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Residential Solar Photovoltaics: Comparison of Financing Benefits, Innovations, and Options

Bethany Speer

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Technical Report
NREL/TP-6A20-51644
October 2012

Contract No. DE-AC36-08GO28308

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Prepared under Task Nos. SM10.2442, SM12.3010

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Acknowledgments

Special thanks are due to Jason Coughlin [National Renewable Energy Laboratory (NREL)] and Matthew H. Brown (Harcourt Brown & Carey) for providing expert insights and reviews that significantly informed this report.

Thank you to Joshua Huneycutt, Jennifer DeCesaro, Stockton Williams, and Charles Coggeshall of the U.S. Department of Energy for their guidance. Much appreciation goes to Robin Newmark, David Kline, Dan Bilello, and Jeff Logan of NREL for their invaluable managerial support and reviews. Also, thanks to Karlynn Cory (NREL) for the ongoing direction she has provided.

Many thanks to the various state, local, and utility employees who helped answer my questions regarding their solar loan programs, including Sheli Jacoby and Kathi Montgomery (Alternative Energy Revolving Loan Program), Keith Kurtz (Iowa Energy Center), Gina Lehl (Sonoma County Energy Independence Program), Jack Osterman (Nebraska State Energy Office), Samuel Walker (Clark Utilities), and Peter J. Rossi (Powder River Energy Corporation). Thank you to Michael Shields and Nick Lara of PHOTON International.

To Scott Gossett, Mary Lukkonen, and Linda Huff (NREL), I appreciate your editorial support.

Thank you to former NREL colleague Ron Koenig for his excellent research into property assessed clean energy (PACE) programs, upon which this report builds.

List of Acronyms

ARRA	American Recovery and Reinvestment Act of 2009
COMR	cash-out mortgage refinancing
DC	direct current
DOE	U.S. Department of Energy
DSIRE	Database of State Incentives for Renewables and Efficiency
FHFA	Federal Housing and Finance Agency
HEL	home equity loan
HELOC	home equity line of credit
ITC	investment tax credit
LIGH	Long Island Green Homes
MACRS	Modified Accelerated Cost Recovery System
NREL	National Renewable Energy Laboratory
O&M	operations and maintenance
PACE	property assessed clean energy
PBI	production-based incentive
PPA	power purchase agreement
PSE&G	Public Service Electric and Gas Company
PV	photovoltaic
REC	renewable energy certificate
SFC	solar finance company
SREC	solar renewable energy certificate

Executive Summary

This report examines relatively new, innovative financing methods for residential photovoltaics (PV) and compares them to traditional self-financing methods. It provides policymakers with an overview of residential PV financing mechanisms, describes relative advantages and challenges between the various financing mechanisms, and analyzes differences between them where data is available. Because these innovative financing mechanisms have only been implemented in a few locations, this report can help enable their wider adoption.

The financing mechanisms currently available to homeowners are grouped into three categories: (1) traditional self-financing, (2) third-party ownership options, and (3) utility and public financing. Self-financing options are widely available across the United States. They include cash purchases, home equity loans (HEL), home equity lines of credit (HELOC), and cash-out mortgage refinancing (COMR). Power purchase agreements (PPAs) and solar leases are the two private sector third-party ownership options. State and local governments and utilities provide a variety of financing options, with the three primary prototypes being utility financing, public loans (i.e., credit-enhanced and revolving loans), and property assessed clean energy (PACE) financing. Although the focus of this report is financing options for PV, many of these financing options may also be used to procure other types of residential renewable energy or energy efficiency improvements.

PACE is not an option for most homeowners at this time due to the Federal Housing and Finance Administration (FHFA) and the Office of the Comptroller of the Currency's safety and soundness concerns regarding underwriting criteria for borrowers in PACE jurisdictions. One of the major concerns surrounds the PACE priority lien that is ahead of mortgage and other lenders' debt. The Federal Deposit Insurance Corporation and National Credit Union Administration have also expressed concerns. The FHFA, specifically, directed the federal mortgage entities to undertake stricter underwriting in districts with PACE (see Section 1.2 for details), which resulted in the suspension of most residential PACE programs.

Currently, the FHFA faces lawsuits regarding PACE. There could be legal or regulatory solutions that would allow PACE. PACE is included in this analysis because the future of the model is uncertain, analysis comparing PACE to other mechanisms is limited, and some localities are pushing forward with PACE or PACE-like programs despite effective moratoriums.[1] This report could help inform future policy decisions regarding PACE.

Policymakers interested in supporting PV in their jurisdiction could consider the various financing options, evaluate those that make the most sense for their constituents, and choose how to support the mechanism(s) that best fits their needs. The following list highlights the primary financing mechanisms for residential PV installations and key conclusions determined in this report:

- **Cash purchases** are the least expensive option in terms of total dollars spent to acquire PV as no financing costs or solar finance company fees are incurred.

[1] Sonoma County, California, is one PACE program going forward with its residential assessments, following a brief stoppage (Sonoma 2010a).

However, the upfront cost of a PV system is significant and likely a barrier for most households. Additionally, the homeowner will need a sufficient federal tax liability ($11,115 in this report's example) to take full benefit of the federal investment tax credit (ITC) (See Section 2.1 for more details).

- **Traditional self-financing, including HELs, HELOCs, and COMR** are provided by banks and credit unions across the country and therefore are likely the most available options for homeowners. However, access to self-financing requires that homeowners have good credit, enough equity in their home to finance the system, and preferably, a home in an area with stable property values. Similar to a cash purchase, homeowners must also determine whether they can take full benefit of the federal ITC.
- **Solar PPAs and solar leases** enable homeowners to benefit from commercial tax incentives available for solar—the ITC and the Modified Accelerated Cost Recovery System (MACRS)—by partnering with a third-party solar provider. By making efficient use of tax incentives, third-party ownership can be cost competitive with local retail electricity rates. Solar PPAs and leases are only widely available in markets with:
    - Favorable interconnection and net-metering policies
    - Legal or regulatory clarity for third-party solar ownership models
    - Local financial incentives.
- **Utility loans** are a low-cost financing option that can either be an on-bill loan or meter-attached (i.e., secured to the meter/electric service). However, only homeowners who are customers of utilities that provide or participate in financing programs can access these loans. While there are many utility financing programs for energy efficiency and other types of improvements, only a few consider PV to be an eligible improvement.
- **Credit enhancements** combine third-party capital from banks or credit unions with public-sector support to encourage lending for solar. Credit-enhanced programs include loan loss reserves, subordinated debt, and interest rate buy-downs.
    - A loan loss reserve is a fund that backs a pool of loans up to a project-specific amount, thereby reducing the loans' risk profile (Kubert and Sinclair 2011). This allows the lender to underwrite loans that might not be affordable or available on the private market. Borrowers benefit from access to more attractive financing terms than would otherwise be available. Loan loss reserve funds can also be combined with other financing programs, such as PACE and revolving loans.
    - State and local governments can provide subordinated debt as part of the capital available for a solar loan program. The private lender provides the remaining principal and takes a senior lien position. In the event of a default, the state/local government takes the first loss on the subordinated debt before the private lender absorbs any losses. Similarly to loan loss reserves,

subordinated debt reduces the risk profile of a loan and improves a borrower's ability to take on affordable debt.

    - Interest rate buy-downs are not technically a credit enhancement as they do not improve a borrower's risk profile. However, interest rate buy-downs do improve the affordability of a loan and the borrower's ability to repay.

- **Revolving loan funds** are typically established by a state or local government or utility and are ideally replenished as loans are repaid. Revolving loan funds often provide low interest rates, greater accessibility due to flexible underwriting guidelines, and extended loan terms.

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1 Introduction

Homeowners who procure solar photovoltaic (PV) energy can benefit from on-site generation in a number of ways, including:

- Saving money by producing their own power or buying directly from the producer at a rate lower than what they pay for retail electricity from their utility
- Locking in a fixed electricity bill expense for up to a 20-year period
- Using electricity from a zero-emissions fuel source
- Potentially increasing the value of their home (adapted from DOE 2010; Hoen et al. 2011).[2]

This report examines the primary tools available to homeowners for procuring PV energy. This research builds upon the following resources:[3]

- Homeowners Guide to Financing a Grid-Connected Solar Electric System (DOE 2010)
- Solar Photovoltaics Financing: Residential Sector Deployment (Coughlin and Cory 2009b)
- Guide to Energy Efficiency and Renewable Energy Financing Districts for Local Governments (Fuller 2009)
- Solar Leasing for Residential Photovoltaic Systems (Coughlin and Cory 2009a).

In this report, the procurement options are grouped into three general categories: (1) traditional self-financing, (2) third-party ownership, and (3) utility and public program financing, as shown in Table 1.

Table 1. Solar Procurement Options

Traditional Self-Financing	Third-Party Ownership	Utility and Public Financing
• Cash purchase • Home equity loan (HEL) • Home equity line of credit (HELOC) • Cash-out mortgage refinancing (COMR)	• Power purchase agreement (PPA) • Solar lease	• Utility financing (including on-bill and meter-secured) • Public financing (including credit-enhanced and revolving loans) • Property assessed clean energy (PACE) financing

Self-financing is widely available from a number of banks and credit unions across the United States, allowing homeowners to borrow against their accrued equity. In the last five years, a number of financing innovations have developed in the marketplace, including **solar power purchase agreements (PPAs) and leases**. Under these models, private industry solar finance

[2] Whether a homeowner sees an increase in its home's value will depend on the specifics of the situation.
[3] Additional useful resources are included in Appendix A.

companies provide solar electricity or solar equipment with no/low upfront costs. In addition to innovative private financing, **utility and public PV loan programs** provide additional creative financing solutions, the availability of which will depend on state laws and regulations, as well as program-specific rules. With the exception of the PPA and solar lease, all of these options may be possible for other types of clean energy improvements, including energy efficiency improvements.

In addition to procuring solar for sole use on their property, homeowners (as well as renters) can participate in community solar programs where they are available. Community solar programs provide a means for those who lack the financial resources to procure an entire system, live in a home with a poor solar resource, or rent a house or an apartment where solar is not an option to take advantage of PV electricity benefits (Coughlin and Cory 2009b). Community solar programs vary widely and allow for participation in a number of ways, including (1) investing directly in a project or (2) paying a subscription fee to receive a credit to their utility bill as "virtual net metering."[4] Homeowners also have the option to participate in "group-buy" programs to aggregate purchases of systems or third-party ownership contracts.[5] These community solar programs are not covered in this report.

1.1 Policy Factors Impacting the Availability of Solar Financing and Energy Purchase Models

There are several factors that influence the availability and affordability of procuring solar energy for homeowners in the United States.[6] First, favorable interconnection and net-metering policies need to be in place. Interconnection policies that support PV development either have high capacity caps or no caps at all (for each system and for all the systems in aggregate).[7] Net metering allows PV system owners to receive credit for excess generation that is fed back into the grid. Appendix C contains maps of recent interconnection and net-metering policies.[8]

Second, there is the 30% investment tax credit (ITC) offered by the federal government that homeowners can either use directly (e.g., self-financing, utility, or public program financing) or indirectly (e.g., third-party ownership). To make use of the tax credit directly, a homeowner would need to pay enough taxes to write off a portion of the liability and therefore receive the benefit. A homeowner who either self-finances or uses a public or utility program can file for the federal ITC to reduce the net installed cost of the PV system, but it is not received until the

[4] Community solar is not covered in this report; for more information, see "A Guide to Community Shared Solar: Utility, Private, and Nonprofit Project Development," U.S. Department of Energy, 2012. http://www.nrel.gov/docs/fy12osti/54570.pdf.

[5] See Appendix B for more information.

[6] In addition to financing options and incentives, homeowners should also consider a variety of other factors, including the availability of roof or land space, shading, solar insolation, solar access laws, and homeowners' association laws, which are outside of the scope of this report. The In My Backyard (IMBY) solar calculator (http://www.nrel.gov/eis/imby/about.html) provides an estimate of solar production based on system size, location, and other variables. The Database of State Incentives for Renewables and Efficiency (DSIRE) provides information on solar access laws (http://www.dsireusa.org/incentives/index.cfm?SearchType=Access&&EE=0&RE=1); consult your homeowners' association about other restrictions.

[7] Interconnection caps are intended to address issues that can arise from high levels of additional electricity added to the grid resulting from an aggregation of many residential systems. Individual smaller systems (e.g., 10 kW) would not significantly impact the function of the distribution system.

[8] For an additional explanation of the importance of net metering on PV system economics, see Coughlin and Cory 2009b.

following year. Therefore, the homeowner will still have to finance the full installation cost (minus any other rebates) until the tax credit is received. Depending on their tax liability, a homeowner may need to carry the tax credit forward across multiple years until it is fully utilized.

Third, in states with existing incentives, homeowners may be eligible for rebates, production-based incentives (PBIs), and renewable energy certificates (RECs). Rebates reduce the upfront cost of the system, while PBIs (including feed-in tariffs) provide a cash in-flow over a certain number of years (e.g., 5 to 10) that reduces the payback period of the system. Similar to the federal ITC, eligible homeowners may be able to use a rebate to reduce the total amount of the loan they take out when self-financing or participating in a utility or public-financing program. In states with REC purchasing programs, homeowners could receive an upfront payment for all estimated RECs or they can receive payments over time, as the RECs are generated, similar to a PBI. With current solar system prices, solar finance companies offering third-party PPAs and leases often need additional state or local incentives to be able to provide homeowners with solar electricity prices (or solar lease rates) that are competitive with the local electricity rates that the homeowner pays to its utility. Appendix D contains a map of current state financial incentives.[9]

Because many homeowners are not able to make use of the tax credit and because there is an additional depreciation (MACRS) tax benefit available only to commercial PV system owners,[10] private industry has developed two models to monetize the tax credits and pass a portion of the savings along to homeowners: the third-party PPA and solar lease.[11] These models are discussed in further detail in Section 3.

1.2 Notice on Property Assessed Clean Energy Financing

All solar energy procurement mechanisms are currently available in many markets, with the exception of PACE financing, which is relatively rare. Residential PACE is under an indefinite suspension due to federal mortgage regulator concerns expressed by the Federal Housing Finance Authority (FHFA) as well as concerns expressed by the Office of the Comptroller of the Currency, the Federal Deposit Insurance Corporation, and the National Credit Union Administration regarding the safety and soundness of PACE programs.

Specifically, the FHFA, which oversees Fannie Mae, Freddie Mac, and the Federal Home Loan Banks, released a letter in July 2010 instructing the lenders to undertake actions to address the safety and soundness concerns by adjusting underwriting criteria for borrowers in PACE jurisdictions. Because Fannie and Freddie own over 50% of the nation's home mortgages, the regulations enacted by them have significant sway on the mortgage markets (Zimring et al. 2010). As a result, most residential solar PACE finance programs are under a practical indefinite moratorium, with Sonoma County, California, being the notable exception (Sonoma 2010a).

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[9] Coughlin and Cory (2009b) provide additional discussion of various incentives, including cash incentives, RECs, and state tax incentives; however, specific policy information may no longer reflect current policy/incentive levels.

[10] MACRS allows owners of certain types of capital investments to claim an accelerated tax deduction due to capital depreciation. See DSIRE at http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US06F&re=1&ee=0 for more information.

[11] For additional information on the 30% federal tax credit, see the DSIRE "Residential Renewable Energy Tax Credit" website at http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US37F.

However, PACE programs for commercial businesses continue to be offered as they do not face the same regulatory constraints.[12]

The FHFA currently faces lawsuits on the matter from a number of entities. In addition to legal actions to re-enable PACE, the possibility of legislative and regulatory solutions exists as well. But unless a resolution is reached, PACE financing will not be an option for most homeowners. To determine whether to support PACE or PACE-like programs, policymakers should understand how PACE financing compares to other solar financing mechanisms that are available to homeowners. For this reason, analysis of PACE financing is included in this report.

1.3 Report Structure

Section 2 includes descriptions of each of the traditional self-financing mechanisms and a quantitative and qualitative comparison of the options. Section 3 focuses on residential PV financing innovations through a discussion and qualitative comparison of the solar PPA and lease options. Utility, public (e.g., revolving loans and credit enhancements), and PACE financing are described in Section 4 with a qualitative comparison of these three options. Section 5 provides a summary description of all the financing mechanisms discussed in this report and conclusions.

[12] For more information on why PACE financing continues to be available to commercial borrowers, see Zimring et al. 2010.

