable upon project completion.[40] The Clean Coalition believes that a $500 application fee and performance deposit around $40/kW$_{AC}$ would be effective for the East Bay Community Energy FIT application process.

Below are a number of FIT application pro formas:

- Marin Clean Energy
- Sonoma Clean Power

[39] Marin Clean Energy requires: financial statements for project participants (developer and financier, in particular); a PG&E Generating Facility Interconnection Application and PG&E notice of complete application; copy of application for RPS certification (from the California Energy Commission) and assigned pre-certification number, if available; and, evidence of environmental compliance review/notice of determination receipt.

[40] *Feed-in Tariff*, Sonoma Clean Power, available at http://2tgc4v3kjp5mrjtdo183d8716ao.wpengine.netdna-cdn.com/wp-content/uploads/2014/09/SCP-ProFIT-Tariff-revised-2014-09.pdf, last visited May 22, 2017.

- City of Palo Alto Utilities

**Project queuing**

East Bay Community Energy needs to clearly define, in advance, how applications will be handled. The Clean Coalition believes it is best practice to kick-off the FIT program with a two-week open application period. At the end of the open application period, a lottery system will be used to determine the order in which projects will be listed in the queue. All applications submitted after the open application period should be accepted on a first-come-first-served basis.

Once East Bay Community Energy accepts an application, the project developer should have a set amount of time, ideally between 15-30 days, to officially move the proposed project into the FIT program queue. Once a project moves into the queue, the stated capacity of the project should be officially reserved in the program. The performance deposit, which should be around $\$40/kW_{AC}$, becomes non-refundable if a project in the queue does not meet agreed upon milestones, including its COD.

**Contracts**

There should be a standard PPA between East Bay Community Energy and a renewable energy facility owner to purchase energy at a predefined, fixed rate for a long duration. The standardized PPA should fulfill the needs of all relevant parties in the simplest fashion possible. The key parties are the utility, the developers, and the project investors (including lenders).

An optimal PPA is simple enough to minimize the review effort by developers and investors, yet substantial enough to avoid potential disputes and provide clear procedures for resolving disputes if there were to occur. The level of complexity of the form will depend on the complexity of the program. For example, the Gainesville Regional Utilities PPA only contains 18 pages, while the Sacramento Municipal Utility District PPA consists of 49 pages.

The standard agreements should be circulated for review by likely project developers and potential investors to ensure that the PPA is straightforward, financeable, and fair to East Bay Community Energy, project developers, and project investors.

Key provisions of an effective FIT PPA are detailed below:

| Contract Provision | Overview |
|---|---|
| Length | This specifies the length of a contract terms between East Bay Community Energy and the project owner. Well-designed FIT programs offer terms of at least 20 years, and sometimes longer. Generally, the longer the contract length, the lower the fixed price offered. Contract length is an essential feature of a FIT that makes it possible for developers to secure financing at reasonable rates and protects CCA customers against rising electricity prices. |
| Performance excuses | This specifies under what circumstances a FIT project is penalized, or not penalized, for not being able to deliver electricity as expected, as well as the timeline for a |

| | |
|---|---|
| | project owner to resolve performance issues. Since FIT project owners are only compensated for delivered energy, they are inherently motivated to promptly resolve performance issues. It is also common to define when the purchaser is not responsible for buying electricity from a FIT facility. Without capping exceptions, it is possible that project financing becomes far more difficult. |
| Environmental attributes | This section details ownership of the environmental or renewable energy attributes of the purchased electricity. This includes: (i) proof that the renewable energy is certified as an eligible resource that meets state and/or local requirements; (ii) conveyance of all renewable energy attributes, such as RECs; and (iii) any reporting obligations necessary to meet state and/or local requirements. |
| Project milestones timeline | This provides deadlines for submitting proof of permit applications, engineering drawings, equipment orders, and commercial operation date. Firm, reasonable deadlines ensure that projects proceed as committed. Projects that are not proceeding in a timely fashion may be removed from the queue. It is common for timelines to reasonably accommodate all good faith applicants and allow for events that are not under the control of the project developer, such as natural disasters. |
| Assignment | This specifies if a contract can be assigned to any new owner that meets program eligibility criteria. In effect, allowing assignment enables program participation by potential facility owners that may sell the facility and/or the real property where the facility is located during the term of the contract. |
| Form of lender consent | A standard form for lender consent adds consistency and streamlines a FIT program, as it avoids negotiating individual lender consent agreements for each project. A standard lender consent form if often included as part of the standard contract. |

