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A Department of the City and County of San Francisco

SolarTech
An initiative of Silicon Valley Leadership Group

Powered by SunShot
U.S. Department of Energy

Protecting Solar Access

I. Summary

This paper discusses public policies that address the risk of solar system shading from development on nearby property. First, the paper briefly discusses the legal background to solar access protection in California. Then, the paper examines four categories of policy solutions: (1) general zoning rules, (2) solar access permits, (3) easements, and (4) a hypothetical public insurance option called a Solar Access Indemnity Fund.

This material was prepared by San Francisco's Department of the Environment under a U.S. Department of Energy SunShot Initiative Rooftop Solar Challenge grant managed by SolarTech.[1] The aim of this paper is to provide a resource to local governments in California and elsewhere that are interested in improving solar access protections in their communities.

II. Introduction

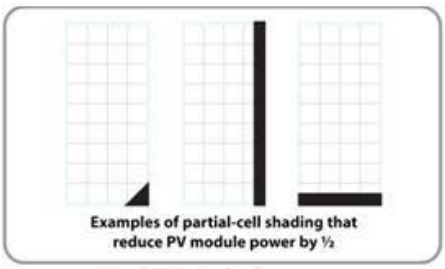
Susan is a San Franciscan who is excitedly installing a solar photovoltaic (PV) energy system on her home. She knows that her new solar system should produce energy for at least 25 years, saving her money each month on her electricity bill. She is paying for her system up-front and expects to earn back her initial investment in about twelve years, and then begin to earn a positive return. However, six years later, her neighbor, Charles, permits and builds a new apartment building next door. Her solar system is now shaded most of the day, producing only a fraction of the energy that she anticipated, thus saving her far less on her electricity bill. She can no longer expect to earn back even her initial investment over the remaining 19 years of the system's expected life.

The imaginary story of Susan and her shaded solar system illustrates one often-overlooked risk of going solar—shading from new development. While California state law offers some protection for shading by vegetation on nearby property (see description in next section), there are no statewide laws addressing shade from nearby buildings. Consequently, a solar system owner in California has little protection from

[1] SolarTech is a non-profit solar PV industry association chartered to streamline industry business practices that hinder the market growth and adoption of solar PV through hidden costs and delays. SolarTech is one of 22 awardees of the DOE SunShot Rooftop Solar Challenge, leading a team comprised of City & County of San Francisco, Solar Sonoma County, East Bay Green Corridor and Clean Coalition. This team is focused on lowering the costs and burdens of permitting, inspection, interconnection, and finance for solar systems in the greater Bay Area. Visit www.solartech.org to learn more.

new development that would block her solar resource. Furthermore, it can be hard to anticipate what new developments might be built nearby that would shade a solar system. As a result, there is a risk that a solar system owner will suffer financially from new development that blocks her access to sunlight. The government, too, risks losing out on its investment – through tax credits and incentives – and expected environmental benefits. Perhaps most important, there is a risk that a prospective solar system owner will be dissuaded from purchasing a solar system altogether.

Protecting access to sunlight is a thorny issue. Should Susan have anticipated that the system might become shaded, and therefore suffer the consequences? Should Charles have been prohibited from shading Susan's solar system, even if that means limiting his building's height to less than what is otherwise allowed by local zoning code? Where should the government's priorities lie? The challenge of this issue is heightened by two factors. First, many cities, including San Francisco, are encouraging higher density development in order to foster transit-, bicycle-, and pedestrian-friendly, energy-efficient neighborhoods that reduce reliance on automobile travel and cut greenhouse gas emissions. This densification will likely increase the occurrence of shading from neighboring buildings. Second, the electrical design of traditional solar PV panels makes them very sensitive to shading. For instance, shading covering just 10% of a solar PV module can often reduce power output by 50%.[2] (Solar thermal panels are less sensitive to shading.)



