PAYBACK ON RESIDENTIAL PV SYSTEMS WITH PERFORMANCE BASED INCENTIVES AND RENEWABLE ENERGY CERTIFICATES

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ABSTRACT

Renewable Energy Certificates (RECs) and Performance Based Incentives (PBIs) can provide important performance-associated incentives for the installation of solar electric systems. They are becoming increasingly popular and scrutinized methods of motivating the purchase of PV systems. In states with Renewable Portfolio Standards (RPS) that have a distributed generation requirement, solar RECs (SRECs), effectively count as part of the incentive to stimulate solar system investment.

Compared to capacity-based rebate incentives, important differences in time-value-of-money and tax treatment cause changes in cash flow and internal rate of return, which need to be considered by the PV system investor, the salespeople and the marketers for such systems.

RECs and PBIs can be equally attractive financially, relative to rebates, in terms of Compound Annual Rate of Return (CARR), improved resale value of the property, and cash flow if the transaction is financed.

1. INTRODUCTION

There are now several forms of financial incentive as part of public policy to support solar electric systems including capacity-based incentives, often in the form of a rebate to discount the initial cost of a system, reducing the initial cost purchase barrier. Rebates are generally based on a rated capacity of the system to produce electricity.

Performance-associated incentives come in two common forms. The direct form is an incentive payment to the purchaser directly proportional to the production of the system. This direct form is often referred to as a Performance Based Incentive or PBI.

In certain U.S. states, utilities must comply with Renewable Portfolio Standard (RPS) mandates. If the RPS has a distributed (or customer sited) generation component or a solar “carve-out” requiring a certain amount of energy be produced by solar electricity, the utility will commonly satisfy that requirement by purchasing the solar Renewable Energy Certificates (SRECs) from qualifying solar installations. Because demand for these SRECs is high, they can have significant value. This is an indirect form of performance-associated incentive, since the number of SRECs an installation can sell is directly related to its productivity.

Tying incentives to performance has many benefits, which have been illuminated by others. A few of those benefits include creating a strong incentive for the system’s owner to clean and maintain the system. This in turn maximizes the public benefit per incentive dollar invested in supporting the system. This type of incentive more strongly encourages PV systems in applications which will benefit from the best location, orientation, sun exposure, wiring, and other factors, and least dust accumulation; factors that are more or less under the control of the customer and system designer. Better systems, locations, designers, and installers will gain favor over those with problems of shading, location, design, or installation that result in lower production.

2. ISSUES TO BE CONSIDERED

Tax treatment, cash flow, time-value-of-money, and predictions in expected performance must be considered in evaluating the financial performance and value of a PV system receiving performance-associated incentives in comparison to the traditional rebate incentives.

If a choice between a capacity-based rebate and a PBI is available, as has been the case during the California Energy Commission's (CEC) "Pilot Performance-Based Incentive Program", this comparison is all the more important, and may explain why the CEC Pilot Program got off to a slow start, with relatively little initial interest.

2.1 Cash Flow of SRECs, PBIs, and Rebates

Performance-associated incentives are typically paid out over time, well after the installation of the solar system has occurred. This delay will typically require the purchaser to fund or finance the full cost of the system, then receive a stream of financial benefits over time comprising any REC or PBI payments enjoyed, plus the benefits of net metering or other avoided cost on the electric bill, if applicable.

In comparison, a rebate program typically pays the rebate upon satisfactory installation of a solar system. Often, this rebate can be directed towards the installing contractor or manufacturer as final payment for the system, allowing the purchaser to pay for only the net "after rebate" amount of the system cost. This substantially reduces the customer's project cash requirements.

In scenarios where the customer is financially indifferent about receiving a rebate or a performance incentive, receiving the performance-associated incentive will typically improve the customer's cash flow during the incentive payment period, even if the larger capital requirements are financed. After the incentive payment period is over, the financially indifferent customer will see a reduced cash flow, relating to the larger remaining loan balance, if any, plus the unchanged benefits of net metering or other avoided cost on the electric bill, as applicable.

2.2 Time-Value-of-Money of SRECs, PBIs, and Rebates

The payment of SRECs and PBIs are often spread out over time, and performance must be demonstrated and earned before payment can be received. The delay in receiving this incentive income means that these future payments have relatively lower value compared to other forms of incentive payment that might be received up front, such as a rebate. Any such delay can and should be included on a financial analysis timeline to properly understand its relative time-value-of-money.

