Economic Benefits of Performance-Based Incentives

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Executive Summary

This paper evaluates the economic consequences of offering consumers performance-based incentives (PBI) for photovoltaic (PV) systems as compared to buy down incentives. The comparison is made for residential and commercial customers in San Jose, CA. The comparison is made using the CEC Emerging Renewables Program incentive and the CPUC Self-Generation Incentive Program incentive. The evaluation is performed from the perspectives of consumer, incentive agency, and state and federal governments.

Results indicate that for-profit commercial customers can experience shorter payback periods and incentive agencies can realize significant cost reductions by offering a PBI rather than a buy down. The case for positive economic benefits for residential customers is not as compelling.

The paper identifies two outstanding issues. First, it assumed that tax credits and depreciation are paid on the full PV system cost, not on the cost minus the present value of the potential PBI savings. While this is a conservative assumption because PBIs are based on system performance and are by definition uncertain, it needs to be clarified. Second, there needs to be clarification on whether or not PBIs are taxable at either the state or federal level.

There are several aspects of future work. First, this is a preliminary analysis for a limited range of applications and there is a need to analyze a wider number of cases. One way to accomplish this is to perform more analysis. Another option is to run a pilot program aimed at determining the correct PBI price. It is recommended that a pilot program for PBI for commercial customers be considered. Second, there is a need to extend the analysis and examine both the costs and benefits from perspectives that include consumer, incentive organization, federal government, state government, local government, utility, and PV industry. Third, consumers experience a higher level of performance risk with PBIs and thus may require additional financial compensation to adjust for the risk; this issue needs to be investigated. Fourth, there is a need to determine how to most effectively implement a PBI.

Introduction

There is a growing interest among individuals and companies in photovoltaic (PV) systems as an alternative to conventional utility electric supply. A challenge that has prevented the wide-spread adoption of PV, however, is its high initial capital cost.

Over the last several years, this situation has changed because a number of states now provide capital cost buy downs, tax credits, and other financial incentives to reduce the net capital cost of PV paid by the consumers. Second, electric rates in a number of locations have increased. Together, these two factors have created a situation where PV has a positive net economic value in many locations.

37 Megawatts of grid-connected PV were installed in the United States in 2003 with more than ¾ of the installations occurring in California.[1] The various California programs apply to residential and commercial customers and use buy downs to bring the cost of PV down to the point where it is cost-effective for consumers to invest. These rebates, combined with high electricity rates (relative to the rest of the country) and a good solar resource have resulted in strong growth in the PV industry.

While this is encouraging, more impressive results are occurring at other locations in the world. In particular, Japan and Germany have developed very successful programs. They have used two different incentive models.

Japan has used rebates to bring the initial cost of the PV system down to the point where consumers are willing to invest. Their program focuses on residential consumers. The program has been very successful in bringing down system prices while continuing to decrease the size of the rebate.

Germany has used performance based incentives (PBI) to ensure customers that the revenue from their PV systems is sufficient to justify the initial cost. While their program is designed for both residential and commercial customers, it is interesting that the growth of large systems in Germany has increased substantially

While there is not conclusive evidence on the best incentive structure, these results suggest that successful programs can use rebates to obtain the desired action from both residential and commercial entities while PBIs may be most effective for commercial entities.

[1] Full report is available at http://solarbuzz.com/USGridConnect2004.htm.

Objective

Some work has been done on the potential advantages of PBIs versus rebates in the U.S.,[2, 3] including the advantage that PBIs may lead to fewer PV performance problems by providing a better incentive for performance. The potential economic consequences, however, have not been well investigated.

The objective of this paper is to perform a preliminary economic evaluation of the effect of PBIs versus buy down incentives for residential and commercial customers.

The analysis is performed by determining the PBI that results in the same net present value (NPV) to the purchasing consumer as the existing buy down. The analysis is performed using QuickQuotes Premier.[4]

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[2] T.J. Starrs, "Designing a Performance-Based Incentive for Photovoltaic Markets", American Solar Energy Society's Solar 2004 Conference, Portland, OR, July 2004.

[3] T. Starrs, "What Is A 'Green Tag' Anyway?", http://www.californiasolarcenter.org/solarforum.html

[4] Information about QuickQuotes and the underlying analytical engine and database (Clean Power Estimator) is available at www.clean-power.com.