Credit: Wholesalesolar.com

This confluence of factors suggests that local governments that desire to promote rooftop solar energy in their communities should consider policies to reduce the risk of financial loss caused by nearby development. At the same time, it is unclear whether the risk of shading is a real and urgent problem. For starters, it is hard to assess if homeowners are dissuaded from installing solar out of fear that the system will be shaded in the future. In addition, it does not appear that many systems have been shaded by new development in San Francisco. The San Francisco Planning Department anecdotally reports that it is only aware of a handful of cases in the city where new development has shaded nearby solar systems.[3] Nonetheless, solar system shading is a problem that will inevitably grow as solar energy becomes more popular. To better inform local governments that are interested in strengthening solar access protections in their communities, this paper reviews current legal protections in California and examines policies to protect solar systems from financial loss due to shading from new development.

III. Review of Current Law

This section reviews current legal protections for solar access in California.

Common Law

There is precedence for protecting the right to sunlight across the airspace of a neighboring property. For example, ancient Romans had a protected right to reasonable sunlight, and English common law had a doctrine of "ancient lights," which held that a person had a natural right to receive the light that

[2] Micro-inverters can help reduce losses due to shading as well. For more information on the impacts of shading, see Deline, C."Partially Shaded Operation of a Grid-Tied PV System." NREL, 2009. http://www.nrel.gov/docs/fy09osti/46001.pdf
[3] SF Planning Commission. "Solar Access Issues." Message to the author. 28 Nov. 2012. E-mail.

passed through his window. This right was codified in England's Prescription Act in 1832, which provided an absolute right to sunlight after a landowner had access to the light for 20 years.[4] U.S. courts, however, have consistently rejected the doctrine of ancient lights. In a seminal case, *Fontainebleau Hotel Corp. v. Forty-Five Twenty-Five, Inc.* (1959), the Florida District Court of Appeals declared that "the doctrine of 'ancient lights' has been unanimously repudiated in this country" and that there is no common law legal right to unobstructed light from adjoining land.[5] The precedent established in *Fontainebleau* remains today.

California Statutory Law

During the first solar boom in the late 1970s, California, like many states, passed laws promoting solar energy. Below is a summary of current California law that addresses property owners' rights to install solar and preserve their solar systems' access to sunlight.

- **Voluntary solar easements**—California's solar easement law ensures that neighbors may voluntarily sign easements to guarantee the right to receive sunlight for active or passive solar energy systems. The exact terms and conditions of an easement must be negotiated between the parties. (Civil Code § 801.5)

- **Solar easements for subdivisions**—The Subdivision Map Act allows local governments to pass ordinances to require solar easements in subdivision projects. (Government Code § 66475.3)

- **Rights to install solar**—The Solar Rights Act prohibits any covenant, restriction or condition contained in any deed or other contractual restriction to limit the installation or use of a solar energy system. (Civil Code § 714)

- **Local government review of solar applications**—California law limits local governments to nondiscretionary review of applications to install solar energy systems. The law limits review to whether the solar system meets health and safety requirements, and expressly prohibits review for aesthetic purposes. (Government Code § 65850.5 and Health and Safety Code § 17959.1)

- **Protection from vegetative shading**—The Solar Shade Control Act provides limited protections against shading from vegetation on adjacent properties. Specifically, the law prohibits adjacent property owners to allow *new* trees or shrubs to grow so as to cast a shadow that covers more than 10% of the solar system's absorption area between 10 a.m. and 2 p.m. Because existing vegetation is excluded, solar owners should account for expected growth of vegetation that might shade their system over its productive life. (Public Resources Code § 25980-25986)

IV. Solar Access Policy Options

The remainder of this paper examines policy options to lessen the risks of financial loss to solar system owners from new development on nearby properties. The paper describes four categories of policies—

[4] McCann Kettles, Colleen. *A Comprehensive Review of Solar Access Law in the United States.* Solar America Board for Codes and Standards, 2008.
[5] Fontainbleau Hotel corp. v. Forty-five Twenty-Five, Inc., 114 So. 2d 357, 359 (Fla. Dist. Ct. App. 1959).

general zoning rules, solar access permits, easements, and public insurance—and discusses their relative advantages and disadvantages.

Zoning Rules

One policy tool for local governments is zoning rules that aim to limit the shading cast by new development on neighboring properties. Because these are zoning rules, they apply across-the-board to all properties within a given zone regardless of whether neighboring properties already own a solar system. Below are examples of zoning policies in three cities.

