Distributed Photovoltaics in New Jersey[1]

Dr. Thomas E. Hoff
Clean Power Research
10 Glen Ct.
Napa, CA 94558
www.clean-power.com

Dr. Robert Margolis
National Renewable Energy Laboratory
901 D Street, SW, Suite 903
Washington, DC 20024
www.nrel.gov

Executive Summary

The New Jersey Board of Public Utilities (NJ BPU) is in the process of designing its Renewable Portfolio Standard (RPS). One aspect of the RPS is a set-aside for distributed solar. The objective of this work is to compare the added value that distributed photovoltaics (PV) provides to the added cost.

Table 1 and Figure 1 present the costs and benefits for various scenarios. The costs include the PV buydown program and RPS costs. The values include jobs, environment, and rate protection. Three scenarios were selected in order to present the range of results: pessimistic (low benefits/high costs), optimistic (high benefits/low costs), and best guess. Results suggest that the pessimistic scenario has a net cost of $1.1 billion, the best guess scenario has a net benefit of $0.2 billion (benefits are slightly greater than costs), and the optimistic scenario has a net benefit of $2.1 billion (benefits are significantly greater than costs).

These results suggest that the RPS is economically justifiable in the best guess and optimistic scenarios. Given that only three values were explicitly calculated (i.e., there are likely to be other values that are not included in this analysis), it appears that the RPS with a PV component is an economically wise decision.

The key assumptions that determine the costs are the rate at which PV prices decline and the factors that consumers use to make investment decisions. The key assumptions that determine the benefits are whether in-state manufacturing jobs are created (versus only installation jobs) and whether future electricity rates are allowed to decline as a result of having PV as a backstop technology.

The RPS is not economically justified in the pessimistic case. This study was not intended to be a cost analysis. However, in order to perform the net benefit analysis, a cost estimate was required. In the process of performing this evaluation, it was determined that the RPS cost had a substantial variation depending upon the expected PV cost reduction and the criteria consumers use to make investment decisions. Future work

[1] Special thanks to Chris Cook (E3 Energy Services), Christy Herig (Segue Consulting), and Cassandra Kling (New Jersey Board of Public Utilities) for their ideas and suggestions. This project was performed under contract to the Department of Energy through the National Renewable Energy Laboratory.

could be targeted at refining the RPS cost analysis in order to reduce the cost uncertainty and thus reduce the net benefit uncertainty.

Table 1. Range of costs and benefits.

	Pessimistic		Best Guess		Optimistic	
Value						
Jobs	$180		$469		$659	
Environment	$95		$166		$237	
Rate Protection	$410		$843		$1,657	
Total Value		*$685*		*$1,478*		*$2,553*
Cost						
Buydown Program	($545)		($446)		($353)	
RPS	($1,234)		($795)		($96)	
Total Cost		*($1,779)*		*($1,241)*		*($449)*
Net Cost or Benefit		**($1,094)**		**$236**		**$2,104**

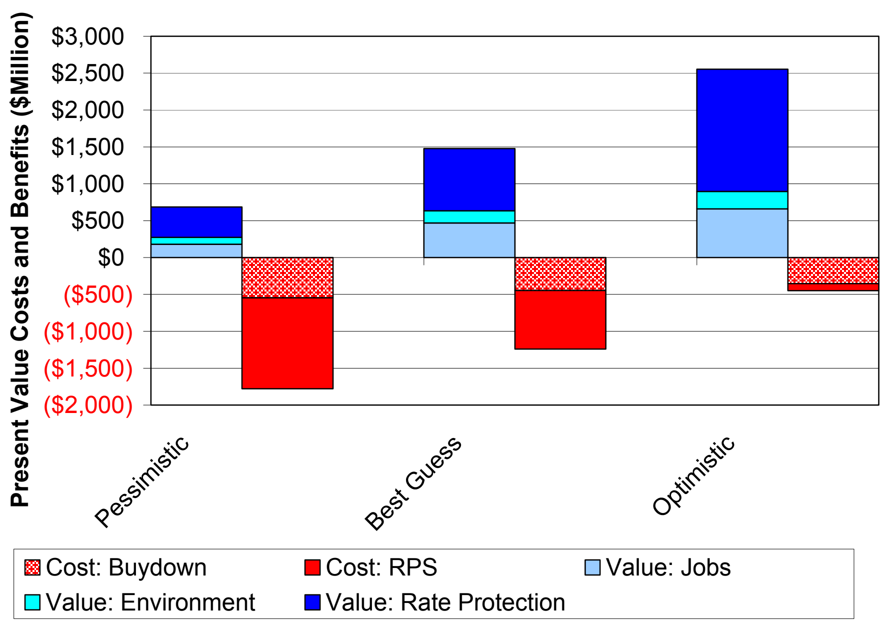

Figure 1. Range of costs and benefits

Introduction

The New Jersey Board of Public Utilities (NJ BPU) is in the process of designing its Renewable Portfolio Standard (RPS). One aspect of the RPS is a set-aside for distributed solar. The objective of this work is to determine if the added value that distributed photovoltaics (PV) justifies the added cost.

Evaluation Framework

Introduction

It is important to clarify the perspective taken in this analysis. Since this is for the state of New Jersey, it is important to look at the combined perspective of the consumers and the businesses that satisfy the needs of those consumers.

Suppose that a consumer wants to satisfy a need by purchasing a particular product. This product has value to the consumer (consumer value), a market price, and production cost.