Colorado to some extent appears to be getting around the issue of time-value-of-money by valuing the 20-year REC output of a system at $2.50 per DC watt of installed capacity (equivalent to $.069/kWh to .079/kWh depending on location in the state) and allowing the utility to pay that up front to the PV customer. The number of RECs for which a facility will be paid is adjusted using the PVWatts[1] calculator. Facilities that are significantly more or less productive than an optimal fixed orientation will receive an adjusted REC up-front payment[2]. This simplifies the REC payment process, but effectively amounts to an orientation-adjusted capacity-based rebate payment, and eliminates many of the benefits of a performance-associated incentive such as avoiding shade, encouraging owner attention and care, and motivating high performance through quality design and installation. Even as a rebate program, Sacramento Municipal Utility District's (SMUD) PV Pioneers program is more effective by including shading along with array orientation in calculating the rebate value[3].

2.3 Tax Treatment of SRECs, PBIs, and Rebates

If the SREC and PBI payments are considered taxable income, the value of these payments may be significantly diminished, depending on the tax status of the entity receiving the payments. The author's current information indicates the taxable status is not consistent from U.S. state to state. Moreover, even within a given state, the various buyers of RECs are inconsistent in issuing 1099 tax forms. Ideally, RECs and PBIs would not be taxed. The IRS has not issued a ruling, and isn't likely to in the near future. In the analyses that follow, it is assumed that RECs and PBIs are taxable for residential applications.

In comparison, rebate program payments may not be taxable to individuals. The IRS has not ruled on this either, however, Section 136 of the IRS Code indicates that rebates received by individuals (residential) from utilities for energy conservation are not taxable. It is not clear if this applies to PV rebates, but there may be enough doubt that individuals may be able to legitimately disclaim the rebate as taxable income, even if they receive a 1099 for the rebate payment. More information is available in the SEIA *Guide to Federal Tax Incentives for Solar Energy*[4].

It was long thought that an individual could avoid taxation of their rebate by having the installer accept the rebate for the customer in lieu of final payment. The author has been informed that this is not permissible. However, as stated above, Section 136 may protect individuals. For businesses, with the new 30% federal incentive tax credit (increased from 10%), it is actually desirable to claim the rebate as taxable income, then claim a larger tax credit and depreciation on the whole system value, rather than just the after tax net cost.

The author is not a qualified tax professional and provides this for informational purposes only. The reader is urged to seek a qualified professional assistance relating to tax matters.

2.4 Sensitivity to System Performance Estimates

The financial analysis and projected benefit are directly dependent on the quality and accuracy of performance estimates. Estimates that are conservative in the anticipated system production will reflect relatively lower projected economic benefit. Projected system performance can be validated with PVWatts[1] and RETScreen[5] estimation tools.

3. FINANCIAL PAYBACK ANALYSIS

As demonstrated in *Financial Payback on California Solar Electric Systems*[6] and *Why Is A Solar Electric Home Worth More?*[7] the financial performance of PV systems can be measured in terms of:

- Compound Annual Rate or Return (using IRR)
- Cash Flow
- Resale Value

3.1 Compound Annual Rate of Return

The Compound Annual Rate or Return (CARR) analysis includes the value, timing, and tax implications of the performance incentives on a multi-year timeline. An example of a 25-year timeline is shown in Appendix A. Internal Rate of Return iterative analysis (using the IRR tool in most spreadsheets) provides accurate calculation of the CARR. Note, to be conservative, the terminal value is assumed to be $0 at year 26. It is likely the system will still perform well, but will be beyond the module warranty period.

Residential application cases from New Jersey and California showing the results of analyses including performance and capacity incentive structures are shown in Table 1. The setup and assumptions for these cases are detailed in Table 2.

Two cases are shown for each type of incentive in California, because the tiered rate structure dramatically varies the results depending on the customer's usage. The larger customer pays $0.33/kWh in the top tier, whereas the smaller customer pays $0.13/kWh.

The California results show that the larger customers enjoy a CARR of over 15% with either the rebate or the PBI. The results are consistently a little better with the rebate. In New Jersey, because the rebate is so generous, combined with attractive SREC valuations (currently over $0.17/kWh), the CARR even outstrips the best cases in California.

Because there is no significant difference in the tier pricing in New Jersey, these excellent results will remain roughly the same for all system sizes up to 10kW, the top of the range for that level of rebate.