Assumptions

The two incentive programs that installed the most PV in the United States in 2003 were the California Energy Commission's Emerging Renewables Program (35% of total) and the California Public Utilities Commission's Self-Generation Program for Pacific Gas and Electric Co. (PG&E) – 16% of total.[1] Based on prior research by Clean Power Research, it is estimated that about one-third of all systems installed in the U.S. were installed in PG&E's service territory. Due to the prominence of PG&E, sample residential and commercial customers from PG&E's service territory are selected to perform the analysis. The assumptions are presented in Table 1.

The analysis is performed for a total of 12 scenarios. The cases of residential (cash), residential (loan), commercial (cash), and commercial (loan) are each evaluated with three different incentive structures:

- Existing buy down
- PBI with no taxes
- PBI with federal and state taxes

Table 1. Assumptions.

	Residential	**Commercial**
Location	San Jose, CA	San Jose, CA
PV System Size	3 kW_{DC}	100 kW_{DC}
Price	\$7,000/kW_{DC}	\$6,000/kW_{DC}
Sales Tax Rate[5]	4%	4%
Buy down Incentive	\$3,200/$kW_{CEC\text{-}AC}$	\$4,500/$kW_{CEC\text{-}AC}$ or 50% of cost
Current Electric Rate	Standard (E-1)	Medium service (E-19S)
Electric Rate Change	Time-of-use rate (E-7)[6]	No Change
Receives value of both net metered energy and PBI (if offered)	Yes	Yes
Annual Utility Bill	\$1,200	\$100,000
Annual Bill Escalation	2%	2%
Tax Status	Taxable Income	Corporation
Discount Rate	7%	7%
Payment Method (Scenario 1)	Cash	Cash
Payment Method (Scenario 2)	30-yr 7% loan	30-yr 7% loan

[5] Sales tax is typically charged only on equipment. Thus, this is the effective sales tax rate on the total amount.

[6] T.E. Hoff and R.M. Margolis, "Are Photovoltaic Systems Worth More to Residential Consumers on Net Metered Time-of-Use Rates?", American Solar Energy Society Annual Conference 2004, Portland, OR found that PG&E customers may be obtain a higher economic value by switching from a standard rate to a time-of-use rate.

Results

Required PBI

The first step of the analysis is to calculate the PBI that results in the same NPV to the customer for the various scenarios. As shown in Figure 1 and Table 2, the required PBI that has a 5-year term ranges from $0.12/kWh to $0.63/kWh for the various scenarios. A 5-year PBI term was used as a starting point. A PBI with a longer term will decrease the required PBI and is discussed in more detail later in the paper.

Note that the substantial difference in required PBI for the cash versus loan cases is due to the assumption that consumers can deduct the loan interest payments, thus reducing their state and federal taxes.