Consider the importance of the perspective as presented in Table 2. As shown in the "Net" column:

- Consumers focus on the value they get from the product and the price they pay for it; the purchase is justified if value exceeds price
- Businesses focus on the price at which they sell the product and what it costs to make it; price minus cost determines profitability
- The combined perspective is only concerned with the consumer value and production cost; net benefit, which equals consumer value minus production cost, is the relevant metric; price is only a transfer mechanism

The focus of this work is from the overall state of New Jersey. Thus, the relevant metric is the product's net benefits: consumer value minus production cost.

Table 2. Evaluation Framework

	Consumer Value	**Price**	**Production Cost**	**Net**
Consumer	Value	- Price		***Value - Price***
Business		Price	- Cost	***Price – Cost***
Combined (Cons. + Bus)	Value		- Cost	***Value - Cost***

Simple Typewriter Example

In order to emphasize the importance this evaluation framework, consider the following simple example. The year is 1985 and the employee of a company needs to perform electronic word processing. The employee earns $50K per year and spends 30 percent of their time writing hand-written memos. A typewriter would reduce this to 20 percent of time while a computer would reduce this to 10 percent of time because computers are more efficient at "retyping" memos when changes are made. Both the computer and typewriter will last 2 years.

In this case, the consumer value is the value from one business purchasing another business' product. Table 3 and Table 4 present the economic picture of purchasing either a typewriter or a computer. The consumer value is $10K for the typewriter ($50K/yr x 2 years x 0.1). The consumer value is $20K for the computer ($50K/yr x 2 years x 0.2).

Table 5 compares the net results for the two purchases. The table shows that the added value from the computer makes all groups of perspectives (consumer, businesses, and combined) with the computer even though it cost more to produce and is sold at a higher price. The only disadvantage is that business 1 losses money and business 2 makes money. If business 1 and business 2 are the same company, even the individual entities prefer the computer.

Table 3. Purchase typewriter.

	Consumer Value	**Price**	**Production Cost**	**Net**
Consumer	$10,000	-$100		***$9,900***
Business 1		$100	- $75	***$25***
(Cons. + Bus)	$10,000		- $75	***$9,925***

Table 4. Purchase computer for word processing only.

	Consumer Value	**Price**	**Production Cost**	**Net**
Consumer	$20,000	-$4,000		***$16,000***
Business 2		$4,000	- $3,000	***$1,000***
(Cons. + Bus)	$20,000		- $3,000	***$17,000***

Table 5. Comparison of net results.

Perspective	**Typewriter**	**Computer**
Consumer (Value – Price)	$9,900	***$16,000***
Business 1 Profit (Price – Cost)	***$25***	$0
Business 2 Profit (Price – Cost)	$0	***$1,000***
Combined Net Benefit (Value – Cost)	$9,925	***$17,000***

Problem Formulation

This paper calculates the net benefit of promoting PV as an alternative to retail electricity for consumers. The current product is labeled superscript S (for standard electric service) and the PV product is labeled superscript PV (for PV produced electricity).

Assume that distributed PV will produce Q_t kWh of electricity in any given year t. The investment is economically justified if the sum of the discounted net benefits of PV exceeds the sum of the discounted net benefits for standard service. That is, invest if

$$\sum_t \frac{\overbrace{\left(Value_t^{PV} - Cost_t^{PV}\right)}^{\text{Per Unit Net Benefit for PV}}\overbrace{\left(Q_t\right)}^{\text{Quantity}}}{\underbrace{\left(1+r\right)^t}_{\text{Discounting}}} > \sum_t \frac{\overbrace{\left(Value_t^{S} - Cost_t^{S}\right)}^{\text{Per Unit Net Benefit for Standard Service}}\overbrace{\left(Q_t\right)}^{\text{Quantity}}}{\underbrace{\left(1+r\right)^t}_{\text{Discounting}}} \qquad \text{Eq. (1)}$$

Since quantity is the same in each year on both sides of the equation, this can be rearranged such that the sum of the discounted additional value of PV must exceed the sum of the discounted additional cost of PV.

$$\sum_t \frac{\overbrace{\left(Value_t^{PV} - Value_t^{S}\right)\left(Q_t\right)}^{\text{Additional value of PV over standard service}}}{\underbrace{\left(1+r\right)^t}_{\text{Discounting}}} > \sum_t \frac{\overbrace{\left(Cost_t^{PV} - Cost_t^{S}\right)\left(Q_t\right)}^{\text{Additional cost of PV over standard service}}}{\underbrace{\left(1+r\right)^t}_{\text{Discounting}}} \qquad \text{Eq. (2)}$$

Discussion

Several important observations can be made based on Eq. (2). First, the fundamental determinant if PV is a better product for customers to purchase is not only the cost of PV compared to the cost of standard service. Rather, it must include PV's incremental value compared to its incremental cost over standard electric service. Second, this equation defines what is needed in order to make a decision. The left side of the equation states that the total economic value that PV provides to consumers is not needed. Rather, only the incremental value that PV provides to consumers over standard electric service is required. Likewise, on the cost side of the equation, only the incremental cost of PV over existing service is required.

Added Value

As stated above, the analysis requires the added value of PV over standard electric service, not the total value of PV. While PV provides electricity to customers, so does standard electric service. Thus, the value of electricity to consumers does not need to be calculated. It is only the added values that PV provides that standard electric service does not provide that needs to be calculated.