3.2 Cash Flow

The Cash Flow analysis compares the original electric bill to the new solar system costs of a smaller electric bill, combined with a loan cost (principal and deductible interest) and maintenance costs. The Cash Flow results in Table 1 need to be interpreted carefully. Because the PBI is paid at a high rate, but only for a short period of time, it makes the California PBI look very attractive in the first 3 years.

For larger California systems, the annual cash flow is always positive (Fig. 1), for smaller, it starts positive, but then dips negative for a few years until electric rate inflation pulls it positive again, compared to loan cost (Fig. 2). On an accumulated cash flow basis, both California PBI cases are always in positive territory, whereas the smaller California rebate case is negative for a few years.

It is expected that New Jersey SRECs will be valued and paid at a high rate over a longer term, so those results show a consistently positive cash flow (Fig. 3). The exceptional year in each of these is for inverter replacement at year 15.

TABLE 1: EXAMPLES OF FINANCIAL ANALYSIS RESULTS FOR CALIFORNIA AND NEW JERSEY SYSTEMS RECEIVING PERFORMANCE AND CAPACITY INCENTIVES.

Case	Monthly Bill Before Solar	Usage kWh per Month	Solar System STC Size	New Monthly Bill with Solar	Cost Before Incentive	Initial Resale Value Increase	Pre-Tax Annual Return (CARR)	Net Monthly Cash Flow with 7% 30-yr Loan (in 1st Yr)
NJ SREC & Rebate	$124	1,000	9.9 kW	$8	$73.4K	$62.9K	17.6%	$152
CA PBI Large	$322	1,500	8.9 kW	$8	$65.6K	$72.2K	15.1%	$540
CA Rebate Large	$322	1,500	8.9 kW	$8	$65.6K	$72.2K	17.3%	$107
CA PBI Small	$75	600	3.2 kW	$5	$24.9K	$15.6K	9.5%	$149
CA Rebate Small	$75	600	3.2 kW	$5	$24.9K	$15.6K	10.8%	-$7

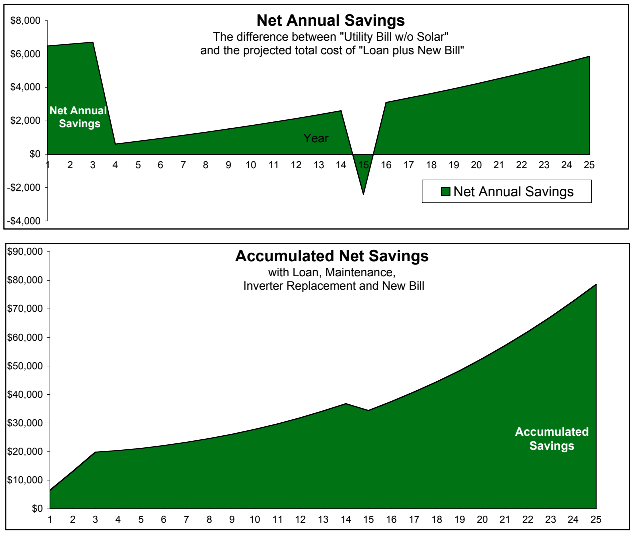

Fig. 1: CA PBI Large cash flow, annual and accumulated.

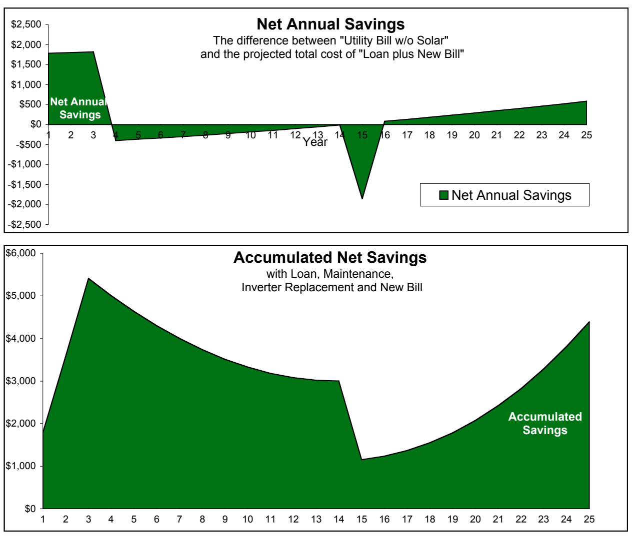

Fig. 2: CA PBI Small cash flow, annual and accumulated.