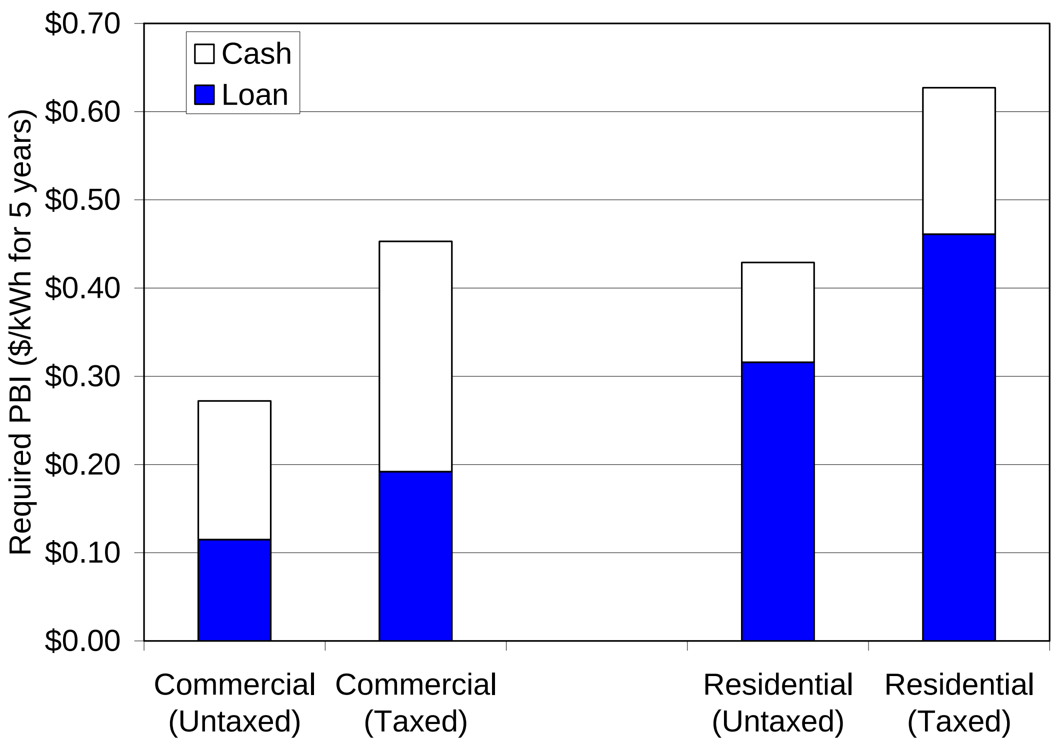

Figure 1. Required PBI (5-year tem).

Table 2. Required PBI (5-year term).

	Loan	Cash
Commercial		
• 5-yr PBI (untaxed)	$0.12	$0.27
• 5-yr PBI (taxed)	$0.19	$0.45
Residential		
• 5-yr PBI (untaxed)	$0.32	$0.43
• 5-yr PBI (taxed)	$0.46	$0.63

Incentive Agency Perspective

The remainder of the results section focuses on evaluating the economic effects from a variety of perspectives.

The first perspective that is evaluated is the incentive agency. Figure 2 presents the ratio of the PBI cost (with and without taxes) for the 4 cases to the corresponding current buy down cost. The blue bars represent the loan payment method and the blue plus the white bars represent the cash payment method. An interpretation of these results is that the loan scenario is a low range estimate while the pay cash scenario is a high range estimate.

The figure suggests that PBIs cost agencies less than buy downs for commercial customers for all scenarios (e.g., whether systems are financed or paid for with cash and whether incentives are taxed or not taxed). The figure also suggests that the cost to the agencies for residential customers depend upon PBI taxation and payment method (some are lower, some are higher, and some result in almost no change).