The added values that PV provides over electric service that are calculated in this study include the following:

1. Increase in-state jobs and state tax revenue
2. Provide electric rate escalation protection
3. Improve environment
4. Increase state's economic health/protection from decline (this value is discussed but not quantified)

Increase In-State Jobs

Description

It is well documented that distributed PV results in an increase in local jobs when compared to standard utility service. It is obvious that one value of an increase in jobs goes to those who get the jobs.

At a state level, however, there are two other important values. First, an increase in jobs corresponds to a decrease in unemployment benefits that the state needs to pay.[2] Second, an increase in jobs over what would have been without the PV corresponds to an increase in state income tax revenue. This increase in tax revenue could be used to reduce the tax rates for all citizens or it could be used to provide additional services. Either way, there is financial benefit to all New Jersey citizens.

Change in Jobs

The Renewable Energy Policy Project has estimated that a MW of PV produces 34.9 new Full-Time Equivalent (FTE) jobs: 25.1 manufacturing jobs, 7.3 installation jobs, and 2.5 O&M jobs.[3] All of these jobs would occur in-state if the PV module manufacturing was performed in-state. If none of the module manufacturing was performed in-state, a MW of PV would produce 9.8 FTEs. Note that these jobs are not assumed to be annually recurring jobs but are recorded in the year the PV is installed.

Jersey Central Power and Light has about 1,000 employees and delivers about 20,000 GWh of electricity per year.[4] As PV energy production increases, the amount of electricity that needs to be supplied by the utility will be reduced. Assuming that utility jobs are proportional to electricity delivered, there are 0.00005 employees per MWh. Notice that, while the PV jobs is a "one-time" credit related to the MW of PV installed, the reduction in utility jobs is an "on-going" expense.

Unemployment Benefits

New Jersey pays unemployment benefits equal to 60% of the person's average weekly earnings during the base year period, up to a maximum of $482 per week. A person may receive up to a maximum of 26 times their Weekly Benefit Rate.[5] It is assumed that each employee is out of work for the maximum of 26 weeks before they found another job. Thus, the maximum unemployment benefit is $25,064 per year

State Income Taxes

The increase in income taxes is based on an annual salary of $50,000 and the New Jersey income tax tables for a single person.[6]

---

[2] This argument is well formulated in http://www.repp.org/articles/static/1/binaries/nevada_comments_first.pdf.
[3] http://www.repp.org/articles/static/1/binaries/Labor_Calculator.pdf.
[4] These estimates are based on a phone conversation with Eva Gardow on August 28, 2003.
[5] http://www.nj.gov/labor/ui/figbenamt.html
[6] http://www.state.nj.us/treasury/taxation/pdf/other_forms/taxrate.pdf

Results and Discussion

The Appendix presents the detailed jobs value calculations. Results suggest that the jobs value is a present value of $180 Million, $460 Million, and $659 Million for the pessimistic, best guess, and optimistic scenarios. These results are based on 9.8, 25, and 35 jobs per MW of PV. If an income multiplier effect is introduced (i.e., increasing the number of PV jobs has a secondary effect of increasing other jobs that are unrelated to the PV but exist because more people have more income), the results will increase.

Provide Long-Term Electric Rate Protection

Description

Options are valuable. One typically thinks about the value of options within the context of the financial world because these options have prices. Other types of options, however, also have financial value. PV has option value if it performs the role of backstop technology.

PV system owners obtain stable electric rates when they purchase their system. Non-PV system owners may also obtain rate protection as a result of consumers who purchase PV. This is because PV could become a backstop technology.

A backstop technology is one that allows large or unlimited quantities of a perfect or virtually perfect substitute to be produced at some price. It ensures the existence of a "choke price," the price above which the product which it is replacing will not go.[7] In the case of PV, it can provide long-term electric rate protection to all customers whether or not they purchase the PV.

Distributed PV is not a perfect substitute for standard electric service because it is a capital purchase rather than an ongoing cost and there are temporal limitations to when the electricity can be delivered (although storage could be used to address this issue). Still, it is the only commercially available generation technology that could approximate the role of backstop technology. It is simple enough so that any customer could purchase it and its variable costs are almost zero. As a result, it could effectively be a backstop technology.

In order to become a backstop technology, PV needs to progress to the point where it could be purchased and installed in very large quantities in New Jersey (i.e., a sales, delivery, and support infrastructure similar to what is beginning to occur in California). Thus, when customers want to purchase PV, it is available for purchase and installation. The existence of these types of companies is predicated upon orderly and sustained market growth.

In order to become a meaningful backstop technology, it also needs to cost less than it currently does, the very goal that the incentive programs throughout the world are trying to achieve.

Analytical Approach

The critical inputs to calculate the benefit of PV as a backstop technology include: number of years until PV becomes backstop technology, and the rate at which the market would "catch" up and provide PV as a backstop technology without the incentive programs.

[7] Kneese, Sweeney, eds. Handbook of natural Resources and Energy Economics, pp. 818-819.

Figure 2 presents the number of years it will take for PV to be competitive with grid power as a function of annual PV cost reduction and annual electric rate increases.[8] For example, if it is assumed that the PV cost will decline by 7 percent per year and electric rates will increase by 2 percent per year,[9] PV will breakeven without incentives in 12 years (breakeven is defined to be the point where the NPV is $0).