2 Traditional Self-Financing Options for Homeowners

Self-financing has been the traditional method for homeowners to finance a PV system (Coughlin and Cory 2009b). Self-financing options are also the most widely available because they are not restricted to certain markets or political boundaries, as is the case with third-party ownership models and utility and public financing programs. However, the ability of homeowners to access self-financing will depend greatly on the availability of cash for a direct purchase or their credit rating and existing home equity for the standard home-equity-based financing options.

The following subsections include brief descriptions, examples, and qualitative analyses of the primary PV procurement options available to homeowners that include cash purchases, home equity loans (HELs), home equity lines of credit (HELOCs), and cash-out mortgage refinancing (COMR). A comparative quantitative analysis is provided in Section 2.3.

2.1 Cash Purchase

An average-sized residential PV system (5.7 kW-DC) costs roughly $37,050 before tax incentives and excluding sales tax.[13] After the 30% ITC is taken into account, the cost of an average-sized PV system falls to $25,935. To take advantage of the tax credit, homeowners must have a significant federal tax liability ($11,115 in this example). Although many homeowners may not have enough tax liability to take the tax credit in the first year, it is possible to carry the tax credit forward over multiple years.[14]

Cash Purchase Cost Example:

$37,050 (market price)

Net Cash Purchase Cost after ITC Only Example:

$37,050 (market price) - $11,115 (30% ITC) = $25,935 (after-tax cost to be financed)

A number of states have incentives for residential PV that directly reduce the cost of the system before the 30% federal ITC is applied. For example, a residential customer of an investor-owned utility in New York is eligible for an upfront rebate of up to $1.50/direct current (DC)-watt

[13] This estimate is based on a 5.7-kW system at $6.50/W. The *2010 Solar Market Trends Report* states that the average-sized PV system installed was 5.7 kW-DC (Sherwood 2011). *Tracking the Sun IV: The Installed Cost of Photovoltaics in the U.S. from 1998-2010* reports installed costs for residential systems to have averaged $6.90/W, excluding sales or value-added taxes (Barbose et al. 2011). However, 2010 installed costs in California were reported to be between $5.00/W and $6.00/W, thus $6.50/W is a moderate estimate to account for variances across the U.S. market and can be considered a conservatively high estimate. Therefore, 5,700 W x $6.50/W = $37,050 for the total system cost.

[14] According to One Block Off the Grid, a community-based group-buy program, the tax credit can be rolled forward until at least 2016, but it is uncertain if the credit can be carried forward beyond that point. For more information, see http://1bog.org/federal-solar-tax-credit/. A tax expert should be consulted if you are considering using the residential ITC. The credit does lose some value if carried forward due to the impacts of inflation.

(W).[15] The total amount of the rebate for which they would be eligible is $9,975 based on the average system size of 5.7 kW. The amount of the ITC is 30% of the system cost after the cash incentives are taken into account. While $18,952 is the after-rebate and tax cost, $27,075 would need to be paid for in cash, or as in the other examples explored in this report, financed to purchase the system up front.

Cash Purchase with State Rebate Example:

$37,050 (market price) - $9,975 (total rebate) = $27,075 (system cost after rebates—to be financed)

$27,075 (system cost after rebates) - $8,123 (30% ITC) = $18,953 (net installed cost)

Paying with cash is likely the lowest total-cost means of buying a PV system because the buyer does not incur any financing costs, which is the case with self-financing, utility, or public financing programs. While a cash purchase is the least expensive option in terms of total cost, there are several challenges with this approach, including that homeowners will need to:

- **Have enough money in the bank**—most homeowners do not have that much cash available (sometimes the installer will float the cost of state incentives, but a large amount of cash is still needed before construction begins).
- **Consider whether it is better financially to purchase a solar system outright and forgo other investment opportunities** as opposed to financing the solar system and investing cash elsewhere (e.g., savings or other investments or other home upgrades).
- **Select a solar installer.**
- **Service or replace the inverter** one to two times over the life of the system (e.g., 25 years or longer), which could cost around $1,600 to $2,600 for each new inverter assuming today's technology and cost (PHOTON Consulting 2011).[16] While these estimated inverter costs are in today's dollars and residential inverter prices are expected to decrease, homeowners will need to consider contracting with a system service provider if they choose not to take care of the operations and maintenance

[15] The rebate amount may be adjusted depending on shading, for example. Although the incentive is considered an upfront rebate, it is paid in two increments with the final installment following interconnection of the system. For additional information, including eligibility requirements, see DSIRE's website on the New York State Energy Research and Development Authority's (NYSERDA) PV incentive program: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=NY10F&re=1&ee=0.

[16] Inverter replacements are assumed to average every 11.9 years for residential PV systems in the United States (PHOTON Consulting 2011), which could result in roughly two inverter replacements per system over the expected 25-year life. According to PHOTON Consulting's "The True Cost of Solar Power: The Pressure's On" report (2011), the 2011 inverter cost for a U.S. residential PV system is assumed to be $0.28–$0.46/W. Using the average residential PV system size of 5.7 kW, or 5,700 W (Sherwood 2011), a new inverter may cost roughly $1,600 to $2,600. These cost estimates do not account for the expected cost reductions resulting from new innovations and technological advancements.

(O&M) themselves.[17] (This is also true for the other financing options excluding third-party PPAs and leases).[18] These challenges, as well as the benefits of using cash to purchase a PV system, are outlined in Table 2.

Table 2. Cash Purchase: Benefits and Challenges

Benefits	Challenges
• No financing costs—this is a significant benefit as interest can add a large amount to the lifetime total cost of the system • Direct system ownership (i.e., non-third-party owned) gives the homeowner control of system management • Ability to choose how to handle O&M • For all methods of procuring solar energy there is the potential for an overall reduction in utility bills as all the savings accrue to the homeowner; however, whether there are savings depends on future electricity prices, the amount of energy produced by the system, and the consumption level of the home, among other unknowns	• Homeowner pays for the total installed system cost up front • Homeowners will have the uncertainty of a new and unknown appliance, which will likely require inverter replacements and monitoring to ensure the system does not go offline (which is rare) • The system will perform better when kept clean and free of debris; some homeowners may wish to contract out the O&M responsibilities, adding additional costs • To maintain system performance, homeowners will have to make additional purchases and maintenance investments (e.g., inverters) in the future • Homeowners will forgo other investment opportunities

[17] For more information, see Greentech Media's *The Global PV Inverter Landscape: Technology and Market Trends, 2011 – 2015* http://www.greentechmedia.com/research/report/the-global-pv-inverter-landscape. Purchasing a license is required.

[18] Although PV systems are considered passive applications because they do not have moving parts (except on ground-mounted systems with trackers), the systems do require regular O&M to ensure optimal performance. Many solar finance companies providing solar leases (and sometimes those who provide solar PPAs) use remote system monitoring to determine if O&M is needed. Here is a sample O&M schedule from Public Service Electric and Gas Company (PSE&G) for residential solar PV systems: http://www.pseg.com/home/save/solar/pdf/sample_OM_residential.pdf.

2.2 Home Equity Loans, Home Equity Lines of Credit, and Cash-Out Mortgage Refinancing

There are several financing options available to homeowners who choose not to (or cannot) purchase a PV system with cash. The options include HELs (also known as second mortgages), HELOCs, and COMRs.[19] Mortgage banks and credit unions provide HELs, HELOCs, and COMRs, so all of these financing options are widely available geographically. Homeowners with reasonable credit, good mortgage payment history, significant equity in their home, and enough income to cover the loan payment may be able to access these financing sources (Geffner 2011). However, homeowners may find these forms of financing difficult to obtain if they live in an area with high rates of home foreclosures, especially as a result of the recent mortgage market crisis (Guillot 2010).[20] Details of these financing options are included in Appendix E.

2.3 Comparative Analysis of Traditional Self-Financing Mechanisms

The self-financing mechanisms (excluding cash purchase) have relatively similar financing structures. As shown in Figure 1 and Table 3, the cost of financing a PV system with an estimated $37,050 in capital costs using HELs, HELOCs, and COMRs varies by location. The locations of Sonoma County, California, and Boulder County, Colorado, were chosen to facilitate comparison with PACE programs in the same locations (see Section 4.3.1).[21] State and local financial incentives were ignored in this analysis to focus on the cost of financing itself. Small differences in interest rates can have a significant impact on the lifetime cost of financing. Interest rates are generally the highest for HELs; however, HELOC rates fluctuate, and therefore, a homeowner could experience a higher effective interest rate with a HELOC over time in comparison to a HEL or COMR. Also, interest rates for HELs and COMR are compound whereas HELOC interest rates are simple and therefore are not incorporated into the principal. There are generally no fees (upfront or yearly) or very low fees for HELs. HELOCs and COMR loan contracts often require upfront or yearly fees with non-interest costs tending to be the highest for COMRs (akin to first mortgages). However, the fees make up a small portion of the overall cost of financing. Note that no national averages of fees were readily available.

[19] Reverse mortgages are another option for qualified homeowners. See http://reversemortgageguides.org/reverse_mortgage/eligibility_requirements/ for more information.

[20] See http://www.bankrate.com/finance/home-equity/home-equity-loans-helocs-tough-to-find-1.aspx for more information.

[21] Note that the Boulder County residential PACE program is not currently operating.

The information included in Figure 1 and Table 3 is based on a small sample of market rates at a given point in time. Actual rates will vary depending on the homeowner's location, credit rating, and extraneous market factors.

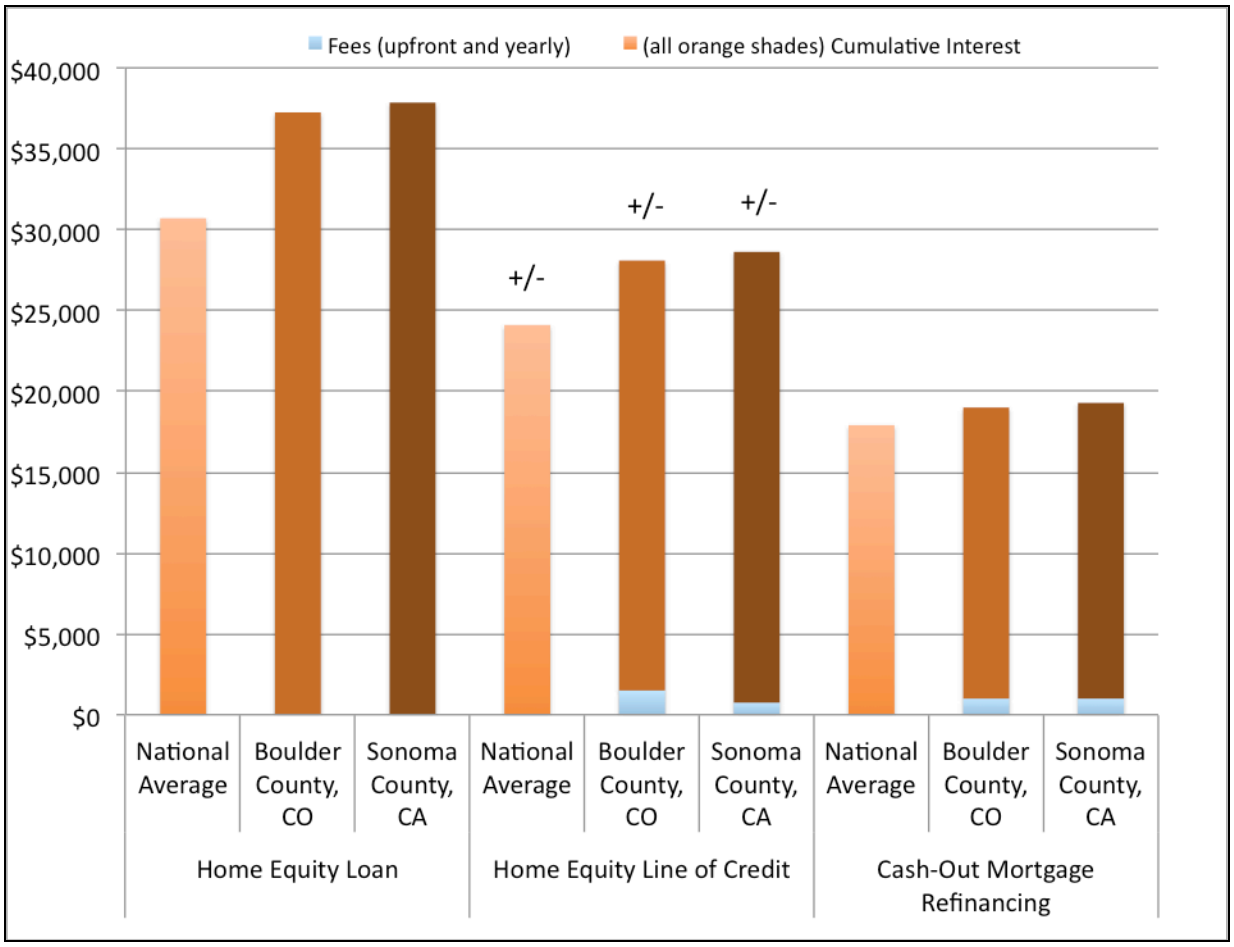

Figure 1. Comparison of traditional self-financing costs for national averages, California, and Colorado, excluding state incentives[22]

[22] Interest rates are based on the following assumption: Cost per watt is $6.50 installed. The total system cost before tax is $37,050 (or 5,700 W x $6.50). Because most homeowners would need to finance the full amount of the system ($37,050), this example calculates interest and fees for the full cost of the system, and thus the ITC is not taken out before financing. The loan term is assumed to be 20 years with 12 payments per year. A 20-year loan term is assumed because the life of a PV system is expected to be greater than 20 years (many solar PPAs and leases are also for 20 years). The average system size of 5.7 kW is from Sherwood 2011. Bankrate.com (2011a) is the source for interest rates and fees, which were averages for the national market; Boulder, Colorado, was used as the location for Boulder County interest rates and fees; and Santa Rosa, California, was used as a proxy for Sonoma County rates and fees. When multiple interest rates were provided, an average of the high and low rate or fee was used. A "good" FICO score of 660–749 was applied. HELs and HELOCs were assumed to be for $50,000 [rates and fees are quoted at fixed levels on www.bankrate.com (e.g., $30,000 and $50,000), and thus the amount was rounded up to $50,000]. For COMR, a 30-year fixed mortgage with a 20% down payment was applied with a $287,050 mortgage to cover $250,000 for a home with an additional $37,050 for cash-out to cover the cost of the PV system. The amortization schedule used for compound interest rates is found at http://www.vertex42.com/ExcelTemplates/loan-amortization-schedule.html (accessed November 28, 2011). Simple interest rates were found at http://www.planningtips.com/cgi-bin/simple.pl.

Table 3. Traditional Self-Financing: Quantitative Comparison of Financing Costs for National Averages, California, and Colorado, Excluding State Incentives[23]

	National Average			Boulder County, CO			Sonoma County, CA		
	Total Fees	Interest Rate	Cumulative Interest	Total Fees	Interest Rate	Cumulative Interest	Total Fees	Interest Rate	Cumulative Interest
HEL	n/a	6.78%	$30,719	$0	7.99%	$37,271	$0	8.10%	$37,881
HELOC[24]	n/a	5.50%	+/-$24,117	$1,500	5.99%	+/- $26,603	$750	6.24%	+/- $27,892
COMR	n/a	4.23%	$17,918	$998	4.25%	$18,012	$998	4.31%	$18,298

[23] Assumptions and sources are the same as for Figure 1.
[24] HELOC interest rates fluctuate and may increase. Thus, it is possible the borrower would pay more or less interest over the term of the HELOC than is shown in Figure 1 and Table 3.

3 Third-Party Ownership

Traditional self-financing tools provide homeowners with a means of purchasing a PV system outright. However, some homeowners have additional options for procuring solar energy via third-party ownership models, such as PPAs or solar leases, offered by multiple local, regional, and national solar finance companies. Currently, third-party financing mechanisms are clearly allowed in 22 states plus Washington, D.C. (DSIRE 2012d). For third-party ownership models to be viable, a state (or locality) needs:

- The right combination of incentives or a renewable energy certificate (REC) market[25]
- Clarity as to whether the models can be used under current state and local laws and regulations
- Favorable interconnection and net-metering policies.

The following sections describe solar PPAs and leases and provide a qualitative analysis. See Appendix F for details of the third-party ownership models.