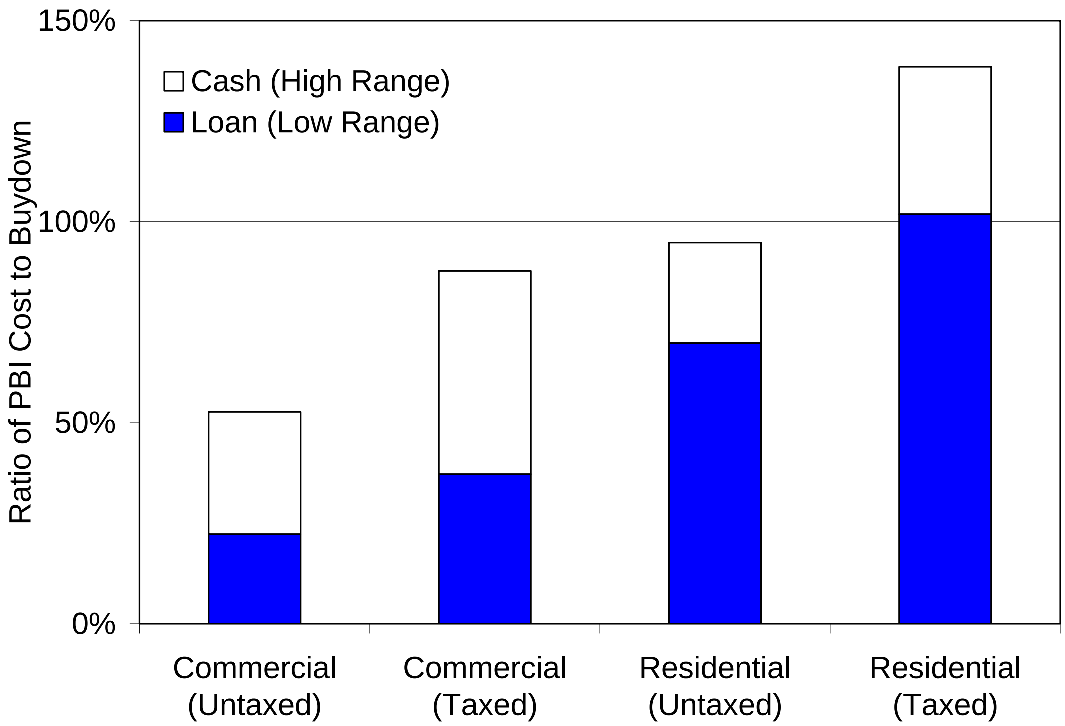

Figure 2. PBI Cost vs. buydown cost (sample customers in San Jose, CA).

Why Do PBIs Cost Agencies Less for Commercial Customers?

Figure 2 suggests that an incentive agency could reduce its costs anywhere from 10 to 80 percent by providing for-profit commercial customers with PBI instead of buy down incentives. This section presents a detailed cash flow analysis to explain why this occurs. In order to simplify the presentation, only the cash payment scenarios with the three different incentive structures are considered.

The cost and benefit categories that are included in the analysis are: buy down or performance-based incentives, taxes on PBI, federal and state tax credits, federal and state depreciation tax savings, utility bill savings, and taxes on utility bill savings.

Figure 3 presents the cash flow components for the three incentive types. The top of the figure corresponds to the buy down, the middle corresponds to an untaxed PBI, and the bottom corresponds to a taxed PBI.

The utility bill savings (gray) and taxes on utility bill savings (red) are the same for all three incentive types. The differences occur in the incentive payments (green) and the tax effects (light blue, dark blue, and yellow).

The most important thing in the figure is that the untaxed PBI is about $40,000 per year for 5 years, which has present value cost of about half the $312,000 buy down. This is because the tax credits (light blue) and depreciation (dark blue) benefits are twice as large for the PBIs than for the buy down incentive (compare top figure to middle figure). A second thing to notice is that the PBIs need to be increased to $67,000 per year to cover the tax payments when the PBIs are taxed; the consumer gets $40,000 and $27,000 goes to cover the tax payments (compare middle figure to bottom figure).

The reason PBIs cost less to the incentive agency for commercial customers is that commercial customers can take full advantage of the federal investment tax credit and accelerated depreciation because they are based on the full system cost rather than the cost after a buy down. This is a key distinction between residential and commercial sectors.