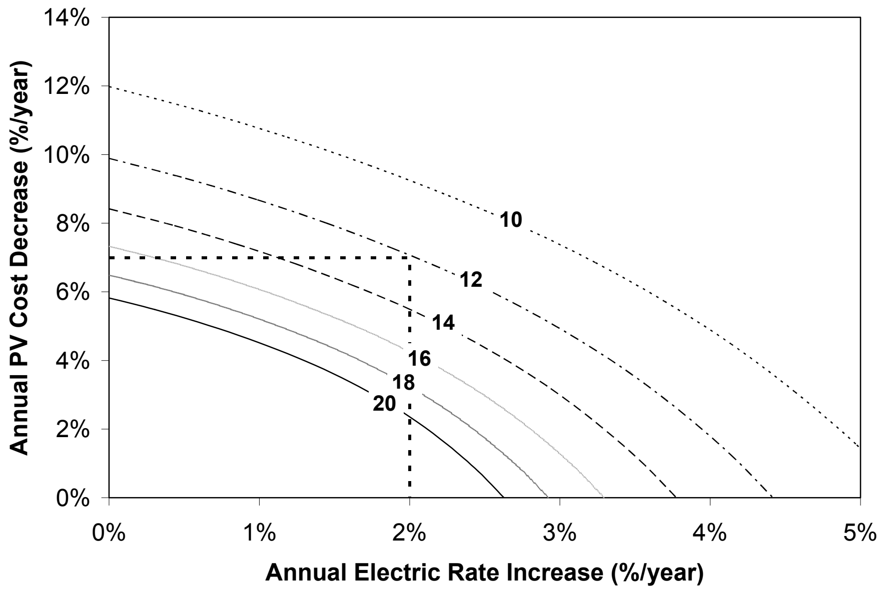

Figure 2. Years to breakeven ($0 NPV) with no incentives for various scenarios.[10]

If PV prices decline at a rate of 7 percent per year and utility rates increase at a rate of 2 percent per year, PV has the potential to be cost-competitive with grid power in 12 years. The green line in Figure 3 presents how much electricity needs to cost in order to justify a PV investment with no incentives for a residential customer. The blue lines represent how much electricity is expected to cost. The dash blue lines show how much electricity is expected to cost in the absence of a backstop technology. The solid blue line starting in 2015 shows what rates are expected to be if PV becomes a backstop technology (Note: the best guess and optimistic scenarios allow rates to decline while the pessimistic scenario assumes that electricity prices will remain fixed once PV is cost-competitive with no incentives.)

[8] NREL's Market and Policy Analysis Tool was used to perform the calculations. It is available at www.clean-power.com/nrelpv.
[9] It is assumed that the cost reductions are only valid until PV becomes a backstop technology.
[10] The reference case is a 1 kW_{DC} PV system for a residential customer in Jersey City, New Jersey with an annual bill of $1,200 per year and a system financed with a 30-year, 7 percent loan.

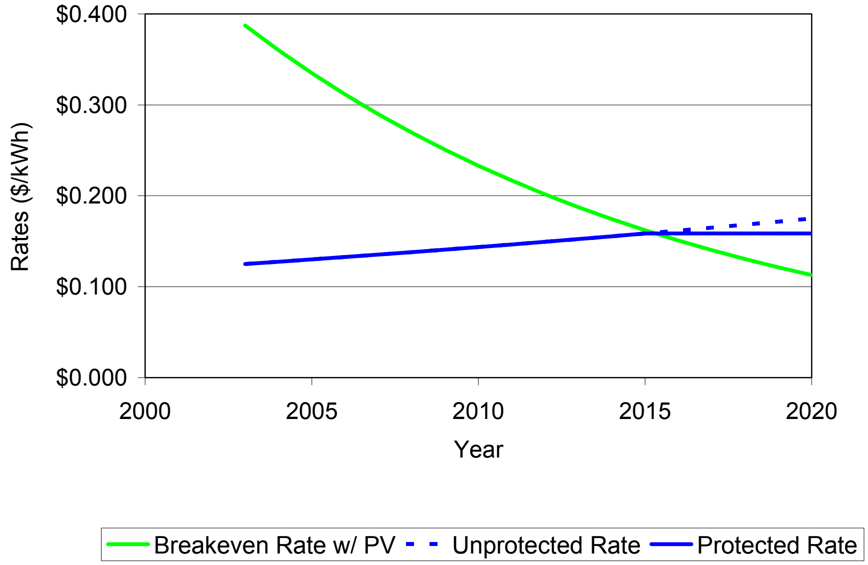

Figure 3. Electricity rates.

It is conservatively assumed that the New Jersey program does not speed up the rate at which PV prices decline. Rather, the value comes from the fact that the buydown and RPS programs create the infrastructure necessary to deploy PV systems. If the buydown and RPS programs were not initiated, the New Jersey market would require time to build an infrastructure to support the deployment of cost-effective PV. It is assumed that there is full protection once the PV is cost-competitive with the programs whereas it requires 3 years for full protection in the absence of the programs. This is shown by the black lines in Figure 4.