- **Boulder, Colorado**[6]—Boulder has created novel protections, called a "solar fence," for most of its development zones. A solar fence is a hypothetical fence along the property line. New structures are not allowed to shade adjacent lots to a greater extent than the hypothetical fence would between 10 a.m. and 2 p.m. on the winter solstice. Boulder grouped its zoning districts into three Solar Access Areas. Properties in Solar Access Area I are protected by a 12-foot solar fence, while properties in Solar Access Area II face a 25-foot solar fence. Properties in Solar Access Area III are not protected by a solar fence, but are protected through solar access permits (discussed below).

  Boulder has also instituted siting requirements for new development. All roofs must have a surface orientation within 30 degrees of true east-west direction, be flat or south sloping, and be structurally capable of supporting at least 75 square-feet of unshaded solar collectors.

- **Ashland, Oregon**[7]—Ashland takes a similar approach to Boulder's solar fence protections. However, rather than regulating the actual height of a potential shadow at the property line, the ordinance creates minimum setback requirements based on the height of proposed structure and the slope of the lot, thereby ensuring a certain level of solar exposure for the neighboring property.

- **Santa Cruz, California**[8]—The City of Santa Cruz has language in its local code that requires buildings to be oriented and located to "preserve solar access of adjacent properties." This review is undertaken during the design permitting process. However, the language does not specify the manner or extent to which solar access should be protected.

[6] Boulder Revised Code: Title 9, Land Use Regulation; Chapter 9, Development Standards; Section 17, Solar Access. http://www.colocode.com/boulder2/chapter9-9.htm#section9_9_17
[7] Ashland Municipal Code Title 18, Land Use; Section 18.70, Solar Access. http://www.ashland.or.us/CodePrint.asp?Branch=True&CodeID=3338
[8] Santa Cruz 24.08: Land Use Permits and Findings; Section 43 (5). http://www.codepublishing.com/CA/SantaCruz/html/SantaCruz24/SantaCruz2408.html#24.08.400

BENEFITS

1. The policy applies equally to everyone regardless of whether a neighbor owns a solar system. This is beneficial because it preserves solar access for future solar owners.
2. The policy protects use of passive solar building designs, including passive heating and natural lighting.
3. The policy may be perceived as fairer because it avoids the arbitrariness of lot-by-lot policies that restrict development only in cases in which a property happens to be adjacent to another property with a solar system.
4. The policy is relatively simple to implement and enforce.

DRAWBACKS

1. The economic costs to society may be higher than in other policies. This is because all properties are being limited in their development rights, while many properties that benefit from protected solar access may never take advantage of it.
2. Any policy that increases property-line setbacks and tightens height restrictions are at odds with policies that attempt to increase urban density.

Solar Access Permits

Numerous states and local governments have adopted policies that grant specific solar access protections to property owners who have installed a solar system. Most jurisdictions that provide these protections grant solar system owners the rights to the airspace over their neighbor's property through a solar access permit. Below are examples of solar permitting laws and ordinances.

- **Wisconsin solar access permitting**[9]—Wisconsin state law allows municipalities to grant a solar access permit to a solar system property owner. The permit protects the solar system owner from future shading from a new structure or new vegetation on a neighboring property. The law requires neighboring property owners to be notified of the pending permit before a permit can be granted. Any impacted neighbor can request a hearing to adequately review the merits of the permit. If granted, the permit protects the solar system from shading between 9 a.m. and 3 p.m. year-round, but exempts existing buildings and vegetation. The statue empowers the solar permit holder to an injunction to require the trimming of vegetation that causes shading, but is limited to damages paid for shading caused by a building. This means that a solar system owner will get paid for shading from buildings but can actually have vegetation removed. The City of Prairie du Sac has instituted its own local ordinance furthering the state statute. The Prairie du Sac ordinance precludes protections from shading that reduces less than 5% of the energy produced on any given day.