3.1 Third-Party, Residential Power Purchase Agreements

Under a residential PPA, a solar finance company designs, purchases, installs, and typically operates and maintains the system that is hosted on the homeowner's property, usually on the roof. The homeowner buys 100% of the energy produced at a cost that is typically competitive with the homeowner's local electric utility rate. It may be established within the PPA that this rate escalates over time (e.g., 2% per year) or remains fixed. The homeowner could also be required to make a down payment (e.g., $1,000). The higher the down payment, the lower the price per kilowatt-hour will be over the life of the contract and vice-versa. Some homeowners may be able to qualify for a zero-money-down contract.

While there are several benefits to solar PPAs, there are also a few challenges, as noted in Table 4. One challenge to obtaining a solar PPA is that the homeowner will need good credit (as is the case for self-financing). According to SolarCity, which offers PPAs but is better known for offering leases, homeowners will need very good credit with a FICO score of 700 or greater (Solar City 2011). Also, PPAs are best for homeowners who plan to own their current residence for a significant length of time. In the event of a move, the homeowner will need to do one of the following[26]:

- Transfer the contract to the homebuyer if the buyer meets the credit requirements of the third-party solar finance company. This assumes that the potential buyer is interested in taking over the PPA.
- Buy-out the agreement by paying for the energy for the remaining term of the contract. This could be expensive for the homeowner, especially if there are a number of years left in the PPA. It would be up to the homeowner to try to regain some or all

[25] For an explanation of REC markets, see http://www.ftc.gov/bcp/workshops/carbonoffsets/presentations/lbird.pdf.
[26] Although it is conceivable that a homeowner could have an installation removed and reinstalled on their new home and continue the contract, the author is not aware of examples of this occurring or solar finance companies providing this option.

of this cost in the selling price of the home. However, offering "free electricity" as a potential perk of buying the home may make it a more attractive property to a prospective homebuyer.

Table 4. Third-Party Power Purchase Agreement: Benefits and Challenges

Benefits	Challenges
• Option for homeowners who cannot obtain self-financing for various reasons (e.g., not enough equity in their home) • Investor monetizes tax benefits and the solar finance company passes some of these cost savings on to the homeowner • Electricity rates are locked in for the life of the contract but may include an escalator (e.g., a 2% annual increase on the $/kWh price) • No/low upfront costs • System O&M is likely provided under the PPA contract. This includes future inverter costs and all other maintenance costs • Often include a buy-out option for the end of the contract (e.g., after year 20) in which the homeowner takes ownership of the system • May be able to pre-pay a portion of the contract in order to receive an overall lower kilowatt-hour rate	• Only available in some states—state incentives or REC markets are needed for the economics of this model to work (e.g., to attract third-party developers to the state) • Homeowner will need strong credit scores • A PPA is a long-term commitment with penalties for breaking the contract

3.2 Third-Party, Residential Solar Lease

The solar lease model is very similar to the third-party PPA. Under both contracts, the homeowner hosts the system and the solar finance company designs, purchases, and installs the system in exchange for payments over a long-term contract. The primary difference between the solar lease and the PPA lies in how the payment is structured. Under a PPA, the homeowner is buying electricity; payments are made for all of the electricity produced (and none are made if there is no production). With a lease, the homeowner is making monthly lease payments and there is no sale of electricity.[27] This lease payment is either fixed over the life of the contract—typically up to 20 years—or it escalates annually (e.g., 2% per year). If there is an escalator, it will be outlined in the contract. A lease may include an upfront payment; however, this appears to be less common. A higher upfront payment would lower subsequent lease payments.

[27] This distinction is important in states, like Florida, that allow solar leasing but not third-party PPAs. For more information, see *Solar PV Project Financing: Regulatory and Legislative Challenges for Third-Party PPA System Owners* at http://www.nrel.gov/docs/fy10osti/46723.pdf.

A solar lease agreement may or may not include O&M. It is important for homeowners to clarify whether their potential lease would include O&M as the system will likely need inverter replacements and monitoring to keep the system operating optimally.[28]

The credit requirements of homeowners are also the same with a lease as they are with a PPA: Lessees need very good FICO credit scores of 700 or above (SolarCity 2011). Additional benefits and challenges of solar leases are outlined in Table 5.

Two examples of public-private lease programs can be found in Solar Phoenix 2 (http://solarphoenix2.org/) and the CT Solar Lease (http://www.ctsolarlease.com/).

[28] Solar modules gradually lose efficiency over time. However, this natural degradation in electricity production is much less significant than it would be with a system that is not cleaned and maintained with necessary part replacements and repairs.

Table 5. Third-Party Solar Lease: Benefits and Challenges

Benefits	Challenges
• Option for homeowners who cannot obtain self-financing for various reasons (e.g., not enough equity in home) • Investor monetizes tax benefits and the solar finance company passes some of the cost savings on to the homeowner • Lease payments are locked in for the life of the contract but may include an escalator (e.g., a 2% increase on the monthly lease payment) • Potentially no/low upfront costs; however, an upfront down payment would result in lower monthly lease payments • System O&M may be included—homeowner should seek clarification from the solar finance company • Often includes a buy-out option at the end of the contract (e.g., after year 20) in which the homeowner takes ownership of the system • May include a production guarantee in which the system owner (the solar finance company) compensates the homeowner in the event of underproduction, as determined in the contract	• State incentives or REC markets are needed for the economics of this model to work (to draw third-party owners to the state) • It is only available in a small number of states • Homeowner likely will need very good credit • A lease is a long-term commitment with penalties for breaking the contract

3.3 Comparative Analysis of Third-Party Ownership Options

This section provides a qualitative comparison of the solar PPA and lease. A quantitative comparison is not applied because costs are unknown and assumed to be roughly comparable. This is in part because larger solar development firms often offer both procurement models, depending on the markets in which they are operating.

As discussed previously, the main difference between the two third-party ownership models is in how the payments are structured: Solar PPAs are priced on a cents-per-kilowatt-hour basis whereas solar leases consist of flat monthly payments. Contracts for either solar PPAs or leases could include price escalators. One important distinction between the solar lease and the PPA is that under a PPA, O&M is very likely included in the contract. Because payment is based on actual electricity output, the solar finance company is incentivized to keep the system performing optimally to increase the amount of power sold (the end user usually agrees to buy 100% of the power produced). Solar leases may also include O&M; the homeowner should check the contract and discuss with the solar finance company to determine if that is the case. Additional similarities and differences between solar PPAs and leases are outlined in Table 6.

Note that the information provided in Table 6 is believed to be generally reflective of the offerings from larger solar finance companies as described in Sections 3.1 and 3.2 and may not be indicative of PPA and lease options available from all solar finance companies.

Table 6. Comparison of Third-Party Ownership Options

	Power Purchase Agreement (PPA)	Solar Lease
Homeowner Owns the System	No	
Financing Provider	Solar finance company	
Funding Source	Tax equity investor	
Sample Fees/Closing Costs	$0–$1,500[a]	
Monthly Payments	Based on electricity production	Fixed monthly payment whether the system operates or not
Full Use of ITC Guaranteed	Yes, by the solar developer	
Contract Length	Up to 20 years	
Payments Stable Over the Contract Term	Yes, although it could include a price escalator (in the case of a PPA) or a payment escalator (in the case of a lease)	
Tax-Deductible Interest Payments	No	
Appears on Homeowner Credit Report	No[b]	
Separate Installer and O&M Contracts	No	O&M may be included in some solar leases; homeowner should check the contract
Collateral	PV system	
Transferable upon Home Sale	Yes, with buyer qualification	
Buy-Out Option	Yes, contracts can include buy-out options, likely at pre-determined points in the contract after year six when the tax benefits have been fully monetized	

[a] Historically, down payments have been required, but they appear to be less common currently.
[b] According to Apollo Energy Partners (third-party solar finance company), a solar lease does not affect a homeowner's credit report unless they are delinquent (Apollo Energy Partners 2011).
Sources: DOE 2010; NREL analysis

4 Utility and Public Financing

Several utilities, states, and local governments have solar PV system financing programs for eligible residents. There are two purposes for creating these programs: (1) to help homeowners who may not have access to traditional self-financing options or (2) to improve the affordability of financing by reducing interest rates and upfront fees and relaxing lending guidelines. Also, some of these programs were created before third-party ownership financing was developed or in those markets where these private finance mechanisms do not exist. In some cases, utility and public program finance mechanisms exist in markets alongside the solar PPA and lease as an additional option.

The following sections briefly describe utility financing (Section 4.1); public financing (credit-public-private co-financing, and revolving loans) (Section 4.2); and PACE financing (Section 4.3) and include the key challenges and benefits of each. Section 4.3.1 contains a detailed comparison of self-financing options and PACE. Section 4.4 provides a qualitative comparison of utility and public-program financing options.

4.1 Utility Loans

Utility financing is available to some residential (and commercial) customers and can be administered at the utility, state, or local/municipal level (Warren 2011). Typically, utility financing programs are structured to be cash-flow neutral or positive so that electricity savings are equal to or greater than the cost of the loan. However, because utility financing is most commonly available for energy efficiency and lower-cost renewable energy technologies, homeowners may not achieve a positive or neutral cash flow with a higher-cost PV system. Utility financing programs can be funded by utilities with ratepayer, shareholder, or borrowed funds (Brown 2009).

Utility loans come in two primary forms: (1) on-bill financing where the customer repays the principal and interest on their electric bill (or on a separate bill) and (2) metered-secured financing, in which the loan is tied to the meter/property. Because an on-bill loan is tied to the borrower, the homeowner must repay the loan when they move. In contrast, a meter-secured loan is underwritten to the property (DOE 2011b). Thus, if the property is sold, the buyer could potentially take over the loan payments.[29]

For example, Powder River Energy Corporation of Wyoming offered on-bill financing for residential customers, although this program is no longer available (PRECorp 2010; DSIRE 2010f). Customers could take out a loan for up to $2,500/year, and there was no limit on the number of loans a customer could have had as long as the previous loan was paid off in full (PRECorp Guidelines). The loans were 0% interest, although there was an application fee of 4% (e.g., $100 for a $2,500 loan). Customers could choose a loan term anywhere from 1 to 36 months. Because the loan offered by Powder River was capped at a relatively low amount, it would not have been sufficient to fund the installation of an average-sized PV system ($37,050 in this report's example, which does not include the ITC or any state/local incentives).

[29] Whether this is a possibility depends on the financing program and the home sale negotiations, among other potential factors.

Another example comes from the Pacific Northwest. Clark Public Utilities provides loans for solar energy equipment, including PV systems, to its Washington State residential customers (DSIRE 2010b).[30] Clark caps its loan at $30,000, which would not be enough to cover the full upfront costs of the system used as an example in this report with a total cost of $37,050. Under the program, the loan is billed separately from the homeowner's electric bill. Table 7 provides a summary of some of the primary similarities and differences between Powder River Energy Corporation and Clark Public Utilities' financing options. Clark currently has four solar loans in place, and PRECorp financed at least 11 systems (Walker 2011; PRECorp 2010/2011).

The information in Table 7 is based on a small sample of programs. Program characteristics vary and innovation can improve program design.

Table 7. Utility Loan Program Examples: Characteristics

	Powder River Energy Corporation (PRECorp)—Wyoming (revolving loan)	Clark Public Utilities—Washington
Program Type	On-bill	
Homeowner Owns System	Yes	
Financing Provider	Co-op utility	
Maximum Amount per Borrower	$2,500 per customer per calendar year	$30,000
Percent of Project Costs	100% up to the maximum loan amount	100%
Fees/Closing Costs	4% application fee	For loans <$5,000, there is a $225 fee; for loans >$5,000, there is a $350 fee; the fee can be paid up front or folded into the loan
Interest Rate	0%	5.25%
Full Use of ITC Guaranteed[31]	No	
Loan Term	Maximum 3 years	Maximum 5 years for loans less than $10,000; maximum 7 years for loans greater than $10,000
Payments are Fixed over Loan Term	Yes	

[30] See the Clark Public Utilities website for more information on its solar energy equipment loan program: http://www.clarkpublicutilities.com/index.cfm/our-environment/generate-your-own-power/solar-options/loans-and-rebates/photovoltaic-systems/.

[31] Homeowners may not have the tax appetite to make full use of the ITC, especially in the first year.

	Powder River Energy Corporation (PRECorp)—Wyoming (revolving loan)	Clark Public Utilities—Washington
State Tax-Deductible Interest Payments	No (0% interest)	Unknown – Clark refers customers to their tax accountants; however, interest paid on other personal loans is generically considered to be tax deductible
Appears on Homeowner Credit Report	No	
Separate Installation and O&M Contracts	Yes, likely	
Collateral	None—unsecured debt	
Transferable Upon Home Sale	No (Clark is not meter-secured and thus is not transferable)	
Buy-Out/Early Repayment Possible	Yes	
Technologies	Renewable energy including PV; energy efficiency	Solar technologies
Billing	Electric bill	Separate bill
Funding Source	Co-op members	

Source: DSIRE 2010b; PRECorp 2011; PRECorp 2010; PRECorp 2010/2011; DSIRE 2010f

Another example of a utility solar loan program is that of the Public Service Electric and Gas Company (PSE&G) of New Jersey. Loans are available to cover around 40% to 60% of the installed system cost. The loans are for 10 years at 6.5% interest, and homeowners can choose whether to repay the loan with cash or sign over the solar renewable energy certificates (SRECs) to PSE&G. The SREC price is locked-in at the time the loan closes and is paid to the system owner for the SRECs generated by the system over the first 10 years. The New Jersey Public Utilities Board has authorized PSE&G to rate-base (or recover) the cost of the program through the electricity rates. The final deadline for loan applications was December 31, 2011, and therefore the program is not detailed in this report. However, it serves as a useful example of an innovative financing program.[32]

Table 8 outlines several of the major benefits and challenges of using utility financing for a residential PV system. One of the key benefits of utility financing is that it may be more accessible to some homeowners than self-financing or third-party ownership procurement because the programs may include relaxed lending guidelines. Also, utility programs can provide competitive interest rates (0% and 5.25% in this report's case studies). Despite the benefits of

[32] For more information on PSE&G's solar loan program, see http://www.pseg.com/home/save/solar/overview.jsp and http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=NJ21F&re=1&ee=1.

utility financing, there are also several challenges, including being limited only to participating utilities' customers and having no guarantee that electricity savings will offset financing costs.

Table 8. Utility Financing: Benefits and Challenges

Benefits	Challenges
• Eliminates upfront cost hurdles: access to financing reduces first-cost project barriers • Low interest rates • Possible option for homeowners who cannot obtain self-financing for various reasons (e.g., not enough equity in their home) • Utilities have access to various sources of capital that can facilitate flexible underwriting and lending terms (i.e., interest rates and term length); meter-secured loans may provide added flexibility with potentially longer loan tenors • The potential for a utility to disconnect a customer's service in the event of non-repayment is a benefit to the program as it is a powerful incentive to repay (also a challenge) • It is possible for the debt to stay with the meter, allowing for the transfer of the loan; however, in the examples of Clark Public Utilities and PRECorp, transfer of the loan is not allowed • With on-bill financing, there is the possibility of the loan appearing on the same bill as the potential electricity savings, depending on the program; this is not the case with the Clark Public Utilities program • Direct system ownership (i.e., non-third-party owned) gives the homeowner control of decisions regarding the solar PV system	• Available only in a few locations; requires authorizing legislation or regulatory order in the case of regulated utilities; for co-op and municipal utility programs, which are not regulated, the utility must be engaged in supporting and funding a program • No guarantees of savings exceeding loan payments: savings or system performance will likely decline over time; even if the homeowner purchases a third-party performance guarantee, the guarantee will not make up for system degradation • In the event of default, the utility could file disconnect notifications and procedures resulting in the termination of services (i.e., the borrower's power could be turned off)

Sources: Kubert and Sinclair 2011; Brown 2011; DOE 2011b; NREL analysis
For more information on utility financing, see Harcourt Brown and Carey Consulting's report *Energy Efficiency Finance: Options and Roles for Utilities* at http://harcourtbrown.com/finance/hbcs-latest-publication-energy-efficiency-finance-options-and-roles-for-utilities/.

4.2 Public-Private Co-Financing and Revolving Loans

There are two main types of state and local loan programs: (1) public-private co-financing and (2) revolving loans. This section describes these loan programs.

Public-private co-financing uses third-party capital (i.e., that of banks or credit unions) to support lending for all or a portion of a loan. The state or local government either provides a loan for the remaining portion of the principal or a credit enhancement for the private-lender portion of the loan. The state or local government portion often subsidizes the net cost of the loan by providing a reduced interest rate. By dividing up the loan, the state or local government and lender share in the risk of default. Credit-enhanced programs include loan loss reserves, subordinated debt, and interest rate buy-downs.