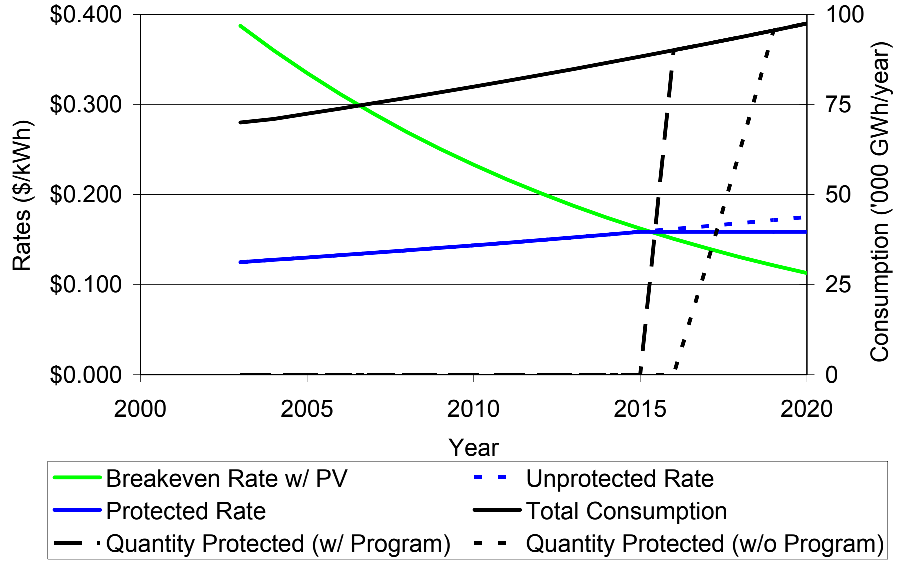

Figure 4. Level of rate protection.

Results

Using the optimistic set of assumptions of 7 percent PV price declines, 2 percent electric rate increases, and a delay of 3 years to obtain full protection, the present value is $1,657 Million. The pessimistic and best guess scenarios have values of $410 Million and $843 Million.

Improve Environment

Description

Renewable energy technologies reduce emissions from fossil fuel plants and thus improve the environment. Distributed PV may provide additional environmental benefits because the emissions reductions can be targeted to specific locations. For example, the value of distributed generation technologies can be higher than central station technologies because they produce energy in transmission and distribution (T&D) system capacity-constrained areas where the need can be substantial. The same concept may apply in the context of environmental emissions. That is, rather than having T&D-constrained areas, there may be emissions-constrained areas.

There is a growing body of literature that is devoted to valuing environmental benefits. There is also a wide range in the value of the benefits.

Analysis Approach

In their report, Death, Disease & Dirty Power: Mortality and Health Damage Due to Air Pollution from Power Plants,[11] the authors used the EPA-accepted valuation methodology and found that the total monetary benefits of cleaning up power plants to modern pollution standards would be over $100 billion per year. Although New Jersey is worse than average in the categories of mortality, hospitalizations, and asthma attacks, assume that they are average. Based on 2.2 trillion kWh consumption in 2002, this translates to about $50/MWh. We will assume that the pessimistic, best guess, and optimistic value are $20/MWh, $35/MWh, and $50/MWh.

[11] The report is available at http://cta.policy.net/fact/mortality/mortalitylowres.pdf.

Promote Economic Health

Description

Recent events indicate that a state's economic health can be significantly affected by economic or technical failures in the electric system. From the economic perspective, California experienced an electricity price crisis as part of deregulation. It resulted in the bankruptcy of a major utility, rates increased substantially, and the state took over the role of purchasing power. While it is difficult to determine the exact correlation, California is currently suffering from a large budget deficit and has a credit rating that is just above junk bond status.[12] The value may be protecting a states credit rating, and thus have lower borrowing costs.

From the technical perspective, a number of relatively minor technical failures have occurred throughout the U.S. that resulted in massive power outages. The August 14, 2003 power outage in the Northeast is the most recent example. The outage cost NYC somewhere around a half a billion in lost revenue alone.[13]

System failures are complex and there is likely to be a long delay until the precise details of the most recent outage are understood. The underlying question is what could distributed resources do to eliminated such outages in the future? It is unlikely that PV alone could have solved these problems. In conjunction with a limited amount of storage, say on the order of about 500 MW (the size of a power plant), however, these systems may have been able to provide a rapid response and to support the system.[14]

There are a variety of ways that the value of improved reliability could be calculated from a state's perspective.

- The value of protecting GDP could be calculating by assuming that the "highest value" customers install the PV with battery backup, thus increasing the likelihood of their ability to endure a long-duration outage; this would protecting the state's GDP and tax revenues
- Another alternative is that a small amount of distributed PV with storage could have prevented the outage; this, in turn, would have a very high value

It is difficult at this time to assign an economic value to this benefit. As the technical research proceeds, however, consideration should be given to this benefit.

---

[12] http://www.bizjournals.com/sanjose/stories/2003/07/21/daily67.html
[13] http://www.cnn.com/2003/US/08/15/power.outage/
[14] Based on phone conversation with Joe Iannucci of Distributed Utility Associates, August 22, 2003.

Added Costs

The added costs of PV equals the difference between the cost of PV and the cost of standard electrical service. The cost of PV can be determined by calculating the initial capital cost plus any O&M costs. The cost of standard service can be calculated using a distributed benefits study, such as has been performed for a number of utilities. These studies can be quite detailed and require much effort. They calculate the cost savings including energy savings, reduced system losses, transmission and distribution system cost savings, etc.

The focus of this study is on the value portion of the equation, not the cost portion. Given this limitation of scope, an alternative approach is to assume that the added cost equals the incentives that must be provided to customers to purchase the systems. These incentives include the New Jersey Clean Energy Program PV buydown and the RPS cost.

The added costs of the PV include:

1. Renewable Energy Credits (RECs) - purchased by the load serving entity (LSE) but passed through to consumer in higher electric rates
2. PV Buydown Program - system benefit charge collected by electric distribution company (EDC)

It is crucial to emphasize that there is a close relationship between the goals for the new MW of PV, the rebate level and amount of money available for the buydown program, and the anticipated costs of the RPS. The scope of this project was on the value portion of the equation. The results presented here are sensitive to the assumptions presented in the Appendix. It would be beneficial to perform a more detailed cost analysis because it involves a number of important assumptions.