- **Massachusetts solar access permitting**[10]—Massachusetts state law grants general permission to local governments to provide special permits to protect access to direct sunlight for solar energy systems. The law does not define what is to be considered impermissible shading, nor does it dictate remedies in the event of a violation of the protections granted. The law encourages local governments to create a local permitting process that "[balances] the need of solar energy systems for direct sunlight with the right of neighboring property owners to the reasonable use of their

[9] Wisconsin Statute § 66.0403. https://docs.legis.wisconsin.gov/statutes/statutes/66/IV/0403?view=section. See Prairie du Sac Code of Ordinances: Title 10, Land Use Regulations; Chapter 8, Solar Access. http://prairiedusac.net/vertical/Sites/%7B9B4AD25B-1470-4128-8A1E-0DB407531D87%7D/uploads/%7B336B25D3-E9EE-44A7-AB3E-AA493B44EFCA%7D.PDF

[10] Massachusetts Statute Ch. 40A § 9B. http://www.malegislature.gov/Laws/GeneralLaws/PartI/TitleVII/Chapter40A/Section9B

property within other zoning restrictions."

- **Ashland, Oregon**[11]—Ashland, Oregon offers solar access permits for protection of shading from vegetation only. The ordinance requires the city to notify neighboring property owners, and allows neighbors to file an objection, which triggers a hearing. At the hearing, the objector must show that the proposed permit would "unreasonably restrict the planting of vegetation." If the objector proves that an unconditional approval of the application would unreasonably restrict use of their property, the city may add exemptions to the permit. If the permit is granted, the ordinance allows for an injunction in the event vegetation shading the panels is not trimmed. The shading can also be declared a public nuisance, which is a criminal offense.

- **Boulder, Colorado**[12]—Buildings in Boulder's Solar Access Area III are allowed to apply for solar access permits. Boulder's law is unique in that it allows the applicant to specify the hours of the day, seasons of the year, and locations on the lot for which protection is desired. Like other solar permitting laws, the City is required to send written notice to affected property owners. The City Manager is instructed to issue a solar access permit if it is "consistent with reasonable use and enjoyment of nearby land." The statute is clear that permits can be issued that impose requirements on a neighboring lot owner that are more restrictive than the height or setback requirements that would otherwise apply.

- The State of Wyoming, State of New Mexico, and Teton County, Wyoming have also developed solar access permitting laws.[13]

BENEFITS

1. The policy is targeted at properties that most benefit from solar access protections (i.e., properties that already have solar or have immediate plans to install solar).
2. The policy encourages people to install solar because their right to solar access only vests once they have a permit.
3. The policy tends to be more protective of solar access than zoning laws.

DRAWBACKS

1. The policy imposes relatively steep costs on the neighbors of solar system owners in the form of restricted property rights.
2. The policy (as implemented in the examples above) does not protect passive solar systems.
3. Protections are not guaranteed in circumstances where permits can be denied if neighbors protest.
4. Enforcement of the policy is potentially costly and time-consuming to the solar system owner and local government. (E.g., securing an injunction on a neighbor.)

Easements

An easement allows an individual to use the property of another for a specific purpose.[14] In the case of a negative easement, the property owner agrees to limit what he can do on his property. Thus, a useful

[11] See footnote 7
[12] See footnote 6
[13] Wyoming Statute Title 34, Ch. 22, § 101. http://legisweb.state.wy.us/statutes/statutes.aspx?file=titles/Title34/T34CH22.htm; New Mexico Statute § 47-3. http://www.emnrd.state.nm.us/ECMD/LawsRegulationsExecutiveOrders/documents/SolarRightsAct.pdf; Teton County, Solar Access Regulations. http://www.tetonwyo.org/plan/docs/ComprehensivePlan/Resolutions/Solar.pdf.

legal tool to preserve solar access is a negative easement that limits one property owner's ability to utilize the airspace above his property to the benefit of the neighboring property owner. California law explicitly authorizes voluntary solar easements and allows local governments to require solar easements when subdividing property. Below are examples of how state and local governments can utilize easements to protect solar access.

- **Sebastopol & San Luis Obispo, California**[15]—The cities of Sebastopol and San Luis Obispo, California have both taken advantage of state law that allows local governments to require the creation of solar easements when approving subdivision projects. Sebastopol requires city planners to set the terms of the easement when the tentative map or tentative parcel map is approved, while San Luis Obispo requires the easements to be recorded with the subdivision map. San Luis Obispo's ordinance also specifies that the solar easement only protects solar access between 10 a.m. and 2 p.m. on the winter solstice.