- A loan loss reserve is a fund that backs a pool of loans up to a project-specific amount (Kubert and Sinclair 2011). This differs from a loan guarantee, which provides repayment for up to the entire amount of a loan.[33] Reserves are paid into an account based on the outstanding loan amount and reflect the risk of non-payment or default. For example, a payment into a loan loss reserve fund could represent 5% to 25% of an individual's loan principal. Typically, only delinquent payments are made up to the lender upon default. In the event of a bankruptcy, the lender will sell the home to the property buyer, who will make the future loan payments. And thus the bulk of the value of the loan survives bankruptcy (Supple and Nix 2010). A loan loss reserve reduces the risk profile of the loans thereby allowing the private lender to underwrite loans that otherwise might be too risky for the lender and too expensive for the borrower. The state or local government often funds the loan loss reserve at the outset of a program and then the fund can be replenished via loan surcharges (Supple and Nix 2010). Loan loss reserve funds can also be combined with other financing programs, such as PACE.
- Under a subordinated debt program, a state or local government provides a loan that is subordinated to the private sector loan. This means that in the event of a default, the subordinated loan absorbs the initial loss before the private loan is impacted. Similar to loan loss reserves, subordinated debt reduces the risk profile of a private loan. As a result, borrowers who would otherwise not have access to a loan may be able to obtain financing, or they may receive improved lending terms (e.g., a lower interest rate or longer loan tenor).
- Although not a credit enhancement per se, state and local governments can provide an interest rate buy-down where they pay for a portion of the interest rate required by the private lender. An interest rate buy-down improves the affordability of a loan and the borrower's ability to repay. In contrast to a loan loss reserve and subordinated debt where total program expenditure is unknown because the rate of defaults is not known (but can be estimated), interest rate buy-downs are sunk costs.

Revolving loan funds provide direct loans to the homeowner that ideally replenish a pool of funds over time as the principal and interest is repaid. Revolving loans may be initially funded (and/or continually supported) by different methods, including appropriations, public benefit

[33] Loan guarantees are not a common credit enhancement provided to homeowners as a means of financing PV projects and therefore are not discussed in detail in this report.

funds, alternative compliance payments, environmental non-compliance penalties, bond sales, and tax revenue (Ellingson et al. 2010). The programs often include additional benefits to consumers such as low interest rates, increased availability due to relaxed lending guidelines, and extended loan tenors. Revolving loans can be combined with the credit enhancements discussed above if the program is a public-private partnership.[34]

Table 9 provides examples of states with public-private partnerships and revolving loan programs for homeowners to finance PV installations. Many states also have loan programs for energy efficiency and non-residential borrowers.

The information in Table 9 is based on a small sample of programs. Program characteristics vary and innovation can improve program design.

Table 9. Public-Private Co-Financing and Revolving Loan Program Examples: Characteristics

	Iowa Alternate Energy Revolving Loan Program (AERLP)[a]	Montana Alternative Energy Revolving Loan Program[b]	Nebraska Dollar and Energy Savings (NDES) Loan Program[c]
Program Type	Public-private partnership/revolving loan	Revolving loan	Public-private partnership/revolving loan
Homeowner Owns System	Yes		
Financing Provider	State government and private lender	State—Department of Environmental Quality/financing contractor	State government and private lender
Maximum Amount per Borrower	$1,000,000	$40,000	Up to $14,000 for the first kilowatt on systems ≤10 kW; $4,000 for each additional kilowatt up to 15 kW, prorated by system size; maximum $125,000 (25 kW)
Fees/Closing Costs	AERLP loan: typically no fees; lender loan: market rate	Application fee: $50; closing costs: 2% of loan request or $250, whichever is greater	Yes—lender determined
Interest Rate	0% for ALERP portion; private lender rate for remaining portion of loan	4%	0% for NDES portion of the loan; market rate for private-lender-provided portion[d]
Percent of Project Costs	Up to 50% of project cost	Up to 100%	Up to 100%

[34] For example, the state/local government could provide a portion of the principal with a revolving loan and support the remaining private-lender provided portion with a loan loss reserve or credit enhancement.

	Iowa Alternate Energy Revolving Loan Program (AERLP)[a]	Montana Alternative Energy Revolving Loan Program[b]	Nebraska Dollar and Energy Savings (NDES) Loan Program[c]
Full Use of ITC Guaranteed	No		
Loan Length	Maximum 20 years	Maximum 10 years	5–15 years
Payments Stable Over Length of Loan	Yes		
Appears on Homeowner Credit Report	Yes		
Separate Installer and O&M Contracts	Possible but not required		
Collateral	Typically land or improvements; other options available at lender's discretion	Installation or first or second mortgage if significant enough equity[f]	Dependent on lender requirements
Transferable Upon Home Sale	No	Yes, pending buyer qualification	Depends on lender
Early Repayment Possible	Yes, on a pro rata share (e.g., 50% to AERLP and 50% to the lender)	Yes	Yes, without penalty
Funding Source	Iowa's investor-owned utilities; state-issued economic recovery bonds	Air quality penalties collected by the state enforcement division	Oil overcharge funds; American Recovery and Reinvestment Act (ARRA); miscellaneous state, public power district, and federal funds[f]
Eligible Technologies[e]	Renewables including PV		Renewables including PV; energy efficiency

[a] Additional information on Iowa's Alternate Energy Revolving Loan Program can be found at http://www.iowaenergycenter.org/alternate-energy-revolving-loan-program-aerlp/.
[b] Information on Montana's Alternative Energy Revolving Loan Program can be found at http://www.deq.mt.gov/Energy/Renewable/altenergyloan.mcpx.
[c] See the Nebraska Dollar and Energy Savings Loan program website for additional information: http://www.neo.ne.gov/loan/.
[d] The interest rate is dependent upon the technology that is funded and the source of the funding (DSIRE 2010e).
[e] Public-private co-financing and revolving loan programs may allow for loans toward other types of improvements outside of the general categories of energy efficiency and renewable energy. For example, the Nebraska Dollar and Energy Savings Loan Program allows borrowers to fund personal computing and telecommunications equipment (DSIRE 2010e).
[f] Nebraska received ARRA funding, which the state directed to fund loans for non-residential borrowers (DSIRE 2010e).
Sources: DSIRE 2010c; Kurtz 2011; Montgomery and Jacoby 2011; DSIRE 2010d; DSIRE 2010e; Osterman 2011

Table 10 highlights some of the main benefits and challenges of using credit enhancements and revolving loans to finance a PV system. One of the main benefits provided by public-private and revolving loans often is below-market financing costs due to subsidized interest rates and fees. When loan loss reserves and subordinated debt are utilized, they reduce lender risk of default, making the investment more attractive overall. Also, homeowners with less-than-excellent credit may find public loan programs to be more accessible compared to self-financing or third-party ownership as a result of more flexible underwriting criteria. Similar to utility financing, state- and local-government-provided loans are only available in certain states and localities that offer the programs.[35]

[35] For more information on revolving loan programs, see the National Association of State Energy Officials' (NASEO) report, *State Energy Revolving Loan Funds – Overview and Trend*s, at www.naseo.org/resources/selfs/State_Energy_RLF_Report.pdf. And for a complete list of loan programs for renewable energy technologies, see http://www.dsireusa.org/incentives/index.cfm?SearchType=Loan&EE=0&RE=1.

Table 10. Credit-Enhanced Financing and Revolving Loans: Benefits and Challenges

Benefits	Challenges
• Cost of borrowing could be below third-party ownership requirements because state and local governments may be more accepting of risk as the programs are non-profit • Possible option for homeowners who cannot obtain a HEL for various reasons (e.g., not enough equity in their home) • Public-private partnership loans leverage government funds as long as the funds are available • Loan loss reserve funds and subordinated debt reduce investor risk and make programs more attractive to lenders; they also reduce the cost of borrowing for participants • With a revolving loan, all funds are recoverable (except for defaults) compared to other types of incentives (tax credits, grants, etc.) • Interest rate buy-downs reduce the cost of borrowing • Loan terms are flexible • Direct system ownership (i.e., non-third-party owned) gives the homeowner control	• Available only in a few locations • Revolving loans are inherently capital constrained. Once all the initial capital is loaned out, the program must await repayment of principal and interest to relend money. One way to lessen this challenge is to shorten the loan tenors. However, this may be challenging with PV due to the higher capital costs that typically require longer repayment terms. • Even with credit enhancements, borrowers may still not have access to a loan • With revolving loans, state or local governments (or utilities) may not have loan origination expertise • When loan origination expertise is transferred to the private lender, there is dependency on the lender for loan approval and to provide improved terms despite credit enhancements. However, lenders are well suited for vetting borrowers and loan origination. • If the closing fees are not subsidized they may be on par with market fees, especially if these fees are not capped by the state or local loan program • These programs depend on subsidies and grants that may be less feasible now due to state and local budget constraints

Sources: Kubert and Sinclair 2011; Brown 2011; NREL analysis

4.3 Property Assessed Clean Energy

As discussed in Section 1.2, PACE financing is largely unavailable to homeowners because of regulatory concerns. Sonoma County, California, is an exception as it still offers residential PACE (Sonoma 2010a), and there are other programs that identify themselves as PACE, though they may be more similar to other loan programs.[36] *PACE is currently available to commercial businesses in a few locations, including San Francisco, Sonoma County, Palm Desert, Placer*

[36] The Babylon Long Island Green Homes program is an example of a PACE-like program but differs in that a lien is only enacted in the event a homeowner defaults on loan repayment. See http://ligreenhomes.com/page.php?Page=home for more information on this program. The Babylon program also does not support solar PV financings.

County, and the Western Riverside Council of Governments, California.[37] *Additional programs are in development.*[38]

PACE is a nascent public financing mechanism that has been utilized by local governments to enable residents to fund a variety of energy efficiency, water conservation, and renewable energy projects, including PV. State and local governments established PACE programs by first passing new legislation or using existing enabling legislation that allows for the creation of special tax assessment districts. Within these districts, homeowners were able to opt into an established PACE program by agreeing to have a senior tax assessment lien placed on their property in exchange for upfront funds to be used toward approved improvements.[39] The homeowner then repays the assessment via semi-annual or annual payments over the term of the contract as part of its regular property tax payments. Homeowners who do not opt to participate in the program do not pay any additional taxes. The basic structure of PACE is illustrated in Figure 2.

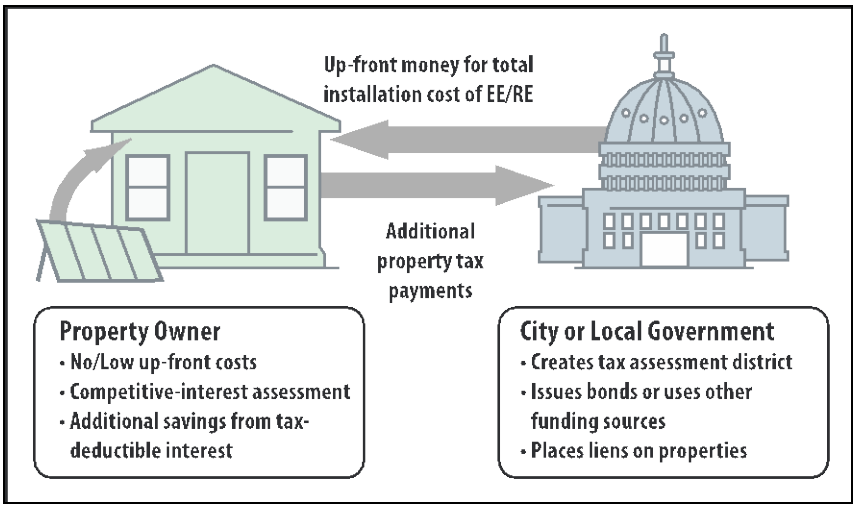

Figure 2. Basic PACE program structure

Source: NREL

Table 11 outlines the important characteristics of two PACE programs: Boulder County, Colorado's ClimateSmart Energy Loan program and Sonoma County, California's Energy Independence program. Note that the Boulder residential program is currently on hold; however, it is used as an example due to the large number of residential financings completed prior to the federal mortgage regulator and lender concerns. For readers interested in how to fund or pay for a PACE program, the options of bonds, micro bonds, general funds, loans, and waste funds are detailed in Appendix G.

[37] The Boulder County PACE program is not currently issuing new commercial PACE assessments. See http://climatesmartloanprogram.org/cslp_commercial.html for more information.
[38] See "Policy Brief: Property Assessed Clean Energy Financing: Update on Commercial Programs" at http://eetd.lbl.gov/ea/ems/reports/pace-pb-032311.pdf for additional information on commercial programs.
[39] A senior lien secures the PACE assessment to the property, requiring repayment. In the event of foreclosure, delinquent assessments are paid to the lien holder (i.e., the state or local government) before a property's first mortgage. This arrangement creates a highly secured repayment mechanism (Fuller et al. 2009).

The information in Table 11 is based on a small sample of programs. Program characteristics vary, and innovation can improve program design.

Table 11. PACE Program Examples: Characteristics

	Boulder County, CO[a]	Sonoma County, CA[b]
Currently Active	Residential: no; commercial: inactive (no new financings)	Residential: yes; commercial: yes
Homeowner Owns System	Yes	
Financing Provider	State, local municipality, or private lender if contracted out by government entity	
Maximum Amount per Borrower	$3,000 minimum to $50,000 maximum (or 20% of the statuary value of the home)	Not to exceed 10% of property value
Fees/Closing Costs	4% of the assessment (rolled into lien); 5% debt service (rolled into assessment and may be received toward the end of the assessment to be used to complete repayment)	Title cost is $50 for <$5,000 loans; $125 for loans $5,000–$499,999; assessment fee: $66; annual administrative fee: $40
Interest Rate	Not to exceed 4.75% (income qualified) or 7.75% (open assessment category)—simple interest	7% simple interest
Full Use of ITC Guaranteed	No	
Contract Length	Maximum 20 years	5 years for systems <$5,000; 10–20 years for systems >$5,000
Payments Stable Over the Loan Term	Yes	
Tax-Deductible Interest Payments	Yes	
Appears on Homeowner Credit Report	No	
Separate Installation and O&M Contracts	Yes	
Collateral	Property lien	
Transferable upon Home Sale	Yes	
Buy-Out/Early Repayment Possible	Yes, complete early repayment is possible (no partial early repayment)	
Funding Source	Bond funded: large bond offerings/pooled approach—	General funds

	Boulder County, CO[a]	Sonoma County, CA[b]
	moral obligation variation[c]	
Eligible Technologies	Renewable energy, energy efficiency	Renewable energy, energy efficiency, water conservation

[a] For more information on Boulder County's ClimateSmart Loan program, see http://www.climatesmartloanprogram.org/.
[b] Additional information on Sonoma County's Energy Independence Program can be accessed at http://www.sonomacountyenergy.org/.
[c] State and local governments can fund PACE programs through a variety of means, including public bonds, bank loans, municipal waste funds, and general funds. These funding mechanisms can impact the cost of the PACE assessment as the cost of borrowing is likely to be passed on to the homeowner, unless the cost is subsidized. Funding mechanisms and their potential implications for program cost are discussed further in Appendix G.

Sources: DSIRE 2010a; DSIRE 2010g; ICLEI 2011; Sonoma County 2010b; Boulder 2011

PACE assessments provide several benefits as well as challenges. Like the other financing options discussed in this report, the primary benefit of PACE assessments is the removal of significant upfront costs. Another potential benefit is the transfer of PACE assessments to property buyers where allowed. Transferring the PACE assessment can ease a homeowner's mind if they are considering selling the home before the assessment is paid in full. However, whether a homebuyer would be willing to take on the remainder of the PACE assessment is entirely dependent upon the buyer and the condition of the housing market. Similar to the other utility and public program financing options, PACE could be more accessible than other means of financing, especially to homeowners with an average credit rating or little equity in their home, making self-financing difficult.[40]

The biggest challenge for PACE is that it is only available to a very few (i.e., those living in Sonoma County, California) due to federal mortgage regulatory and others' concerns. In addition, most PACE programs charge significant administrative fees. For example, the Boulder PACE program required a 4% closing cost that would be rolled into the loan as well as a 5% debt service payment (also rolled into the loan) that could be received toward the end of the assessment to help complete repayment.[41] See Table 12 for additional challenges as well as benefits of PACE.