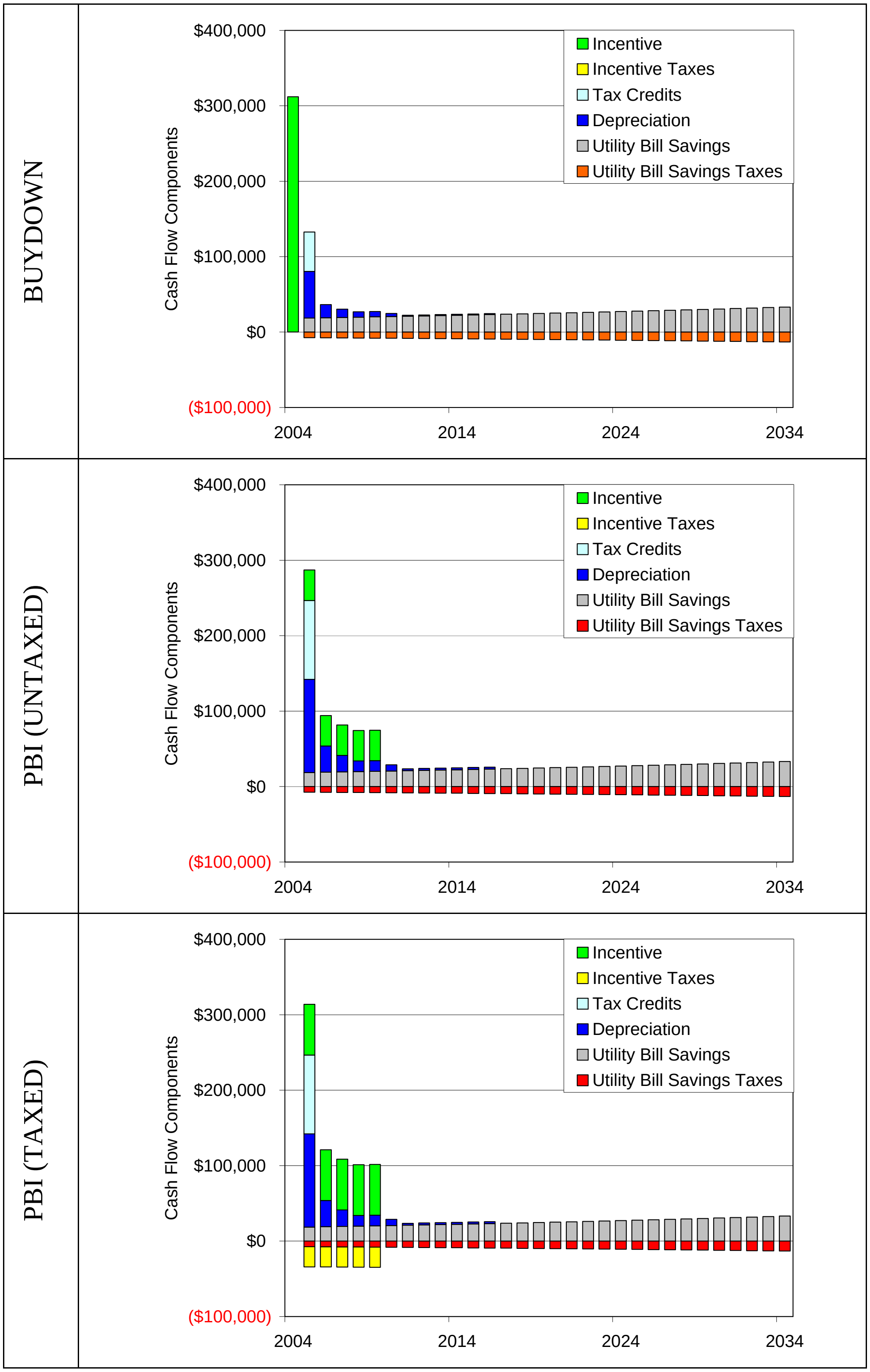

Figure 3. Cash flow components for three incentive types with pay cash method (for-profit commercial customer).

Consumer Perspective

The previous section suggested that a PBI may lower the incentive cost to the agency for commercial customers. By definition, the analysis was performed from the consumer's perspective because the PBI was selected such that the NPV with the PBI equaled the NPV with the buy down.

NPV, however, is not the only economic test that consumers use to make investments. Some give consideration to other factors, such as out-of-pocket cost and payback. This section examines the effect on the amount of time it requires for the system to "breakeven". Breakeven is defined to be the year in which the cumulative cash flow becomes positive.

Figure 4 presents the cumulative cash flow for the buy down and the PBI incentives.[7] There are several things to notice in the chart. First, the cumulative cash flow is much more negative in the first year with the PBI (i.e., the consumer pays the full amount of the system). Second, the PBI has a higher cumulative cash flow than the buy down after 4 years. Third, the PBI "breaks even" in 8 years while the buy down "breaks even" in 12 years. This means that the PBI is superior to the buy down from the consumer's perspective after 4 years on a non-discounted cash flow basis. Adding discounting would shift the break-even points out further.