- **Iowa**[16]—Iowa is the only state that allows a solar system owner to record an easement with the county without the agreement of the subservient property (i.e., the property whose airspace is being restricted). Iowa's law requires the solar system owner to first attempt to negotiate a voluntary easement with the neighboring property, and if the local regulatory board or district court grants an easement, requires the solar system owner to compensate the neighboring property for the impairment of his property. The compensation is the difference between the fair market value of the property prior to and after granting the solar access easement, and is determined by the local regulatory board or court.

- **Voluntary easements**—Although SF Environment did not find any examples where this has occured, local governments could promote voluntary solar easements between neighboring property owners. Governments could promote easements by providing solar system owners with model solar easement agreements or providing free legal services to support the negotiation of easements.

BENEFITS

1. The policy is better for the neighbors of solar system owners. Under voluntary easements, the neighboring property owner has agreed to the restriction on his property. Even under the Iowa model, although he need not agree to the easement, he will be compensated for the loss.
2. The policy is flexible. Easements can be tailored to specific circumstances, such as specific hours of the day, permissible levels of shading, and length of time it applies.

DRAWBACKS

1. The policy, particularly the Iowa model, imposes financial costs on solar system owners. In San Francisco, if a solar system owner were to compensate her neighbor for the lost rights to develop his property (either through a voluntary easement or the Iowa model), she could easily pay many times

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[14] A typical easement would allow a property owner who has no street front to use a designated piece of a neighbor's property to gain access to the road. See "Easement Basics." *Findlaw*. Web. 01 Nov. 2012. http://realestate.findlaw.com/land-use-laws/easement-basics.html.

[15] Sebastopol Zoning Ordinance: Title 16, Subdivision Regulations; Chapter 36, Dedications, Fees, and Reservations; Section 60, Dedication of Solar Easements. http://ci.sebastopol.ca.us/sites/default/files/mgourley/pdf_2012_zoning_ordinance_master_updatd_as_of_3_27_2012.pdf
San Luis Obispo Municipal Code: Title 16, Subdivisions; Chapter 18, General Subdivision Design Standards; Section 170, Easements for Solar Access. http://www.codepublishing.com/ca/SanLuisObispo/?SanLuisObispo16/SanLuisObispo1618.html

[16] Iowa Code § 562A, Access to Solar Energy. http://coolice.legis.iowa.gov/cool-ice/default.asp?category=billinfo&service=iowacode&ga=83&input=564A

more for the easement than the cost of the solar system due to the high value of real estate and development rights in the city.

2. The process of creating an easement is time consuming and typically requires a lawyer. Moreover, easements are typically enforced through lawsuits, which also can be time consuming and costly. Consequently, easements are rarely used even when they are allowed.
3. Voluntary easements require the agreement of neighbors, who often are uninterested, particularly if there is no perceived benefit to themselves.
4. Subdivision easements are, by definition, limited to circumstances where property is being subdivided.

Public Insurance – Solar Access Indemnity Fund

Another option for reducing the financial risk of lost solar access is to insure a solar system. While some forms of private insurance exist for large solar projects, there is no standard insurance product to protect small-scale rooftop solar from shading from new development. However, a state or local government could create a public insurance program. While no public solar insurance program exists today, SF Environment has envisioned a Solar Access Indemnity Fund (SAIF) as a potential policy to compensate the owner of a solar system in the event the performance of the system is impaired from shading by new or additional construction on neighboring properties. A SAIF may be a particularly useful tool for local governments that want to mitigate harm to solar owners from local policies that encourage dense development.

There are numerous details to be considered in designing a SAIF program. Below are a few features that influence program design.