[40] For more details on PACE program design and operation, see Fuller 2009.
[41] This was for a subsequent issuance that has not come to fruition.

Table 12. Property Assessed Clean Energy Financing: Benefits and Challenges

Benefits	Challenges
• Reduces upfront cost • May allow for transfer of the debt obligation to future building owners, reducing the uncertainty of recovering long-term energy efficiency and renewable energy investments • Option for homeowners who cannot obtain self-financing for various reasons (e.g., not enough equity in their home) • Direct system ownership (i.e., non-third-party owned) gives the homeowner control	• Residential solar PACE is generally not available except in a few locations, notably Sonoma County, California, whose program has continued despite federal regulatory concerns over PACE underwriting and lien practices • Interest rates may not be competitive with other financing options • Unless program administration costs are covered by the program through an initial capital infusion, the administrative fees can be quite high to the system owner—for example, to cover the initial setup of the program, the ongoing annual participation, and the debt reserve fund • The time to originate the loan may be considerable (Brown 2011) • Transferability of the assessment could be both a legal and practical issue (e.g., Will the property be more difficult to sell with the additional tax liability?)

Sources: Adapted from Kubert and Sinclair 2011; NREL analysis

4.3.1 Quantitative and Qualitative Analysis of PACE Assessments to Traditional Self-Financing Tools

This section includes a quantitative and qualitative comparison of PACE with self-financing to provide additional insights into the cost of participating in a PACE program. A more detailed comparison of PACE with third-party ownership is not included because the data on the costs of PPAs and solar leases is not publicly available. A detailed comparison of PACE to other public PV financing mechanisms (i.e., public-private partnerships, revolving loans, and utility financing) is also excluded because these other programs are available only in a few select locations for PV (more programs allow financing of energy efficiency and weatherization improvements). However, general qualitative comparisons between all of the financing mechanisms are made in Section 5.

HELs, HELOCs, and COMR are provided by lenders to homeowners with interest rates and fees determined on a case-by-case basis. In contrast, interest rates and fees for PACE assessments are the same for all participants of a particular program, although the amount and possibly the term of the assessment can differ.[42] As discussed earlier, HELs and COMR have compound interest rates whereas HELOCs are paid back via simple interest. Similarly, PACE interest rates are also simple.

PACE assessments are legally distinct from HELs, HELOCs, and COMRs in several regards. The PACE assessments consist of debt tied to the property; HELs, HELOCs, and COMRs are tied to the property owner as well as the property itself. Like all other property tax assessments, a PACE assessment has a priority lien ahead of mortgage and other lenders, which is one of the major regulatory concerns. However, non-acceleration of the unpaid portion of the lien in the event of default is a potential solution as it allows only the overdue portion of the PACE assessment be repaid to the state/local government, with the mortgage lender next in line to lay claim on the property. In contrast, the pilot Boulder PACE program required that payment of the entire assessment be accelerated in the event that the property was foreclosed based on Colorado law (Strife 2010).

Figure 3 presents cumulative interest costs and fees for self-financing and PACE programs.

[42] Boulder's PACE program offered two categories of participation: (1) income-qualified assessments with a lower interest rate and (2) the open assessment category for non-income qualified participants.

The information in Figure 3 is based on a small sample of programs and market rates at a given point in time. Actual self-financing rates will vary depending on the homeowner's location, credit rating, and extraneous market factors. PACE program characteristics vary, and innovation can improve program design.

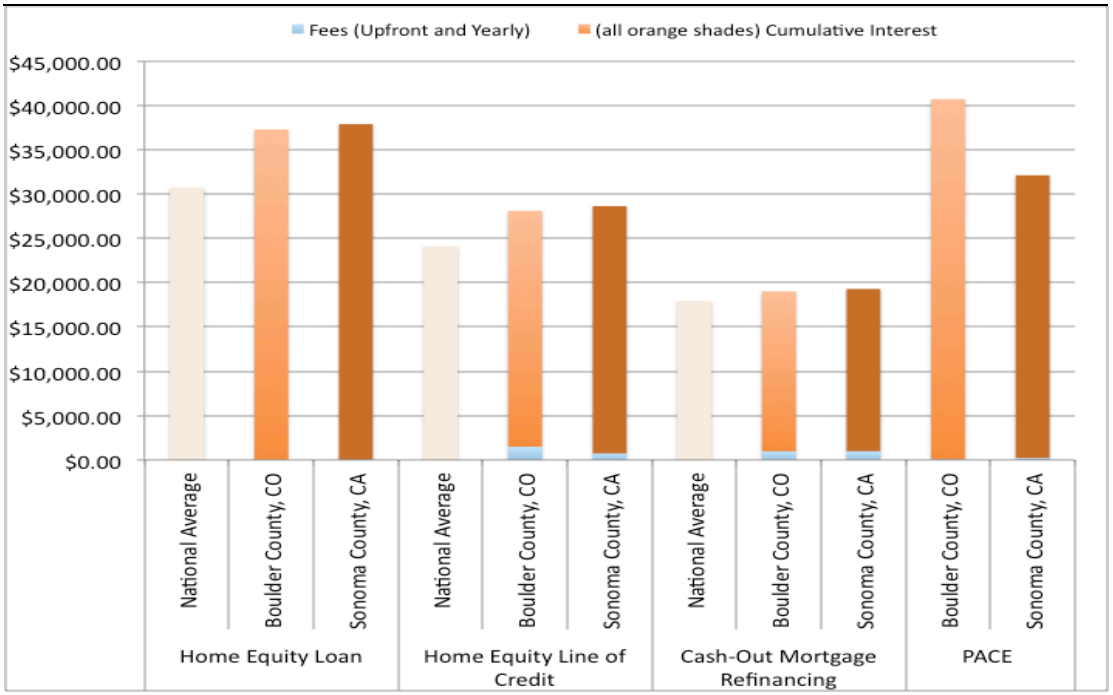

Figure 3. Comparison of PACE assessment to traditional self-financing in Boulder County and Sonoma County, excluding state and local financial incentives[43]

[43] Assumptions are the same as for Figure 1. Interest rates and fees for Boulder are from Boulder 2011, and interest rates and fees for Sonoma are from Sonoma 2010. Interest rates for HELOCs and PACE are simple; HEL and COMR interest rates are compounded. http://www.planningtips.com/cgi-bin/simple.pl.

Table 13. Comparison of PACE to Self-Finance Rates for National Averages, Boulder County, and Sonoma County, Excluding State and Local Financial Incentives[44]

	National Average			Boulder County, CO			Sonoma County, CA		
	Total Fees	Interest Rate	Cumulative Interest	Total Fees	Interest Rate	Cumulative Interest	Total Fees	Interest Rate	Cumulative Interest
HEL	N/A	6.78%	$30,719	$0	7.99%	$37,271	$0	8.10%	$37,881
HELOC[a]	N/A	5.50%	+/- $ 24,117	$1,500	5.99%	+/- $26,603	$750	6.24%	+/- $27,892
COMR	N/A	4.23%	$17,918	$998	4.25%	$18,012	$998	4.31%	$18,298
PACE	N/A	N/A	N/A	+$79[b]	7.75%	$40,621[c]	$225[d]	7.00%	$31,890

[a] HELOC interest rates fluctuate and are likely to increase; thus, the borrower would likely pay more interest over the term of the HELOC than shown in Figure 1 and Table 7. The +/- signs indicate possible fluctuations in interest rates and thus cumulative interest payments.
[b] Fees are based on those estimated on the Boulder County PACE website: http://www.climatesmartloanprogram.com/terms.htm. PACE assessments were planned but not issued at the amount due to the mortgage regulator's concerns. If Boulder County had issued new bonds for another round of PACE assessments, actual interest rates and fees may have varied from those currently on the county's website. The closing fee is included in the financed principal and will therefore accrue interest. Thus, the effective closing cost is higher because of the interest paid on that amount.
[c] This includes a capitalized 13% closing cost, which consists of 4% cost of issuance, 4% capitalized interest, and 5% debt service reserve. This results in the addition of $4,817 to the principal. The debt service reserve fund contribution may be returned to the borrower toward the end of the assessment tenor to be used toward repayment.
[d] This amount includes a $40 application fee, a $125 title fee, and a $60 recording fee.
Source: Bankrate.com 2011a

The cost of PACE financing in Boulder is potentially high with a simple interest rate cap of 7.75% for non-income-qualified participants. If assessments were issued at that rate, the cost of financing may not be competitive with self-financing rates offered in the Boulder area. Sonoma County's PACE assessment rate of 7% and low fees ($225 in this report's example) make this option competitive with local self-financing rates, which are higher in Sonoma County than those of Boulder County and the national average. Of course, to compare actual costs of self-financing to other options, homeowners must get quotes based on their financial standing, needs, and the market in which they live. In the event that residential PACE programs are allowed to go forward, the cost of PACE assessments and possible ways to reduce interest rates and fees for participants should be considered to improve the appeal of PACE compared to other financing mechanisms, especially in markets with moderate to low self-financing rates.

4.4 Comparative Analysis of Utility and Public Program Financing Options

This section includes a comparison of the utility, credit-enhanced and revolving loan, and PACE program examples.

[44] Assumptions are the same as for Figure 1.

The information in Table 14 is based on a small sample of utility and public financing programs. Program characteristics vary and innovation can improve program design. The information provided in Table 14 is reflective of the sample programs described in Sections 4.1, 4.2, and 4.3 and is not indicative of every utility, public, or PACE financing program.

Table 14. Comparison of Utility and Public Program Financing Options from Sample Programs

	Utility Examples	Credit-Enhanced and Revolving Loans Examples	PACE Examples
Homeowner Owns System	Yes		
Financing Provider	Utility (co-op utilities in this report's examples)	Government, financing contractor, or private lender	Government or financing contractor
Loan Amount Range	Up to $30,000	$14,000–$1,000,000	$50,000 maximum (no maximum under Sonoma's program)
Portion of Costs	100%	50%–100%	100%
Sample Fees/Closing Costs	$100–$350	Government portion: $0; private lender portion: market rate	$225–$1,025
Sample Interest Rates	0%–5.25% (simple)	Government portion: 0%; private lender portion: market rate	4.75% (income qualified) to 7.75% (simple)
Full Use of ITC Guaranteed	No		
Contract Length	3–7 years	5–20 years	10–20 years
Payments Stable over the Loan/Contract Term	Yes		
Tax-Deductible Interest Payments	Potentially, when interest is paid (some programs may provide 0% interest)	Potentially	Potentially, for most PACE assessments
Appears on Homeowner Credit Report	N/A	Yes (private lender portion)	No
Separate Installation and O&M Contracts	Yes (unless installer provides O&M)		
Eligible Technologies	Renewable energy and energy efficiency		Renewable energy, energy efficiency, and water conservation
Transferable upon Home Sale	Yes	Depends on program	Yes

	Utility Examples	Credit-Enhanced and Revolving Loans Examples	PACE Examples
Buy-Out/Early Repayment Possible	Yes	Yes; proration for state- and private-lender-provided portion of loan may be required	Possible—depends on program; may require repayment of entire remaining balance
Funding Source	Shareholders, ratepayers, co-op members in this report's examples	Utilities, air quality penalties, oil overcharge, ARRA, federal funds, state funds	Bonds, general funds, other types of funding possible; see Appendix G

Sources: DSIRE 2010a; DSIRE 2010b; DSIRE 2010d; DSIRE 2010e; ICLEI 2011; Kurtz 2011; Montgomery and Jacoby 2011; Osterman 2011; PRECorp Application; PRECorp Guidelines; PRECorp 2010; PRECorp 2010/2011; Sonoma County 2010b

5 Summary Analysis and Conclusions

This section contains a summary that outlines key characteristics of cash purchases, traditional self-financing, solar PPAs, solar leases, utility loans, public-private partnership and revolving loans, and PACE financing, also shown in Table 15.

5.1 Summary Table and Analysis

With traditional self-financing, utility, and public program financing, homeowners own the PV system. With the use of solar PPAs and leases, homeowners do not own the system but instead host the system on their roof or in their yard and either buy the energy produced (under a solar PPA) or pay to lease the system (under a solar lease).

Of all the financing options, a cash purchase is the least expensive in terms of total dollars spent, as long as the homeowner can fully monetize the federal ITC. However, many homeowners may not have the option of a cash purchase or may choose to invest their savings differently. Utility and public loans (i.e., credit-enhanced and revolving loans), as shown in the examples explored in this paper, have simple interest rates ranging from 0% to 5.25% for utility financing and are lower than 5% for revolving loans.[45] Self-financing compound interest rates were in the 4% to 8% range for the markets sampled in this report (i.e., national, Colorado, and California) with simple HELOC interest rates starting at around 5% to 6%. However, due to the mortgage crisis and subsequent depressed home sales, interest rates are trending low. Perhaps surprisingly, interest rates for the PACE programs outlined in this report have been on par or more expensive than self-financing, with a 7.75% simple interest rate in Boulder, Colorado, and a 7.00% simple interest rate in Sonoma, California.[46] In Boulder, Colorado, "income-qualified" homeowners within a certain income bracket could potentially be eligible for a 4.75% simple interest rate if the program is reenacted.[47]

In addition to interest rates on par or higher than private market financing, PACE programs also can have significant administrative costs and other fees. In the examples of the Boulder and Sonoma programs, upfront administrative costs were between $79 and $225, respectively. However, Boulder's assessments included a capitalized 13% closing cost consisting of 4% cost of issuance, 4% capitalized interest, and 5% debt service reserve. This amounted to the addition of $4,817 to the principal based on this report's example of a system cost of $37,050. While the debt service reserve fund contribution may be returned to the borrower toward the end of the

[45] For revolving loans that are public-private partnerships in which the government provides a portion of the loan and a private lender provides the remainder of the loan, the effective interest rate is a prorated simple average. For example, if the government provided 50% of the loan at a 0% interest rate and the private lender provided the remaining 50% of the loan at 6% interest, the effective interest rate would be 3%.

[46] Note that other PACE-like programs, such as the Long Island Green Homes (LIGH) program, have had lower interest rates (3%) (LIGH "How our Energy & Money Saving Program Works"). The LIGH program subsidizes the interest rate with solid waste funds. However, the LIGH program is not a true PACE program as the senior lien only takes hold in the event of a default. Because that program does not provide financing for PV systems, it is not profiled in this report. For additional information on the LIGH program, see http://ligreenhomes.com/page.php?Page=home.

[47] Boulder issued lower interest rate PACE assessments for those who qualified as having a below-average household income level. Income qualified was later termed moderate income household. To qualify for this interest rate, the household income has to be less than $99,754 for 1 to 2 people and less than $114, 718 for three or more people.

assessment tenor to be used toward repayment, the other 8% in fees added to the capital is significant at $2,964 and is augmented by interest charges. The fees required by the Boulder program surpass those that are close in range to current rates for HELOCs ($1,500) and COMRs ($998) in Boulder.

Fees/costs for solar PPAs and leases are unknown: solar PPAs and leases are often structured to be competitive with local retail electricity rates, and the price includes a return on investment for the solar finance company and tax equity investor. Public-private partnerships involve private lenders who offer market rates, which may be subsidized by the state/local government sponsor either directly with an interest rate buy-down or by providing a loan loss reserve fund or subordinated debt, which reduce the risk of the loans and thus the required interest rate from the lender.

With the cash purchase, self-financing, and utility and public financing options, there is no guaranteed use of the federal ITC. Under a solar PPA or lease, use of the tax credit is ensured as the solar finance company involves a third-party tax equity investor to monetize the value of the tax credit, and a portion of the value of the ITC is passed down to the consumer in the form of a lower solar energy/lease price.

Loan terms tend to be the shortest for utility financing with 3- to 7-year loan terms for the sample programs examined in this report. Under self-financing, third-party ownership, and the remaining utility and public program financing programs (i.e., credit-enhanced and revolving loans and PACE), longer loan terms in the 15- to 30-year range are possible. Longer loan terms allow for payments to better match energy production over the life of the PV system, which are assumed to have an economic life of 25 to 30 years.

The information in Table 15 is based on a small sample of market rates (in the case of self-financing) and programs. Self-financing rates depend on a homeowner's credit rating, amount of home equity, and other market factors. Loan program characteristics vary, and innovation can improve program design.