As shown in the Appendix, the added cost of the buydown program and the RPS ranges from $0.4 to $1.8 billion.

Summary

The objective of this work is to compare the added value that distributed PV provides to the added cost for pessimistic, best guess, and optimistic scenarios. The Appendix lists all assumptions for the optimistic scenario. The difference in assumptions between the various scenarios is presented in Table 6.

Table 6. Scenario differences.

	Pessimistic	Best Guess	Optimistic
PV Price Decline (%/year)	5%	6%	7%
PV System Life (used in consumer value analysis)	15 years	20 years	30 years
Include Tax Benefits (used in consumer value analysis)	No	Partial	Full
Direct Jobs Gained per MW PV	9.8	25	35
Limit Rate Decline	Yes	No	No
Environmental Value ($/MWh)	$20	$35	$50

Figure 5 presents the costs and benefits for various scenarios. The costs include the PV buydown program and RPS costs. The values include jobs, environment, and rate protection. Three scenarios were selected in order to present the range of results: pessimistic (low benefits/high costs), optimistic (high benefits/low costs), and best guess. Results suggest that the pessimistic scenario has a net cost of $1.1 billion, the best guess scenario has a net benefit of $0.2 billion (benefits are slightly greater than costs), and the optimistic scenario has a net benefit of $2.1 billion (benefits are significantly greater than costs).

These results suggest that the RPS is economically justifiable in the best guess and optimistic scenarios. Given that only three values were explicitly calculated (i.e., there are likely to be other values that are not included in this analysis), it appears that the RPS with a PV component is an economically wise decision.

The key assumptions that determine the costs are the rate at which PV prices decline and the factors that consumers use to make investment decisions. The key assumptions that determine the benefits are whether in-state manufacturing jobs are created (versus only installation jobs) and whether future electricity rates are allowed to decline as a result of having PV as a backstop technology.

The RPS is not economically justified in the pessimistic case. This study was not intended to be a cost analysis. However, in order to perform the net benefit analysis, a cost estimate was required. In the process of performing this evaluation, it was determined that the RPS cost had a substantial variation depending upon the expected PV cost reduction and the criteria consumers use to make investment decisions. Future work could be targeted at refining the RPS cost analysis in order to reduce the cost uncertainty and thus reduce the net benefit uncertainty.

Table 7. Range of costs and benefits.

	Pessimistic		Best Guess		Optimistic	
Value						
Jobs	$180		$469		$659	
Environment	$95		$166		$237	
Rate Protection	$410		$843		$1,657	
Total Value		*$685*		*$1,478*		*$2,553*
Cost						
Buydown Program	($545)		($446)		($353)	
RPS	($1,234)		($795)		($96)	
Total Cost		*($1,779)*		*($1,241)*		*($449)*
Net Cost or Benefit		**($1,094)**		**$236**		**$2,104**

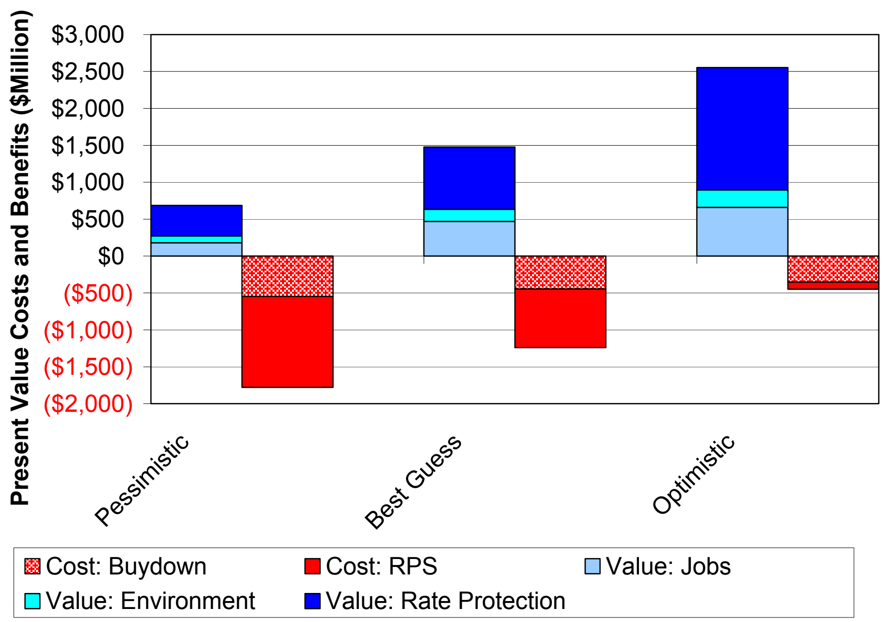

Figure 5. Range of costs and benefits.

Appendix – Optimistic Scenario

Table 8. Assumptions (optimistic scenario).