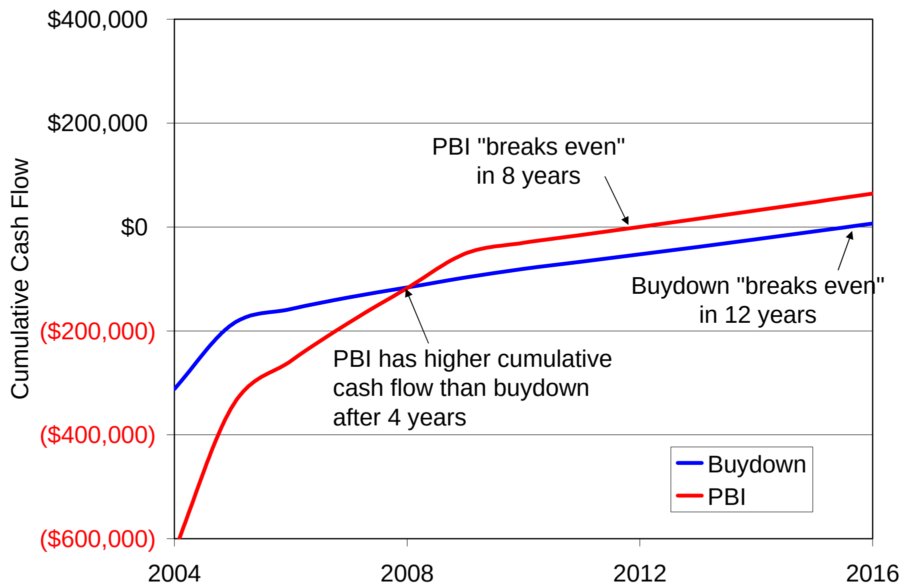

Figure 4. Cumulative cash flow with buy down and PBI incentives.

[7] The cumulative cash flow makes no distinction between PBI with and without taxes. When the PBI is taxed, the PBI payment must be increased such that it covers the cost of the taxes on the PBI. As a result, there is no difference in the annual cash flow from the consumer's perspective.

Up to this point, the analysis has assumed that the PBI is paid over a 5-year term. The question remains as to the effect that the term has from the consumer's perspective.

Figure 5 presents the breakeven point as a function of PBI term. The blue line is the breakeven point for the buy down incentive (included for references purposes). The red line is the breakeven point with the PBI. The gray line is the number of years until the PBI has a higher cumulative cash flow than the buy down's cumulative cash flow (i.e., the number of years until the PBI is "better" than the buy down).

A number of observations can be drawn out of Figure 5. First, the breakeven point is shorter for the PBI than the buy down for all terms presented. Second, a longer PBI term requires more time until it has a higher cumulative cash flow than the buy down. Third, there is an optimal PBI term if one is trying to minimize the number of years to breakeven (it is 7 years in the case presented due to the structure of the federal depreciation schedule).

The general conclusion is that PBIs provide commercial customers with shorter payback periods than buy downs and that there appears to be an optimal PBI term that produces the shortest payback period.

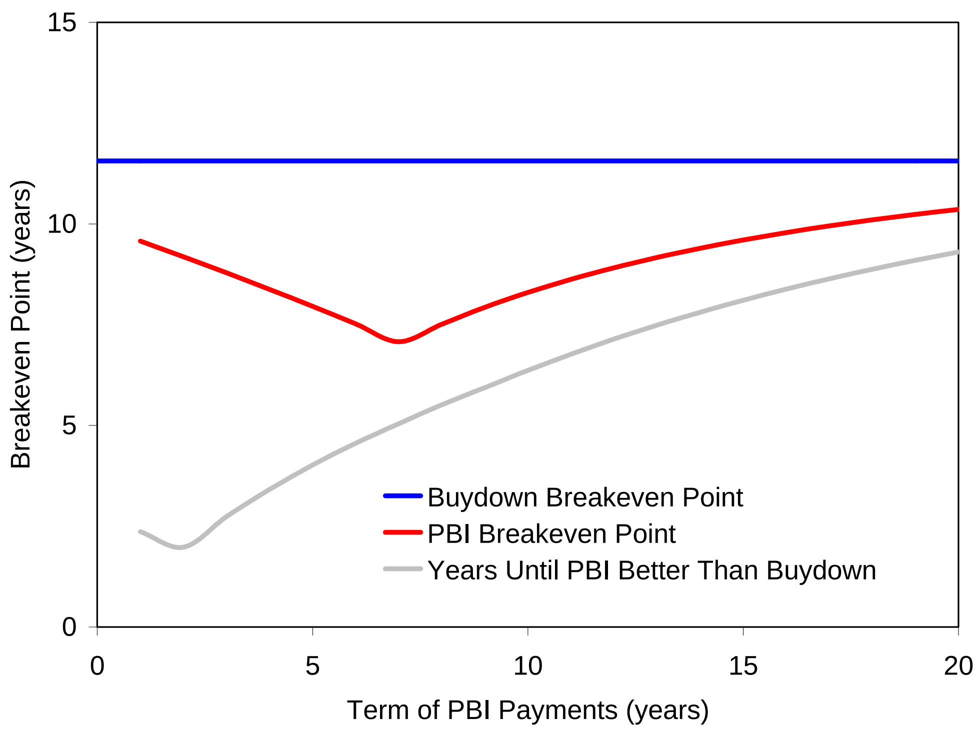

Figure 5. Breakeven point versus PBI term.