Table 15. Summary Table—Comparison of Residential Solar Photovoltaic System Financing Options

	Cash	HEL, HELOC, and COMR	PPA	Solar Lease	Utility Financing	Public Program Financing	PACE
Homeowner Owns System	Yes		No		Yes		
Financing Provider	N/A	Private lender (i.e., bank or credit union)	Solar finance company		Utility, private lender, or government		Government or private lender
Maximum Loan Amount	N/A	None—dependent upon equity in the home, income level, etc.	N/A		Program dependent (e.g., $2,500–$30,000)	Program dependent (e.g., $14,000–$1,000,000)	Program dependent (e.g., $50,000; 10% loan to value)
Sample Fees/Closing Costs	N/A	Dependent on market rates and borrower's credit rating (e.g., HEL: $0–$78; HELOC: $375–$869; COMR: $1,078–$1,182)	$0[a]		Program dependent [e.g., $100–$350 (maximums)]	Program dependent (e.g., government portion: $0; lender portion: market rate fees)	$79–$1,025 (Boulder had 13% of loan added to principal for the cost of issuance, capitalized interest, and debt service reserve)
Sample Interest Rate	None	HEL: 7%; HELOC: 6%; COMR: 5%	N/A		Program dependent (e.g., 0%–5.25%)	Program dependent (e.g., government portion: 0%; remainder: market rate	Program dependent [e.g., 4.75% (income qualified)–8.75%]
Full Use of ITC Guaranteed	No		Yes		No		
Financing Term/Contract Length	N/A	5–30 yrs	15–20 yrs		Program dependent (e.g., 3–7 yrs)	Program dependent (e.g., 5–20 yrs)	Program dependent (e.g., 10–20 yrs)

	Cash	HEL, HELOC, and COMR	PPA	Solar Lease	Utility Financing	Public Program Financing	PACE
Payments are Stable Over the Loan/Contract Term	N/A	HEL: yes; HELOC: no; COMR: yes	Varies—could include escalator		Yes		
Tax-Deductible Interest Payments	N/A	Yes	No—PPA/lease payment is not tax deductible		Not likely		Yes
Appears on Homeowner Credit Report	No	Yes	No		Yes		No
Homeowner Completes Incentive and Interconnection Applications	Yes (unless installer completes)		No—solar finance company files applications on behalf of homeowner		Yes (unless installer completes)		
Collateral	N/A	Home	PV system				Tax lien
Transferable Upon Sale of Home	No		Yes, with buyer qualification		Depends on the program (Yes in this report's examples)	Depends on the program	Yes, depending on the terms of sale
Buy-Out/Early Repayment Possible	N/A	Yes, penalties may apply	Possibly, at predetermined points in contract		Depends on the program (Yes in this report's examples)		Often yes, but remaining balance must be repaid
Funding Source	Self-funded	Bank or credit union	Tax equity investor		Utility capital/debt; ratepayer funds	SBF, rates, taxes (e.g., ARRA)	Bonds and public funds are the most common

[a] Historically, down payments have been required, but they appear to be less common currently.
[c] Additional funding options could include boutique private capital investors, waste funds, and loans.
Sources: DOE 2010; Brown 2011

The payments made for PV are fixed (including those with escalators) for all procurement methods except for HELOCs. While HELOCs may have low interest rates initially, they are variable and it is possible they will increase over the term of the credit line. Thus, homeowners should consider this characteristic of HELOCs when comparing interest rates and fees of other financing mechanisms, as the effective interest rate of a HELOC could ultimately be higher than those of other types of financing. The cost of a solar PPA on a cents-per-kilowatt-hour basis and a solar lease on a monthly payment basis is determined at the onset. However, solar PPAs and solar leases sometimes contain price escalators (e.g., 2%) to track the cost of inflation. Any escalator will be included in the PPA or lease contract.

Additional benefits and challenges of the various PV energy procurement options include:

- Homeowners with tax liability have the option to deduct tax payments for interest paid on a self-financed loan (HELs, HELOCs, and COMRs) or a utility or public program loan. Deducting payments for solar PPAs or leases is not assumed to be legal under tax code, but homeowners should consult their tax accountants or attorneys to make this determination.
- Solar finance companies offering solar PPAs and leases often file incentive, interconnection, and net-metering applications on behalf of their customers in addition to the design, purchase, construction, and O&M (for PPAs), making the solar PPA and lease a one-stop shop for PV procurement. With a cash purchase, traditional self-financing, or utility or public program financing, homeowners could choose to handle incentive, interconnection, and net-metering applications (if this service is not offered by the solar installer) and acquire an O&M contract separate from the installer contract (if this is not included within the solar lease).
- With solar PPAs, leases, and utility and public program financing, it is possible that the homeowner may be able to transfer the system and remaining payments to a qualified buyer with program/lender approval. Transfer of the PV system upon sale is not an option under self-financing as outstanding debt will have to be paid with the sale of the home. However, depending on negotiations with the buyer, homeowners may be able to pass on some of the value of a PV system via a higher selling price.[48]
- Utility and publicly provided loan programs are often the most flexible when it comes to allowing borrowers to repay loans early or to overpay monthly payments. PACE loans can usually be repaid early, but often the entire remaining balance must be repaid—partial repayments are not accepted. Solar PPAs and leases may include predetermined buy-out options at certain points in time (e.g., year 6 or year 15).

5.2 Conclusions

There are several options for financing residential PV systems, including cash purchases, HELs, HELOCs, COMR, solar PPAs, solar leases, utility financing, public-private partnership and revolving loans, and PACE financing.

Policymakers who want to support residential PV should choose the option that best fits their constituents' needs. The following are the primary conclusions from this report:

- **Cash purchases** are the least expensive option in terms of total dollars spent to acquire PV as no financing costs or solar finance company's fees are incurred. However, homeowners would be foregoing other investment opportunities, and a cash purchase may not be an option for many homeowners. Also, the homeowner will need enough federal tax liability ($11,115 in this report's example) to take full benefit of the federal ITC in the first year. Homeowners may want to consider acquiring an O&M contract separate from the installation to handle inverter replacements and monitor major malfunctions, which are rare.

[48] A study by the Lawrence Berkeley National Laboratory showed that PV systems installed as part of home retrofits in California increased the value of homes upon sale (Hoen et al. 2011).

- **Traditional self-financing, including HELs, HELOCs, and COMR,** is provided by banks and credit unions across the county, and therefore is likely the most available option geographically. However, to access self-financing, homeowners need good credit and significant home equity. Home equity financing may not be available to many homeowners, especially because of the lingering impacts of the mortgage crisis, which has reduced home values, increased foreclosures, and resulted in more conservative lending practices. Similar to a cash purchase, the homeowner must determine whether they can take full benefit of the federal ITC and how to best manage O&M.
- **Solar PPAs and solar leases** provide a one-stop shop for the purchase, installation, O&M, incentive and interconnection application filing, and use of the federal ITC and MACRS. In order for third-party solar finance companies to make efficient use of federal tax incentives (i.e., the ITC and MACRS), the solar finance companies often partner with tax equity investors who have significant tax liability. Third-party mechanisms are only available in markets with (1) favorable interconnection and net-metering policies, (2) legal/regulatory clarity for third-party solar energy sales, and (3) significant state/local incentives. There may be many states where the right mix of policies does not exist, and thus solar finance companies are not very active in those markets or are not able to provide solar energy at a price competitive with local electricity rates. In states without significant third-party PV development, state and local policymakers interested in increasing residential PV may want to reconsider current policies. Discussions with key stakeholders can help identify barriers to third-party PV development and potential solutions that are best in that location.
- **Utility loans** are a low-cost financing option; however, only homeowners who are customers of utilities that provide or participate in utility financing programs can access these loans. While there are many utility financing programs for energy efficiency and other types of improvements, only a few offer PV as an eligible measure. Utility financing programs could be expanded, but utility and regulator involvement (in the case of regulated utilities) and support will be necessary.
- **Public-private co-financing** and **revolving loans** are provided by state and local governments, often with reduced financing costs to the borrower (utilities can also provide revolving loans). By dividing up the loan under a public-private partnership, the state and local government shares some of the risk of default with the private lender. **Credit-enhancement programs** include loan loss reserves, subordinated debt, and interest rate buy-downs.
    - A **loan loss reserve** is a fund that backs a pool of loans up to a project-specific amount, thereby reducing the loans' risk profiles (Kubert and Sinclair 2011). A loan loss reserve allows the private lender to underwrite loans that might not be feasible on the private market. Borrowers benefit from access to attractive financing terms. Loan loss reserve funds can also be combined with other financing programs, such as PACE and revolving loans.
    - Similar to loan loss reserves, **subordinated debt** reduces the risk profile of a loan and improves a borrower's ability to take on affordable debt. However,

strong underwriting is needed to ensure that the program is not put at undue risk (i.e., in the event that many borrowers default on their loans).

  - **Interest rate buy-downs** improve the affordability of a loan and the borrower's ability to repay. However, the partnership with the private lender will need to be strong to ensure that lenders are not requiring above-market rates (which are then subsidized by the interest rate buy-down).
  - **Revolving loans** often include benefits, such as low interest rates, increased availability, and extended loan tenors, and they may also be combined with the public-private credit enhancement programs described above. That said, revolving loans are inherently capital-constrained and may need to be supported by other methods of funding aside from the loan payments, as discussed in Section 4.2. Also, because loan payments must be received before new loans can be issued, there are boom/bust cycles in loan issuances. Careful underwriting and shorter loan tenors can help ameliorate these challenges; however, they may reduce the accessibility and attractiveness of the loan. Utility loan programs can also be structured as a revolving loan.

- Most **PACE financing programs** are on hold due to concerns by federal regulators; however, several commercial programs continue to finance clean energy improvements. The ability of PACE financing to offer a below-market cost of financing depends on the interest rate and fees charged by the program and the market in which the program is operating. In this report's example, Boulder County's PACE interest rates were higher than the interest rates of HELs and COMRs offered in the area (although PACE interest rates are simple, which reduces their overall cost). However, in Sonoma County, the PACE financing rate is lower than the cost of a HEL but higher than the initial rate for a HELOC and higher than COMR. Fees for PACE financing can also be significant, as demonstrated by the 4% cost of issuance, 4% capitalized interest, and 5% debt service reserve fund required by the Boulder program. Nonetheless, PACE programs have been effective at financing PV installations in their markets, and perhaps just as important, have served as the first point of contact for those who were interested in PACE but ultimately went on to use other forms of procurement. In the event that residential PACE programs are allowed to go forward, the cost of PACE assessments and ways to reduce interest rates and fees for participants should be considered. This would improve the appeal of PACE compared to other financing mechanisms, especially in markets with moderate to low self-financing rates.

The first four (cash purchases, HELs, HELOCs, and COMR) are the basic options that are available today across the United States. There are also more innovative mechanisms that can be offered by private or public entities. For the most part, these innovative residential PV financing mechanisms require laws, regulations, or direct government support (financial and/or administrative) before they are available in specific jurisdictions.

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Appendix B. Group-Buy Options for PV

Homeowners may have the option to participate in "group-buy" programs, which aggregate multiple residential projects into a single bid to solar finance companies. The solar finance companies that meet the program's quality assurance standards with the lowest cost win the bid. The intended result is that homeowners buy solar installations at a below-market cost.

Programs vary from commercial (One Block Off the Grid[49]) to community (Solarize Portland[50]) to local governments (San Jose[51]). Group buys can be combined with all forms of traditional self-financing, pending homeowner qualification (see the next section for more information). With One Block Off the Grid, homeowners can also participate in group purchases of PPAs and solar leases. State and local governments could combine group buys with public financing options as well.

Similar to choosing a lender, solar installer, and solar finance company, homeowners must also carefully choose a group-buy provider.

[49] For more information on One Block Off the Grid, see http://1bog.org/.
[50] Additional information on the Solarize Portland program can be found at http://www.portlandonline.com/bps/index.cfm?c=51902.
[51] A news story on the San Jose group-buy program can be found at http://www.prnewswire.com/news-releases/first-of-its-kind-organizational-solar-group-buy-program-established-101088804.html.

Appendix C. Maps of Interconnection and Net-Metering Policies

Interconnection policies outline the technical and procedural processes for connecting a distributed generation system, including PV systems, to the electrical grid. Most states have interconnection policies; however, in some states the policies are only applicable to investor-owned utilities and not to other non-regulated utilities (i.e., electric cooperatives or municipal utilities). State public utility commissions most often develop interconnection standards.[52]

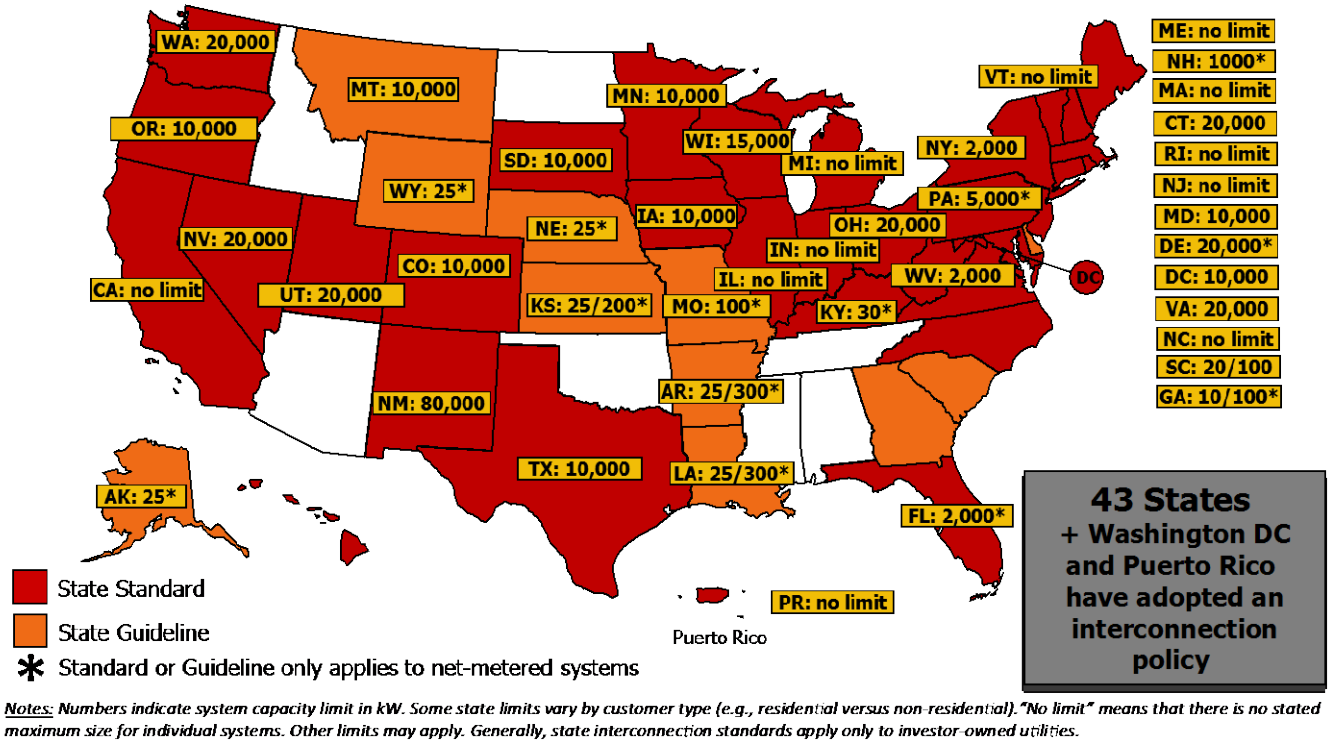

Figure C-1. Interconnection policies
Source: DSIRE 2012b

[52] For an evaluation of state interconnection policies, see "Freeing the Grid: 2011 Edition" (http://freeingthegrid.org/) from The Vote Solar Initiative and the Network for New Energy Choices.