General	
Discount Rate	6%
Current Retail Electric Rate	$0.125
Retail Electric Rate Increase (% per year)	2%
Current PV Price ($/kW$_{DC}$)	$8,000
PV Price Decline (%/year)	7%
PV Output (MWh/yr per MW of PV)	1,274
PV Price Target After Buydown	$4,000
Jobs Value	
Direct Jobs Gained per MW PV	35.0
Direct Jobs Lost per MWh per year	0.00005
Avg. Annual Wages	$50,000
Unemployment Benefits ($/yr)	$25,064
Rate Protection Value	
Lag w/o Program (%/year)	33%
Limit Rate Decline	no
Environmental Value	
Environmental Value ($/MWh)	$50
Cost Analysis	
REC Market Duration (yrs)	17
Maximum REC Price	$0.25
Expected PV System Life	30
Consumer Tax Benefit (% of capital)	23%
Include Future Esclation for Consumer	no

Table 9. PV Output.

	PV Installation		
	New PV (MW)	Cumulative PV (MW)	PV Output (GWh/yr)
2004	4	4	6
2005	8	12	15
2006	13	25	32
2007	23	49	62
2008	41	90	115
2009	47	137	175
2010	54	191	244
2011	62	254	323
2012	72	326	415
2013	83	408	520
2014	95	503	641
2015	109	612	780
2016	126	738	940
2017	144	882	1,124
2018	166	1,048	1,335
2019	191	1,239	1,578
2020	220	1,458	1,858
2021	252	1,711	2,180
2022	290	2,001	2,550
2023	334	2,335	2,975
2024	384	2,719	3,464
2025	442	3,161	4,027

Table 10. Cost Calculations (optimistic scenario).

	PV Installation			PV Price ($/kW)			Energy ($/kWh)
	New PV (MW)	Cumulative PV (MW)	PV Output (GWh/yr)	Current	Buydown	After Buydown	Energy Price
2004	4	4	6	$8,000	$4,000	$4,000	$0.125
2005	8	12	15	$7,440	$3,440	$4,000	$0.128
2006	13	25	32	$6,919	$2,919	$4,000	$0.130
2007	23	49	62	$6,435	$2,435	$4,000	$0.133
2008	41	90	115	$5,984	$1,984	$4,000	$0.135
2009	47	137	175	$5,566	$1,566	$4,000	$0.138
2010	54	191	244	$5,176	$1,176	$4,000	$0.141
2011	62	254	323	$4,814	$814	$4,000	$0.144
2012	72	326	415	$4,477	$477	$4,000	$0.146
2013	83	408	520	$4,163	$163	$4,000	$0.149
2014	95	503	641	$3,872	$0	$3,872	$0.152
2015	109	612	780	$3,601	$0	$3,601	$0.155
2016	126	738	940	$3,349	$0	$3,349	$0.159
2017	144	882	1,124	$3,114	$0	$3,114	$0.162
2018	166	1,048	1,335	$2,896	$0	$2,896	$0.165
2019	191	1,239	1,578	$2,694	$0	$2,694	$0.168
2020	220	1,458	1,858	$2,505	$0	$2,505	$0.172
2021	252	1,711	2,180	$2,330	$0	$2,330	$0.175
2022	290	2,001	2,550	$2,167	$0	$2,167	$0.179
2023	334	2,335	2,975	$2,015	$0	$2,015	$0.182
2024	384	2,719	3,464	$1,874	$0	$1,874	$0.186
2025	442	3,161	4,027	$1,743	$0	$1,743	$0.189

Continued

Consumer Analysis - Pres. Value ($/kW)					Buydown Program		REC Program		
Bill Savings	Tax Benefit	Required REC Value	Years of Payments	Required REC Price	Cost ($M)	Discounted Cost ($M)	Constrained Price ($/kWh)	Cost ($M)	Discounted Cost ($M)
$2,192	$920	$888	17	$0.067	$18	$18	$0.067	$0	$0
$2,236	$920	$844	16	$0.066	$26	$25	$0.066	$1	$1
$2,281	$920	$799	15	$0.065	$39	$35	$0.065	$2	$2
$2,326	$920	$754	14	$0.064	$57	$48	$0.064	$4	$3
$2,373	$920	$707	13	$0.063	$81	$64	$0.063	$7	$6
$2,420	$920	$660	12	$0.062	$74	$55	$0.062	$11	$8
$2,469	$920	$611	11	$0.061	$64	$45	$0.061	$15	$10
$2,518	$920	$562	10	$0.060	$51	$34	$0.060	$19	$13
$2,568	$920	$512	9	$0.059	$34	$21	$0.059	$24	$15
$2,620	$920	$460	8	$0.058	$13	$8	$0.058	$30	$18
$2,672	$891	$309	7	$0.043	$0	$0	$0.043	$28	$16
$2,726	$828	$47	6	$0.008	$0	$0	$0.008	$6	$3
$2,780	$770	$0	5	$0.000	$0	$0	$0.000	$0	$0
$2,836	$716	$0	4	$0.000	$0	$0	$0.000	$0	$0
$2,892	$666	$0	3	$0.000	$0	$0	$0.000	$0	$0
$2,950	$620	$0	2	$0.000	$0	$0	$0.000	$0	$0
$3,009	$576	$0	1	$0.000	$0	$0	$0.000	$0	$0
$3,069	$536	$0	0	$0.000	$0	$0	$0.000	$0	$0
$3,131	$498	$0	0	$0.000	$0	$0	$0.000	$0	$0
$3,193	$463	$0	0	$0.000	$0	$0	$0.000	$0	$0
$3,257	$431	$0	0	$0.000	$0	$0	$0.000	$0	$0
$3,322	$401	$0	0	$0.000	$0	$0	$0.000	$0	$0
					$458	$353		$148	$96

Table 11. Jobs value calculation (optimistic scenario).