Federal and State Government Perspectives

The previous sections examined the economic impact of a switch to a PBI from the perspectives of the incentive agencies and consumers. Results suggest that the effect is positive from both perspectives.

Other perspectives that need to be considered are the state and federal governments. Note, the state government does not include the rebate organization's costs. While this requires a more detailed analysis than can be presented in this paper, this section begins to formulate the analysis.

Table 3 presents the tax consequences of a purchase of a $600,000 system by a for-profit commercial customer with incentives from the perspective of the state and federal governments for the various incentive structures. Included in the table for comparison purposes are the tax effects of a purchase of a $300,000 system (i.e., $3/W) with no incentives. This corresponds to the situation after there are PV system price reductions.

For each scenario, the first line (labeled Consumer) presents the economic effects only at the consumer level. These effects include government costs of tax credits and depreciation and government benefits of increased tax revenue due to reduced utility bills (and sales tax at the state level).

The purchase of a PV system, however, has other economic benefits from the government's perspective.[8,9,10] One tangible benefit is the creation of jobs. While there needs to be further analysis as to exactly how many jobs are created and the value to the government, a recent study used an Input/Output model to estimate that each MW of PV creates 40 jobs (this would correspond to 16 direct jobs and 24 indirect jobs if the study used an economic multiplier of 2.5).[11],[12]

Assume that each job pays $50,000 per year.[13] A 100-kW_{DC} system would create 4 direct plus indirect jobs. This means that, for a $600,000 system, $80,000 or 12 percent of the

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[8] A. Lovins, et. Al., *Small is Profitable: The Hidden Economic Benefits of Making Electrical Resources the Right Size*. Rocky Mountain Institute, 2003.

[9] T. E. Hoff, C. Herig, and L. Gillette, "Tax Revenue Protection Through Outage Risk Mitigation: The Value of Distributed PV to The Federal Government," October 2002, available at www.clean-power.com.

[10] T. E. Hoff, "Distributed Generation and Local Governments: An Introduction," September 2000), available at www.clean-power.com.

[11] G. Wayne, "The Costs and Benefits of the Extension of California's PV Incentive Program", Prepared for California Solar Energy Industries Association for CPUC testimony, June 4, 2004. This study estimated that 40 jobs (direct + indirect) are created per MW of PV. It is important to note that most of the jobs that are created will be created during the installation of the PV system.

[12] These results were confirmed by comparing them to a previous study. The REPP Labor Calculator (http://www.repp.org/articles/static/1/binaries/Labor_Calculator.pdf) estimated that PV would produce 25 manufacturing jobs, 7 installation jobs, and 3 O&M jobs per MW. The REPP study did not include an I-O multiplier effect. The study referenced above (11) assumed that 25% of the PV system components would be supplied by in-state manufacturers. Based on the REPP study, the total direct jobs produced by PV = 10 jobs per MW + 25 jobs per MW * 0.25 = 16 jobs per MW. If we assume there is a 2.5 multiplier, the REPP study would also estimate 40 direct + indirect jobs.

[13] This is estimated based on a discussion with a PV dealer in the Los Angeles area.

total cost is spent on direct labor costs (manufacturing and installing the systems). From a tax perspective, if the person files taxes as a single person, there will be $9,316 paid in federal taxes[14] and $2,812 paid in state taxes for each $50,000 job.[15]

The second line for each scenario in Table 1 presents the jobs benefits and the bottom line adds the jobs benefits to the consumer analysis. The results are presented in Figure 6 and have several important implications. First, the federal and state governments currently have an economic benefit from the installation of PV systems with the existing buy down incentive structure. Second, moving to an untaxed PBI makes the state almost economically indifferent to PV and increases the cost to the federal government.