Under a net-metering policy, owners of distributed generation systems can earn credit on their electric utility bills for any additional electricity that they do not use and feed back into the electric grid. The main benefit of net metering is that the owner of the system is able to offset a portion of or their entire electric utility bill (Coughlin and Cory 2009b).[53]

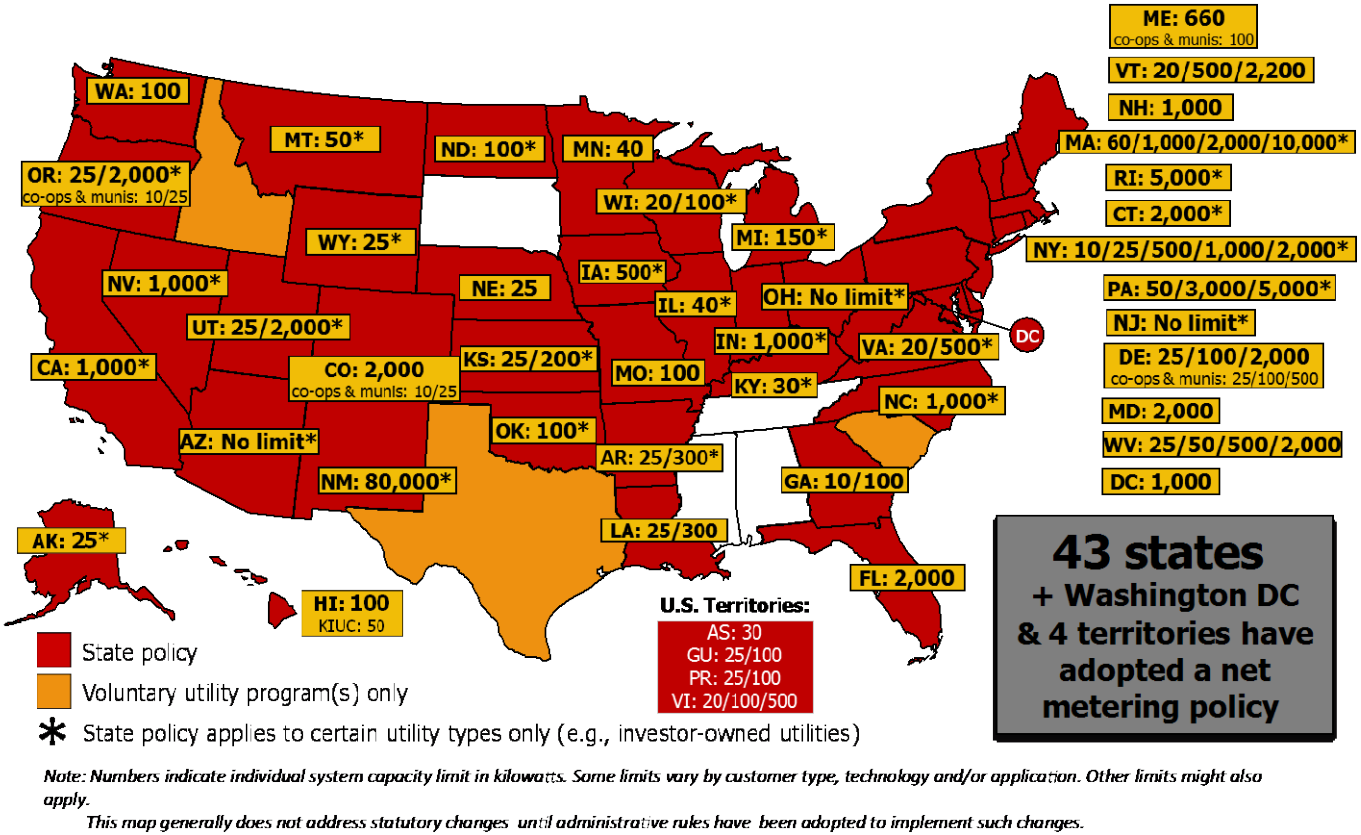

Figure C-2. Net-metering policies

Source: DSIRE 2012c

[53] "Freeing the Grid: 2011 Edition" (http://freeingthegrid.org/) report from The Vote Solar Initiative and the Network for New Energy Choices also provides an evaluation of state net-metering policies.

Appendix D. State PV Financial Incentives

Forty-seven states plus Washington, D.C., Puerto Rico, and the U.S. Virgin Islands have some sort of financial incentive for installing a PV system; see Figure D-1. In addition to direct cash incentives, states and utilities provide tax credits, tax deductions, sales tax incentives, property tax incentives, utility direct cash incentives, local options for sales tax incentives, and local options for property tax incentives. See DSIRE at http://www.dsireusa.org/solar/summarymaps/ for additional information on financial incentives for solar PV.

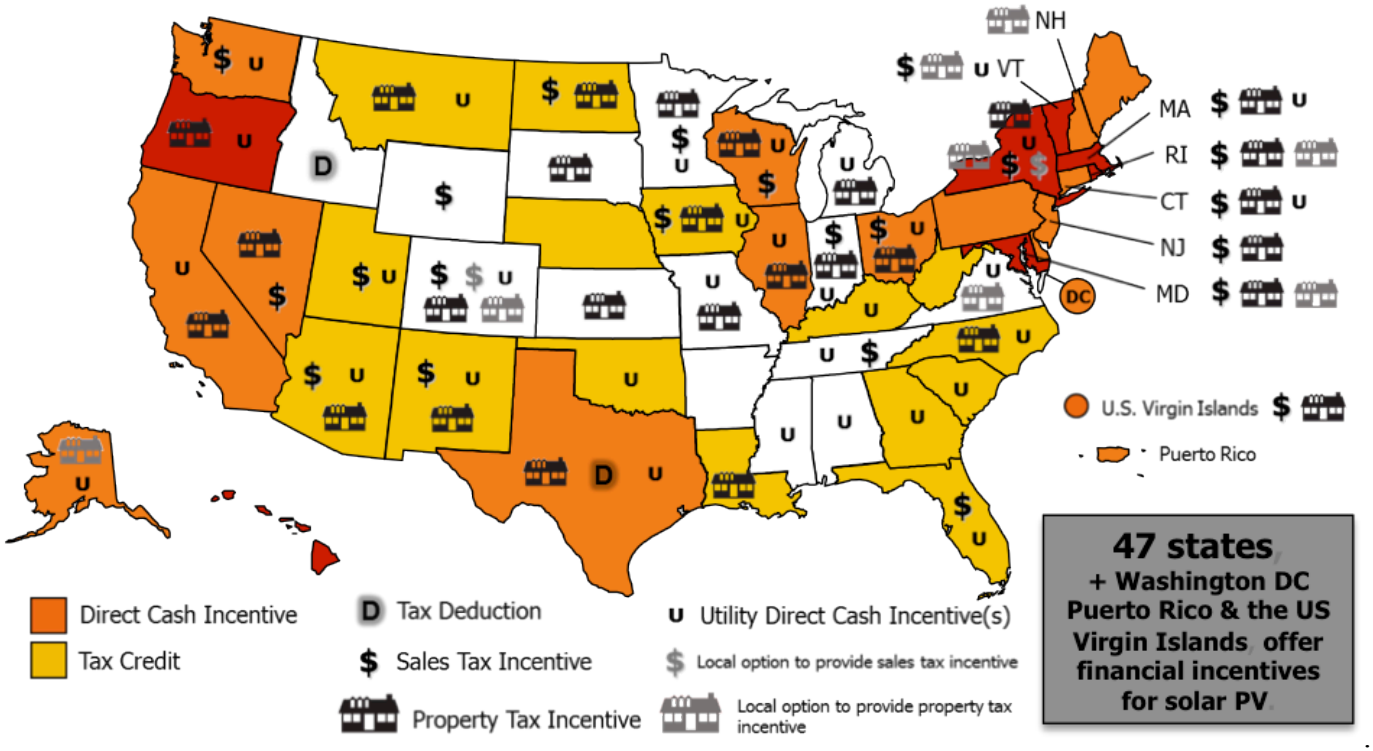

Figure D-1. Financial incentives for solar photovoltaics

Source: DSIRE 2012a

Appendix E. Detailed Description and Comparison of HELs, HELOCs, and COMRs

Home Equity Loan

An HEL is a second loan in addition to the first mortgage. To obtain an HEL, the homeowner must have equity in their home. In today's market, homeowners cannot get an HEL for more than 80% of the appraised value of the home (Guillot 2010), including any existing mortgage debt. So, if the homeowner has a mortgage of $60,000 and their home is valued at $100,000, they will likely only have $20,000 available to take out as an HEL (i.e., 80% of the appraised value of the home at $100,000 is $80,000), assuming that the homeowner has no other existing debt. Key benefits and challenges of using HELs to finance a PV system are highlighted in Table E-1.

Table E-1. Home Equity Loans: Benefits and Challenges

Benefits	Challenges
• Allows for the outright purchase of a PV system • Tax-deductible interest payments • Locked-in interest rate • Fixed payments • Direct system ownership (i.e., non-third-party owned) gives the homeowner control	• Dependent on homeowner's credit and equity in the home • May be dependent on the market in which they are located (e.g., high rates of foreclosure) • Non-transferable; the loan will have to be paid off in the event the home is sold

Home Equity Line of Credit

A HELOC is an open line of credit from which an approved homeowner can borrow against at any time for various amounts. This contrasts with an HEL, which consists of a lump sum principal amount that is received initially and paid off with fixed payments at a fixed interest rate over a predetermined number of years. Like an HEL, homeowners likely cannot get a HELOC for more than 80% of the appraised value of the home (Guillot 2010) after any existing mortgage debt. The primary challenge of HELOCs is the fluctuating interest rate that increases or decreases depending on market conditions (although there is normally an interest rate floor and ceiling). However, one benefit of HELOCs compared to other types of loans (including HELs and HELOCs) is that they are repaid via simple interest, which is not incorporated into the principal. Additional benefits and challenges to homeowners financing PV with HELOCs are outlined in Table E-2.

Table E-2. Home Equity Lines of Credit: Benefits and Challenges

Benefits	Challenges
• Allows for the outright purchase of a PV system • Tax-deductible interest payments • Option for financing an inverter purchase • Direct system ownership (i.e., non-third-party owned) gives the homeowner control • Simple interest rates	• Homeowner will need good credit and mortgage payment history to obtain financing • Better for small purchases—potentially higher interest rates could result in increased financing costs for larger purchases that the homeowner will need several years to pay off • Availability may be dependent upon the market in which the homeowner is located (e.g., Are there high rates of foreclosure?) • If a homeowner already has a significant HEL, their ability to obtain an additional loan could be hindered • Non-transferable; the loan will have to be paid off in the event the home is sold

Mortgage Refinancing

COMR is different from HELs and HELOCs because the homeowner receives cash back as opposed to taking out an additional loan. A COMR requires that a homeowner has more equity in the home than they are looking to borrow. The homeowner negotiates with a lender for a new mortgage with a higher principal and, ideally, a lower interest rate compared to their previous mortgage rate.

For example, suppose a homeowner has a $250,000 home fully mortgaged. The homeowner has $100,000 in equity and therefore owes a remaining $150,000 in principal on their mortgage. The owner of the home takes out a new COMR for $175,000. The homeowner then gets the cash difference between the amount of the COMR and the remaining amount owed on the home.

Cash-Out Mortgage Refinancing Example

$250,000 (mortgage/home value) - $100,000 (equity in home) = $150,000 (remaining principal)

$175,000 (new cash-out mortgage) - $150,000 (remaining principal) = $25,000 (cash out)

In this example, the homeowner gets a check for $25,000, which could be enough to purchase a PV system. Similar to closing other mortgages, a lender will require a fee from the borrower that could be a significant cost (e.g., $1,000 or more). If a homeowner refinances with a loan-to-value of more than 80% of the home's appraised value, the homeowner may be required to purchase private mortgage insurance (Taylor 2010). Table E-3 provides a summary of benefits and challenges for using COMR for a PV purchase.

Table E-3. Cash-Out Mortgage Refinancing: Benefits and Challenges

Benefits	Challenges
• Results in cash for upfront purchase or could be used to pre-pay a solar PPA or lease (see Section 3) • PV systems have expected useful lives of 25 to 30 years, which can potentially correspond with the term length of the refinanced mortgage (e.g., 20 years), depending on the homeowner's specific circumstances • Tax-deductible interest payments • Direct system ownership (i.e., non-third-party owned) gives the homeowner control	• Homeowner will need good credit and mortgage payment history to obtain refinancing • Homeowner will potentially extend the tenor of their mortgage (e.g., five additional years) • Refinancing requires closing costs, which could be hundreds to thousands of dollars • Might not be the best financial choice for homeowners who are nearing the end of their mortgage as they are paying more toward the principal than interest and thus might not benefit or benefit as much from a COMR even if they can secure a lower interest rate (Lewis 2009) • Non-transferable; the loan will have to be paid off in the event the home is sold

Qualitative Comparison of Traditional Self-Financing Mechanisms

Table D-6 highlights some of the key similarities and differences of using cash, HELs, HELOCs, and COMR to acquire a PV system. Note that the information provided in this table is thought to be generally indicative of current market offerings in the sample markets explored in Section 2.3, and they are provided so that policymakers understand the most widely available financing mechanisms for residential PV systems (i.e., the baseline). However, interest rates and fees differ across the United States, will change over time, and will reflect the borrower's credit history, among other factors.

Boulder County, Colorado, and Sonoma County, California, were selected as two locations to correspond with the two largest PACE programs of the same locales. Boulder County currently does not have an active residential PACE program.[54] Sonoma County is the largest active residential PACE program.[55] Palm Desert is another active residential PACE program, but because it has issued fewer assessments to homeowners and, like the Sonoma County program, is located in California, it was not used as an example. National average loans are listed as well to include a broader geographic scope; however, actual lending rates will vary by location.

[54] At the time of publication, Boulder County, Colorado, is not issuing new PACE assessments as 2010 funds have been committed. The commercial program continued to remain active even though its residential PACE program was halted as the commercial program was not subject to the same regulatory concerns. See http://climatesmartloanprogram.org/cslp_commercial.html for more information.

[55] Sonoma County, California, has an active commercial PACE program. For additional information, see http://www.sonomacountyenergy.org/lower.php?url=commercial.

The information in Table E-4 is based on a small sample of market rates. The availability of self-financing as well as the actual rates and fees depend on a homeowner's credit rating, amount of home equity, and other market factors.

Table E-4. Traditional Self-Financing Mechanisms: Qualitative Comparison

	Cash Purchase	Home Equity Loan (HEL)	Home Equity Line of Credit (HELOC)	Cash-Out Mortgage Refinancing (COMR)
Homeowner Owns System	Yes			
Financing Provider	N/A	Bank or credit union		
Sample Fees/Closing Costs[a]	N/A	$0–$78	$375–$869	$1,078–$1,182
Sample Interest Rates[a]	None	6.84%–8.48% (fixed rate)	5.10%–5.99% (fluctuating rate)	4.84%–4.98% (fixed rate)
Full Use of ITC Guaranteed	No			
Length of Contract Term	N/A	5–30 yrs[c]		
Payments Stable Over Loan/Contract Term	N/A	Yes	No	Yes
Tax-Deductible Interest Payments[b]	N/A	Yes		
Affects Homeowner Credit Report	No	Yes		
Separate Installer/O&M Contracts	Yes, possible			
Collateral	N/A	Home		
Transferable upon Home Sale	N/A	No		
Buy-Out/Early Repayment Possible	N/A	Yes; fees may apply[a,c]		

[a]Loan terms are based on a 5.7-kW system at $6.50/W. The *2010 Solar Market Trends Report* states that the average-sized PV system installed was 5.7 kW (Sherwood 2011). *Tracking the Sun IV: The Installed Cost of Photovoltaics in the U.S. from 1998-2010* reports installed costs for residential systems to have averaged $6.90/W, excluding sales or value-added tax (Barbose et al. 2011). However, 2010 installed costs in California were reported to be between $5.00/W and $6.00/W, thus $6.50/W is a moderate estimate to account for variances across the U.S. market. Therefore, 5,700 W x $6.50/W = $37,050 for the total system cost.

[b] A tax professional should be consulted to make the determination whether interest payments are tax deductible.

[c] For example, Chase bank charges fees for repayment within 36 months of closing. See https://www.chase.com/index.jsp?pg_name=ccpmapp/home_equity/tools/page/faqs.

[d]Homeowners may be required to pay a fee for early repayment. See the CitiBank Web page as an example: https://www.myhomeequity.com/MHE/home.do?sc=0&page=initialProScreen.