More information on FIT contract provisions is available on the Clean Coalition website.[41] Below are FIT program PPA examples:

- Sacramento Municipal Utility District
- City of Palo Alto Utilities
- Los Angeles Department of Water & Power
- Sonoma Clean Power
- Marin Clean Energy

The Clean Coalition worked closely with the City of Palo Alto and its municipal utility to open City-owned properties up to solar installations. Through this effort, a lease agreement for siting solar on municipal properties was developed and is available to East Bay Community Energy for reference.

# VI. Anticipated challenges

Based on the experience of other FIT programs nationwide, below are anticipated challenges East Bay Community Energy may face.

[41] "Local CLEAN Program Guide: Module 6," Clean Coalition, available at http://www.clean-coalition.org/site/wp-content/uploads/2012/10/Local-CLEAN-Program-Guide-Module-6-Designing-CLEAN-Policies-Procedures-SSW_21-12-June-2012.pdf, last visited May 22, 2017.

**Interconnection**

Interconnection of FIT projects can be a lengthy and expensive process. The timeline, costs, and uncertainly involved in interconnection can be reduced through active support from the local utility, which in this case is PG&E. The Clean Coalition recommends proactive engagement with PG&E staff to streamline interconnection to the extent possible. One key step for East Bay Community Energy is to identify feeders and line segments within PG&E's grid, where new local capacity will be quickest and easiest to interconnect. Much of this information is now available due to the Distribution Resources Planning effort spearheaded by the Clean Coalition. For publicly available details regarding PG&E's distribution network, please visit http://www.cpuc.ca.gov/general.aspx?id=5071. This information was used in the Solar Siting Survey created in association with this report to identify locations with adequate hosting capacity and the quantity of PV that can be interconnected without requiring significant distribution upgrades.

**Property owner participation**

There is large potential for the installation of solar PV systems on commercial and industrial properties. However, building owners often have concerns regarding solar installations on their facilities, and these concerns fall into five major areas.

*1) Economic considerations*: Building owners are concerned about the cost of the system, as well as ongoing operations and maintenance (O&M) costs.

*2) Outside core business area*: Building owners see solar as a distraction to their core business area.

*3) Facility concerns*: Building owners see solar installations as a facility liability.

*4) Vendor and technology* risk: Building owners have expressed concern regarding the reliability of solar developers—with respect to workmanship, project management, and length of time in business.

*5) Permitting and approvals*: Building owners do not want to navigate the permitting and approval process for a solar installation. Additionally, some building owners need approval from the landowner to make significant modifications.

The Clean Coalition created the Solar Solutions Guide to address these building owner concerns, and this guide is available at www.clean-coalition.org/resource/solar-solutions-guide/.

# Appendix – pricing analysis assumptions

Below are our assumptions for the System Advisory Model (SAM) pricing analysis.