3.3 Resale Value

The resale value must also be carefully interpreted, as its results are dependent on net annual savings (excluding loan costs) [7,8,9]. Because of this dependency, large perturbations due to short term PBIs create misleading results if the PBI payment is included as part of net annual savings. For the examples in Table 1, the PBI has been excluded.

For the New Jersey case, the SRECs are expected to have value over the long term, commensurate with the life of the solar system. It is then reasonable to include these SREC payments in the net annual savings produced by the system. This analysis assumes SREC values have an initial contract of $0.17/kWh for the first 10 years, then drop to $0.10/kWh for the remaining 15 years of conservatively estimated system life.

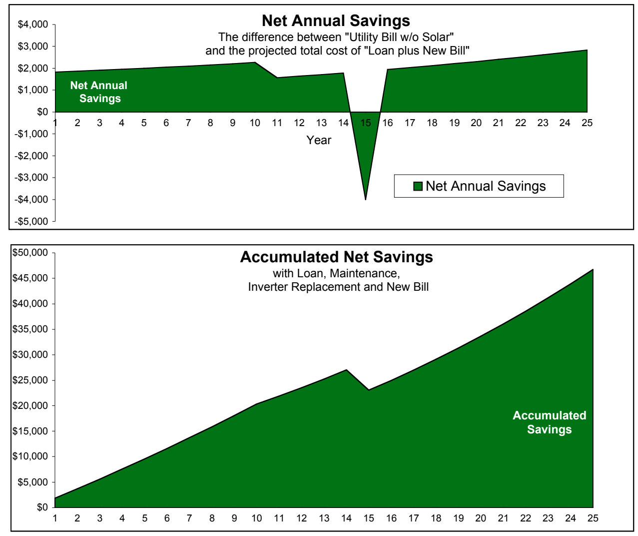

Fig. 3: New Jersey cash flow, annual and accumulated.

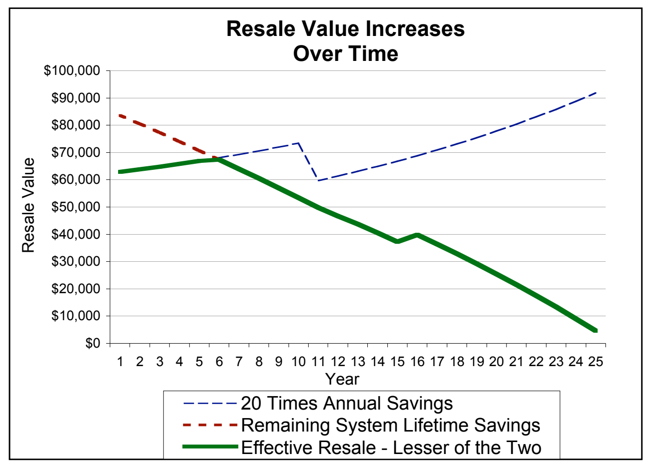

Fig. 4: New Jersey resale value. The heavy green line represents the justifiable limit to appreciation.

The electric rate tiers must be considered when comparing the California large and small system resale values with initial costs, otherwise the results appear inconsistent.

3.4 Comparison To Capacity-Based Incentives
In the California examples shown, capacity-based incentives are slightly more attractive in the long term. However, this is simply due to the specific levels of each incentive. Slight changes, or the removal of taxation of the PBI could reverse the balance.

3.5 Sensitivity of the Variables

The CARR is highly sensitive to the installed cost of a system. A $1/watt increase in installation cost reduced the NJ CARR from 17.6% to 12%. The analysis is increasingly sensitive to the reduction in duration of the performance-related incentive below 10 years. An increase in a 10-year performance-related incentive of $0.06/kWh increases the CARR by 1%. $0.055/kWh is required to achieve the same 1% rise in CARR if the incentive is paid over 25 years (as in SRECs).

4. CONCLUSION

The author anticipates that due to the very attractive state of incentives and investing in solar in New Jersey, that a very large solar market will be stimulated, allowing supply of SRECs to meet demand, putting downward pressure on the value of SRECs, and reining in the currently very high returns solar investor are now enjoying to more reasonable levels. Performance-associated incentives can be very effective in creating an attractive economic case for solar. PBI incentive programs need not be longer than 10 years to provide meaningful incentive. Payments beyond 10 years have little effect on results, and become a long-term challenge for the funding agency.