NJ Tax Schedule (single person)

Over	But not over	Marginal Tax Rate	Marginal Income	Marginal Tax
$0	$20,000	1.40%	$20,000	$280
$20,000	$35,000	1.75%	$15,000	$263
$35,000	$40,000	3.50%	$5,000	$175
$40,000	$75,000	5.53%	$10,000	$553
$75,000	$300,000	6.37%	$0	$0

Total Tax	$1,270
Avg. Tax Rate	2.5%

Calculations

Year	Additional MW of PV	Cumulative MW of PV	PV Energy (GWh/yr)	PV Jobs Added	Utility Jobs Reduced	Net Job Change
2004	4	4	6	153	0	153
2005	8	12	15	268	1	267
2006	13	25	32	469	2	467
2007	23	49	62	821	3	818
2008	41	90	115	1,436	6	1,430
2009	47	137	175	1,652	9	1,643
2010	54	191	244	1,899	12	1,887
2011	62	254	323	2,184	16	2,168
2012	72	326	415	2,512	21	2,491
2013	83	408	520	2,889	26	2,863
2014	95	503	641	3,322	32	3,290
2015	109	612	780	3,820	39	3,781
2016	126	738	940	4,393	47	4,346
2017	144	882	1,124	5,052	56	4,996
2018	166	1,048	1,335	5,810	67	5,743
2019	191	1,239	1,578	6,682	79	6,603
2020	220	1,458	1,858	7,684	93	7,591

Calculations (cont.)

	Current			Discounted		
	Savings in Unemployment Benefits ($M)	Change in Wages ($M)	Discount Factor	Savings in Unemployment Benefits ($M)	Change in Wages ($M)	PV Output (GWh)
2004	$4	$8	0.943	$4	$7	5
2005	$7	$13	0.890	$6	$12	14
2006	$12	$23	0.840	$10	$20	27
2007	$20	$41	0.792	$16	$32	49
2008	$36	$72	0.747	$27	$53	86
2009	$41	$82	0.705	$29	$58	123
2010	$47	$94	0.665	$31	$63	162
2011	$54	$108	0.627	$34	$68	203
2012	$62	$125	0.592	$37	$74	245
2013	$72	$143	0.558	$40	$80	290
2014	$82	$164	0.527	$43	$87	338
2015	$95	$189	0.497	$47	$94	388
2016	$109	$217	0.469	$51	$102	441
2017	$125	$250	0.442	$55	$110	497
2018	$144	$287	0.417	$60	$120	557
2019	$165	$330	0.394	$65	$130	621
2020	$190	$380	0.371	$71	$141	690
Total	**$1,267**	**$2,527**		**$627**	**$1,251**	**4,736**

Reduced Unemployment ($M)	**$627**
Increased Income Taxes ($M)	**$32**
Total: Unemployment + Taxes ($M)	***$659***

Table 12. Environmental value calculation (optimistic scenario).

	New PV (MW)	Cumulative PV (MW)	Annual Output (MWh/yr)	Total ($Million)	Discounted ($Million)
2004	4	4	6	$0	$0
2005	8	12	15	$1	$1
2006	13	25	32	$2	$1
2007	23	49	62	$3	$2
2008	41	90	115	$6	$4
2009	47	137	175	$9	$6
2010	54	191	244	$12	$8
2011	62	254	323	$16	$10
2012	72	326	415	$21	$12
2013	83	408	520	$26	$15
2014	95	503	641	$32	$17
2015	109	612	780	$39	$19
2016	126	738	940	$47	$22
2017	144	882	1,124	$56	$25
2018	166	1,048	1,335	$67	$28
2019	191	1,239	1,578	$79	$31
2020	220	1,458	1,858	$93	$35

Value	$237

Table 13. Electricity rate protection value calculation.

	$/kWh				000 GWh			$Millions	
	Breakeven PV Rate	Unprotected Rate	Protected Rate	Savings	Total Consumption	Quantity Protected (w/ Program)	Quantity Protected (w/o Program)	Savings	Discounted Savings
2004	$0.387	$0.125	$0.125	$0.000	70	0	0	$0	$0
2005	$0.360	$0.128	$0.128	$0.000	72	0	0	$0	$0
2006	$0.335	$0.130	$0.130	$0.000	74	0	0	$0	$0
2007	$0.312	$0.133	$0.133	$0.000	75	0	0	$0	$0
2008	$0.290	$0.135	$0.135	$0.000	77	0	0	$0	$0
2009	$0.269	$0.138	$0.138	$0.000	78	0	0	$0	$0
2010	$0.251	$0.141	$0.141	$0.000	80	0	0	$0	$0
2011	$0.233	$0.144	$0.144	$0.000	82	0	0	$0	$0
2012	$0.217	$0.146	$0.146	$0.000	83	0	0	$0	$0
2013	$0.202	$0.149	$0.149	$0.000	85	0	0	$0	$0
2014	$0.187	$0.152	$0.152	$0.000	87	0	0	$0	$0
2015	$0.174	$0.155	$0.155	$0.000	88	0	0	$0	$0
2016	$0.162	$0.159	$0.159	$0.000	90	0	0	$0	$0
2017	$0.151	$0.162	$0.151	$0.011	92	92	0	$1,005	$471
2018	$0.140	$0.165	$0.140	$0.025	94	94	31	$1,544	$683
2019	$0.130	$0.168	$0.130	$0.038	96	96	64	$1,205	$503
2020	$0.121	$0.172	$0.121	$0.050	97	97	97	$0	$0

Value	$1,657