| Location | Type of system | Size of solar PV system ($W_{AC}$) | Installed cost ($/$W_{DC}$) | Initial output ($kWh_{AC}$/ $kW_{DC}$/yr) | 20-year fixed PPA price | 20-year PPA price (real $)[42] |
|---|---|---|---|---|---|---|
| Oakland | Built environment | 100 kW roof | $2.30 | 1521 | 15.6¢ | 13.0¢ |
| Oakland | Built environment | 350 kW roof | $2.12 | 1521 | 14.5¢ | 12.0¢ |
| Oakland | Built environment | 500 kW roof | $2.06 | 1521 | 14.2¢ | 11.8¢ |
| Oakland | Built environment | 1 MW | $1.90 | 1521 | 13.5¢ | 11.2¢ |
| Livermore | Built environment | 100 kW roof | $2.30 | 1605 | 14.8¢ | 12.3¢ |
| Livermore | Built environment | 350 kW roof | $2.12 | 1605 | 13.8¢ | 11.5¢ |
| Livermore | Built environment | 500 kW roof | $2.06 | 1605 | 13.5¢ | 11.2¢ |
| Livermore | Built environment | 1 MW | $1.90 | 1605 | 12.8¢ | 10.6¢ |
| Livermore | Ground-mount | 1 MW tracking | $1.86 | 2024 | 10.0¢ | 8.3¢ |
| Livermore | Ground-mount | 3 MW tracking | $1.78 | 2024 | 9.74¢ | 8.1¢ |

## Modeling assumptions

- NREL System Advisor Modeling performed with PVWatts system design standards
- Installed cost is turnkey cost per nameplate capacity for completed interconnected system delivering power to the grid, including all permits, fees, taxes, administrative costs, overhead and margin for projects with assumed 50% debt ratio. Installed costs vary with market maturity (date, size, market development).
- Analysis includes no escalator and no residual value after 20-year term of PPA
- Renewable Energy Credits (RECs) are bundled with energy sales
- Internal Rate of Return (IRR): 8%
- DSCR 1.3 (50% debt financing of project development costs, excluding site lease)
- Interest rate on debt: 6%
- Nominal discount rate: 8% (6% real + 2% inflation)
- Federal depreciation: MACRS 5-year (without bonus option)
- Federal income tax rate: 35%
- Federal Investment Tax Credit (ITC): 30%
- O&M: $15/kW/yr for fixed tilt rooftop
- Inverter replacement reserve: $20/kW/yr

[42] Constant 2018 dollar value, levelized rate assuming 2% inflation.

- Interconnection costs: Urban $70,000/MW$_{DC}$, including gen-tie and system upgrades, assuming siting to existing grid capacity, rural $200,000/MW.
- Insurance costs: 0.5%
- Total system losses: 11.5%

**Location specific assumptions**

- System output based on NREL's TMY solar resource value, (Rooftop installation at 20º fixed tilt, ground mount with single axis tracking)
- Flat Rate – no Time of Delivery price adjustment
- Site rental: $40,000/MW/yr (20% of FIT project revenue over its 20-year lifespan)
- State corporate income tax rate: 8.84%
- State tax benefits: MACRS schedule (§171.107)
- Sales tax: 9.25%
- Property tax: 0%
- Debt & tax equity financing rates can affect results if they differ from the IRR.

**Potential adjustments influencing PPA price**

For a baseline pricing of 9¢/kWh:

- Installed cost +/- 25¢/W: 1.1¢/kWh
- Site rental costs +/- $15,000: 1.0¢/kWh
- Labor Prevailing Wage reqmt: 0.3¢/kWh
- PPA term 25 years: - 0.5¢/kWh
- Add PPA escalator @ 1%: - 0.8¢/kWh starting price reduction
- IRR target +/- 1%: 0.2¢/kWh (subject to debt assumptions)
- O&M cost +/- $5/kW-yr: 0.4¢/kWh
- Inflation Rate +/- 1%: 0.4¢/kWh
- Interest Rate +/- 1% 0.4¢/kWh
- BOS cost +/- 20% 0.3¢/kWh
- Grid Interconnection +/- 5¢/W 0.2¢/kWh
- Installer Margin & Overhead +/- 20% 0.4¢/kWh
- Sales tax exemption[43] 0.5¢/kWh

[43] California Assembly Bill 398 included a provision to exempt renewable electric generation facilities from sales tax. The bill passed the California legislature July 17 and is expected to by signed into law — taking effect in 2018.