- **Defining the economic loss for which the solar system owner should be compensated**—One key feature is how the economic loss to the solar system is defined. In particular, whether the solar system owner should be compensated for lost income due to reduced energy production, or only for the up-front system costs that have not been recovered. Consider a solar system that costs $15,000 when installed (after tax credits and rebates), and is expected to produce cumulative income of $60,000 over 25 years. Imagine, for simplicity, the system becomes fully shaded after the owner has recouped $10,000 through reduced utility bills. The program designer must determine if the owner is eligible to be compensated only for the unrecovered $5,000 in system costs, the net present value of the remaining $50,000 in expected income, or some value in between.[17]

- **Determining eligible methods to make the system owner "whole"**—There are potentially multiple ways for reimbursing the system owner for her loss, or making her "whole." For example, if there is another location on the same roof that is unaffected by shading, the SAIF could simply pay to move the panels to an unshaded spot on the same roof. This would be a relatively inexpensive solution, but is probably unavailable in most circumstances. Assuming there is no unshaded location on the roof sizeable enough for the solar system, there are two other main options: (1) the solar system could remain in place and the SAIF could pay the system owner to make her whole; or (2) the SAIF could purchase the system from the owner, remove the system from the house, and reinstall the system in a non-shaded location where the system can maximize its energy production and

[17] If the system is not fully shaded, then there is a chance that the net present value of future cash flows—although reduced—will exceed the $5,000 in system costs that have yet to be recouped. In that case, the owner would not be eligible for any compensation if the program limits compensation to unrecovered up-front system costs.

generate revenue for the SAIF.[18] The first option is likely least expensive when the system is not significantly shaded, or the shading occurs later in the system's life. The second option is likely least expensive when the system is highly shaded, or if the shading occurs earlier in the system's life. An exception is if a commercial system becomes shaded within five years after being installed. Commercial systems benefit from five-year accelerated depreciation, and those benefits are lost if the system changes ownership within that time.

- **Determining whether to make annual payments or a lump-sum payment**—In addition to defining the economic loss to the solar system owner, and determining what method to use to make the owner whole, the SAIF program designer must determine whether to reimburse the solar system owner in one lump-sum payment, or make a series of payments over the remaining life of the system.

- **Creating a funding source**—A SAIF requires revenue to finance payments to impacted solar system owners. Securing a funding source may be complicated by Proposition 26, discussed in the text box. Setting aside those hurdles, small fee increases to building-related permits could provide the necessary funding. For example, a surcharge could be added to all building permits or electrical permits issued, or only to permits issued for solar systems. Setting the "right" fee will require forecasting expected shading incidence, and thus claims against the fund, and balancing that against forecasted permit applications. The SAIF could also be funded through other discretionary sources that a city might have available to it. (See the appendix for an analysis of SAIF funding requirements for a hypothetical San Francisco program.)

IMPLICATIONS OF PROPOSITION 26

In California, the establishment of a SAIF is complicated by Proposition 26, passed by voters in 2010, which reclassified many regulatory fees as taxes. If revenue is classified as a tax, then it requires approval by two-thirds of local voters. These constraints are somewhat reduced by seven exemptions in the law.* Three of these exemptions appear most relevant to the creation of a SAIF.

(1) The "special benefit or privilege" exception, which provides that a fee imposed by local government that provides a special benefit to the person paying the fee or directly grants the person some privilege is not a tax.
(2) The "licenses and permits" exception, which provides that a fee imposed for issuing licenses and permits, as well as the costs of administrative enforcement of licenses and permits, are not taxes.
(3) The "property development" exception, which provides that a fee imposed as a condition of property development is not a tax.

Further legal analysis is required to determine what sources of revenue might be classified as fees.

* "Proposition 26 Implementation Guide." *League of California Cities.* April 2011.

- **Requirements for eligibility**—A SAIF program must also determine what requirements should be made of solar system owners in order to be eligible to receive SAIF funds. It may be wise, for example, to require new solar systems to be registered in a city database. This would empower the city to conduct shadow analysis to better understand shading that may occur in the future as new buildings are constructed. The program

[18] Though not currently an option, if community solar laws are passed in California, the SAIF could also reinstall the system in an unshaded location, and credit the original owner with the system's production as if it were still on their own roof.

could also require that solar systems be initially sited in the best possible location to limit the potential of future shading. In addition, the program could require a solar system owner to demonstrate that a neighboring property does not have pending development plans by, for example, requiring a check against the city's building permit database.

BENEFITS

1. The policy avoids restricting the development rights of or imposing costs on neighboring property owners.
2. The policy does not conflict with densification goals.

DRAWBACKS

1. The policy obligates a local government to uncertain future expenditures.
2. It may be challenging to find an adequate revenue source that can be classified as a fee, and thus avoid the requirement of two-thirds approval from local voters under Proposition 26.