5. REFERENCES

(1) National Renewable Energy Laboratory (NREL), *A Performance Calculator for Grid-Connected PV Systems, Version 1*, from the NREL website, March 14, 2006, http://rredc.nrel.gov/solar/codes_algs/PVWATTS/

(2) Xcel Energy, *Calculate Your REC Payment*, from the Xcel Energy website, March 14, 2006, http://www.xcelenergy.com/docs/retail/conmrkts/CalculateYourRECPayment.pdf

(3) Sacramento Municipal Utility District (SMUD), *Solar for your home: PV Pioneers*, from the SMUD website, March 14, 2006, http://www.smud.org/green/solar

(4) Chadbourne & Parke, LLP, *Guide to Federal Tax Incentives for Solar Energy,* Solar Energy Industries Association, Version 1.0, p 6, 23, January 27, 2006

(5) Natural Resources Canada, *RETScreen International*, from the Natural Resources Canada website, March 14, 2006, http://www.retscreen.net/

(6) Black, Andrew, Financial Payback on California Solar Electric Systems, Proceedings of the 32nd ASES Annual Conference, The American Solar Energy Society, July 2003

(7) Black, Andrew, Why Is A Solar Electric Home Worth More?, Proceedings of the 33rd ASES Annual Conference, The American Solar Energy Society, July 2004

(8) Nevin, Rick et al, Evidence of Rational Market Valuations for Home Energy Efficiency, The Appraisal Journal, The Appraisal Institute, http://www.icfconsulting.com/Markets/Community_Development/doc_files/apj1098.pdf, October 1998

(9) Nevin, Rick et al, More Evidence of Rational Market Values for Home Energy Efficiency, The Appraisal Journal, The Appraisal Institute, http://www.icfconsulting.com/Markets/Community_Development/doc_files/apj1099.pdf, October 1999

TABLE 2: ASSUMPTIONS FOR THE ANALYSES IN TABLE 1.

<table>
<tr><th>Variable \ Case</th><th>NJ SREC & Rebate</th><th>CA PBI Large</th><th>CA Rebate Large</th><th>CA PBI Small</th><th>CA Rebate Small</th></tr>
<tr><td>System Cost ($/watt STC)</td><td colspan="3">$7.38</td><td colspan="2">$7.80</td></tr>
<tr><td>Permits & Fees included</td><td>$500</td><td colspan="4">$500 + $277 TOU Meter Fee</td></tr>
<tr><td>Inverter Replacement</td><td colspan="5">$700/kW at Year 15</td></tr>
<tr><td>Rebate ($/watt STC)</td><td>$4.95</td><td></td><td>$3.15</td><td></td><td>$3.15</td></tr>
<tr><td>PBI ¢/kWh / years</td><td></td><td>50¢ / 3 years</td><td></td><td>50¢ / 3 years</td><td></td></tr>
<tr><td>1st REC Contract</td><td>17¢/kWh for 10 years</td><td colspan="4"></td></tr>
<tr><td>2nd REC Contract</td><td>10¢/kWh for 15 years</td><td colspan="4"></td></tr>
<tr><td>Tax Brackets</td><td colspan="5">Residential, 28% Federal and 9.3% state</td></tr>
<tr><td>PBI or REC taxable?</td><td colspan="5">Yes</td></tr>
<tr><td>Federal Tax Credit</td><td colspan="5">30%, capped at $2,000</td></tr>
<tr><td>Length of IRR analysis</td><td colspan="5">25 years</td></tr>
<tr><td>Utility</td><td>PSE&G</td><td colspan="4">PG&E</td></tr>
<tr><td>Starting Rate Schedule</td><td>RS</td><td colspan="4">E1 SB</td></tr>
<tr><td>Ending Rate Schedule</td><td>RS</td><td colspan="4">E7 SB</td></tr>
<tr><td>Percent “peak” usage</td><td></td><td colspan="4">25%</td></tr>
<tr><td>NREL WBAN Station</td><td>Newark</td><td colspan="4">Sacramento</td></tr>
<tr><td>Array Orientation, Shading</td><td colspan="5">South, 22° pitch, No shading</td></tr>
<tr><td>Electric Inflation</td><td colspan="5">5%</td></tr>
<tr><td>Maintenance Cost, Inflation</td><td colspan="5">0.25% of gross system cost per year, adjusted annually for 3.5% inflation</td></tr>
<tr><td>Annual Module Degradation</td><td colspan="5">0.5%</td></tr>
<tr><td>Total of All System Loss Factors</td><td colspan="5">29.2% including inverter and module temperature losses</td></tr>
<tr><td>Annual AC kWh per STC kW</td><td>1146</td><td colspan="4">1424</td></tr>
</table>

APPENDIX A: Financial Detail of the Examples.