Source: DOE 2010

Appendix F. Third-Party Ownership Overview

At current installed costs, solar finance companies (SFCs) need several policies to be in place to operate and compete with local retail electricity rates. As illustrated in Figure F-1, if one policy is out of place, the rest of the policy stack may not be effective as a whole and may fall apart. First, SFCs strongly prefer interconnection and net-metering standards that allow for systems that are large enough to meet end-users' needs and provide compensation for excess power generated under net metering.[56]

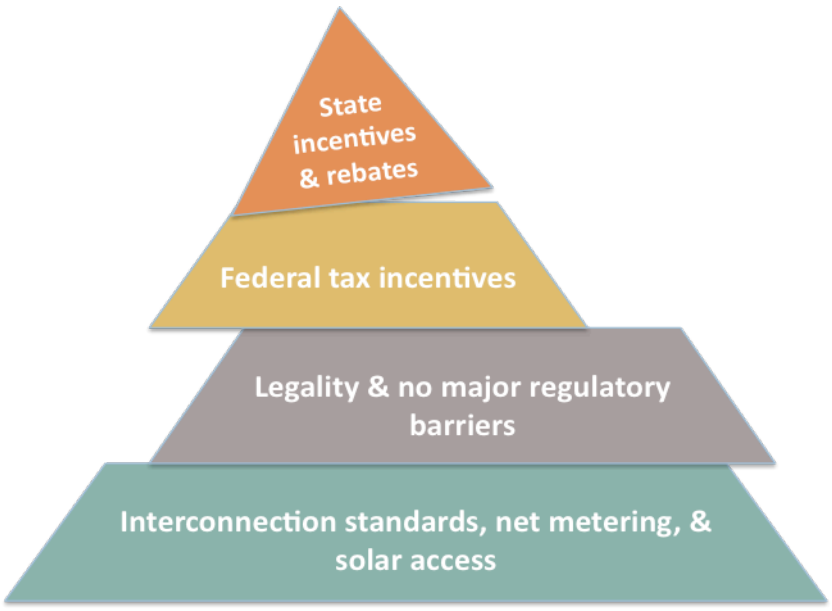

Figure F-1. Hierarchy of third-party solar finance company market needs

Second, SFCs need regulatory and legal clarity regarding the sale of electricity and whether or not third-party sales could qualify as wholesale electricity, which would subject them to regulation as utilities (Kollins et al. 2010).[57]

[56] See Appendix B for more information on interconnection and net metering.
[57] For additional details on the types of regulatory and legal challenges faced by third-party SFCs, as well as solutions applied, see Kollins et al. 2010.

As of June 2012, only 21 states had authorized the use of PPAs, and three states had disallowed or otherwise restricted their use (See Figure F-2).

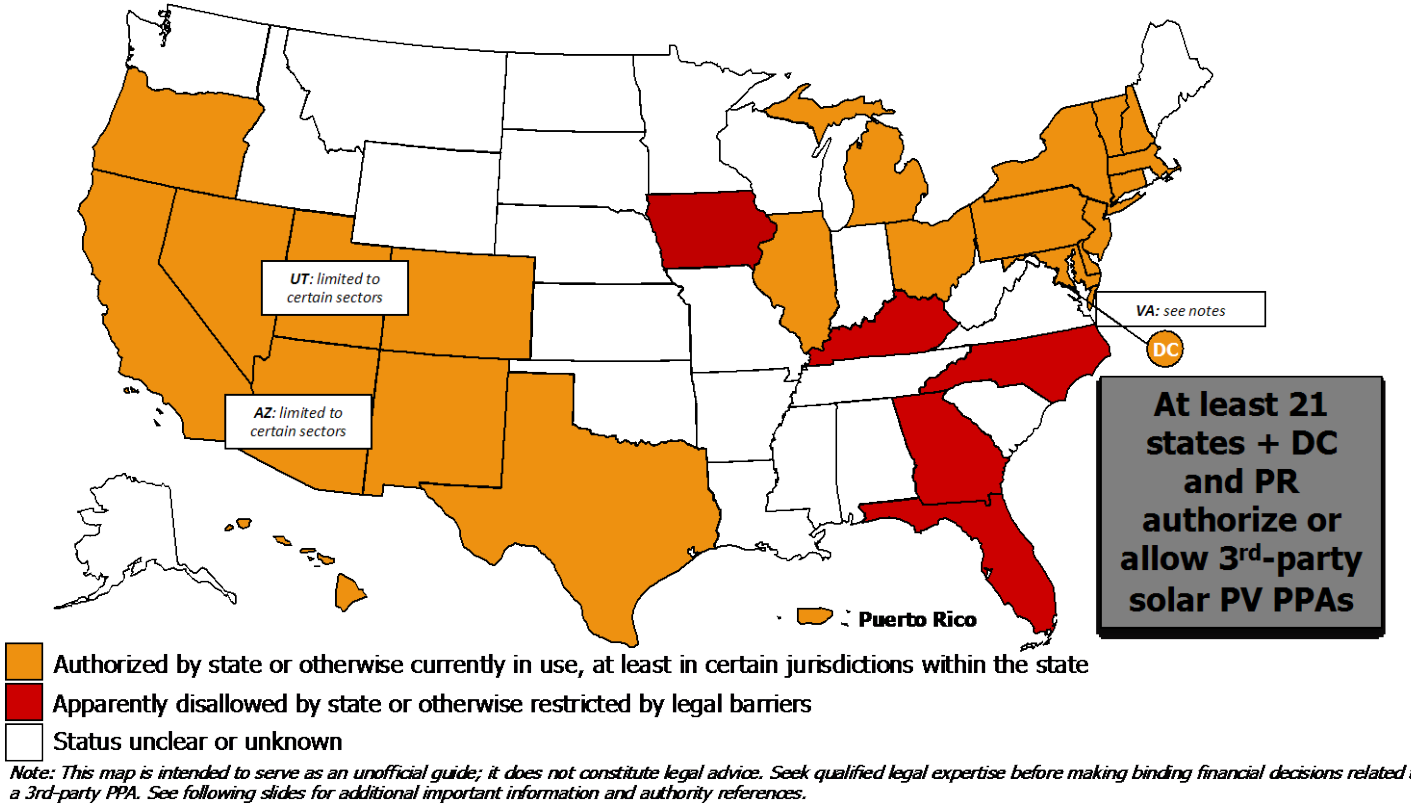

Figure F-2. Third-party PV power purchase agreements

Source: DSIRE 2012d

Third, to make third-party PPAs competitive with local retail electricity, SFCs need to be able to make use of federal tax incentives. SFCs have access to two types of significant tax incentives: (1) the 30% ITC and (2) accelerated depreciation.[58] SFCs were able to directly use the 1603 cash grant as they did not need tax liability to monetize the value as it is received as a cash refund as opposed to a tax credit. However, the 1603 cash grant expired at the end of 2011 for projects that have not already met the safe harbor requirements; going forward, SFCs will only have access to the 30% ITC.

To use the ITC or accelerated depreciation, the SFC would have to monetize these benefits directly or involve a third-party tax equity investor. But SFCs often do not have sufficient tax liability to take advantage of accelerated depreciation and the 30% ITC. Accelerated depreciation can equate to an additional 26% benefit of the pre-tax installed cost of the system on top of the 30% ITC, not including any year-one bonus depreciations (Bolinger 2009). Thus, in exchange for a fee, the SFC and the tax equity investor form a limited liability company to monetize the tax benefits (this is done on a portfolio basis for residential and small commercial projects). The tax equity investor—often a large bank or insurance company—is looking to offset a portion of its tax liability (i.e., taxes owed). The homeowner receives a portion of this benefit via a lower power purchase price.[59]

Finally, SFCs need state or local incentives that are long-term and reliable. There is a significant outlay for SFCs to establish themselves within a new market (e.g., hiring legal teams, building storefronts and offices, and establishing contractor relationships). To finance business development in a new market, SFCs and their investors must determine that the incentives are bankable (i.e., a secure cash in-flow for the project). There may be additional market drivers not discussed in this report, such as availability of tax equity investors (especially because of the economic recession), consumer behavior, or interest in buying renewable energy.

Third-Party Ownership Market

According to a recent report from Greentech Media and the Solar Energy Industry Association, third-party ownership accounted for 17% of total residential PV installations in 2010 (Greentech/SEIA 2010). However, third-party ownership is not available in several states. In states where the financial model is accessible, it contributes to a much higher percentage of the market share. For example, in Colorado, the solar lease was used for 36% of total installations.

[58] SFCs can access the MACRS as one form of accelerated depreciation. In addition, SFCs may be eligible for year-one bonus depreciations for a limited time. See DSIRE at http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=US06F for details.

[59] For more information on the third-party PPA business model, including an in-depth discussion of relevant incentives and the impact of PPAs on electric utility bill savings, see Coughlin and Cory 2009b.

Appendix G. Comparison of Approaches to Fund PACE Programs

A discussion of funding sources is included within this report as funding mechanisms and structure impact the PACE program's interest rate and possibly fees. The financing terms impact how PACE financing compares quantitatively to other residential PV financing options.

Table G-1 summarizes current PACE funding processes in the initial programs. The table describes the benefits and challenges of each strategy.[60] Each locality designed its funding program to take advantage of its unique situation.

- Boulder County, Colorado, leveraged its high credit rating (AAA) to issue municipal bonds directly in public markets rated at A- (investment grade), independent of a moral obligation.
- Berkeley, California, innovated by creating "micro-bonds." The city contracted with an aggregator (Renewable Funding, LLC) to periodically issue a series of small bonds at predetermined fixed interest rates. Renewable Funding, in turn, received third-party financing based upon the bond portfolios.
- Sonoma County, California, and Palm Desert, California, initially used available general funds.
- Babylon, New York, created the Long Island Green Homes (LIGH) program and classified carbon dioxide as waste to take advantage of an existing municipal waste management funding program to support energy efficiency assessments.[61]

[60] Note that these programs are in early stages and that more experience is needed before the advantages and disadvantages of these programs can be fully understood.

[61] Babylon is included here because of its innovative funding source, but the program is excluded from in-depth analysis elsewhere in this report because Babylon does not provide assessments for PV.

Table G-1. Summary of Benefits and Challenges of Funding Mechanisms for Initial PACE Programs

Funding Source	Bond Funding Mechanisms[a]		Other Funding Mechanisms		
	Large Bond Offerings/Pooled Approach—Moral Obligation Variation	**Micro-Bonds—Revenue Bond Variation**	**Bank Loans**	**General Funds**	**Solid Waste Revolving Fund**
Program Example	Boulder County, CO	Berkeley, CA (only PV systems)	Annapolis, MD, Phase II (program pending)[b]	Sonoma County, CA	Town of Babylon, NY (only energy efficiency)
Initial Funding	Issued ~$10 million; authorized $40 million	$1.5 million for the pilot phase[c]	$1 million	$20 million	$1.5 million
Interest Rate	5.2% (income qualified); 6.68% (open assessment category)	7.75%	Unknown	7%	3%
Benefits	Local government's balance sheet not used Temporary financing from bond aggregator not needed	Can be tied to administrative role Aggregator serves as a good staging area for converting assessments to commercial bonds Does not affect balance sheet of local government	Banks have experience securitizing loans/assess-ments (e.g., mortgages) Access to large pools of capital Faster deployment, less complexity, and less cost compared to issuing bonds	Third-party financier not involved Funds easily accessible	Quick startup Liens are placed on properties only if a borrower defaults on payments
Challenges	Assessments are issued before interest rates are known Lien placed on property before installation (i.e., risk that the installation is not	Could require boutique investor to purchase assessments in tranches (pools) A bank warehouse line of credit is only an option for third-party	High interest expense Requirements for guarantees and other covenants can complicate and delay program implementation	Locality at greater risk by self-funding Funds—where they exist—are inherently limited	Need to reconstitute waste fund as applying to carbon emissions or other pollutants that can be mitigated through

Funding Source	Bond Funding Mechanisms[a]		Other Funding Mechanisms		
	Large Bond Offerings/Pooled Approach—Moral Obligation Variation	Micro-Bonds—Revenue Bond Variation	Bank Loans	General Funds	Solid Waste Revolving Fund
	done) Might need borrowers to fund debt service reserve, which would increase upfront costs for program participants Local government might need to offer moral obligation, which could hurt its credit rating if it is not able to meet the obligation	administration or if the state or local government puts up a moral obligation; a party must be willing to take the risk Likely that only big banks would be willing to provide warehouse credit More complex to implement but easier to scale to demand	Loan term typically is limited to 10 years or less	Potential to negatively affect credit rating Many local governments might not have sufficient general funds to launch a program	energy efficiency and renewable energy Might not be expandable Might not be replicable

[a] Localities can use municipal bonds to fund PACE, including general obligation bonds, moral obligation bonds, and revenue bonds. Any of these types of bonds can be issued either as a larger bond after aggregating a group of assessments or as micro-bonds as assessments are made.
[b] Annapolis was expected to launch Phase I of the EZ program in 2010. It was planned to be funded at $325,000 by grant money from the Maryland Clean Energy Center and to provide 50 assessments for homeowners. The interest rate for Phase I was unknown but was expected to be about 6% to cover administration costs.
[c] Note that $1.5 million was allocated to finance 39 installations in the pilot phase. Only 13 assessments were completed, however, and the assessments therefore did not exhaust the initial funding amount (Berkeley 2010).
Sources: DOE 2009—program details; NREL analysis and Fuller 2009—benefits and challenges

Challenges and Benefits of Using Micro- and Regular Bonds to Fund PACE Programs

Although PACE programs can access a variety of funding, the more unique and challenging method of financing is to issue bonds. This type of funding also is easiest to scale with demand, and it attracts significant private capital. This approach was used by both Boulder County and the City of Berkeley. One benefit of issuing regular bonds or micro-bonds is that this form of financing is less likely to affect the local government's balance sheet. If a moral obligation is established, however (as was done in Boulder), then the risk to the local government's balance sheet is greater.

A benefit of selling micro-bonds to investors as assessments are issued is that the risk profile of the underlying security of the bonds (i.e., the PACE assessment) is known to investors, as bonds are sold per demand. The challenge posed by the timing of issuing regular bonds is that the assessments are issued before the interest rates are known because assessments must be aggregated into large pools for them to equate to typical bond issuances. Thus, the assessments cannot be funded until after the bonds are sold. The Boulder program required participants to partially commit to the assessment with a not-to-exceed interest rate. After the bonds were sold, the program returned a locked-in interest rate to the program participant. Boulder County had a smaller bond issuance and therefore decided to provide a moral obligation fund to maintain a credit rating good enough for the bonds.[62] Revenue bonds also might be able to receive an investment-grade rating (Renewable Funding 2010).

Selling micro-bonds has its challenges, including creating the need for a niche investor interested in purchasing the small tranches of bonds, aggregating them, and then reselling the securities in the form of regular bonds. The aggregator also must be able to gain interim financing to fund the purchase of the micro-bonds. This could be difficult to do, especially if the aggregator has limited capital and if aggregating micro-bonds is the main source of income. Further, the aggregator could bear significant risk in holding mismatched durations on its assets and liabilities.

General Considerations for Choosing Funding Mechanisms

To make proper funding decisions, a locality developing a PACE program should consider its current financing situation and the goals for the program. Considerations could include intended program size, targeted interest rates, willingness to work with an aggregator, and risk preferences. Also, although the use of bonds ideally will not impact a locality's credit rating, this is another aspect that should be considered. Some of the initial pilots leveraged high credit ratings, above-average property values, and low mortgage foreclosure rates, but it should be made clear that not all localities are in that situation. Thus, the more generally applicable approaches (such as micro-bonds and bank partnerships) could be more relevant to certain PACE programs.

Another important design element is the timing of the construction, funding, and assignment of the lien. Boulder County issued its bonds, received financing, and assigned the assessments and

[62] In addition to a moral obligation fund for smaller bond issuances, programs of any size can use a number of program design elements to improve the bond rating, including having a variety of properties and good underwriting standards.

liens simultaneously with the start of the project's construction.[63] Conversely, Berkeley assigned the liens and assessments at the completion of project construction and certification. Babylon designed a third variation; it followed Berkeley by assigning the assessment at the completion of construction. Babylon chose to only assign the liens when (and if) a default occurred, however. This might provide some assurance to local mortgage lenders that the senior PACE lien only will be used in the case of default. Each of these methodologies provides benefits and challenges in terms of funding and administration that should be considered in program creation.

It is important to note that all the programs—when compared to municipal bond markets—have fairly small initial funding, ranging from $1.5 million to $20.0 million, but there are larger programs planned (Renewable Funding 2010). Although the capital markets provide an opportunity to finance at this level, the current process is an important building block for possible future securitization of PACE assessments. State and local PACE administrators provide the initial aggregation of assessments, which then feed completed assessments into the pooling process. This could enable the banks and micro-financiers to recycle their capital into the next set of assessments. To make the process work at a larger scale, it will be important to apply the lessons learned thus far to the aggregation process.

[63] Although the assessment is delivered at the start of construction, the interest on the assessment begins to accrue once the property owner has signed the agreement with the County of Boulder.