Furthermore, the federal and state governments are about economically neutral when the price is $3/Watt price and there are no incentives from the incentive agency. Note that this analysis only includes the tax consequences from the purchasing consumer's perspective plus the tax revenue from the jobs created. Many other benefits have been identified in other studies but are not included in this analysis. As a result, the benefit to both the federal and state governments is likely to be much higher than what is presented in the figure.

Table 3. Present value costs and benefits from government perspectives with and without jobs tax benefits for installation of 100kW system.[16]

	Jobs Per 100 kW	Federal Government	State Government
$6/W w/ Buydown			
Consumer		($26,806)	$13,836
Jobs	4.0	$37,264	$11,248
Consumer + Jobs		$10,458	$25,084
$6/W w/ PBI (untaxed)			
Consumer		($139,491)	($20,821)
Jobs	4.0	$37,264	$11,248
Consumer + Jobs		($102,227)	($9,573)
$6/W w/ PBI (taxed)			
Consumer		($54,619)	$3,385
Jobs	4.0	$37,264	$11,248
Consumer + Jobs		($17,355)	$14,633
$3/W w/ no incentives			
Consumer		($26,806)	$1,836
Jobs	2.5	$23,290	$7,030
Consumer + Jobs		($3,516)	$8,866

[14] http://www.irs.gov/pub/irs-pdf/i1040.pdf.
[15] http://www.ftb.ca.gov/forms/01_forms/01_rate.pdf.
[16] These federal government costs include a investment tax credit and accelerated depreciation and benefits of increased tax revenue due to reduced utility bills. The state government costs include a tax credit and depreciation and benefits of increased tax revenue due to reduced utility bills and sales tax revenue. The incentive organization costs are not included.

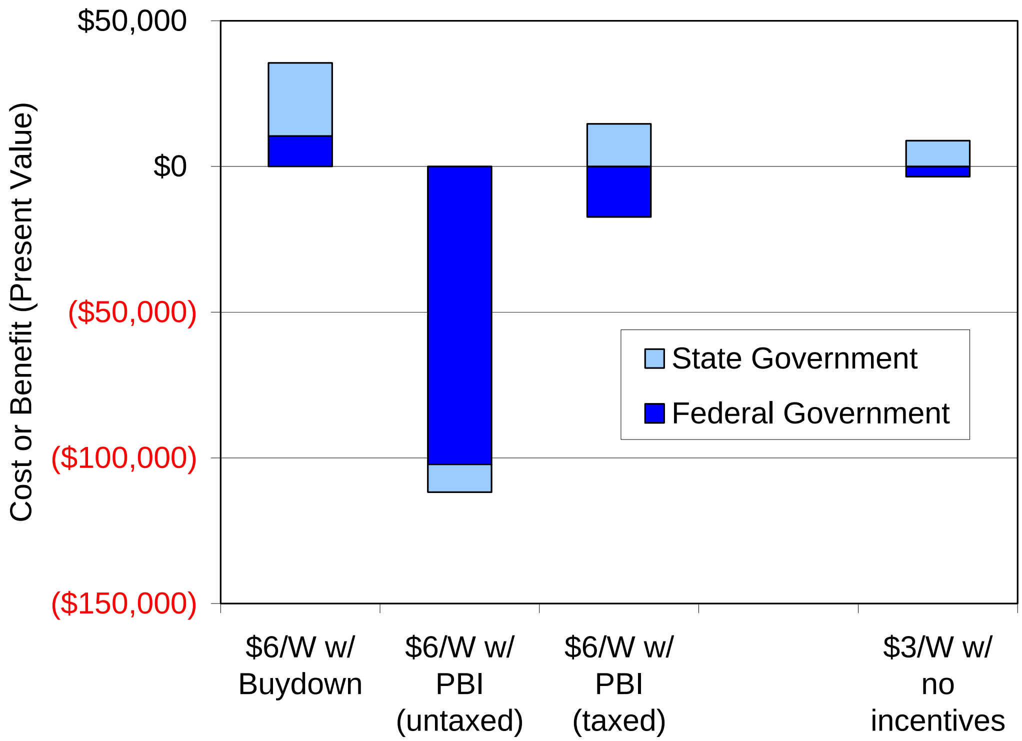

Figure 6. Present value costs and benefits for 100kW commercial system (with installed system cost of $6/W and $3/W) from various perspectives with jobs benefits.

Conclusions

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Acknowledgements

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