NJ SREC & Rebate

Solar Analysis provided by:
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OnGrid PV Sizing & Solar Financial Analysis Calculator v2.07

Residential Pre-Tax Analysis: After-Tax amounts are adjusted to pre-tax equivalents. Pre-Tax amounts are not adjusted

	Year: 0	1	2	3	4	5	6	7	8	9	10	11	12
Operating Savings:													
Avoided electricity Purchases		2,207	2,306	2,410	2,518	2,631	2,750	2,874	3,003	3,138	3,279	3,427	3,581
REC (Green Tag) Income. Assumed Taxable		1,937	1,928	1,918	1,908	1,899	1,889	1,880	1,870	1,861	1,852	1,084	1,078
No Performance Based Incentive Included													
Operating Expenses:													
System Maintenance at 0.25% of gross system cost pe		(291)	(301)	(312)	(323)	(334)	(346)	(358)	(370)	(383)	(397)	(411)	(425)
System Capital Cost after Rebates & Fees	(26,413)												
Inverter Replacement at $700 per kW in Year 15													
Energy Efficiency Net Expense													
Operating profit (loss):	**(26,413)**	**3,853**	**3,932**	**4,016**	**4,104**	**4,196**	**4,294**	**4,396**	**4,503**	**4,616**	**4,735**	**4,100**	**4,235**
Federal & State Tax benefits													
Fed Tax Creditable Basis:	26,413												
30% Federal Tax Credit up to $2,000, Infl to Pre-Tax	3,173												
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.													
Pre-Tax Net Annual Profit/Loss for IRR	(23,240)	3,853	3,932	4,016	4,104	4,196	4,294	4,396	4,503	4,616	4,735	4,100	4,235
Pre-Tax Cash Flow, Cumulative	(23,240)	(19,387)	(15,455)	(11,439)	(7,335)	(3,138)	1,155	5,551	10,054	14,670	19,405	23,505	27,740

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v

	Year: 13	14	15	16	17	18	19	20	21	22	23	24	25
Operating Savings:													
Avoided electricity Purchases	3,742	3,911	4,087	4,271	4,463	4,664	4,873	5,093	5,322	5,561	5,812	6,073	6,346
REC (Green Tag) Income. Assumed Taxable	1,073	1,068	1,062	1,057	1,052	1,046	1,041	1,036	1,031	1,026	1,021	1,015	1,010
No Performance Based Incentive Included													
Operating Expenses:													
System Maintenance at 0.25% of gross system cost pe	(440)	(455)	(471)	(488)	(505)	(522)	(541)	(560)	(579)	(599)	(620)	(642)	(665)
System Capital Cost after Rebates & Fees													
Inverter Replacement at $700 per kW in Year 15			(5,870)										
Operating profit (loss):	4,376	4,523	(1,192)	4,840	5,010	5,188	5,374	5,569	5,774	5,988	6,212	6,447	6,692
.													
Pre-Tax Net Annual Profit/Loss for IRR	**4,376**	**4,523**	**(1,192)**	**4,840**	**5,010**	**5,188**	**5,374**	**5,569**	**5,774**	**5,988**	**6,212**	**6,447**	**6,692**
Pre-Tax Cash Flow, Cumulative	**32,115**	**36,638**	**35,446**	**40,286**	**45,296**	**50,484**	**55,858**	**61,427**	**67,200**	**73,188**	**79,400**	**85,846**	**92,539**

ANNUAL RATE OF RETURN

Pre-Tax Annual Rate of Return

17.6% IRR (Pre-Tax Rate of Return)

For comparison with other investments
Additional value as a hedge against future electric rate increases

SFA-B4EI1ZMZL3SM9HVAIOM4

Fig. 5: Timeline for 25-year analysis for calculating IRR and CARR.