V. Conclusion

There are multiple public policies that can reduce the risk of financial losses from solar system shading, many of which have already been implemented by state and local governments across the country. While it is unclear whether solar system shading from new construction is an urgent problem, it is sure to become more prevalent as solar energy becomes more ubiquitous and urban densification continues.

Appendix – SAIF Financial Analysis for San Francisco

Looking at San Francisco in recent years, the City has annually issued approximately 20,000 building permits, 13,000 electrical permits, and 600 electrical permits for solar PV. SF Environment's preliminary analysis of a SAIF for San Francisco shows that payments might start at about $13,000 annually and climb to about $270,000 over 25 years.

The table below shows the potential revenue requirements of a hypothetical SAIF program for the City and County of San Francisco. This analysis assumes:

- The economic loss to property owners is defined as the value of lost energy production over the system's lifetime;
- Depending on whichever method is least costly to the SAIF, the SAIF will either pay the solar system owner for the value of energy lost to shading, or remove and reinstall the system, and pay the owner for the value of all energy the system has yet to produce;
- Annual payments will made to the solar system owner over the remaining 25 years of the system's life, reducing immediate and unexpected drains on the fund, and providing the fund administrators better ability to plan for expected outlays.

	SF Solar Capacity (Excluding Municipal)			Impairment		SAIF Outlays
Year	Annual growth	MW	kWh	Rate	Capacity Impaired (kWh)	Dollars
2012	20%	13.64	18,564,040	1.50%	278,461	$13,283
2013	18%	16.05	21,840,239	1.54%	335,794	$16,018
2014	16%	18.84	25,640,630	1.58%	404,080	$19,276
2015	14%	22.02	29,973,076	1.62%	484,166	$23,096
2016	12%	25.59	34,825,415	1.66%	576,611	$27,506
2017	10%	29.51	40,162,989	1.70%	681,611	$32,515
2018	9%	33.78	45,980,944	1.74%	799,857	$38,155
2019	8%	38.40	52,264,335	1.78%	931,888	$44,453
2020	7%	43.34	58,987,563	1.83%	1,078,059	$51,426
2021	6%	48.58	66,114,186	1.87%	1,238,513	$59,080
2022	5%	54.08	73,597,139	1.92%	1,413,158	$67,411
2023	5%	59.85	81,454,240	1.97%	1,603,125	$76,473
2024	5%	65.91	89,704,196	2.02%	1,809,633	$86,324
2025	4%	72.21	98,284,151	2.07%	2,032,287	$96,945
2026	4%	78.77	107,207,304	2.12%	2,272,217	$108,390
2027	4%	85.59	116,487,382	2.17%	2,530,627	$120,717
2028	3%	92.61	126,045,863	2.23%	2,806,737	$133,888
2029	3%	99.85	135,891,099	2.28%	3,101,616	$147,955
2030	3%	107.30	146,031,691	2.34%	3,416,394	$162,970
2031	2%	114.90	156,375,096	2.40%	3,749,836	$178,876

2032	2%	122.65	166,925,368	2.46%	4,102,900	$195,718
2033	2%	130.56	177,686,646	2.52%	4,476,589	$213,544
2034	1%	138.54	188,555,537	2.58%	4,869,177	$232,272
2035	1%	146.61	199,533,117	2.65%	5,281,474	$251,939
2036	1%	154.75	210,620,472	2.71%	5,714,321	$272,587

Below are key assumptions:

Residential systems	
Percent of total SF solar capacity	70.0%
Average system size	3 kW
Initial installation cost	$5.00 / W
Lifespan	25 years
Commercial systems	
Percent of total SF solar capacity	30.0%
Average system size	25 kW
Initial installation cost	$4.50 / W
Lifespan	25 years
Electricity production & value	
Electricity production	1361 kWh / kW
Average retail electricity rate	$0.20 / kWh
Annual retail electricity rate inflation	3%
Discount rate	4%
Shading	
Total shaded solar in SF, 2012 (% of total installed capacity)	1.5%
Annual increase in percentage total shaded solar	2.5%
Percent shading on each system that is impaired	50%
Reinstallation costs	
Residential systems	$1.75 / W
Commercial systems	$1.25 / W